Dictionary of Flavors

Third Edition

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Introduction

This dictionary book has more charts which are placed at the end of book for the readers to refer.

Since the last publication of the 'Dictionary of Flavors', the industry has gone through a monumental change. This author cannot remember as many accomplishments in the science, as many regulation changes or as many challenges, day to day pressures and concerns that have occurred as in the last few years. Tremendous strides have occurred in identifying nerve receptors for flavor chemicals to the point where receptors are being linked to specific chemical structures. Culinary considerations and their effect on flavor creation continue to explode. Regulatory concerns for food safety and worker safety are on the minds of every successful flavorist today. Marketing concerns such as 'Gluten-Free', 'All Natural', 'GMO Free', 'Clean Label' and on and on drive project decisions and flavor creation techniques. FSMA, HACCP, SDS, BRC, SQF are acronyms now part of the flavorist's everyday life. We live in a time when technology is exploding and the successful flavorist must meet these challenges head on. I hope that some of the additional citations made in this third edition of the 'Dictionary of Flavors' will help make this happen and aid in the future flavorist of tomorrow.

I have said many times that sometime in the future someone will look back and exclaim 'Those were truly exciting times during the early new Millennium, I wonder what it would have been like to be part of all that excitement'. Enjoy!

Non-Text and Numerical Abbreviations

Non-Alphabetic Symbols
0 – Symbol meaning nil or no sensory stimulus
)(– Symbol meaning threshold sensory stimulus

Numerical Items
2-AFC – Two Alternate Forced Choices – A sensory evaluation technique that evaluates two choices wherein the attribute and direction is known. It is randomized as AB and BA and alternatively a third choice of 'neither' is also allowed. See Sensory Evaluation, Discrimination Tests.
3-AFC – Three Alternate Forced Choices – Considered being more powerful than the triangle test, although the reasons for that increased power are debated. The design of the test is: one item (A) is the target character item and two items (B) are the ones in question. The design is ABB, BAB and BBA. Unlike the triangle which would have AAB, ABA and BAA, the target appears only once. The question is posed: which of these is more 'x'? See Sensory Evaluation, Discrimination Tests.

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A

Abaisse – A sheet of rolled out pastry.

A' blanc – Food that is cooked or partially cooked, but not browned.

Abbreviations and Acronyms – See Appendix 1.

Absinthe – An alcoholic beverage made from wormwood, having a characteristically astringent bitter flavor. Thujone, the active narcotic ingredient present in this beverage, was found to be responsible for toxic side effects. Upon this discovery, France banned the drink in 1915. See Artemesia – Wormwood, Bitter.

Absolute – The alcoholic extract of a concrete, otherwise known as the absolute d'concrete. A concrete is the oil base extractive of a botanical, usually a floral, a herb, or a spice. Due to the cost of most absolutes, they usually are used at lower levels in flavors. Absolutes, therefore, are found in formulations where they lend themselves to fine nuances and backgrounds. It is also typical that these characteristics are not characterizing, but which contribute a differential nuance to the flavor blend. For listing, see under individual botanical listings. See Concrete, Extraction, Extract, Extrait, Extractant, Differential Ingredients.

Absolute Oil – The subsequent steam distillation of the essential oil from an absolute. See Essential Oil, Absolute, Concrete.

Absolute Zero – The lowest temperature possible, equivalent to 273 degrees below 0 °C.

Absorption – Absorption is the process describing either:

1. A liquid or a solid taking in a gas in the form of aromas, or
2. A substance taking up energy in the form of heat, light, or X-rays. See Adsorption.

Acacia Gum – See Arabic Gum.

Acai (Euterpe Oleracea) – The Acai Palm is a tall and slender plant whose clusters of new leaves are eaten as hearts of palm. This is also called the cabbage of the plant. It produces a very dark edible berry high in essential fatty acids (omega 3, 6, and 9 fatty acids) as well as high concentrations of anthocyanin, a phytochemical found in other dark berries that have antioxidant properties. It grows mainly in South America. The açai palm is related to Euterpe edulis juçara known for hearts of palm. Purported high levels of anthocyanins considered good for promoting health benefits as an antioxidant and is usually on the top ten list when people ask for a grouping of 'superfruits'. See Chart 496 Acai, Superfruits. See LDL, Anthocyanins, Phytochemical, Palm, and Appendix 2 – Nutraceuticals Overview.

Acaricide – A chemical that kills or controls mites or ticks. See Herbicide, Pesticide.

Accelerated Shelf-Life Testing – See Accelerated Storage Stability Testing.

Accelerated Storage Conditions – Conditions such as moisture, temperature, light (usually ultraviolet), and atmosphere (usually oxygen) have a tendency to decrease the shelf life of a product. Accelerated storage conditions are designed to enhance, accelerate, and simulate changes that will occur at ambient conditions over a longer period of time. See Accelerated Storage Stability Testing, Ambient Conditions, Shelf Life.

Accelerated Storage Stability Testing – A method by which a product is exposed to elevated temperatures simulating what would happen over longer periods on the shelf. This technique is usually conducted at ambient temperatures and conditions.

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Increased temperatures accelerate those chemical reactions which occur normally at lower rates at lower temperatures. A rule of thumb is for every increase in temperature of 10 °C, the reaction rate doubles. There are some exceptions to this rule, however, and reaction dynamics are not always linear. For example, some reactions do not take place until a certain threshold reaction temperature is reached. (Below this temperature, the action rate is insignificant.) Some general guidelines have been established as follows: A product kept 4 months at 100 °F is equivalent to 6 months at 70 °F. See Attribute Tests, Storage Stability, Shelf Life.

Acceptance – A sensory term meaning the approval of or positive attitude toward a food or flavor or the state of being whereupon a substance is described as being within expected or desired parameters within a specified range. Acceptance can also be directly proportional to a rating on a Hedonic scale. See Hedonic (Rating) Scale, Attribute, Sensory Evaluation.

Acceptance Number – Otherwise designated as the C factor, relating to the number of 'out-of-specification' data versus the 'within specification' data in a given study. See Sensory Evaluation.

Acceptance Quality Level – See AQL.

Accord – When two or more flavor substances are so finely balanced that they take on an aroma character unlike either of the individual substances. An example is a blend of citrus and spices with brown notes blended in such a way as to be reminiscent of a cola beverage. See Balance.

Acerola (Malpighia punicifolia L.) or Barbados Cherry and Wild Crapemyrtle – See Appendix 2.

Acetaldehyde – The second simplest of aliphatic aldehydes (formaldehyde, of course is the simplest) that is found in many natural flavor systems. Due to its extreme volatility, it is often an important, yet fleeting contributor toward the top note of many products, including the fresh juicy character of orange juice and other citrus juices, as well as many other fruits and vegetables. For this reason, a patented spray-dried form is used in a popular orange-type powdered drink mix. Acetaldehyde has been shown to have adverse feeding study data, and California has regulated its use it that state according to Proposition 65. See Aldehydes Aliphatic, Keto Aldehydes, and Cyclic Aldehydes; Juicy, Freshness.

Acetals – Formed through the action of aldehydes and alcohols. Because solvents such as glycerine, alcohol, and propylene glycol contain a hydroxyl moiety, and as these solvents are used in most flavors, acetals are formed upon standing with most flavor systems. Acetals have very limited flavor use per se, as most acetals have little or no odor due to their higher molecular weight. Often acetals have off flavor like the floral character of benzaldehyde P.G. acetal, or the harsh flavor of valeraldehyde P.G. acetal. Acetals revert in slightly acid pH aqueous systems, so in most cases, when used in a final food product like an acidified food or beverage, acetals will revert back to the starting aldehyde. It is likely that the inclusion of acetals on the GRAS lists is not necessarily for their flavor characteristics, as they are not generally useful as such. However, the inclusion of chemicals and their acetals onto the GRAS list was more likely done preemptively. As a flavor sits, many reactions occur. Acetal formation is just one of these. At the time, a few companies' regulatory departments felt that all of the myriad of acetals might have to be accounted for. As this line of thinking went on, many began to realize that an insurmountable task was at hand. When we age wine, do we need to consider all of the reactions that went into the aging process? The answer is obvious. This expanded concept has never come to fruition. See Glycerine, Propylene Glycol and Derivatives, Valeraldehyde, Benzaldehyde, Aqueous, Harsh, Floral, Beverage, Acid, Hydroxyl, Alcohol, Moiety, Dioxolanes, Dioxanes (Glyceryl Acetals), Hemiacetals, Ketals, Chart 2 – Acetals, and Figure 1.

Acetals

Acetals are a group of compounds formed when aldehydes are linked to alcohols after the removal of water.

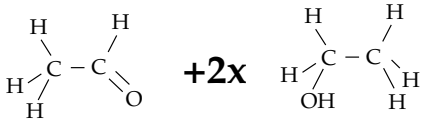


Fig 1a - Acetaldehyde plus Ethanol yields Acetaldehyde diethyl acetal.

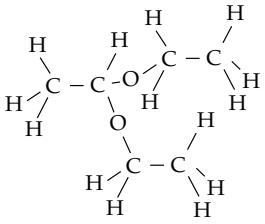


Fig 1b - Alternate ways to designate the same formula.

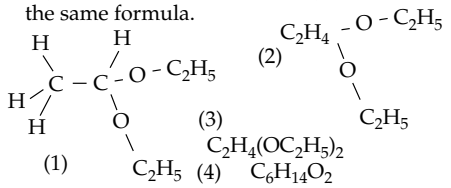


Figure 1

Acetic – The olfactory property in which a substance is reminiscent of acetic acid. See Descriptive Terminology, Acid, Fatty Acids.

Acetic Acid – The volatile acid that is reminiscent of and the active ingredient of vinegar. It occurs in lower levels as a by-product of fermentation. Acetic acid is found in cheese products, other dairy systems, ripened fruits, and many other natural flavor systems. Acetic acid is formed from the oxidation of the alcohol contained in spirits. Microorganisms such as Acetobacteria aceti are ones that could be responsible for this change. Before these microorganisms were identified, it was thought that the turning of alcohol to vinegar was due to contamination by a fly subsequently named a vinegar fly. Acetic acid is a classic example of an aroma compound that also affects a taste (by lowering the pH and adding a sour character). See Oxidation, Vinegar, Fermentation, Partitioning.

Acetoacetates – Chart 3 – Acetoacetates are compound ketone-containing esters. Some of them occur in nature (ethyl acetoacetate in baked products). They may have questionable stability in a finished flavor and have been observed to give off carbon dioxide upon standing in acidic conditions. See Ketones (Aliphatic), Stability, Keto and Hydroxy Esters, and Chart 3 – Acetoacetates.

Acetoin Acetyl Methyl Carbinol – Although many claim it has a faint aroma and taste, it seems more likely that trace quantities of oxidized diacetyl are responsible for its apparent odor characteristics. It seems to have more of an effect on the trigeminal and taste receptors than the olfactory senses. See Oxidation, Reduction, Diacetyl, Butter, Buttery, Ketones (Aliphatic).

Acetyl Propionyl – A chemical which has been reported by RIFM not to have the same biological effect and transference into the bronchioles as diacetyl, but nonetheless has been linked together with diacetyl by the government as a potential cause of bronchilitis obliterans. See Diacetyl, Bronchiolitis Obliterans, Popcorn Lung.

ACF – Quote from the website: The American Culinary Federation, Inc. (ACF) is the premier professional chefs' organization in North America, with more than 240 chapters nationwide and 18,000 members. ACF offers culinarians of all ages, skill levels, and specialties the opportunity to further their careers, as well as enhance their lives.

Achene – The yellow seeds of a strawberry fruit or the seedy fruits inside a fig receptacle.

Achillea – See Yarrow Herb.

Achilleic Acid – See Acidulant(s), Aconitic Acid.

Acid –

1. In flavors, the nonvolatile acids that are important are those GRAS substances that affect the pH of a food product, and can be therefore tasted via taste buds located on the tongue.
2. In flavors, the organic acids, some of which can have both appreciable vapor pressure and aroma type, so as to be perceived as an aroma can have the above effect on pH as to be both tasted and smelt (acetic acid, propionic acid, butyric acid). Therefore, it is important to distinguish between the aroma called acidic aroma and the taste called the acid or sour taste. Acid aromas range from pungent to cheesy to waxy. Some of the higher molecular weight branch chained isomers tend to be gamey and meaty. See Acetic Acid; Butyric Acid; Pungent; Taste; Aroma; Sour; Branched Chain Molecule; Gamey; Meaty; Acids, Chart 4 – Acids All Types, Chart 5 – Acids Unsaturated Aliphatic, Chart 6 – Acidulants.

Acid Hydrolysis – The process of breaking down of more complex, usually water-insoluble substances, like proteins, into simpler, more water-soluble components like amino acids. Acid hydrolyzed proteinaceous substances, commonly called HVPs contribute taste enhancement, as well as trace aroma components. HVPs are usually used in savory-type applications. Acid hydrolyzed products can also be used as sources for amino acids combined with reducing sugars as ingredients to be used in a Maillard Reaction. See Hydrolyzed Plant Protein, Autolysis, Autolyzed Yeast, Tastant, Taste, Maillard Reaction, Reducing Sugar, Non-Enzymatic Browning, Enzymatic Browning, Enzyme Hydrolysis.

Acidified Foods – An acidified food is one where the pH is reduced for the purpose of enhanced microbial stability and shelf life. To prevent the growth of harmful bacteria, such as Clostridium botulinum and other pathogenic organisms, foods may have acid added to them to a final equilibrium pH level of 4.6 or lower. It is also recommended that the water activity of the food system be greater than 0.85 for the acidification to be most effective. Acidification of dairy products can denature or granulate the milk proteins and therefore, one would need to add phosphates to help retard this effect. Disodium phosphate, tetra sodium phosphate, and sodium hexa meta phosphate seem to work best in this regard. Flavor changes can also occur at low pH, and both the effect on flavor and the pH effect on the base product that in turn can affect the flavor becomes a synergy, which must be addressed in these types of products. See pH, Acidity, Microbiological Stability, Processing, Processing Conditions, Production Issues.

Acidity –
1. The quantity of hydronium ions.
2. The lowness of the pH (less than 7.0).
3. The sharpness on the tongue as perceived by the taste buds that are sensitive to pH.
4. The overall acid character of a flavor profile.
5. The sourness of a flavor. The degree acidity is the amount of pH units below a pH of 7.0, or neutrality.
6. In wine, an essential characteristic.

The proper balance of acidity and sweetness usually makes for a mouth-watering flavor profile. See pH, Acid, Acidulant(s).

Acidophilic Microorganisms – Microorganisms that grow well in acid conditions. See Microbiology.

Acidophilus bacterium – See Starter Cultures.

Acidophilus Milk – Milk fermented by the Lactobacillus.

Acidulant(s) – Acidulants are flavor compounds that contribute to taste only and do not have any aroma. Therefore, citric acid is an acidulant; acetic acid is not, even though the addition of either one in a food system will affect a downward result (more acid) on the pH. See Acids, Chart 6 – Acidulants.

Aciduric – A description of the types of organisms that can grow in high acid foods. This is synonymous with acidophilic. See Microbiology.

Acitrónes – Candied prickly pear cactus leaves (Mexican).

Aconitates – Esters of the singly unsaturated version of glycerine (Propenetriol). See Glyceryl Esters.

Aconitic Acid – See Acidulant(s).

Acrid – A characteristic both biting and stinging to the mucosa (an effect on the trigeminal and touch sensing nerves) as well as an unpleasant acidic, pungent odor. Acridity is usually a negative attribute. See Trigeminal Nerves.

Acrylamide – Formed from the reaction of sugars and amino acids (Maillard Reaction). Acrylamide has been found to be a carcinogen at higher levels as well as a compound that could do damage to the nervous system. Recent studies such as the one conducted at University Public Health Schools show that the cancer correlation cannot be confirmed. However, because acrylamide is a genotoxic or DNA damaging chemical, future indications are less clear cut. See Maillard Reaction, Carcinogen, Genotoxin.

Actinase – See Enzymes.

Actionable Process Step – The part of a Food Defense Plan that describes a point at which a Focused Mitigation Strategy can be employed to address a significant vulnerability. This step is designed to avoid and protect against purposeful adulteration of the food supply. This is similar in concept to the Critical Control Point of a HACCP Plan. See Food Defense Plan, Focused Mitigation Strategy, Significant Vulnerability, Purposeful Adulteration, HACCP, HACCP Plan, Critical Control Point.

Active Oxygen Method – See AOM.

Acuity – The degree of sensitivity. Flavor, taste, or organoleptic acuity means the degree a person can perceive those corresponding sensations. See Supertasters, Taste, Tongue, Olfaction, Sensation.

Acyl – The term for the fatty acid portion of an ester. Example: Ethyl laurate is ethyl alcohol and lauric (dodecanoic) acid. The fatty acid portion or acyl group is lauric acid. See IUPAC, Aryl, Fatty Acids, and Chart 146 – Alkyl Esters – Grouped by Alcohol Moiety, Alkyl Esters, Grouped by Alcohol Moiety.

Adaptation – The decrease in the sensitivity to change due to continued exposure to sensory stimuli. Also known as fatigue, saturation, and satiation. See Saturated (Satiated).

Adaptogen – A term first described by mid-twentieth century by the Soviet scientist Nicolai Lazarev. An adaptogen is a substance that maintains health by increasing the body's ability to adapt to environmental and to internal stress. By definition, an adaptogen causes no side effects and can treat a wide variety of illnesses. An adaptogen helps an organism come into balance or homeostasis, despite the reason for the imbalance. See Nutraceuticals.

Addiction – An excess craving for something. It has been said that flavor make food addictive. This is preposterous. Flavors make food processed for safety whose flavor is lost or depreciated much more palatable, enjoyable and therefore beneficial. See Aversion.

Additives (Food Additives) – Substances that are added to foods for their improved benefit, be it flavor, shelf life, texture improvement, color, or other improvements to the physical, chemical, or sensory attributes. See Regulations.

Adenosine – Adenosine monophosphate, monosodium, or disodium adenylate – A nutraceutical that has been studied for its use in healing wounds, its treatment of diabetes mellitus, and its ability to lessen the effects of some instances of tachycardia (rapid heart racing, whose long lasting severity can cause death). It is a nucleotide found in RNA. Linguagen Corp. has patented its use as a bitter blocker. See Appendix 2 – Nutraceuticals Overview and Chart 29 – Amino Acids.

Adhesion Starch – A modified food starch, which allows a batter to stick more efficiently to a food. See Batter, Standard Breading Procedure.

Adjuvant – An ingredient that affects the food product and/or aids in the perception of the flavor. These are the non-flavoring ingredients that are also non-foods. See Regulations, Code of Federal Regulations.

Adsorption – The action of taking up of a gas by a liquid or by a solid, or the taking up of energy (heat, light, or X-rays) on the surface of a food. See Absorption.

Aduki Bean – See Adzuki Bean.

Adulteration –

1. The criminal offense of adding a non-food grade product to a food-grade product.
2. The illegal addition of a synthetic flavor and calling it a natural flavor.
3. The illegal and generally unethical practice of adding non-indigenous ingredients to another product, and not declaring the addition. Note: This is especially true with adulteration of essential oils, where the final product is still declared as natural, and should not be under our regulations. Example: The addition of trace amounts of synthetic citral to a field distillation of lemon oil to boost the natural citral content of the oil, and not declaring the citral. Unfortunately, some crop reports available indicate some natural products' available world or regional supply far exceeds the expected source potential. It is suspected that essential oils of this nature are extended by use of clever techniques, like adulteration. Unfortunately, it is very difficult to isolate these instances and prove that this is occurring, especially when the oil or other so-called natural product has passed through many hands, and the original source might be a Third World country whose fields might be difficult to access. One newer development is the analysis by isotopic abundance. Lately some very interesting research has also been done on chiral configuration. There are some problems concerning this method, including cost of analysis and sample size. The best way to avoid overpaying for what should be a legitimate product, but is not, is to know your supplier very well, and do gas chromatographic analyses and organoleptic evaluations from time to time, comparing with other sources, and also to check your gas chromatographic breakdowns with those found in the literature.

See Natural (Flavors); Artificial, Synthetic, or Not Natural; Sophistication; Cut (Cutting); Coupage; Isotopic Analysis (Isotopic Ratio); Carbon 13; Carbon 14; Half-Life; Chirality; Optical Rotation.

Adverse Event Reporting System – AERS – As cited in one report by the Food and Drug Administration, "The Adverse Event Reporting System (AERS) is a computerized information database designed to support the FDA's post-marketing safety surveillance program for all approved drug and therapeutic biologic products. The ultimate goal of AERS is to improve the public health by providing the best available tools for storing and analyzing safety reports.' It goes on further to say: 'The reports in AERS are evaluated by clinical reviewers in the Center for Drug Evaluation and Research (CDER) and the Center for Biologics Evaluation and Research (CBER) to detect safety signals and – to monitor drug safety. They form the basis for further epidemiological studies when appropriate. As a result, the FDA may take regulatory actions to improve product safety and protect the public health, such as updating a product's labeling information, sending out a "Dear Health Care Professional" letter, or re-evaluating an approval decision.' See FDA, Food Safety, Reportable Food Registry.

Adzuki Bean (Phaseolus angularis or Vigna angularis) – Also called aduki bean. Ranks second in importance to the soybean. Usually brown with a long white hilum, but comes in other colors like pale yellow, gray, green, or black. In China the bean is considered to bring good luck. Recently a popular food for macrobiotic diets as a good source of needed essential amino acids. See Legumes, Beans, Broad Bean, Buck Bean.

AEDA – Aroma Extract Dilution Analysis. The process of diluting the flavorant until the odorant is no longer perceptible. See Charm Analysis.

Aerating Agents – See Foaming Agents.

Aeration – The addition usually by beating, bubbling, or high speed mixing of air into a product. See Foam, Foaming Agents.

Aerobic – An adjective meaning in the presence of air.

Aerobic Organisms – AO, Otherwise called aerobes, these are organisms that thrive only in the presence of air. See Anaerobic Organisms.

AERS – See Adverse Effect Reporting System

AFA or aphanizomenon flos aquae – See Appendix 2 – Nutraceuticals Overview.

AFC – See Alternate Forced Choice, Sensory Evaluation.

Affective (Methods) – Sensory methods that are either qualitative or quantitative analyses done by consumers as opposed to analytical methods that are discrimination or descriptive panels of trained or semi-trained panelists. See Sensory Evaluation, Consumer Testing.

Aflatoxin – Organic substance(s) that are generated by molds such as Aspergillus flavus or A. parasiticus. Typically, they are found as contaminants in food products such as peanut, grains, etc. Aflatoxin has been seen to be a potent carcinogen and has been extensively studied in that regard. See Pathogenic (Pathological) Organisms.

Agar (Agar Agar) – A seaweed-based gelatinous colloid that is used as a thickener or stabilizer for food systems. Nutrient agar is an agar blend where nutrients are added to agar to provide an environment that accelerates microbial growth for the purpose of

bacterial testing in a petri dish. See Microbiological Assay, Nutrient Agar, Petri Dish.

Agaricus Blazei Murrell or Hime-Matsutake Mushroom – See Appendix 2 – Nutraceuticals Overview.

Ageusia – Lack or impairment of the sense of taste. See Agustia.

Agglomeration – The forming of a larger mass by causing a substance like a liquid to combine with another ingredient like a powder. Agglomeration is used for many reasons, such as instantization, particulate formation, bulk density adjustment, physical appearance, etc. See Spray Drying, Dehydration, Hygroscopic or Hygroscopicity.

Aging –

1. The process of mellowing over a period of time. The aging of wine, mints, and cheese means the process of continually reacting ingredients, which lead to a more complex number of flavoring materials lending to a more rounded profile. These reactions can include enzymatic reactions, oxidations, Schiff base formation, transesterification, rancidification, Maillard Reaction, interesterification, polymerization, saponification, etc.
2. The simulation of the aging process on the shelf (in the stores, refrigerator, etc.) so as to predict the changes developing upon storage.
3. The process of maturation of a person. This is a complex system that is currently being researched. There is a disease where the aging process is accelerated. This rare disease is called progeria. It is postulated that if a condition or circumstances can accelerate the aging process there might be other conditions or circumstances that can decelerate the process as well. Some believe that telomeres, a region of repetitive nucleotide sequences at each end of a chromatid have also to do with the aging process. See Transesterification; Enzymes; Schiff Base; Rancidification; Interesterification; Polymer, Polymerization; Saponification, Accelerated Shelf-Life Testing, Oxidation, Senescence, Ripening, Chromatid, Chromosomes, DNA, Oak Barrel Aging.

Agitating Cookers – Retorts or other cooking machinery that provide a mixing or agitation during the cooking process.

Aglycone – The chemical tied up in a glycoside. The chemical expressed usually through enzymatic reaction of a glycosidase on a glycoside. The glycoside amygdalin has amygdalase breakdown products of glucose, cyanide, and benzaldehyde. See Enzymes; Almond, Bitter; Benzaldehyde, Amygdalin.

Agropyrum – See Dog Grass.

Agustia – The inability to discern taste components via the taste buds of the tongue. There is a condition known as partial agustia wherein the ability to taste is either significantly reduced in intensity or absent for certain ingredients. See Anosmia, Gustation, Olfaction, Temporary Agustia.

AIB Food Safety Audits – Established in 1919, the American Institute of Baking has conducted training and audit based certification for many years. Although it is not necessarily recognized by the GFSI protocols of the United Nations perhaps because it is made up of the individual companies it is meant to audit, it is an audit protocol used by many companies in the United States in response to the Food Safety Modernization Act (FSMA). See FSMA, GFSI, UN, Third Party Audits.

Aioli – A garlic flavored mayonnaise. Similar to a Rouille without the coloring. See Rouille, Culinary Arts.

Ajowan – It is a relative of the caraway and cumin plants. The essential oil contains thymol. The botanical is also called ajwain, bishop's weed, omam, and omum. See Caraway, Cumin.

A La – A French phrase used often in recipes, which means a food is cooked in a certain style or manner. See Culinary Arts.

A La King – A cooked chicken dish with mushrooms, bell peppers, which is cooked in a velouté sauce. See Culinary Arts.

A La Minute – A culinary term literally meaning 'in a minute' and more broadly meaning the dishes cooked to order rather than for production, shipping, distribution, and storage in the food processing industry. Describing the on the spot cooking style used in restaurants. It is the a la minute style that provides for the use of fresh herbs and the finest of flavors.

A La Minute versus Industrial Scale Production – When translating the a la minute developed 'Gold Standard' to a practical form for industrial production, many compromises need to be taken into account, such as:

1. Availability of the product – Example: fresh herbs and spices are not available in industrial settings. IQF (Instantly Quick Frozen) items can suffice, but they bring other attributes as well. Very large volume companies might use a product that there is just not enough in the world to provide.
2. Cost – Costly items can be absorbed in a menu setting at a restaurant but oftentimes contribute too high a raw material cost in an industrial environment.
3. Quality – Some items are just not available in the finest grades in larger quantities.
4. Processing Changes – As the food undergoes changes during the processing – necessary for microbiological stability and product safety – many component food characteristics can be altered often resulting in less than a Gold

Standard Profile. One issue is the lowered boiling point in higher altitudes. Temperatures might not be reached to fully cook starches or reach food safety temperatures adequately.

5. Processing Requirements – For example, the pH must be lowered in a canning environment in order to assure for protection against clostridium botulinum. Hot packing also needs lower pHs and can curdle cheese and other proteins. Pump pressures must be developed, therefore gums or other thickeners need to be used to build up pump pressures. This often affects flavor quality.
6. Technique Inappropriateness – The development of a roux, often used to thicken in culinary applications, is infeasible in large-scale production.
7. Marketing Position – The position of the product, be it low fat, organic, or other type of claim might make the source of ingredients difficult, if not impossible, to find. Use of salt replacers; fat mimetics; starches, gums, or other thickeners can affect flavor release and mouthfeel and often introduces off characters and undesirable flavor characters of their own. Marketing considerations might also include religious consideration such as Halal and Kosher. Nutrient additives can also introduce undesirable characteristics.
8. Storage and Shipping – Shipping, storage, and packaging might also have a significant effect on the product's quality. Hot climate can degrade quality significantly. Using antioxidants, preservatives, and other similar additives can affect flavor quality.

A La Mode – Similar to the simpler phrase 'a la,' but in a special way as in pie a la mode, meaning with ice cream on top. See Culinary Arts.

Albedo – Whiteness, referring to the inside pulpy layer of the citrus rind, which contains alkaloids such as naringin, which is a bittering principle. See Flavedo.

Albumen – The white portion of the egg, which contains albumin. See Albumin.

Albumin – A protein, which is soluble in salt-free water at a pH of 7. Most albumins come from animal products. Plants usually contain less than 1% albumins. Albumins also include glucoproteins. Egg albumin, which is found in the white portion of the egg, otherwise known as the albumen. Albumen, for example contains 2 moles of glucosamine and 4 moles of mannose. Albumin is synthesized by the liver using proteins that we consume. Its presence in blood plasma creates a cellular pressure (osmotic force) that helps develop a cellular equilibrium. Albumin, therefore, is a good indicator of health. A low albumin level in a blood test is a sign of poor health. See Protein, Globulin.

Alcohol – Also known as ethyl alcohol as is commonly used. See Solvent.

Alcoholic Beverages – Drinks, drink mixes, and related products that are produced using ethyl alcohol for the purposes of intoxication. These products include dry bar mixes, cordials, wines, beer(s), spirits, distilled spirits (hard liquor), liqueurs, and wine coolers and many more. It does not include products that albeit contain appreciable amounts of alcohol and are not purchased for the express purpose of intoxication including medicinal preparations, mouthwashes, or similar items. See Alcohol, TTB, Limited Use Ingredients.

Alcohol Industry – The Beverage Industry segment that produces alcoholic beverages. See Alcoholic Beverages, TTB.

Alcohols (Saturated) – A group of chemicals that correspond to the presence of a hydroxyl group (hydrogen plus oxygen). When the hydroxyl group is associated with a benzyl group (aromatic compound), it is a phenol. When it is a non-aromatic compound, it is an aliphatic alcohol. Simple phenols are associated with burned, tar-like, and oxidized odors; complex phenolic compounds like vanillin tend to be sweet, warm, and brown. It is important to note that the lower molecular weight alcohols are used as solvent in flavors. See Hydroxyl, Benzyl Esters, Phenol, Aromatic, Aliphatic, Tar-like, Tarry; Burnt or Burned, Vanillin, Warm, Brown, Glycerides, Terpenes – Oxygenated and Other Related Compounds, Chart 7 – Alcohols – Aliphatic Alcohols, and Chart 8 – Alcohols – Aliphatic Cyclic Alcohols. See also Figure 2 and Figure 3.

Alcohols (Aliphatic Cyclic) – These compounds can have a saturated or non-aromatic cyclic structure. Compounds that have at least one double bond in the ring structure are listed here. These compounds could also fall into the class of terpene alcohols. See Chart 8 – Alcohols – Aliphatic Cyclic Alcohols.

Alcohols (Aromatic) – A complex group of compounds that includes simple phenols having a tar-like aroma and taste. Eugenol is the characteristic clove flavorant. Vanillin is chemically a combination of an ether, aldehyde, and alcohol. It has the aroma of vanilla, is used in the standard of identity of chocolate, and is widely used in most of the sweet flavor types for its ability to round out the profile, and reduce harsh notes. Phenyl ethanol, and its esters, range from floral to honey like. See Phenol; Eugenol; Clove; Vanillin; Chocolate; Harsh; Esters (Aliphatic) and Ester Chart; Honey; Floral; Ethers; Aldehyde; Alcohol; Alcohols (Unsaturated, Aromatic) Chart 10 – Alcohols – Unsaturated Non-Aromatic, Chart 13 – Aldehydes Aliphatic & Keto Aldehydes & Cyclic Ald, Chart 146 – Alkyl Esters Grouped by Alcohol Moiety.

–YL Alcohol Structures

The following are alcohol groups. When combined with acid become xxx –yl esters.

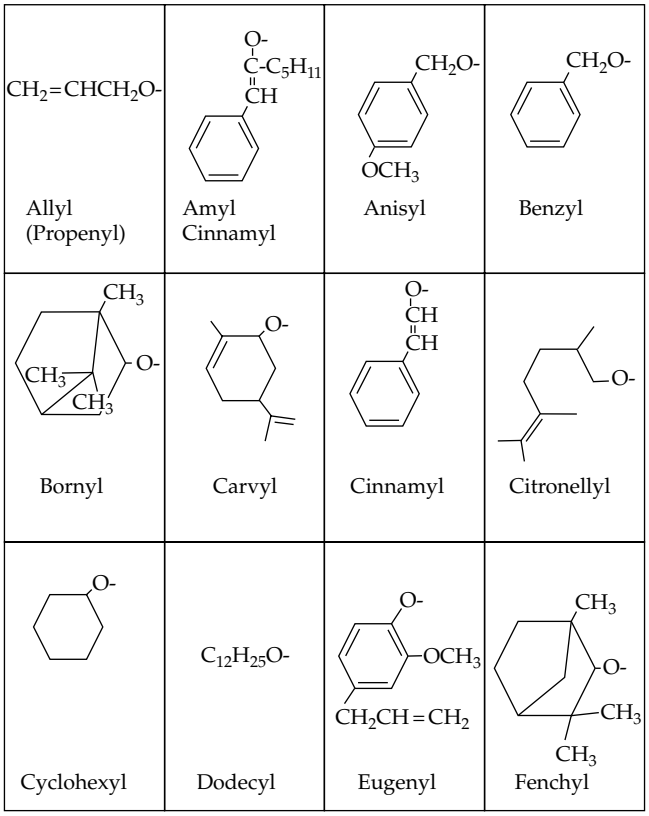


Figure 2

–YL Alcohol Structures - Continued

The following are alcohol groups. When combined with acid become xxx –yl esters.

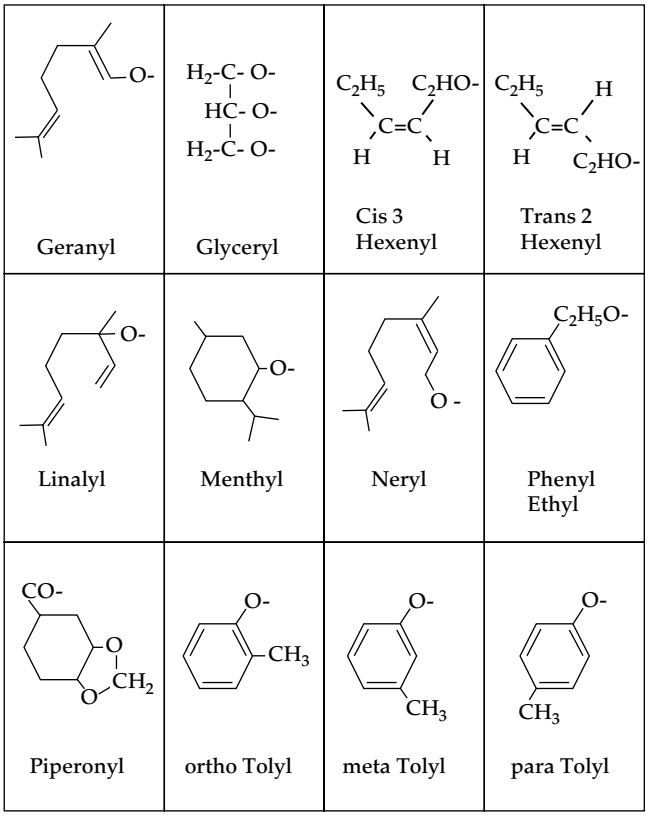


Figure 3

Alcohols (Unsaturated, Non-Aromatic) – Aliphatic alcohols with one or more double- or triple-bond sites often possess varying degrees of green flavor. One of the most popular is cis 3 hexenol or leaf alcohol. Compounds with a trans unsaturation are usually harsher than their cis counterparts. Double bonds are usually less pungent than triple bonds, and multiple bonding increases the strength and pungency as well. An example of increased pungency would be cis 3 hexenol, trans 2 hexenal, hexadienol, and hexadienal. The sterically hindered cis forms are usually chemically more instable than their trans counterparts with more molecular room to breathe. An example of the conversion from cis to trans isomerism is found in fresh tomato juice, which has a prevalence of the cis hexenol that changes form through the cooking into tomato sauce (which then has a higher ratio of trans hexenal). Triple-bonded alcohols like methyl heptine carbonate are very green and have a watermelon rind-like character. Unsaturated cyclic compounds like cycloalkenes, etc., are also included here, as are hydroxy furanones and heterocyclic compounds with the enol group. However, this class of compounds tends not to be green but is quite brown, nutty, and roasted in flavor profile. See Aliphatic; Double Bond; Triple Bond; Alcohol; Cis (Isomerism); Trans (Isomerism); Isomer; Dienal; Dienol; Steric Hindrance; Ionones, Methyl Ionones, Irones, Pseudo Ionones, and Ionols; and Chart 10 – Alcohols – Unsaturated Non-Aromatic.

Alcohols (Unsaturated, Aromatic) – These compounds have a benzene structure and also an unsaturated side group. They possess a varied odor profile from resinous or floral, to vanillic (propenyl guaethol) and pungent/phenolic.

Aldehydes (Aliphatic, Keto Aldehydes, and Cyclic Aldehydes) – A group of chemicals that corresponds to the presence of a terminal carbonyl group. (C=O) Aldehydes are generally stronger and harsher than their corresponding alcohol counterpart. Example: Hexanal is harsher and stronger than hexanol.

When there is a presence of a double bond, the difference is usually exaggerated, and when there are two or more double bonds, as in the case of dienals, the differences are compounded further still. As with most of the esters, these compounds show a similarity of flavor profile within carbon number. Therefore, butyl butenal is similar to octenal. From one double bond to an aldehyde dienal counterpart, the flavor attribute within the same carbon number is roughly similar, although a lot stronger in the two double bond counterparts. See Chart 16 – Alfalfa.

Aldehydes (Aromatic) – Aromatic aldehydes generally range from harsh and pungent to sweet and heavy. Some of the better-known aromatic aldehydes are benzaldehyde, the almond/cherry compound, vanillin, ethyl vanillin, and heliotropine. Benzaldehyde is used in cherry-type cough drops, and is useful in many fruit flavors as a sweet berry note, and the last three being commonly used in flavors for their contribution to the warm sweet background of a flavor profile. Profiles are extremely variable in character and intensity. Specific flavor identity for these compounds has more to do with other structures present and less to the fact that they are aromatic aldehydes. The aldehyde heliotropine (aka piperonal or methylene dioxy benzaldehyde), which is found in nature, including vanilla extract, yields a sweet cloying vanilla note and can be used in vanilla flavors and many other flavors for its sweet sugary contribution. See Vanillin, Ethyl Vanillin, Benzaldehyde, Harsh, Pungent, Sweet, Heavy, Aromatic, Aldehyde, Fruit, Berry (Like), Background, Top Note, Middle Ground, Flavor Profile, Intensity, Structure, Heliotropine, Piperonal (Heliotropine), Vanilla (Extract), Sugary, and Chart 15 – Aromatic Aldehydes.

Aldehydes (So-called) – When aroma chemicals were first being researched and identified, it was erroneously thought that the aldehydes were the main aroma compounds, that is, citral, decanal, benzaldehyde, heliotropine (piperonal), octanal, acetaldehyde, tolyl aldehyde, vanillin (hydroxy methoxy benzaldehyde), etc. In fact, in 1899, over 20 aldehydes were either found or used in food products. Some are no longer approved for use in foods. For example, Aldehydes C-7 and C-8 were derived from castor oil at this time for use in flavors. The abundance in flavor-characterizing compounds falling into the chemical aldehyde category leads to the false conclusion that all aroma compounds should fall into this category. The advent of modern structural chemistry of course proves that concept to be mistaken. See Dienal, Alcohol, Pungent, Unsaturated (Bond), Double Bond, Comparative Flavor Chemistry, Esters, Fatty/Green. These chemicals are listed in Chart 12 – So-called Aldehydes.

Aldehydes (Unsaturated Alkenals, Alkadienals, Alkynals, and Cyclic Non-Aromatic Aldehydes) – As with most of the alkyl esters, these compounds show a similarity of flavor profile within carbon number. Therefore, butyl butenal is similar to octenal. From one double bond to an aldehyde dienal counterpart, the flavor attribute within the same carbon number is roughly similar, although a lot stronger in the two double bond counterparts. See Esters, Green, Fatty/Green, and Chart 11 – Alcohols – Aromatic and Unsaturated.

Aldehydic – Reminiscent of aldehydes, specifically, aliphatic aldehydes of the C8 to C12 carbon number. See Flavor Description.

Al Dente – Literally 'to the tooth'. A degree of cooking (usually grains and pasta, not beans) that gives a little bit of resistance to the chew and is not mushy. See Culinary Arts.

Alfalfa (Medicago sativa L.) – Usually eaten as sprouted seeds that develop greater flavor and are also easier to digest. The natural extract containing xanthophyllic colorants (lutein dipalmitate, etc.) are used as coloring additives for grains so that poultry egg yolks will obtain a bright desirable yellow coloration. See Grains, Chart 16 – Alfalfa, and Appendix 2 – Nutraceuticals Overview.

Alfredo – A sauce or style made with butter, garlic, cream, Italian cheese (typically Parmesan or Romano), with black pepper. Alfredo sauce is usually served with a pasta called fettuccini. See Culinary Arts.

Algae – The group of simple plants that contain chlorophyll, but do not have a vascular system, that is, roots, stem, etc. These plants include the seaweeds. The body of the seaweed or algae is called the thallus. Out of the more than 20,000 species of seaweed, only 40 to 50 have a pleasant taste. Four different types of algae are listed. Brown algae (Pheophyceae) is the most common. The yellow and brown xanthophyllic compounds actually cover up the green from the chlorophyll in the plant. Edible types include arame (Eisenia bicyclis), hijiki (Hizikia fusiforme), wakame (Undaria pinnatifida), and kombu (Laminiaria spp.), which is high in glutamic acid. Red algae (Rhodophyceae) is colored by a natural pigment called phycoerthrin. The pigment covers up the green of the chlorophyll in the algae. The red variety of algae is usually used to derive most algal thickeners. Dulse (Palmaria palmata) with a strong flavor, nori (Porphyra spp., asuki nori [P. tenera]), of which sheets are made to serve the sushi trade, carrageenan (Chondrus crispus), also known as Irish moss, and agar agar (Gelidium spp.) are included here. Galactose is usually the sugar that combines with polysaccharide to form viscous polysaccharides. Green algae (Chlorophyceae) are

devoid of other pigments, and include kelp (Macrocystis pyrifera), sea lettuce (Ulva latuca and Ulva fascia), and sea grapes (Caulerpa spp.). Both latter varieties have a green vegetable taste like lettuce. Glasswort is included here as a seaweed as it grows in marshes throughout the world. Blue-green algae (Cyanophyceae) are usually microscopic plants. Included in this group is spirulina, an algae-based health food. Eaten by ancient people of Africa and the Aztecs, it is formed into a sweet pancake called a dihe, or added to millet or vegetables with a thick tomato sauce like chillimolli. See Gums and Thickeners.

Algae, Green Blue – See AFA and Appendix 2 – Nutraceuticals Overview, Nutraceuticals Overview.

Alginates – Ammonium, calcium, potassium, and sodium alginates. See Gums and Thickeners.

Algorithm – A set of rules and sequence of events or parameters that set the stage for the next sequence of events designed to solve a problem. Usually having to do with computer programming. The quality of the computer algorithm dictates the accuracy of computerized interpretation of GC or MS data. See Gas Chromatography (GC), Internal Standards.

Aliphatic – As opposed to aromatic, a chemical compound that does not contain a benzene ring. These include straight-chained, branch-chained, and non-aromatic cyclized compounds containing carbon, hydrogen, and oxygen (also called cyclic aliphatic structures). See Aromatic, Benzene Ring, and Appendix 2 – Nutraceuticals Overview.

Alkali – A substance which, when added to water, raises the pH above 7.0. See Acid, Alkaline.

Alkaline – A chemical state in which an abundance of hydroxyl ions (OH) is present in an aqueous system. To be alkaline is to have a pH greater than 7.0. See Acid.

Alkaloids – GRAS ingredients that fall into this category, like caffeine and theo-bromine, must be used sparingly. By definition, alkaloids are very complex compounds that can have a biological effect on the user. The term alkaloid derived from alkali-like refers specifically to the presence of nitrogen in the molecule. Theobromine (demethylated caffeine) is found in chocolate. Caffeine (methyl theobromine) is found in many items including chocolate, coffee, tea, and some common extracts. Some alkaloids are highly toxic. See Caffeine, Theobromine, and Chart 17 – Alkaloids.

Alkanet Root (Anchusa officinalis) – Dye and Nutraceutical. See Nutraceuticals, Chart 411 – Alkanet Root, and Appendix 2 – Nutraceuticals Overvie.

Alkekengi (Physalis alkekengi) – Also known as a Chinese lantern or Cape Gooseberry. It is a fruit with a thin membranous covering resembling a Chinese lantern called a calyx. The flavor is acidic, very juicy, and has an astringent aftertaste. The seeds are also edible. See Gooseberry.

Alkyl – Non-Aromatic Hydrocarbons – As opposed to aromatic compounds, that is, chemical compounds which contain at least one or more benzene rings. 1,3,5 undecatriene is found in many natural products, and has a very green and piney flavor. It has been isolated from apple, celery, kiwi, mandarin, parsley, passion fruit, pear, peach, pineapple, peppermint, and galbanum, and is therefore an important component for flavors. See Benzene Ring, Aromatic, Hydrocarbons, Cyclic Compounds, Terpenes, and Chart 18 – Hydrocarbons - Alkyl Non Aromatic.

Alkyl Esters – Esters made up of an alcohol or acid, one of which at least is an alkyl compound. See Chart 146 – Alkyl Esters Grouped by Alcohol Moiety and the general ester charts for all alkyl esters. See Esters, Alcohol, Acid, Methyl Esters, Ethyl Esters, Propyl Esters, Butyl Esters, Amyl Esters, Hexyl Esters, Cyclohexyl Esters, Heptyl Esters, Octyl Esters, Nonyl Esters, Decyl Esters, Allyl Esters, Hexenyl Esters, Floral Esters, Floral Terpene Esters, Linalyl Esters, Geranyl Esters, Citronellyl Esters, Terpinyl Esters, Alkyl Esters.

Allergens – Food allergens are often confused with food intolerances, or food sensitivities. Food intolerance is the body's difficulty to metabolize certain substances. These include lactose and other substances. Intolerance to an ingredient usually is due to a lack of a certain enzyme or a reduction of that substance in the body to a point where it is no longer effective. Lactose is digested by the enzyme lactase. Sensitivities such as chemical sensitivities, sulfite sensitivity, and sensitivity to monosodium glutamate can have varying degrees of severity and are much harder to identify. Sulfite sensitivities have proven to be fatal in rare instances. However, common food allergies, that is, those that elicit production of the immunoglobulin IgE, are easier to understand. Most food reactions are not life threatening, although are very bothersome to extremely problematic. Asthmatic reactions and respiratory congestion are the more difficult symptoms. Those with these types of allergies can be treated with antihistamine-type blockers or rescue inhalers, or in very severe instances, must go to the nearest emergency room. However, the most severe reaction is one called anaphylaxis, where the body can totally shut down and result in death within minutes. This is so severe that those who have been diagnosed with this potential reaction must carry an epinephrine auto injector with them at all times to avoid a deadly reaction in case of accidental exposure. These injections are called epipens. The major allergens are listed below. It must be pointed out that the most

severe reactions have been typically found within the groups that have an asterix. Phenylketonuria is the inability to digest the amino acid phenylalanine. This is especially important in that phenylalanine is one of the two components used to develop aspartyl phenylalanine or Aspartame. See Food Allergen Labeling and Protection Act of 2004. Most foods however are not totally innocent, and allergic reactions have been seen for certain fruits (strawberries, peaches, etc.), vegetables (mushrooms, bell peppers, etc.), and others. There are some cross responses between animal and vegetable products. It is thought that the protein tropomycin, which is found in varying amounts in dust mites, crustaceans, and bell peppers could be an example of this. Putative allergens are those that specifically react with IgE immunoglobulins in the bloodstream. As published by ServSafe™, only eight food categories cause 90% of all food allergy reactions and out of those, nuts cause four out of five fatalities. And twice as many people are allergic to shellfish than to nuts. See Chart 19 – Allergens.

Allergies – Allergy – See Food Allergy.

Allicin – Found in garlic. See Appendix 2 – Nutraceuticals Overview.

Allopathic Medicine – Coined by Samuel Hahnemann, the founder of homeopathic medicine, to describe present and conventional medical practices. See Homeopathic Medicine.

Allspice – See Pimento and Appendix 2 – Nutraceuticals Overview.

Allumette – See Knife Cuts.

Allura Red – See Colorings, Red #40.

Allyl Compounds – The esters of the singly unsaturated propenyl alcohol (allyl alcohol) are generally harsher and more pungent than their saturated propyl counterparts. The compound allyl caproate is felt by many to be the most pineapple like of any of the GRAS esters, although it is not nature identical (not found in nature). The allyl GRAS ingredients are quite varied ranging from the fruity esters to the sulfur containing garlic (allyl disulfide, allyl mercaptan) and mustard (allyl iso thio cyanate) notes. See Nature Identical, Pineapple, GRAS, and Chart 20 – Allyl Compounds.

Allyl Esters – See Allyl Compounds.

Allyl Isothiocyanate – Also known as mustard oil. Allyl isothiocyanate is the sulfur compound characteristic of influorescent and bulb vegetables like horse-radish, broccoli, mustard; it is formed through enzymatic conversion of a glycoside through the action of the endogenous glycodase enzyme. See Mustard, Lachrymator.

Almond, Bitter (Prunus spp.) – Almond as a nut is derived from the Prunus species such as P. dulcis or P. amygdalus. The Romans referred to almond as the Greek nut. A green husk that opens when the almond is fully grown surrounds the almond. From a legal perspective, the oil of bitter almond can come from specified sources. These sources include the pits of peaches, cherries, plums, apricots, and from almonds themselves. Almonds can be classified into two categories: bitter and sweet. The bitter almond oil (P. amygdalus var. amara) contains HCN and other toxins, which must be removed before the bitter almond oil is suitable for food use. The sweet almond (P. amygdalus var. dulcis) is the edible seed known as the almond as commonly consumed. There is a lesser amount of amygdalin in sweet almond oil than in the bitter variety. Note: Amygdalin, which is the component used to make Laetrile™, is attacked by endogenous amygdalase to form benzaldehyde and HCN (prussic acid). Therefore, derivatives for food use must be FFPA (free from prussic acid). Bitter almond can be derived from a number of different foods including prune pits, almonds, cherry pits, peach pits, and apricot pits. See Benzaldehyde, Chart 21 – Bitter Almond, and Appendix 2 – Nutraceuticals Overview.

Almond Oil, Bitter – The essential oil obtained from the distillation of the partially de-oleated press cake of crushed seed meats inside the hulls of the pits of prunus (bitter almond [Prunus amygdalus], apricots [Prunus armeniaca], plums [Prunus domesticus]), amygdalus (peach [Amygdalus persica]) or cerasus (cherry [Cerasus sp.]) species. Amygdalin (used to produce the controversial cancer treatment chemical laetrile) is a glucoside, which when attacked by endogenous type enzymes (amygdalase) is broken down into hydrogen cyanide (a poison that produces cyanosis), and benzaldehyde. Bitter almond oil is approximately 90–95% benzaldehyde. Because of the presence of cyanic acid, a poison, the oil must be treated, altering all of the HCN to ferrocyanide (Prussian blue), or removed by other means. This oil is then termed FFPA (free from prussic acid), and is acceptable for use in flavors. Although the yield of the oil seems to dictate a correspondingly high cost, alternatives of naturally derived benzaldehyde alternatives have recently hit the marketplace. These 'natural' alternatives use a variety of catalyzed oxidative pathways and other means to develop the aldehyde commercially. See Cyanosis, FFPA, Natural (Flavors), Aldehydes (Aromatic).

Aloe Extract (Aloe spp.) – Aloin, its active constituent varies from 5–25%. Aloe is also used for its healing properties and benefits to the skin. See Bitter, Chart 22 – Aloe, and Appendix 2 – Nutraceuticals Overview.

Aloe Cape (Cape Aloe Ferox) – See Appendix 2 – Nutraceuticals Overview.

Aloe Vera – See Appendix 2 – Nutraceuticals Overview.

ALOP – Appropriate Level of Protection. See HACCP, Food Safety.

Alpha, a (Greek A, α) – Chemically, a structure that is next to or adjacent to another specified structure. Example: Alpha ionone indicates that the double bond is next to the 3-butene 2-one structure, while beta ionone indicates that the double bond is one carbon away from it. See Trans (Isomerism), Cis (Isomerism), D (Isomer), L (Isomer), DL (Isomer), Chemical Structure, Meta, Ortho, Para, Beta, Gamma, Delta, (Z), (E), Tert, Iso, Enantiomer, Racemic, Omega, Sec.

Alpha Risk – The risk of being wrong by not being able to show samples to be the same, and declaring them different instead, or said a different way, the risk of concluding the samples are different from each other when they are really the same. The risk in this is coming out with what you think is a product improvement, when there really is none. In this, a company might risk credibility. A value from 0.1 to 0.05 means that there was a slight trend that the sample was not different and the tester was wrong. A 0.05 to 0.01 value means that there was a moderate trend that the tester saw a difference when there was none. A value of 0.01 to 0.001 means that there was strong evidence to show that the tester claimed there was a difference and there was none. A value for the alpha risk of less than 0.001 means that the evidence that the sample was different was very strong, but it was in fact, not. See Beta Risk; Pd (Proportion of Discriminators); Sensory Evaluation; Statistics, Statistical Analysis.

Alternate Forced Choice – In a set of two or more items, an AFC test decides which defined criteria and the direction (more of or less of something). See 2-AFC, 3-AFC, Sensory Evaluation.

Alternative Hypothesis – The opposite of the null hypothesis wherein there is no correlation between two factors, the alternative hypothesis relates to a correlation between two factors. In statistics, if an outcome is determined to be unlikely to have occurred by probability alone, the result is called statistically significant. See Statistical Significance, Sensory Evaluation, P-value.

Alternate Source – Alternate Supply – When crop shortages or price increases occur due to one reason or another, alternate suppliers might be brought in. In a well-run HACCP system, the alternates are reviewed and analyzed for all aspects of safety and quality. See HACCP.

Althea Root (Althaea officinalis) – See Marshmallow and Appendix 2.

Althea Root – See Chart 23 – Althea Root.

Amadori Rearrangement – A chemical reaction where one molecule undergoes a change or rearrangement in molecular configuration and forms another perhaps more stable molecule. The first step in the Maillard reaction is the development of an n-substituted glycosylamine a Schiff Base product which is very unstable and undergoes an Amadori Rearrangement forming chemicals like pyrazines. See Maillard Reaction, Schiff Base Reaction, Pyrazines, Browning, Non-Enzymatic Browning, Enzymatic Browning.

Amaranth (Amaranthus spp.) – Like quinoa, the Spanish forbade the growing of this grain when they conquered the ancient American cultures (Aztecs). However, the plant is drought resistant, which makes it especially interesting as a source of nutrients during tough weather conditions. Similar to quinoa and buckwheat, amaranth is not really a cereal, but it is used as such and ground into a flour for cooking. It is a highly colored grain whose flowers are often bright red. It was used as a coloring agent by the Hopi Indians and in foodstuffs as well. Today Red Dye #2 is used instead in certain instances. See Grains, Color (Colorants).

Ambergris – Often as a tincture (Source: Physeter macrocephalus or P. catodon). A very rare and expensive ingredient that is not commonly used in flavors, caused by the pathological condition in a whale's stomach due to indigestible food particles. Ambergris is also called ambra to avoid confusion with tinctures of fossil amber used in fragrances. See Castoreum, Civet Absolute, and Chart 24 – Ambergris.

Ambient Conditions (Ambient Storage Conditions) – Ambient conditions are defined as the ever-changing conditions of temperature, moisture, and light that occur during normal storage conditions. What are ambient conditions to a warehouse in the South might however be drastically different from those in an office R&D facility in Chicago, Illinois.

Ambient Temperature – Ambient temperature is a somewhat confusing terminology. Some citations refer to it as the temperature of the environment, whatever that is. Others say it is the temperature in a closed environment like a storage room or box. It is much more accurate to define a temperature range after the term ambient temperature to mean a reasonable environmental fluctuation with this given range. See Temperature, Heat, Storage Conditions, Warehouse.

Ambra – See Ambergris.

Ambrette Seed (Hibiscus abelmoschus L.) – Musky and heavy with limited use in flavors. Some have reported using ambrette seed oil in pear flavors, apple flavors, and cheese products. Contains the macrocyclic musk, ambrettolide. See Musks and Chart 25 – Ambrette Seed.

Ambrosia – In ancient Greek mythology, the food of the gods (nectar being the drink of the gods).

Another such wondrous description for a food is manna (from heaven) as written in the Bible. Recently, the term ambrosia relates to a sweet-tasting liqueur, or a tasty dessert made of fruits, gelatin, and whipped cream. See Culinary Arts.

Amelioration – The act of balancing the starting materials of a wine must before fermentation by the addition of necessary amounts of sugar, water, or grape concentrate. See Wine, Balance, Fermentation, Sugar(s) and Polyhydroxyl Compounds.

American Institute of Baking (AIB) – A baking industry organization that oversees the AIB Audit, a quality control quality assurance audit for bakeries, food ingredients manufacturers, and food manufacturing plants. See FPA, FPA – Safe Audit, and NFPA Safe, AIB Audits.

American Oil Chemists Society (AOCS) – An organization that sets standards on the quality, use, and testing of oils including food-grade vegetable oils. See Standard, Analytical Chemistry, Fats and Oils.

American Pennyroyal – See Pennyroyal.

American Society for Testing and Materials – See ASTM.

American Spice Trade Association (ASTA) – An organization of spice suppliers and users that sets standards for testing the quality of spices. ASTA units are commonly used measurements of the color value of ground paprika powder. See Spice and Appendix 1, Abbreviations and Acronyms.

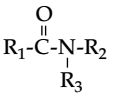
Ames Test – Originally developed by Dr. Bruce Ames for the purpose of screening potential carcinogenic chemicals. This and other similar test were conceived in response to the Delaney Clause. The Delaney Clause is still on the books, but has not been actively enforced in recent times due to the sensitivity of today's instrumentation. When the Delaney Clause was first passed, it was surmised by Dr. Ames that cell mutagenicity implies human carcinogenicity. Therefore, the Ames test measures cell mutagenicity potential. Test cells of E. coli were exposed to chemicals, and DNA comparison of those cells was undertaken to see if any of the test cells showed that they have mutated. Recently, this test has fallen into lesser use in favor of other screening techniques. The Delaney Clause states that no substance can be used in foods at any level if it has been shown that it contains an ingredient in it that has shown anywhere at any level to be a possible carcinogen. Since the passage of Delaney, more sensitive instrumentation has picked up carcinogens almost everywhere in cooked foods, albeit at miniscule amounts. The concept of de minimus, or too small to have an effect, has now been considered. See GRAS, Carcinogenicity, FEMA, Mutagenicity, Safety, Toxicology, FDA, Regulations.

Amides – Secondary amines attached to a carbonyl group (NH-C=O—). It is the amide linkage that ties amino acids to each other to build complex proteins. An amide linkage of geranyl amine and cyclopropyl ethanol that has an Umami effect. See Protein, Protein Expression, nerve Receptor, and Chart 26 – Amides.

Amines (Primary, Secondary Non-cyclic) and Ammonium Compounds – Chemically, an amine is an organic compound that contains a nitrogen atom. Primary amines have an R1-NH2 group, secondary amines have an R1-NH-R2 group, and tertiary amines have an R1-NR2-R3 structure. The primary amines and ammonia compounds are listed together because they share a typical fishy, ammonia odor. These products could be useful sources for the Maillard Reaction. Secondary amines are listed under the section 'Secondary Amines, Pyridines, Pyrazines, and Pyrimidines.' Secondary amines combined with sulfur atoms are listed under the section 'Thiazoles, Thiazolines, and Thiazole Compounds.' See Ammonia, Pyrazines, Secondary Amine, Pyridine, Pyrimidine, Pyrrole, Quinoline, Chart 27 – Amines, and Figure 4.

Structures of Amides and Amines

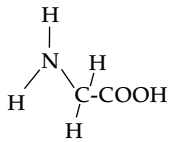
Where R is any other chemical structure (moiety)



Amide

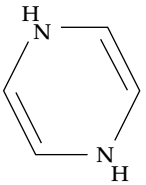
Amines are classified as to the number of hydrogens attached to the nitrogen atom. If three hydrogens are attached, the amine is classified as a primary amine. An amine acid typically has a primary amine attached.

Primary Amine
Glycine



In a secondary amine the nitrogen has only one hydrogen attached.
Example: The nutty smell of Pyrazine.

Secondary Amine
Pyrazine



A tertiary amine is where the nitrogen has no hydrogen attached.
Example: The pungent smell of allyl isothiocyanate.

CH_2=CH–CH_2–N=C=S

Figure 4

Amines (Secondary, Cyclic) – See Pyrazines, Pyridine, etc.

Amino Acid – Because they are the building blocks of proteins, amino acids are a necessary nutrient. Twenty-two amino acids have been isolated that represent components found in natural proteins. Of these, eight are considered essential because the body does not produce them, and must therefore derive them through the intake of food. In addition, there are 200 other amino acids that are not found in proteins, but that play an important role in cellular processes. Amino acids are chemicals that contain an amino (nitrogen plus hydrogen) group and an organic acid group. (An organic acid group is called a carboxyl group made up of a carbonyl = carbon plus oxygen and an alcohol = oxygen plus hydrogen). Amino acids or proteins can react with reducing sugars to produce roasted aroma compounds via the Maillard Reaction. Because an amino acid has both a basic (alkaline) segment (the amino group), and an acid segment (the carboxyl group), the ionized molecule is called a zwitterion. The pH at which these ionized molecules are at the greatest amount is called the isoelectric point for that particular compound. The 22 main amino acids are grouped as shown in Chart 28 – Amino Acid Groups.

Proteins are expressed through the RNA/DNA mechanism. Protein structure is crucial to their performance. Proteins are folded due to internal attractions and loose molecular bonding. This folding is determined by the amino acids that make up the proteins and the structure of the nitrogen site. Primary amines form straight protein chains. Secondary amines form folded or helical protein structures. Tertiary amines form double folded structures. Quaternary amines form bundled or doubled folded structures. The nature of the shape of the protein is very significant in its overall reactivity and properties. See Maillard Reaction; Reducing Sugar; Roasted (Notes); Pyrazines; Thiazoles, Thiazolines, Thiazyl Compounds; Pyridine; Strecker Degradation; Amadori Rearrangement; Essential Amino Acids; Nucleic Acid; Enhancers; Isoelectric Point. Note: Not all of the amino acids listed in Chart 28 – Amino Acid Groups are food approved. Please check status of each.

Aminoid – Reminiscent of the aliphatic amines, fishy. See Amines (Primary, Secondary Non-cyclic) and Ammonium Compounds.

Amioca (Starch) – Starch obtained from waxy maize corn (as opposed to starch that is obtained from dent corn or tapioca root). See Starch and Appendix 2 – Nutraceuticals Overview.

Ammonia – A gas (NH_4), which has a typical (ammoniacal) odor. It is often dissolved as a 40% saturated solution in water. Ammonia-like compounds are by-products of decomposing protein matter. This is the reason for the ammoniacal odor of rotting fish. See Fishy, Nitrogen Compounds.

Ammoniacal – An aroma that is reminiscent of ammonia, having an ammonia-like or spoiled fish-like odor. See Amines (Primary, Secondary Non-cyclic) and Ammonium Compounds.

Ammoniated Glycerrhiza – See Glycyrrhizin.

Amoore's Theory – The theory that odor chemicals (odorivectors) fit into certain molecular jigsaw-like 'holes' in the nerve endings of the olfactory nerve exposed in the olfactory bulb region. It is the fit of a chemical into a certain hole that elicits a response to the brain corresponding to the recollection of the odor memory, according to Amoore. Some research has confirmed the theory in principle but equates the reaction to that of an enzyme upon a substrate with a corresponding excitation energy developed that then is transmitted along nerve endings. Recent theories presented by Luca Turin pose that odors are perceived by the body differently based on their vibrations. The initial theory was based on the fact that both visual and sounds cues were based on frequencies on one sense, sound wave frequencies, and on the other, visual light frequencies. A recent paper published by The Rockefeller Scientist. The URL for this publication is http//www.rockefeller.edu/pubinfo/news_notes/rus_032604_b.php. See Odorivector, Aroma, Sensory Perception, Descriptive Analysis.

Ampholyte – A liquid ionic carrier that is capable of either reacting as an acid or a base. See Zwitterion.

Amuse Bouche – Literally to amuse the mouth, an amuse bouche is typically a small culinary delight served in a restaurant as an appetizer, palate cleanser or as part of a tasting menu.

Amygdalin – The glucoside, which by endogenous enzymatic action of amygdlase, produces benzaldehyde and cyanide. This is found in peach pits, apricot pits, plum pits, cherry pits, almonds, pear pits, and apple seeds. See Bitter Almond Oil, Benzaldehyde, Persic Oil, Hydrogen Cyanide.

Amyl Acetate – Also known as banana oil. Amyl acetate is used in nail polish remover for both its aroma and salivation properties. It is found in numerous natural products. Its main aroma description is inexpensive banana like, but is used to blend with other esters to give a fruity sweet roundness as most esters of the C-7 type. It is most famous as a single component flavor ingredient in chewy puffed peanut-shaped candies. It is also used to test the effectiveness of carbon filtered fitted respirator masks. See Banana, Esters, Fruity, Solvent.

Amylase – The enzyme that breaks down starch molecules into glycogen and maltose. See Enzymes.

Amyl Cinnamyl Compounds – Amyl Cinnamyl Compounds are generally heavy and resinous. They can find use as background characters for many brown flavors like vanilla, honey, chocolate, and even fruits like berries. See Cinnamates and Related Compounds. See Chart 30 – Amyl Cinnamyl Compounds.

Amyl Esters – See Alkyl Esters and Chart 146 – Alkyl Esters - Grouped by Alcohol Moiety.

Amylograph – A time temperature starch/viscosity measuring device. Brabender™ is one example of a company that makes these types of instruments. See Starch, Syneresis, Food Technology.

Amylopectin – The branch chained polysaccharide that makes up a starch. See Amylose, Starch, Modified Food Starch, Gums and Thickeners.

Amylose – The straight chained polysaccharide that makes up a starch. It can, however, form helical structures due to hydrogen bonding. Amylose is a better film former than amylopectin and gives the mother starch a good degree of setting potential. It is more apt to retrograde, however and is harder to cook out. It is still easier to cook out than a fluidity starch used in starch candies. See Amylopectin, Fluidity Starch, Retrogradation, Syneresis, Modified Food Starch.

Amyris – See West Indian Sandalwood.

Anaerobes – Organisms that survive and thrive in the absence of oxygen. See Anaerobic Bacteria.

Anaerobic Bacteria – Those microorganisms that grow in the absence of air. One of the better-known anaerobes and perhaps the deadliest is Clostridium botulinum. The toxin of that organism is one of the most powerful known to man. Luckily, contamination of C. botulinum is rare. When it does occur it is usually in canned food where the pH is higher, and a seam in the can might have split. A pH below 4.5 and proper canning techniques usually are sufficient to avoid this problem. Although the spores are extremely resistant to heat, the application of a sufficient amount of heat degrades the toxin produced by the spores. The potent toxin is responsible for a 40% mortality rate if ingested. See Microbiology.

Anaerobic Organisms – Organisms that thrive in environments absent of oxygen. See Anaerobic Bacteria.

Analysis of Variance – A statistical method that tabulates the comparison between the spread of values within multiple candidates, products, or examples. Multiple comparison procedures are used to evaluate three or more examples. This system is often used to plot attribute ratings for panelists. Both sensory data and consumer data use multivariate testing. This procedure analyzes complex data. Linear regression is a method to fit lines to data, and scatter plot analysis is used to define a locus of interrelated points. See Sensory Analysis, Statistics, Statistical Analysis, T-Test, Multivariate Analysis.

Analytical Chemistry – The branch of chemistry that deals with the testing and analysis of substances. In analytical food chemistry, gas chromatographic (GC) analysis, high pressure or high performance liquid chromatography (HPLC), and mass spectroscopy (MS) analysis are some of the techniques employed.

1. Acid Value of Fats – A determination of the free fatty acids (FFA) in a fat. The more critical test is the report of FFA. See Free Fatty Acids.
2. Active Oxygen Method (AOM – AOCS Cd 12-57) – Measures oxidative stability of an oil by bubbling air into a fat at a certain temperature.
3. Alkaline Soaps (AOCS Cc 17-95) – Measures the reactivity of metals on fats in water to determine the relative instability of a fat.
4. Anisidine Value (AOCS Cd 18-90) – Measures the aldehyde content of a fat, a measure of the degree of partial oxidation.
5. Arsenic, Lead, and Heavy Metals (FCC III) Third Ed. – An analytical to determine the presence of trace lead, arsenic, and other heavy metals and subsequent food grade status.
6. Ash (FCC III) – Flamed oxidation test of acid soluble, acid insoluble ash, and total ash.
7. Curcumin Test (FCC III) – Spectrophotometric assay of the coloring principle of turmeric.
8. Enzyme (Alpha Amylase Titrametric Test using Iodine/Starch reaction) and others (pages 479 to 499 FCC 111).
9. Fatty Acid Methyl Esters (FAME AOCS Ce 1-62) – Determines the fatty acid composition of a glyceride.
10. Fiber Tests – Total Dietary Fiber: AOAC 985.29 AACC 32-05; Insoluble Fiber: AOAC 991.42, AACC 32-21; Soluble Fiber: AOAC 991.19, AACC 32-21; Total Fiber: AOAC 991.43, AACC 32-07; Polydextrose: AOAC 2000.11; Fructans: AOAC 997.08, AACC 32-23; Beta D Glucans: AOAC 992.28 and 995.16, AACC 32-22 and 32-23.
11. Free Fatty Acids (FFA AOCS Ca 5a-40) – Measures by titration, the non-attached fatty acid ratio in an oil.
12. GLC Profile (FCC – EOA Method) – Uses relative retention time and internal standards for the identification and separation of volatile materials by GC.
13. Infrared Photospectrometric Method (FCC III) – A match of an unknown material to a standard fingerprint pattern. Also called Ramen Profile.
14. Iodine Value (AOCS Cd 1-25) – Measures the degree of unsaturation of an oil and therefore

the degree of potential instability due to oxidative rancidity.

15. Kjeldahl Nitrogen Assay – Determines the amount of nitrogen present (mostly from amino acids and proteins).
16. Karl Fischer Determination – Pyridine based titration used to detect small amounts of water. (See Number 17, Loss on Drying below.)
17. Loss on Drying (FCC III) – A sample heated to constant weight (water driven off), analytically weighed, and calculated.
18. Oil Stability Index (OSI AOCS Cd 12b-92) – Measures the content of formic acid present as a measure of the degree of oxidation of an oil.
19. Optical Rotation – An instrumental analysis indicating the degree of rotation of polarized light by an optical active chemical. A clockwise rotation is a dextrorotatory (d or +) and a counterclockwise rotation is laevorotatory (l or –). A substance that has both dextro- and laevo- rotatory species in equal amounts is called racemic (dl). Substances that share the same structural and chemical formulae but are different by optical isomerism are called enantiomers of each other.
20. Peroxide Value (PV AOCS Cd 8b-90) – Measures the degree of peroxides present as a measure of the amount of partial oxidation of an oil.
21. Piperine Test (FCC III) – Spectrophotometric analysis of piperine in black pepper oleoresin.
22. pH (FCC III) – The determination is usually done by electrode, pH paper, or titration, although electrode is far more accurate and more prevalent.
23. Polar Materials (TPM AOCS Cd 20-91) – Considered one of the most important tests for the determination of the degree of oxidation of an oil. It measures the total amount of non-lipid compounds in a fat system.
24. Polymers (AOCS Cd 22-91) – Includes dimers, trimers, and tetramers, or dark shellacs of oils formed on surfaces of ovens, etc., indicating the degree of oil degradation other than polar compounds.
25. Refractive Index – An instrumentally measured test that determines the degree of change of the angle of incidental light as it passes through a substance (also can be used as an indication of purity).
26. Saponification Value – Amount of sodium hydroxide to neutralize free fatty acids.
27. Scoville Heat Units (FCC III) – A dilution/comparison taste test to determine the heat principle, capsaicin, present in oleoresin of capsicum.
28. Solidification Point (FCC III) (or Melting Point) – This test can be run by an instrument that slowly lowers the temperature of a known sample until solidification is reached.
29. Specific Gravity – The weight per volume of a given liquid versus that weight of water at the same volume at a given temperature (usually 20 degrees Centigrade). This, like optical rotation can be a measure of flavor raw materials, but is a poor measure of finished flavorings.
30. Spray Dried Efficiency – (Entrapped Oil) = Total Oil – Surface Oil/Total Oil.
31. Surface Oil (Spray Dried Material) – Using ethyl ether or other non-aqueous solvent, gently mix powder and evaporate analytically. The surface oil is then weighed.
32. Thiobarbituric Acid (TBA AOCS Cd 19-90) – A spectrophotometric test of TBA reacted oxidation products present in a fat.
33. Total Oil (Spray Dried Materials) – Add water to powder. Extract oils with solvent. Evaporate and weigh. Consider water soluble fraction.
34. Viscosity (FCC III) – Ubbelohde Glass Bored Viscometer measures the time a thickened liquid travels from one point to another.
35. Viscosity (FCC III) (Brookfield Viscometer) (Model LVG) – An instrument that measures the degree of friction-based obstruction of a rotating disk due to the viscosity of a liquid in which it is immersed. The variable thickening of a modified food starch as it gelatinizes with temperature is measured by a Brabender Viscometer. A characteristic that is similar to viscosity but not quite the same is flow rate. See Bostwick Consistometer.
36. Volatile Oil Content (FCC III) – Distillation method with a V.O. (Clevenger) trap.
37. Water Determination (FCC III) – Karl Fischer Titrametric Determination. This is a fairly accurate determination for water using a methanol, a pyridine, and an iodine titrametric indicator called Karl Fischer Reagent. Other moisture methods include loss on drying and the toluene method.
38. Flow Rate – Bostwick Consistomer. Measuring the rheological characteristics of a semi-liquid at a certain temperature. This apparatus gives a number representing the distance travelled (the scale is built into the unit) by a semi-fluid mass achieved by raising a trap door and measuring a defined time passed. (typically 30 seconds).

Note: AOAC (American Association of Analytical Chemists); FCC (Food Chemicals Codex); AACC (American Association of Clinical Chemists).

See Wet Analysis, Physical, Analysis, Instrumental Analysis.

Analytical Sensory Methods – As opposed to consumer or effective methods, those methods that employ trained or semi-trained panelists. Analytical Sensory Methods include discrimination methods and descriptive methods. See Sensory Evaluation.

Anaphylaxis – An extreme reaction to a foreign substance that can often result in death. See Food Allergy, Allergens.

Anchovy – Salted preparations of tiny fish of the species Engraulis encrasicolus. Anchovies are used in Caesar salads, often added as a paste or whole or diced as toppings on pizza, and commercially, as anchovy paste often used in Worcestershire™ type sauces. Flavor-wise, anchovy flavor has ammoniacal compounds like trimethyl amine and oil type notes from oxidized fish oils. See Amines (Primary, Secondary Non-cyclic) and Ammonium Compounds, Ammoniacal, Fish, Fishy.

Andrographis paniculata (Burm. F.) Nees or Kalmegh – See Appendix 2 – Nutraceuticals Overview.

Androstenone – The pheromone that is found in human, dog, and porcine urine, and in certain fungi like truffles. This chemical is perceived in four different ways, with subtle variations: (a) sweet/fruity and almost grape-like; (b) camphoraceous and aromatic; (c) uriney, with sexual undertones; or (d) odorless. Some people can perceive this compound with great intensity and others do not. The very perception of very large molecules like this is not typically accomplished through olfactory organs, but through vomeronasal nerve endings, linked to subconscious and instinctual response. The fact that dogs or boars are used to hunt truffles down is illustrative in that the vomeronasal (sexual) attraction had been exploited without knowing the presence of this compound or the reason why the technique worked. Our intense appreciation of truffles as a food could be partly due to their pleasant aroma, partly due to their rarity, and partly due to some subconscious stimulus being perceived. The four types of characters perceived by subjects exposed to androstenone might be an odor-based analogy to the response of tasters to PROP. As with PROP testing as an indicator or supertasters, perhaps studies might prove the ability to perceive androstenone could correlate with degree of acuity of both vomeronasal sensitivity and relative olfactory sensitivity. Another interesting hypothesis to the variance of odor response to androstenone might be linked somehow to difference in sex histocompatibility. (Scientific evidence leads to the possibility of the differential attributes being linked to, or indicative of, histocompatibility genotype profiles, aka sex-gene type profiles.) See Vomeronasal Organ, PROP, Taste Buds, Supertasters, Truffles, Mushrooms (food), Specific Anosmia, Specific Agustia, Boar Taint.

Anethole – The characterizing flavor ingredient for black licorice. Licorice or glycerrhiza is usually flavored with anethole to make the black licorice type of profile. Anethole is found in star anise oil and is often found in many other natural products. Anethole is used mixed with methyl salicylate, vanillin, and other sweet/spicy notes like ethyl vanillin, eugenol, camphor, etc., to produce root beer flavors. The cis form is not approved, due to its toxicity, but the trans form is food grade. See Ammoniated Glycerrhiza, Monoammonium Glycyrrhizinate (MAG), Licorice (Root), Root Beer, and Chart 174 – Glycerrhiza.

Angelates – See Unsaturated Esters (Cis 2 Methyl Buteonates).

Angelica or Angelica pubescens or Angelica archangelica – See Appendix 2 – Nutraceuticals Overview.

Angelica Root (Angelica archangelica L.) – Can be used in combination with juniper berry products to create a gin type character. Occasionally used in European type toothpaste flavors. Can be made into a tisane (herbal tea). Used in some dishes to enhance sweetness and minimize the need for adding large amounts of sugar to cut the acidity in some food preparations. Contains angelica lactone. See Lactone, Musks, and Chart 32 – Angelica.

Angola Weed (Roccella fuciformis Ach.) – A rare lichen used to flavor alcoholic beverages. Some species of angola weed are used for their purple coloration. Angola weed has been used to cleanse the hair. See Appendix 2 – Nutraceuticals Overview and Chart 420 – Angola Weed.

Angostura (Galipea officinalis Hancock) – The active constituent is angosturin (Empirical formula C9H12O3). Angostura Bitters™ is a commercial product developed from the botanical. See Bitter and Chart 33 – Angostura.

Anhydro Glucose Unit – The building block of a starch molecule. See Starch, Carbohydrates.

Animal – Reminiscent of animal type aromas. Examples are civet, castoreum, tonkin musk, ambergris, and in some instances, labdanum. Gamey aromas occur in the substituted fatty acids of the C-7 to C-9 type. See Gamey, Flavor Description.

Animal Feeding Studies – See Ames Test, Toxicology, LD20, LD50.

Animal Feed – Nutritionally based foods designed for livestock: chickens, cows, lambs, pork, etc. Often whole yeasts are used for sources of B vitamins, minerals, etc. Masking flavors are used to cover up off odors coming from vitamin supplements.

However, this is typically more for the benefit of the farmer and less for the animal. There is, however, a side effect for this addition in that animals become imprinted upon an early age to these aroma volatiles and might show a resultant affinity or preference to that brand. This has no positive result except to the flavor supplier and feed manufacturer, of course. See Pet Food Flavors.

Animal Feed Flavors – Masking agents that can have an imprinting as well as a masking effect in the long term. See Animal Feed.

Anions – Negatively charged ions. See Cations.

Anisates – See Benzoates and Benzyl Esters (particularly p-methoxy benzoic acid esters) and Anisyl Esters and Anisates.

Anise (Pimpinella anisum) – The family that anise belongs to is Umbelliferae, which means it is related to members of the carrot family, that includes dill, fennel, coriander, cumin, and caraway. The active ingredients are trans anethole (approximately 90%) and methyl chavicol. The botanical is a fruit and improperly called a seed. Anise-flavored liqueurs are very popular in many different countries; Pernaud™ is an anise-flavored French liqueur. Pastis the generic French term for any anise-flavored alcoholic drink. Other similar anisic alcoholic drinks are Sambuca™ (Italian), Anisette™ (Italian and North African), Ouzo™ (Greek), and Raki™ (Turkey), and other similar anisic liqueurs from throughout the world. The trans isomer is food grade, however the cis anethole is toxic. Anise, with its sweet smooth aroma profile, is used in many areas as a masking agent for off odors like acid, rancid, or sulfurous malodors. Anise was used in Europe as a bait in mousetraps. It most common usage in flavoring non-beverage foods is in black licorice. See Alcohols, Spice, Licorice (Root), Glycerrhiza, Chart 31 – Anise – Aniseed, and Appendix 2 – Nutraceuticals Overview.

Anise, Star (Illicium verum Hook f.) – The active ingredient anethole (85 to 90%). See Alcohols, Spice, Licorice (Root), Glycerrhiza.

Anise Star – See Chart 46 – Anise – Star.

Anisyl Esters and Anisates – Anisyl formate is an interesting compound because tasted at very high levels, it imparts a sweet taste, as well as an anetholic or anisyl character. Most anisyl notes and the anisates have a corresponding sweetness. See Anethole, Sweet, Taste, and Chart 34 – Anisyl Esters and Anisates.

Annatto – Also called achiote, bija, bijol, roucou, lipstick tree. See Color (Colorants).

Anogeissus Latifolia Gum (Ghatti Gum, Indian Gum) – See Gums and Thickeners; Gum Ghatti, Elemi, Tragacanth Gum, Araic, Acacia, etc.

Anomer – A type of isomer or epimer of a sugar. Strictly classified as a stereoisomer or diasteromer, it differs in configuration at the hemiacetal or hemiketal carbon also known as the anomeric carbon (the one next to the cyclized oxygen).

Anosmia – The inability to smell odors in an individual. This inability could be widespread among many foods or could be specific to certain foods, chemicals, or chemical categories. The corresponding inability to taste is called agustia or ageusia. It could be a permanent state or one that is temporary due to satiation (strong foods or coffee, etc.). See Agustia, Odor, Aroma(s), Volatiles, Temporary Anosmia.

A-Not-A – A simple sensory evaluation method that relies on the panelist's recollection of the previous example. First the testant will be shown a product. It is then removed. Then another product is introduced. The panelist is then asked 'Is the second product the same as the first?' So randomness is introduced into the scheme. The following presentation order is recommended: AB, AA, BA, BB. See Sensory Evaluation, Discrimination Test, Two Stimulus Tests.

ANOVA – See Analysis of Variance.

Antepasta – Meaning before pasta or dinner. Usually a blend of savory meats and cheeses served before the dinner to whet the appetite in anticipation of the meal to come. See Flavor Benefits, Taste, Tongue, Saliva.

Antetaste (Top note taste, foretaste, or beginning taste) – The antetaste is followed by the middle ground taste, then background taste. See Flavor Description, Taste, Gustation, Time Intensity Profile.

Anthocyanins – A category of natural colors that displays bluish to reddish hues. Examples of anthocyanins are betanin, the bluish red colorant of beets, and enocianina, the bluish colorant at high pH to reddish at acid pHs, and the colorants found in grapes and in most berry juices like raspberry, blueberry, strawberry, etc. Anthocyanins contribute to ORAC value as they have oxygen scavenging properties. See Color (Colorants), Carotenoid.

Anthranilate – Ortho amino benzoates, anthranilates are generally grape like. Anthranilates also exhibit varying degrees of iridescence. Methyl anthranilate has a slight purplish and violet iridescence in the light. Anthranilates are used in animal feed due to their negative perception by birds (Joint patent developed by this author and Dr. Russell Mason, formerly of The Monell Center, Philadelphia). Anthranilates are found in neroli oil (orange flower oil) and are the characterizing compounds for grape flavors. Enologists often call the presence of anthranilates in wine the foxy character. They are generally heavy

compounds and appear in the middle to background of the flavor profile. Anthranilates undergo a Schiff base reaction. See Schiff Base, Grape, Perception, Neroli Bigarade, Enologist, Wine, Foxy, and Chart 35 – Anthranilates.

Antibiotic – A substance that inhibits the growth of microorganisms. Penicillin was one of the first antibiotics developed. It was initially discovered by accident by Dr. Jenner, when microbial growth around certain penicillium molds was found to be nil. Recently, use of antibiotics in our livestock's feed supply purportedly to ward off disease and produce more cost-effective livestock, has been a controversial problem. It has been hypothesized that recent 'super' strains of microorganisms might be developing in the tissues of livestock due to the ever-present development of resistant strains in nature. Furthermore, the over prescription of antibiotic medications for almost any disease, including viral strains that are resistant to antibiotics, and the misuse of antibiotics by people who terminate antibiotic treatments upon the first signs of relief, rather than continuing the medication to assure the eradication of the invading organisms, further exacerbates the development of resistant organisms. See Pathogenic (Pathological) Organisms.

Anticaking Agent – A product, which when added to a powder, will assist in preventing the powder from caking or forming lumps. Many products have been used as anticaking agents, but they fall primarily into two categories: those that protect the powder from external moisture, and those that absorb moisture both internally or externally. Products that absorb water are silica gels, phosphates, etc. Products that protect the powder from external moisture by virtue of their fine particle size are phosphates, silicas, cellulosics, etc. See Silica and Silicates, Phosphates, Cellulose, CFR Definitions 170.3 (o) (1) (from CFR Food and Drug 27), Caking, and Chart 36 – Anticaking Agents.

Antifoaming and Defoaming Agents – Antifoam or defoaming agents are listed below. Also specific antifoaming agents for use in beet sugar and yeast production are listed in 173.340 Sections (a)(3) and (a)(4). Antifoaming agents prevent foam from occurring; defoaming agents reduce or eliminate the foam that has already formed. See Defoaming Agents and Chart 37 – Antifoaming Agents.

Antigua – A coffee variety from Guatemala that develops a characteristic chocolate/cocoa type flavor upon proper roasting of the beans. See Coffee, Coffee Profiler – Coffee Profile Method.

Antimicrobial Agents – Preservatives, bacteriostatic ingredients, and other substances that destroy or inhibit the growth of microbial organisms. See Preservatives.

Antimycotic Agents – Substances that inhibit the growth of molds or other fungi. See Microbiology.

Antioxidants – A material that retards the reaction of oxygen with a substance. The following are FDA-approved antioxidants and their regulatory citations. See Additives (Food Additives), Preservatives, and Chart 38 – Antioxidants.

AOAC (Association of Official Analytical Chemists) – See organizations listed in Appendix 1 – Abbreviations and Acronyms.

AOCS (American Oil Chemists Society) – This organization compiles tests and protocols for the determination of the quality of food oils and fats. See Analytical Chemistry.

AOM (Active Oxygen Method) – A test that determines potential rancidity of an oil upon extended storage conditions. See Analytical Chemistry.

APC – Average Plate Count – One of the typical test done on a food ingredient to determine overall cleanliness. Average plate counts can vary depending on the source material(s). Items that come from the ground, dairy environments or similar types most likely will have an APC greater than those items which are purely synthetic. The question is whether products come in contact with environmental contamination after or during processing. See Food Safety, HACCP, Environmental Sampling Plan, Microbiological Assay, Yeast and Mold, E. coli.

Aperitif – Beverages that are usually alcoholic, served before the dinner to elicit the same appetite-enhancing function as antepasta. Aperitifs often are sweet and spicy or bitter and piquant. See Bitter, Piquant, Antepasta, Flavor Benefits, Taste, Tongue, Saliva.

Apopin Oil – See Camphor.

Appearance Test – An attribute test that regards the visual attributes of a product, either alone or in combination with other attributes. See Attribute Tests.

Appetite – The desire for food. Defined as the pleasant comfortable feeling of food desire rather than the unpleasant feeling of hunger for food. The desire for food is controlled by two sites in the brain: one in the cerebral cortex, and the other in the hypothalamus. See Cerebral Cortex, Hunger, Brain, Ghrelin, Leptin, Satiety.

Appetizer – Small quantities of food served before the main meal as a taste preview and experience enhancer/appetite stimulus. Appetizers usually include flavorful bits like spicy seafoods, meats, or vegetables. Some appetizers include antepasta, aperitifs, canapés, hors d'oeuvres, or cocktails. See Aperitif, Appetite, Antepasta.

Apple (Malus spp.) – There are over 7,500 varieties of apple. Some of the more popular fruit types are the Jonathan, Winesap, New York, and Stayman. The Cortland, which was bred from the McIntosh, is large and flat on both ends with white flesh, and aromatic flavor. It does not brown and remains whole when baked. The Melba is medium round and irregular. It is juicy, but browns quickly. The Golden Delicious is elongated, narrowing at the base with five elongated bumps. It is juicy, sweet, and low in acid. The Red Delicious is the same as the Golden Delicious with red streaks in the flesh. The Empire is a cross between Red Delicious and McIntosh, with a flavor like the McIntosh, but it has a greater resistance to browning. The Gala, which is a cross between Cox's Orange Pippin and both Red and Golden Delicious, is sweet and very aromatic. The Golden Russet has a reddish brown skin with a very good taste, although it browns easily. The Granny Smith was actually cultivated by a grandmother named Smith. Its fruit is larger in size and more acidic than most, and is appreciated in cooking. The Idared is a large apple that stays firm even when cooked. The McIntosh, first created in Canada, has a good, juicy flavor and a good amount of acidity. The Rome Beauty is juicy, and acidic with red stripes and little spots. The Spartan variety is a cross between McIntosh and the Yellow Newton, which has a good amount of sweetness. Apple essence produced by the condensation of air in apple processing plants often has erroneous and arbitrary folds associated that do not represent real ratios to the singlefold fruit. See Essence, Essence Recovery, Folding of Extracts and Essences, Distillate, and Appendix 2 – Nutraceuticals Overview.

Apple Cider – The beverage made by crushing whole or peeled apples. Endogenous enzymes produce a browning reaction that quickly turns the product to a golden brown and produces brown flavor compounds. On the peel, yeasts grown naturally, and care must be taken to either refrigerate the product, use it quickly, or add anti-fermentation products like sulfites, benzoates, sorbates, etc., to prevent the cider from fermenting, producing alcohol, and turning into hard cider. See Fermentation, Apple Jack.

Apple Cider Vinegar – The result when apple cider develops acetic acid through fermentation of apple juice directly or indirectly (through apple jack, apple juice). See Vinegar.

Apple Jack – See Jack, Apple.

Application Rate – The percentage amount that a flavor is added to a food product base. Also known as the usage level. See Food Technology.

Apprentice – Beginning in the feudal system, a person who is trained under a more experienced tradesman or master. The training of flavorists still employs this type of system because it is both a science and an art. See Flavorist, Certified Member, Society of Flavor Chemists.

Apricot Kernels, Apricot Kernel Oil or Prunus Armeniaca (LINN.) – The belief was that the apricot had originated in Armenia, hence the name prunus, armeniaca. The apricot has a flavor similar to a peach, is very creamy, necessitating the use of lactones. One example of these lactones is gamma undecalactone known as aldehyde C-14 (peach lactone). See Fats and Oils and Appendix 2 – Nutraceuticals Overview.

Apricot Kernel Oil – See Chart 47 – Apricot Kernel Oil.

AQL (Acceptance Quality Level) – The specification range wherein a product meets acceptable quality standards. See Quality Assurance.

Aquaculture – The agricultural specialty using nutrient-rich water to grow food products.

Aqueous – The property of having, being similar to, or pertaining to water. Example: An aqueous solution is a solution of an ingredient in water. See Hydrophilic, Hydrophobic, Oleophilic, Oleophobic, Lipophilic, Lypophobic, Solubility.

Arabic Gum – Acacia senegal L. Willd, the plant exudate of a tree grown in Senegal. Gum arabic is known as a lower viscosity gum, with high emulsification properties. These specific properties lend themselves to excellent film formation and the formation of high quality elastic matrices in spray drying systems with good oil particle size. Therefore, it makes an excellent spray drying media for very difficult to handle oils like citrus where solubility and oxidative instability problems are a factor. To date, some other gum blends and modified starch plus alternatives have been produced as a replacement for arabic when the product is in short supply. It is reported by many that these alternatives are still not totally as effective as gum arabic and when pricing and availability of arabic comes back in line, many switch back, at least until the next shortage. Acacia seyal or Tahla gum has been used as an extender or replacer for arabic, but these products fall short in some of the true arabic's special qualities. Gum arabic has been modified as the hydrogen octenylbutane dioate. See Spray Drying, Emulsion, Emulsification, Citrus, Solubility, Oxidation, Crop-to-Crop Deviation, Crop Shortages, Gums and Thickeners, and Chart 164 – Gums and Thickeners

Argan Oil (Argania Spinosa) – A somewhat obscure oil derived from goats that have eaten the nuts of the argan tree grown in Southwest Morocco. The

goats apparently are attracted to the fruit as catnip affects cats. This predigested product is then harvested and, through a time-consuming process, melted down and purified. It is an oil with a color similar to olive oil but with a slightly reddish cast. Recent studies have shown a possible nutraceutical use to control cholesterol and help fight disease. See Nutraceuticals (Appendix 2 – Nutraceuticals Overview).

Arillode – The structure that sits atop the nutmeg 'nut' also called mace. See Mace, Nutmeg.

Arjuna or Terminalia Arjuna – See Nutraceuticals (Appendix 2 – Nutraceuticals Overview).

Armois Oil – See Artemesia.

Arnica (Arnica spp.) – Arnica Montana L. or Leopards bane, Wolfsbane. Arnica is similar to chamomile in flavor profile. See Chamomile, Chart 48 – Arnica, and Appendix 2 – Nutraceuticals Overview.

Aroma(s) –

1. The volatile or odoriferous portion of a flavor profile. Aroma usually connotes a positive odor profile. The words smell or odor is used more often to describe off or undesirable volatile attributes.
2. In wine terminology, the aroma refers more to the volatile profile of the grape versus that of the wine that is called the bouquet. See Attribute, Volatiles, Evaporation, Vapor Pressure, Off Odor, Taint.

Aromatherapy – A range of procedures and treatments that use volatile compounds. Although the concept goes back to ancient civilizations, the practice has recently gained attention once more. The aromas are inhaled or rubbed on the skin or on occasions, ingested. Although there are some preparations, such as menthol, camphor, capsicum, methyl salicylate, and other cooling or heating ingredients that have been long used as topical pre-parations for the relief of pain and irritation, the other internal results and homeopathic gains claimed by aroma therapists have not yet been confirmed scientifically. However, as odors are received by the brain in the limbic system, which controls the most primitive of our emotions, it is likely that flavors trigger very important psychophysical effects, and aromatherapy has some basis after all. See Menthol and Menthone Derivatives; Cool(ness), Cooling, or Mintyness; Minty; Rubescence; Hot; Trigeminal Nerves; Volatiles; Aroma(s).

Aromatic –

1. Containing a benzene ring.
2. Having a sufficiently high degree of aroma.
3. Possessing an aroma typical of a class of compounds like camphor, menthol, eucalyptol, thymol, i.e., terpenoid-based compounds that have a warming or a cooling effect, with a heavy, resinous, terpene-like profile.See Aromatic Compounds.

Aromatic Compounds – Chemicals that possess one or more benzene rings. A benzene ring is a six-membered ring with alternating double and single bonds between the carbons. If you look at the molecule from a static model, the two pairs of double bonds can alternate between positions in the hexagon. In reality, the electrons are constantly shifting or it is uncertain where they are at any one given time (Heisenberg Uncertainty Principle). The constant shifting of charge is called the electron cloud. This makes for a very stable molecule. Few purely aromatic compounds are GRAS; in fact, benzene (one ring) and naphthalene (two connected rings) are quite harmful and toxic, with mutagenic and carcinogenic properties. See Mutagenic, Mutagenicity; Carcinogenic; GRAS; Hetero Molecule; and Chart 39 – Aromatics.
Note: These purely aromatic compounds are devoid of any other elements but carbon and hydrogen. Many other hetero-aromatic compounds are listed throughout the book.

Aromatics –

1. Any number of compounds that have an odor.
2. A group of chemical compounds containing a benzene ring.
3. In culinary arts, aromatics include those sulfuraceous foods that give intense flavor including onions, leeks, garlic, scallions, and related items. But some broaden the term aromatics to mean any flavor item including herbs, spices, other vegetables, citrus fruits, wines, and vinegars, all of which can be used to enhance the flavor and fragrance of food. See Culinary Arts.

Arrowroot – Possibly derived from an obsolete South American Indian term meaning root flour. Arrowroot has evolved to mean the flour obtained from many different types of roots in general, including the original maranta, zamia, curcuma, and the musa species. Arrowroot is used for flour replacements (for allergic purposes) and to thicken oils without the corresponding clouding effect. Arrowroot powder is twice as effective as a thickener versus flour. Although it is costly and lends itself to culinary preparations, it forms a clear consistency without retrogradation of other starches. See Starch Culinary Arts, Gums and Thickeners, Culinary Thickening Techniques.

Art –

1. The practice or state of being whose sole purpose is to stimulate the senses. The practice of development of flavors is both an art and a science. See Science.
2. A technique or procedure that can be improved upon by experience, creativity, and manipulation.

Artemesia (Artemisia absinthum or Wormwood, Artemesia vulgaris) – All derived from artemesia intended for food use must be thujone free. Used in vermouth bitters, Compari™ type products, etc. Artemesia absinthum is also known as wormwood and in the United States as mugwort. Chinese so-called mugwort is a different product. Vermouth and absinthe are made with wormwood; however, France banned the latter in 1915. The dark blue-green color comes from azulenes like in chamomile. See Vermouth, Absinthe, Artemesia, Thyme, Chart 49 – Artemesia, and Appendix 2 – Nutraceuticals Overview.

Artichoke (Cynaea scolymus L.) – The flower bud of a vegetable that was developed from the cardoon, both members of the thistle family. Each leaf is attached to the bottom of the head or heart and when removed is retained partially on the leaf. This structure is called a bract. The leaves, which can have a purplish tint, become softer toward the center. At the very center a hair-like structure called the choke is inedible. The stem and bottom known as the heart is often pickled and served alone. The Provencal variety comes mostly from Europe. Artichoke contains a substance that enhances sweetness after ingesting an acidic substance and is therefore a subject of research in this age of non-nutritive sweeteners. See Vegetable, Vegetative; Non-Nutritive Sweeteners; Chart 50 – Artichoke; and Chart 373 – Non-Nutrative Sweeteners.

Artificial Color – See Color (Colorants).

Artificial Flavor – Definition of the FDA, from the Code of Federal Regulations, Title 21 Paragraph 101.22: (a) (1) "The term 'artificial flavor' or 'artificial flavoring' means any substance, the function of which is to impart flavor, that is not derived from a spice, fruit, or fruit juice; vegetable or vegetable juice; edible yeast; herb, bark, bud, root, leaf, or similar plant material; meat; fish; poultry; eggs; dairy products; or fermentation products thereof. Artificial flavor includes the substances listed in PP 172.515 (b) and 182.60 in this section of code except where these are derived from natural sources". See Natural Ingredients, Nature Identical, Food and Drug Administration, Processing Aids, Incidental Additives.

Artificial Sweeteners – Non-nutritive sweeteners that are also synthetically produced. See Non-Nutritive Sweeteners.

Artificial, Synthetic, or Not Natural – The Food and Drug Administration (FDA) of the United States deems anything that is not natural to be synthetic by definition. The definition of natural by the FDA at the time of this writing is found in the Code of Federal Regulations, Title 21 Paragraph 101.22. See Artificial Flavor.

Artisanal – A description of quality and skill, literally 'skilled in the arts.' There are many types of artisinal varieties including artisinal cheese, breads, and other foods all of which are produced and created in smaller production units with great care and creativity. See Culinary Arts.

Artisan Movement (The) – A wave of creative and novel verities of beer, wine, and other alcoholic beverages has been created. Smaller local enterprises have developed and carefully crafted smaller batch runs of unique products are now marketed under the 'artisinal' category. This also includes chocolates, baked goods and a host of other foodstuffs and beverages. See Marketing.

Arugula (Eurca sativa) – Similar in flavor to watercress. Arugula is also known as rocket. See Watercress, Water Cress.

Aryl – Means aromatic, or containing at least one benzene ring. In flavors, these compounds include the aromatic ester group. See Benzyl Esters, Tolyl Esters, Aromatic, Alkyl.

Aryl Compounds – Chemical compounds that contain at least one benzene group. See Chart 40 – Aryl Compounds.

Asafoetida – An herb of lesser use today in flavors. It has a characteristic garlic/onion aroma and taste.

Asafoetida (Ferula asafoetida L. and other spp.) – The product is extremely harsh and sulfury and does not normally lend itself for use in flavor applications although some of the crushed dried roots are used in curry recipes. The extract contains a significant amount of an ester of ferulic acid. Ferulaldehyde is the active ingredient of maple syrup. Worcestershire Sauce™ uses asafoetida. Ferula narthex is a smaller variety finding use in foods. Chat masala is an Indian spice blend using asafoetida, mint, ginger, ajowan, cayenne, black salt, mango powder, cumin, and dried pomegranate seeds. See Sulfur, Garlic, and Chart 52 – Asafoetida.

Asepsis – The state of being free from viable organisms. See Aseptic Packaging, Standard Plate Count, Microbiological Analysis.

Aseptic Packaging – The process by which a product is both pasteurized and packed in a steam environment. The system is entirely enclosed and is therefore devoid of microbial contamination. Flavors used in these systems exhibit some volatile loss, but the loss of volatiles and the development of off notes are not quite as bad as with the retort process.

Aseptic Processing – The process of producing an aseptic package. See Aseptic Packaging.

Ash – The residue of ignition. The ash test is used to determine the mineral content of a product by igniting an original weight of material at temperatures of about 525°C (approximately 975°F). The residual

ash is then weighed, and the ash content is reported as the percentage of the original weight of material. See Analytical Chemistry, USP.

Ash Bark (Fraxinus excelsior [LINN.]) – A bitter tonic and astringent. Also known as prickly ash, toothache tree, American prickly ash, and specifically zanthoxylum clava-herculis and zanthoxylum americanum. See Ash Bark, Nutraceuticals, Chart 53 – Ash Bark, and Appendix 2 – Nutraceuticals Overview.

Ashwagandha – Withania somnifera or Indian Winter Cherry. See Appendix 2 – Nutraceuticals Overview.

Asian Pear (Pyrus ussuriensis and P. pyrifolia) – Also known as the sand pear. Asian pears look like a golden delicious apple and has a taste reminiscent of a pear with a texture of an apple. It is believed that this fruit is an ancestor of the common pear. See Pear.

Asilomar Conference – Held in the conference center at Asilomar State Beach Conference Center in February 1975, this conference is considered a watershed event in the area of genetic engineering. Considering many of the catalysts and other ingredients used in the production of natural chemicals and other ingredients used in the food supply today utilize this technology, its importance cannot be understated for flavorings. The important accomplishments of the meeting were the establishment of principles to eliminate the spread of recombinant DNA, a protocol for recommendations based on the risk assessment of the experiment type and a schema for establishing prohibited experiments. Unfortunately, many opponents point out the lack of total oversight of every experiment conducted throughout the world in secret laboratories. See DNA, Recombinant DNA, Genetic Engineering.

Asparagus (Asparagus officinalis) – The spears or edible shoots of the above species are eaten. White varieties are grown in the dark similar to the process of forcing of chicory (to become endive). Purple asparagus is a fruity-flavored variety and is picked when the spears are only 2 to 3 inches high. Green asparagus is harvested at a height of about 8 inches. See Sulfur.

Asparagus racemosus or Shataveri-kalp – See Appendix 2 – Nutraceuticals Overview.

Aspen – See Poplar.

Aspic – A food that has been added to a gelatin and then placed into a mold. Aspics are usually sour, bitter, or sweet or a combination thereof. See Culinary Arts.

Aspidosperma – See Quebracho.

Assessors – In sensory evaluation another – name for panelists or testers. See Sensory Evaluation.

Association of Official Analytical Chemists – See AOAC.

Associations – See ASTM, FEMA, NAFFS.

ASTA –

1. American Seed Trade Association – A quote from their website: 'ASTA Promotes the development of better seed to produce better crops for a better quality of life.' An organization that promotes the exchange of quality seeds.
2. American Spice Trade Association – A quote from their website: 'The American Spice Trade Association is a United States based organization whose worldwide membership is comprised of the leading firms in the spice industry.'

ASTM – American Society for Testing and Materials. An organization that sets testing standards in the United States. See ASTA, USP, NF, FEMA, NAFFS.

Astragalus Gum – See Gums and Thickeners, Tragacanth Gum.

Astragalus membranaceous – See Appendix 2 – Nutraceuticals Overview.

Astringent – The physical characteristic wherein a drying, puckering, or tightening of the mucosa or lining of the mouth is perceived. Many salts have an astringent property. Also, astringency is often associated with some bitter principles. See Bitter, Salt.

Asymmetric Carbon – A molecular carbon attached to four other moieties labeled R1, R2, R3, R4 in which the mirror image of itself cannot be superimposed. The structure in three dimensions is configured as a tetrahedron around this asymmetric carbon. The result of an asymmetric carbon is the potential for optical isomerism. See Optical Rotation, Chirality, D (Isomer), L (Isomer), and DL (Isomer), Racemic.

Atitlan – A Guatemalan coffee variety with a quality acid character. See Coffee.

Atmosphere –

1. The environment in which a food is eaten, as is in a restaurant. That is, the other sensory cues accompanied with the flavor while it is being perceived. In other words, the flavor's atmosphere is the environment in which the perception of many secondary senses occurs. Examples of this are the visual cloudiness of orange juice (light), the fizz of champagne or the crunch of a nacho chip (sound), the temperature of meat, the heat of chilli (touch and trigeminal sensation). Therefore, the ambience of the surroundings plays an importance in the overall perception of the flavor and the degree to which positive flavor cognition is derived and remembered.
2. The measurement of the normal pressure of air at sea level.
3. The quality of the air around a substance chemically, sensorially, and physically. The atmosphere around a Maillard Reaction brought to high pressures and temperatures is often purged by a nitrogen blanket. In this manner, the replaced atmosphere contains little oxygen, and the development of harmful phenolic substances is avoided. See Food Technology, Oxidation.

Atmosphere, Modified – See Modified Atmosphere.

Atom – The single unit of an element having a certain atomic number and atomic mass. An atom has a specific electron con-figuration that determines how it will behave with other or similar atoms. See Molecule.

Atomic Number – In an element, the number of protons equal to the number of electrons in a non-ionized atom. When an element is ionized, the protons remain the same, and whether or not it receives electrons or gives up its electrons determines the overall charge. Electrons can also be shared. In this example, the resultant bond is called covalent and is devoid of ionic bond. Dipole moments can be derived by the orientation of charge along a molecule even in a covalent system. See Ionization, Atomic Weight, Neutrons, Electrons, Ions, Proton, Dipole Moment.

Atomic Weight – The sum of the mass of all electrons, neutrons, and protons in an atom. The weight of an electron is virtually '0' for the purpose of atomic weight calculations. A neutron is a proton plus an electron, so it is virtually the same weight as a proton. The weight of a proton is defined as '1.' Therefore, the atomic weight or atomic mass is equal to the sum of the protons plus the neutrons. See Isotope, Isotopic Analysis (Isotopic Ratio), Mass, Density.

Atomization – The dispersing of a liquid into a fine spray. This is typically used for (1) dehydration (i.e., spray drying) or (2) for the coating of materials (spray coating) onto a matrix. See Spray Drying.

Atomizer – Referring typically to the part of a spray dryer that sprays the liquid system in a fine mist then to be exposed to the heat of the chamber for dehydration. There are two types of atomizers used in spray dryers; centrifugal head atomizers and spray atomizers. Both have their advantages and disadvantages. See Spray Drying, Spray Atomizers, Centrifugal Head Atomizers.

ATP/ADP Cycle – See Ribose.

Atractylodes microcephela – See Appendix 2 – Nutraceuticals Overview.

Attribute – The perceived characteristic of a food product. See Attribute Tests, Sensory Analysis, Duo-Trio Test, Paired Comparison Test.

Attribute Tests – One of many sensory tests. Tests that measure characteristics such as flavor nuances, textural description, and other non-comparative type tests. See Comparative Tests, Triangle Test, Paired Comparison Test, Sensory Analysis, Directional Testing, Ranking Test, Compared or Comparison Tests.

Au Fait – Ice cream that has interspersed layers of frozen fruit. See Culinary Arts.

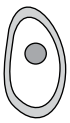
Au Gratin – A mode of food preparation, which means that on top of the food breadcrumbs and cheese are added, which is cooked or browned in the oven. The resultant chemistry would include combinations of Maillard browning on both the bread and the dairy systems. Lactose would act as the reducing sugar, and proteins and amino acids inherent in the system would feed the non-enzymatic browning. See Culinary Arts.

Au Jus –

1. A mode of preparing meat where the juice from the cooking process is added back, or perhaps first thickened and/or further seasoned.
2. The juice obtained as above. See Culinary Arts.

Autolysis – The self-lysing or the internal breakdown of non-water-soluble components into simpler more water-soluble components. See Hydrolysis, Autolyzed Yeast, Autolyzed Yeast Extract, Natural (Flavors).

Autolyzed Yeast – A yeast that has been brought to an intermediate temperature (one that is far less than cell destruction temperatures), and held at this temperature until an internal enzymatic destruction of more complex proteins occurs. In this process, simpler amino acids are formed. These amino acids have a tendency to enhance taste profiles, while also providing nutrients. Furthermore, they can supply needed components to react with reducing sugars in a subsequent potential Maillard Reaction. See Yeast and Figure 5.



Yeast and Yeast Autolysates

Yeasts are single cellular plants that propagate through budding. One species, saccharomyces cerevesiea, is responsible for the metabolism of simple sugars into alcohol by the process we know as fermentation. When grown for the baking or brewing industry, they are known as primary yeasts. When they are collected after fermentation, they are known as secondary yeasts.

	Whole active yeast suitable for fermentation	Not Soluble	Contains Nutrients and Cellular Material
	Dead whole yeast suitable as a dry medium for seasonings, feed	Not Soluble	Contains Nutrients and Cellular Material
	Autolyzed yeast suitable as flavor enhancer, starting material for processed flavors where clarity is not important	Not Soluble	Contains Nutrients and Cellular Material
	Autolyzed yeast extract suitable as flavor enhancer, and clear starting material for processed flavors	Soluble	Contains Nutrients

Figure 5

Autolyzed Yeast Extract, Autolyzed Yeast, and Related Yeast Products – An autolyzed yeast that has been separated from its insoluble cellulosic materials produced during the autolysis breakdown of the cell wall. Separation of this cell wall material through centrifugation or through other means yields the clear resultant extract called an autolyzed yeast extract. See Natural (Flavors), Meaty, Hydrolyzed Vegetable Protein. See Chart 41 – Yeast Products, Yeast Products.

Autosmia – A disorder of the sense of smell whereby a person smells an odor when there is none present. See Odor, Perception, Olfaction.

Autumnal Flavor – In the parlance of tea descriptive terminology, an autumnal flavor is the first stage of the development of a hay-like aroma. Autumnal flavor is reminiscent of dry leaves in autumn. See Industry Vernacular.

Availability – See A La Minute versus Industrial Scale Production, Sustainability.

Average – The total number divided by the number of individuals. See Standard Deviation, Mean, Mode, Sensory Analysis, Sensory Evaluation.

Aversion – A strong feeling of dislike or opposition to a stimulus. Food aversion can be learned especially if it is associated with a bad experience, or it can be innate for the protection of health due to toxins, produced either biologically or chemically. See Addiction.

Avocado (Persea americana) – Also called alligator pear. It is very high in fat (approximately 15%). Varieties include Haas avocado (dark green with mottled skin) and Bacon Avocado (light green smoother skin). The dip common to Mexican food and made from avocado is called guacamole. This dip is usually made with a citrus (lime or lemon), spices, and alternatively with tomatoes, and other seasonings and vegetables. The skin of the avocado is inedible. Florida and California are the main sources of avocados in the United States. The 'Old Wives' Tale' that avocados do not brown if the pit is left in is indeed true but not for obvious reasons. Polyphenyl oxidase or the enzymatic browning enzyme does not work in the absence of oxygen or in a lower pH environment. Thus the reason way the addition of lemon juice or another acidulant works the same way. See Sulfur, vegetables, enzymes, oxidation, enzymatic browning, non-enzymatic browning, Maillard Reaction.

Avocado Oil – See Appendix 2 – Nutraceuticals Overview.

Avogadro's Law – Equal volumes of gases at equal temperatures and pressures contain the same number of molecules. One 'gram molecular weight' or a mole of gas has 6.02×10^{23} molecules. This number is called Avogadro's number or Avogadro's constant. See Gram Molecular Weight (Mole).

Avoirdupois – A system of weights and measurement wherein the pound is 16 ounces, and an ounce is 16 drams. See Gram, Conversions and Definitions.

A_w – Water activity or available moisture. That is, the measure of unbound water and thermodynamic potential of a product. Water activity is important because its measurement indicates the stability of a product in terms of its freshness, microbiological stability, and overall shelf life. See Shelf Life, Microbiology, Accelerated Storage Conditions.

AYE – See Autolyzed Yeast Extract.

Ayurveda/Ayurvedic Medicine – A system of medical treatment mostly used in the Indian subcontinent. It literally means the science of life. This practice, which dates as far back as 3300 B.C. and might even go as far back as 7,000 B.C., employs techniques and herbs. In this system it is believed that ether and air combine to form 'vata' dosha, which is the driving force for nerve impulses, circulation, respiration, and elimination. Fire and water combine to form the 'pitta' dosha, which is the force of bodily and cellular metabolism. Water and earth elements combine to form the 'kapha' dosha, which is responsible for growth. The usage of some of the nutraceuticals mentioned in this book go back to the beginnings of Ayruvedic practices. See Nutraceuticals (Appendix 2 – Nutraceuticals Overview).

Azeotrope – A mixture of two volatile substances, which when combined, usually evaporate at a different temperature than either of the two would evaporate singly. This occurs until conditions are changed (like pressure) or until one of the ingredients is used up. Azeotroping of two volatile flavoring materials could at least partially explain the concept of the masking effect of flavoring materials. It explains why a simple distillation of fermented ethyl alcohol will yield a 95% (190 proof) mixture with water. See Distillation.

Azuki Bean – See Adzuki Bean.

Azulenes – Complex molecules that contribute coloration to essential oils such as chamomile. The azulene found in chamomile is called chamazulene, and in vetiver, vetivazulene, in guaiacwood, guaiazulene and so on. See Chamomile.

B

Babcock Test Bottle – A glass extraction apparatus that looks like a tube with a pinched flattened bulb at the end. This bottle is typically used for fat extractions. See Fat, Analytical Chemistry, Extraction.

Bacillus – A rod-shaped bacterium. Bacilli are responsible for many diseases such as tetanus, diphtheria, dysentery, and tuberculosis. See Coccus, Streptococcus, Staphylococcus, Microbiological Assay, Pathogenic (Pathological) Organisms, Gram Negative Bacteria, Gram Positive Bacteria, Bacteria.

Background –

1. The end of the flavor profile when described versus time. A background character is associated with the perception of higher molecular weight compounds with lower volatility and lower vapor pressures or of some non-volatile or trigeminal responsive substances that appear at the end of a flavor profile.
2. The background could also be described as the base character of the food product either with or without a flavor system added. This background could have off flavors that have developed through time or through processing. A flavor could then be developed to cover up these undesirable characters. See Top Note, Middle Ground.

Bacon – A meat product taken from the side or belly of a hog, prepared by brining, smoking and seasoning. Strips of bacon are prepared then cooked. Turkey bacon has also gained popularity as a leaner alternative. Bacon has grown much in popularity and can be seen mixed with coffee flavoring, chocolate and many other foods. Flavor Dynamics, Inc. makes a Maple Bacon Flavor ® for coffee. See Meat, Spice, Smoke.

Bacopa monnieri or Water Hyssop – See Appendix 2.

Bacteria (plural) – Single-celled microorganisms that are found in many shapes. A rod-shaped bacterium is called a bacillus, a spirilla is a spiral bacterium, and a globe-shaped bacterium is called a coccus. Many bacteria are harmful (pathogenic), but some are also useful.

Bacteria that grow at low temperatures are called psychrophilic (or cryophilic), those that grow at optimum temperatures of 20–45 °C are mesophilic, and those that grow best at temperatures above 45 °C are called thermophilic. See Pasteurization; Sterilize; Sterilization; Microbiological Assay; Microorganisms; Pathogenic (Pathological) Organism.

Bactericidal – That which has the ability to kill bacteria. See Pasteurization; Sterilize, Sterilization; Aseptic Processing.

Bacteriology – The study of microorganisms called bacteria. See Virology.

Bacteriophage – A virus that attacks and consumes a bacterium. Phages are specific to certain organisms. Bacteriophages have been researched recently as non-antibiotic alternatives. See Microbiology.

Bacteriostatic – That which prevents the further growth of bacteria. Some phenols have this property. For this reason, phenolic compounds are used in plastic first aid strips. Compounds such as ethyl phenol, etc., can have both an antiseptic-smelling odor and also hold down further bacterial growth and are thus used for this purpose. See Bacteria.

Bake – To cook by dry heat in an oven. The baking process usually develops temperatures high enough to produce the reaction of proteins and sugars called the Maillard Reaction with a good amount of sugar caramelization as well. The leavening or gas formation of yeasts adds to the flavor system.

Dictionary of Flavors, Third Edition. Dolf De Rovira, Sr.

However, chemical leaveners can also be added. Here no fermentation would occur. See Maillard Reaction, Browning, Fermentation.

Baked Goods Industry – The industrial segment that includes breads, bagels, pitas, muffins, and other bread-like items, such as cookies, prepared bakery mixes, prebaked products, batters, and breadings.

Baker Percentage – The weight ratio of the ingredient in a bakery formula versus the weight of the flour used. Because the percentage of the ingredients is based on the flour the total will come up to more than 100%.

Baker's Emulsion – An emulsion whose particles are usually in excess of 15 microns in size, typically used in the flavoring of cookies, cakes, and other baked products. See Emulsion, Colloid.

Baker's Yeast – Yeast, usually of the variety Saccharomyces cerevisiae that has been grown on molasses and is used for dough rising purposes. Baker's yeast is therefore a primary grown yeast, rather than a by-product yeast like brewer's yeast. Baker's yeast can be further processed for use as a food ingredient. It can be deactivated by heat, enzymatically treated, autolyzed, or further processed for use in processed flavor systems. See Secondary Yeast, Autolyzed Yeast, Autolysis, Whole Yeast, AYE, Autolyzed Yeast Extract.

Bakey – In tea terminology, a slightly high-fired tea that comes across as having a profile reminiscent of the odors found in baked systems. See Industry Vernacular, Tea.

Baking – Generically, the process of producing baked goods, like cookies, cakes, pies, etc. These items usually employ flour, with sugar, flavoring of some type, leavening, or shortening. In culinary terms, baking usually applies to lower heat cooking done where the food is in a semi-solid state, cooked in a bake-proof container, and not moved as in roasting. Examples of baked culinary products would be French onion soup, soufflé, quiche, and some cheese dishes. See Cooking, Fermentation, Maillard Reaction.

Baking Powder – An artificial leavening agent made of different chemical substances designed to give off a gas during baking conditions. Examples are monohydrous monocalcium phosphate (fast acting baking powder), a combination of anhydrous monocalcium phosphate, sodium phosphate and aluminum phosphate (slow acting baking powder), or monohydrous monocalcium phosphate plus aluminum phosphate and sodium phosphate (double acting baking powder). See Leavening and Aerating Agents, Bread, Baking.

Balance –

1. A flavorist's essential tool. The history of the sensitive balance has seen an evolution from simple double platform types, to more complex mechanical/analytical counterweight types, to mechanical/digital, to today's balances that are strictly electronic with pressure/load sensing cells. A typical balance for the laboratory should range between 100 grams to 1,000 grams (1,500 to 2,000 grams is better to allow for flexibility), and should have a sensitivity of at least 0.02 grams (better still at 0.01 gram) with a deviation of 0.01 (better still 0.005 grams).
2. The overall best combination of top note, middle ground, and background of a flavor profile.
3. The best combination of all sensory stimuli in a flavor profile.
4. In wine, the highest quality combination of all the necessary characters: fruitiness, alcohol, tannin, acidity, and the less tangible characters of 'breed,' 'character,' and 'finesse.' See Bouquet, Character, Finesse, Breed, Top Note, Middle Ground, Background, Balanced (Flavor Profile).

Balanced (Flavor Profile) – A combination of all tastes and aromas that do not change often, do not 'stick out,' or appear overwhelming, out of place, or inordinately high, where an accord is reached and appear in a good combination with one another. See Accord.

Ballotine – A culinary preparation usually made from a deboned poultry stuffed with forcemeat and seasonings, tied to hold its shape, sometimes stitched with a trussing needle and braised or roasted. See Culinary, Charcuterie.

Balm (Melissa officinalis L.) – Has a flavor similar to lemon rind (citral). See Lemon, Aldehydes – (Citral), and Chart 54 – Balm.

Balsam – A natural raw material usually exuded from a plant, a balsam can be used to produce a solid extract as in Peru balsam. Balsams have a heavy character (low vapor pressure) and contain fairly heavy molecules as their active ingredient like benzyl cinnamate, cinnamyl acetate, benzoic acid, benzoates, and similar compounds. See Balsamic, each of the separate Balsam listings, i.e., Balsam Peru, Labdanum, Olibanum, Balsam Tolu, also see Balsamic, Flavor Descriptors, Solid Extracts, Balsam Peru, Balsam Tolu.

Balsamic –

1. In flavors, resembling the heavy flavor character of the balsams. Usually present are heavier molecules like heavier salicylates, heavier cinnamates, heavier cinnamyl esters, etc.

2. In fragrances, it means a combination of vanilla with a woody background. See each of the separate balsam listings, i.e., Peru Balsam, Labdanum, Olibanum, Balsam Tolu, etc., also see Balsamic, Flavor Descriptors.

Balsamic Vinegar – Developed around the area in Italy called Modena, this product is a vinegar that through aging and evaporation becomes heavier and darker. Wine vinegar is kept in a cool dry place and left to evaporate. As the liquids evaporate off, more wine vinegar is added until the right flavor is reached. Some balsamic vinegars are hundreds of years old and are correspondingly priced. Balsamic vinegars are extended or replaced with solid extracts and other flavors and contain at least some ingredient made in the Modena style. It is questionable as to how much of it represents product made by the classical method and does not use additions of distilled concentrates, direct vacuum distillation, etc. See Vinegar.

Baltic Redwood – See Pine.

Balsam Pear (Momordica charantia) – Balsam pear contains quinine and is quite bitter. See Bitter.

Balsam Peru – See Peru Balsam.

Balsam Tolu – See Tolu Balsam.

Bamboo Shoots (Phyllostychys spp.) – Bamboo shoots contain toxic substances that must be neutralized by cooking. Bamboo shoots are endogenous to oriental cultures. The shoots are grown in the dark to retard development of a typical bitter green flavor. The procedure is similar to the development of white asparagus or the forcing of chicory to endive. The taste is similar to artichoke hearts. See Artichoke.

Banaba Leaf – See Banba (Banaba) Leaf and Appendix 2.

Banana (Musa spp.) – The fruit of the banana tree. According to Indian legend it is the fruit that Adam ate in the garden of Eden. It is called the fruit of paradise in India. The bunches of bananas that first grow upward, turn down as the 'hands' of fruits get heavier upon ripening. The three types of bananas are Musa sapienta or Musa nana, the sweet banana; M. paradisiaca, the cooking banana; and the inedible varieties, M. textilis and M. ensete. Bananas are a good source of potassium. The aroma of bananas is largely based on green compounds and the esters like cis 3 hexenol and cis 3 hexenyl esters. Lactones, alcohols, aldehydes, and esters are also quite important to the flavor profile. The most popular ester to simulate banana is iso amyl acetate. This oil is so characteristic of banana flavor it is called synthetic banana oil. Bananas come in a red variety as well. See Alkyl Esters grouped by Alcohol Moiety, Chart 146 – Alkyl Esters Grouped by Alcohol Moiety; Unsaturated Esters (Aliphatic), Chart 333 – Unsaturated Esters Aliphatic.

Banba (Banaba) Leaf or Lagerstroemia speciosa – See Appendix 2.

Barbecue –

1. To cook in a metal container, often outdoors, by searing the outside of a food with intense heat generated by coals, or hot rocks or other substances found in the barbecue. The degree of pyrolysis or burning is dependent on the longevity of the food exposed to the temperature source.
2. The sauce that is typically a sour, sweet blend of spices, often with added smoke flavoring, tomato, vinegar, pepper, onions, garlic, and other flavorings.
3. To cook a food by first marinating in a barbecue sauce or by spreading a barbecue type sauce on the outside of the food and cooking in the same manner as item number 1. See Roast, Roasting; Tomato; Grilled; Browning; Caramelization.

Barberry or Berberis vulgaris – See Appendix 2 – Nutraceuticals Overview.

Barley (Hordeum vulgare) – Hulled barley is produced when the outer husk of the grain has been removed. Pot or scotch barley are grains that are triple polished. Pearled barley goes through five or six polishing steps. Barley flakes are rolled like rolled oats. Whole grain barley flour is made from barley grain and has a nuttier flavor than its wheat counterpart. Certain varieties of barley are used to make malt. Germinating, drying then a subsequent roasting makes malt. Germination of the barley seeds increases Vitamin B complex and reduces starch. Malt is used to make beer and whiskey or made into a syrup or dried, which can be used to flavor milk, and other foodstuffs. It can also be used as a baking ingredient. When used for brewing, the longer the malt is roasted, the darker the beer. The roasted barley can also go into coffee replacers. A thick porridge made from barley flour is called tsampa in Tibet. It is also made into an alcoholic beverage called chang in the same region. See Replacers.

Barley Grass – See Appendix 2 – Nutraceuticals Overview.

Base – A chemical which when solubilized in water will shift the pH upward toward the alkaline side (above a pH of 7.0). See Acid, Neutral, pH.

Base (Chef Base) – The item used often in restaurants to replace or enhance stocks and sauces which are often time-consuming and costly to make. These bases are usually bases of hydrolysates, autolysates, meat extracts, and meats cooked up and concentrated. These bases are usually supplied in paste form, however, they are occasionally available in liquid and dry concentrated forms as well.

Base (Food Base) – The terminology used for the food product or beverage system without the flavor. Due

to the complexity of synergism and masking of base ingredients with the flavor, demonstrating a flavor in its base is crucial for a proper evaluation of the flavor's potential performance. Also, due to the many interactions of a flavor's components during the processing of the food base, it is also necessary to evaluate the flavor not only in the base but expose it to the processing conditions as well. This will often change the flavor profile, but adjustments can be made accordingly. After the final flavor has been developed and perfected, the final formulation can have very little likeness to the original profile. This is illustrative of the fact that flavors cannot be evaluated by smelling them out of the bottle, but must be tried in the system in which it is to be used. See Synergism, Masking, Processing Conditions.

Basil (Basil, Bush) (Ocimum minimum L.) – Bush basil is similar in organoleptic characteristics to sweet basil. See Spice, Pesto Sauce, and Appendix 2.

Basil, Sweet (Ocimum basilicum L.) – Basil is the main ingredient in pesto sauce. It is a sweet, spicy oil due to the presence of estragole and methyl chavicol. See Spice, Pesto Sauce, Chart 55 – Basil, and Appendix 2 – Nutraceuticals Overview.

Basket Method – See Frying Methods.

Baste – To pour a liquid over food as it is being cooked. This process ensures that the food remains moist. Basting is an interesting process, because the juice undergoes further Maillard browning as it is exposed directly and closer to the heat source. Basting is often used in the roast and broiling processes. See Hydrolysis, Maillard Reaction, Culinary Arts.

Batch Control – A process within the HACCP system whereby lots or batches of product can be identified for quality and safety reasons. Periodic mock recalls are run to test the system. One example of a Batch Control System is to identify the day, year and batch of a product and document it on the batch sheet, Invoice and shipping papers. See Invoice, Shipping Documents (Papers).

Batch Process – A method of production where the system is non-continuous. This type of processing can produce inconsistencies and also can represent higher costs per pound over similar continuous processes. Freeze drying is an example of a batch process because of the need to evacuate the system in an airtight container before the subsequent removal of water through sublimation in a reduced pressure environment. See Continuous Process, Production Methodologies.

BATF (Bureau of Alcohol Tobacco and Firearms) – Part of the Department of The Treasury of the United States government. Now it is called the TTB (Alcohol and Tobacco Tax and Trade Bureau). See Regulations, Code of Federal Regulations, TTB.

BATF Restrictions Chart – See Chart 42 – TTB Restrictions Chart, Regulations, Drawback, Non-Potable.

Batter – A liquid or paste that is made by blending flour with a liquid (milk, eggs, etc.) often used to coat a food for frying. A breading is similar to a batter in that a food is first battered, then added to breadcrumbs. The batter makes the breadcrumbs stick to the meat, fish, vegetables, etc., for subsequent frying. See Frying Methods, Fried (Oil) Flavor.

Bâtonnet – See Knife Cuts.

Baumé – A scale that is used to measure amounts of soluble solids (usually sugars) and density indirectly by measuring its specific gravity. The correlation is not linear to Brix. Some values for Brix to Baume are 30:16.6, 40:22.0, 50:27.3, 60:32.5 and 70:37.6. See Brix.

Bayberry or Myrica cerifera (LINN.) – See Appendix 2 – Nutraceuticals Overview.

Bay Leaf, West Indian (Pimenta racemosa Mill) – See Spice and Appendix 2 – Nutraceuticals Overview.

Bay, Sweet (Bay Laurel) (Laurel nobilis L.) – Sweet bay is used in gravies, sauces, general seasonings, and pickles due to its sweet, spicy character. The spice contains fatty acids (lauric and myristic). The essential oil can also be used in insect repellents alone or blended with other similarly active oils like citronella. Bay is a useful oil blended with other oils to make complex spice notes, and is used in pickles and general seasonings. The leaf oil contains an appreciable amount of eugenol, over 30%. The name laurel is given because it is the herb that was used entwined to create the laurel worn by those of high station and by the victors of both sports contests and battles. Old leaves lose their flavor and should not be used. The bay leaf should not be eaten when used in cooking, due to its safrole content. See Spice.

Bay Leaf and Bay Sweet Bay Laurel – See Chart 56 – Bay.

Bean –

1. The edible seeds of plants of several genera of Fabaceae (formerly Leguminosae) used for food.
2. Seeds or fruits that are themselves beans or that resemble beans.
3. Leguminous plants grown for their edible seeds and pods.

Beans (Phaseolus spp.) – The edible seed or pod of plants native to Central and South America. The pods are edible only when immature. Beans belong to the legume family and number over 100 species in all varieties of colors. Some types are listed below:

- Black beans – Black outside coating used in Mexican foods, namely refried beans.
- Flageolet – Pale green thin and flat.
- Red kidney bean – Dark red and kidney shaped.

- Roman bean – Kidney shaped and mottled although darker than the pinto bean.
- Pinto bean – Both pinto and Roman beans lose their mottling during cooking. This bean has a stronger flavor than either the kidney or Roman beans.
- White beans.
  - White kidney bean – Kidney shaped, fairly large and squared on either end.
  - Small white bean – Like white kidney only smaller.
  - Great northern bean – Medium sized round bean with rounded ends.
  - Navy bean – Oval shaped bean light reddish brown in color.
  - White pea bean – Oval shaped bean.
  - Cranberry bean – Large, round and creamy white with pink and brown dots. Beans are a good source of B-vitamins and sulfur containing amino acids. Bean flours make good sources of sulfur precursors for use in Maillard Reactions. See Soybean, Adzuki Bean, Buck Bean, Green Bean, Bean.
  - Textured Vegetable Protein, Lima Beans, Mung Bean, Black Gram, Scarlet Runner Bean, Lupines, Lentil, Dolichos Bean, Broad Bean, Pea, Chickpea, Peanut, Alfalfa.

  Beans are a member of the legume family and therefore contribute to soil nitrogen fixation. However, there are a few Issues with beans that should be considered: (1) Beans contain oligosaccharides such as raffinose and stachyose contributing to flatulence. Some over-the-counter enzymes can minimize this effect, however; (2) Phytic acid and phytates and other toxins are present and must be eliminated by cooking as they can disrupt bone growth and inhibit vitamin D production; (3) sprouted beans commonly used in culinary applications have a high moisture content and care must be given that no microbiological contamination occurs. See Legumes, Nitrogen Fixing Bacteria, Favism, Fava Beans.

Béarnaise – A sauce made from a combination of tarragon, shallots, tarragon vinegar, eggs, butter, and wine that is used on fish, meat, or eggs. See Culinary Arts.

Bear's Weed – See Yerba Santa.

Béchamel – A sauce made by mixing milk or cream plus butter and flour cooked as a roux with the addition of seasonings. The seasoning usually used is a combination of an onion with cloves. This is called an onion clouté or an onion piqué. Béchamel is considered one of the Mother Sauces and is the basis for most cream/cheese sauces. Classically an Alfredo would start with a béchamel and have the parmesan/romano, pepper, and onions added to it. See Culinary Arts.

Beechnut (Fagus spp.) – Used more for animal feeds, but once used for human consumption when food was in short supply. The brown nut capsule from the beech tree can be made into bread or roasted to make a coffee substitute. The fat in the beechnut is made up of 75% unsaturated acids, but is still quite stable leading one to believe that the oil contains a natural antioxidant. See Smoke and Chart 57 – Beechnut and Beech Creosote.

Beef Fat (Tallow) – Beef fat is similar in chemical profile to chicken fat, except for the many sulfur compounds and substituted fatty acids found therein. Although there is a predominance of unsaturated dienals in both chicken fat as well as in beef tallow, the presence of a fair amount of these other compounds in beef covers up the character of those compounds and distinguishes beef profile from chicken profile. See Rendering, Chicken Fat, Lard, Tallow.

Beefy Meaty Peptide – A combination of several amino acids that has been identified as a contributor to the flavor of meats along with inosinates, guanylates, and glutamates. The structure has been identified as Lysine-Glycine-Aspartamine-Glutamine-Glutamine-Serine-Taurine-Alanine. See Enhancers, Meat, Protein, Amino Acid.

Beer – An alcoholic beverage made by the fermentation of malted barley and yeast (Saccharomyces cerevisiae). The beer is flavored by extracts, or bits of hops, and recently other items and flavors as well. The yeast by-product or secondary yeast from the brewing industry is used in animal feeds, nutrient supplements, as protein sources for further reactions and as a direct flavoring additive as defined by the CFR as a natural flavoring substance. See Yeast, Natural Flavor.

Beeswax (Apis mellifera L.) – Beeswax absolute is used as a modifier (and per-haps adulterant) in higher priced absolutes like jasmine, mimosa, and violet leaf, as well as others. Its pleasant background character and rounding-out ability makes it a useful component in many WONFs. See Jasmine, Absolute, and Chart 58 – Beeswax.

Beets (Beta vulgaris) – The dried red juice concentrate of beet is also used as a colorant having a reddish blue tint due to beta cyanin, an anthocyanin. It has been used to both augment and replace colorants extracted away from, processed out of, or otherwise gone from natural materials, both alone and in combination with other colorants in apple, tomato, red pepper, wine, or grape. See Color (Colorants) and Chart 59 – Beet.

Beety – Having the earthiness reminiscent of beets. See Earthy, Terpenes, Alcohol, Fenchyl Alcohol, Ethyl Fenchyl Alcohol.

Beidler Model – Derived from the mass action law and animal experimentation, Beidler developed an equation for taste responses. McBride further refined this. The equation states that the ratio between the response and the maximum response shows a sigmoidal relationship to the molar concentration of the tastant, or it is proportionate to the molar concentration divided by the inverse of the binding constant (the affinity of a stimulus compound and its corresponding receptor site) plus the molar concentration of the substance or Psi/Psi – Max = [Stim]/(1/K + [Stim]) where Psi is the Response, [Stim] is the Molar Concentration of the Stimulus, and K is the binding constant. See Least Noticeable Difference, Threshold Level.

Bell Pepper – See Pepper, Sweet.

Belleric myrobalan (aka Bulu) or Terminalia belerica – See Appendix 2 – Nutraceuticals Overview.

Bellywash – The not so flattering term meaning the inexpensive, highly colored, flavored, and sweetened products with little nutritional value other than carbohydrate intake, usually sold in the refrigerated dairy section of supermarkets, delis, and other stores. See Beverage.

Belt Conveyor – One of the more ubiquitous pieces of equipment in a food plant, the belt conveyor distributes product from the process to the packaging areas. See Production.

Benedictine™ – A cordial that is a blend of spices, extracts, and essential oils including iva oil. See Chartreuse™. See Alcoholic Beverages, Botanicals (Iva).

Benne – See Sesame.

Benzaldehyde – One of the more commonly used flavor ingredients. Its use includes the bitter almond note of Amaretto, cherry flavor in cough drops, as a main constituent in almond and cherry flavors in general, and useful in contributing a nutty character obviously useful in nut flavors, and the fruity sharpness found in apricot, peach, and many other flavors. It is almost impossible to list all of the uses of benzaldehyde because they include everything from vanillas and chocolates to passion fruit and kiwi. See Aldehydes (Aromatic).

Benzene Ring – A carbon- and hydrogen-based molecule, which is made up of six carbons attached to each other by alternating single and double bonds, each attached to one hydrogen atom. If the structure is drawn, it becomes clear that the double bonds can exist alternatively on either side of any particular carbon atom as long as they alternate. In fact, the molecule does not possess a static structure, and the bonds do not exist as double and single bonds at any one site. As the electrons can exist on either side of any given atom of carbon, they form a continuous electron cloud, resonating from carbon atom to carbon atom. This electron cloud makes the molecule extremely stable. See Aliphatic, Aromatic, and Figure 6.

Benzoates and Benzyl Esters – The benzoates and benzyl esters are relatively interchangeable by molecular weight as are the alkyl esters and phenyl acetates/phenyl ethyl esters. Odor types range from sweet and pungent (some people describe the odor as shoe polish like) to floral. Some esters like benzyl benzoate are relatively odorless, and if not for their cost would make relatively good solvents. As is typical throughout, some moieties would characterize compounds specifically and would not be interchangeable by carbon number. The phenyl ethyl ester, the eugenyl ester, and the geranyl ester lend themselves toward a combination of floral or spice overtones. Lighter benzoates are found in floral isolates like ylang-ylang and jasmine. It is used as a modifier in many fruit flavors to round out the otherwise chemical-like fruitiness of the lighter alkyl esters. See Sweet, Pungent, Solvent, Floral, Alkyl, Unsaturated Esters – Aromatic, Chart 43 – Benzoates and Benzyl esters, and Figure 7.

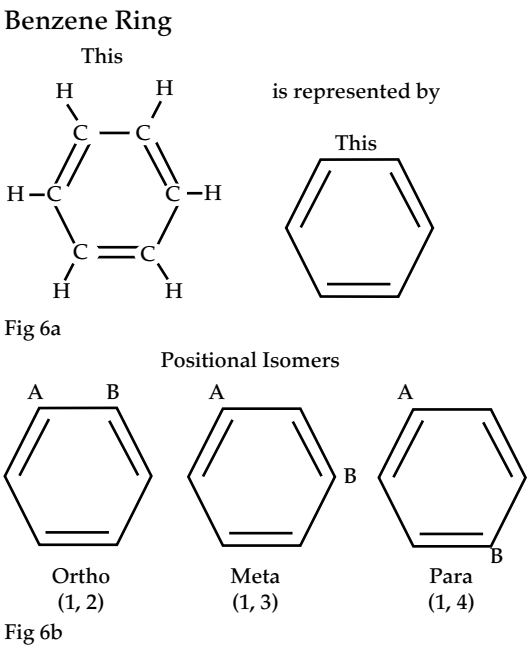


Figure 6

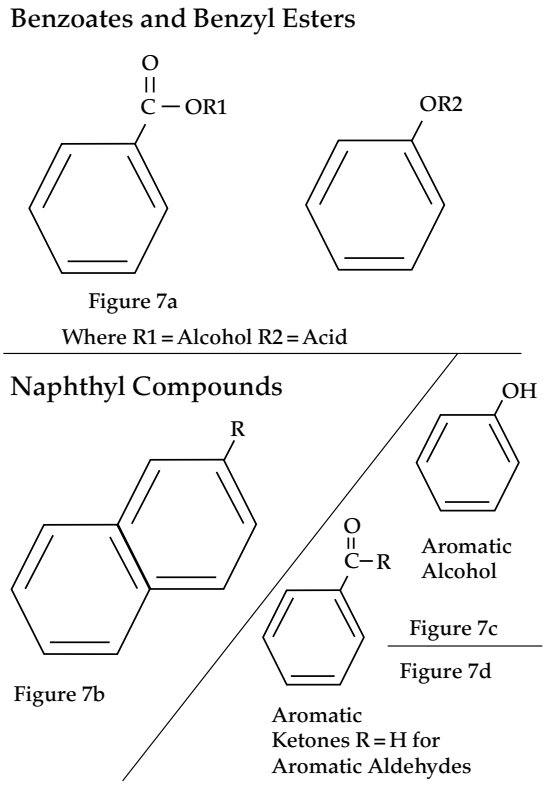


Figure 7

Benzodihydropyrone – A useful compound for any brown type nuance. Can be used in everything from fruits, vanillas, chocolates, nuts, ripened, fermented, and browned foods, etc. See Brown (Compounds).

Benzoin (Styrax benzoin Dry and Other Species) – Benzoin has a sweet balsamic vanilla-type odor and can be used in many flavor compounds including vanilla, chocolate, or many other products where this background character could be useful. See Resinous, Chart 60 – Benzoin, and Appendix 2 – Nutraceuticals Overview.

Benzyl Esters – See Benzoates and Benzyl Esters.

Berberis Vulgaris – See Barberry and Appendix 2 – Nutraceuticals Overview.

Bergamot (Citrus bergamia Risso and C. aurantium L. subspecies Bergamia Wright and Arn) – The bergamot is thought to be a cross between the bitter orange and the lime. It is cultivated mostly in Italy. The fruit itself, although juicy, is too bitter and acidic to be edible. Bergamot contains 30–45% linalyl acetate. Produced from the peel and flowers of the C. bergamia tree, many producers use the old sponge method for collecting the oil. Anthranilates, which occur naturally in the oil, can be problematic, however, and can cause highly colored Schiff base reactions whenever there are aldehydes present. Because of adulteration possibilities, the Consorzio di Bergamotto was established to assure the authenticity of Italian oil. Wild Bergamot is another plant of the Monarda sp. See Citrus, Horsemint, and Chart 61 – Bergamot.

Berry (Like) – Reminiscent of a berry, usually strawberry, raspberry, or blackberry. See Ionones, Methyl Ionones, Irones, Pseudo Ionones, and Ionols.

Beta, b (Greek B, β) – In structural chemistry, a secondary group that is one away from a designated primary group. See Chemical Structure, Chemistry, IUPAC.

Beta Factor, Beta Risk – In sensory and statistical measurement, the probability of acceptance of a product. Also called the buyer's or consumer's risk. In strict testing terms, it is the probability of not noticing a difference when there is one. The real risk here is making a change such as a cost reduction and thinking the overall quality is the same when it is not. The error in not catching this 'consumer risk' might be the loss of a franchised product name. A value of 0.1 to 0.05 means that there was a minor indication of acceptance when there was a difference. A beta value of 0.05 to 0.1 means that there was a moderate evidence of acceptance when there was a difference. A value of 0.001 to 0.001 indicates a strong probability of acceptance when a difference is at hand. A value of less than 0.001 means that there is a good probability that the product will not be considered to be different when a difference exists. See Alpha Risk, Pd (Proportion of Discriminators).

Beta Risk – See Beta Factor.

Betaine Trimethyl Glycine – An amino acid that is beneficial for cardiovascular health. It regulates toxic buildup of homocysteine. See Amino Acid, Nutraceuticals, Appendix 2 – Nutraceuticals Overview.

Betanin – The colorant in beets. Other colorants in beets include isobetanin, probetanin, neobetanin, indicaxanthin, and vulgaxanthins. See Color (Colorants), Beets.

Beverage – A liquid product that is usually consumed for the purpose of quenching thirst, providing nutrition, and/or for its alcoholic content or other functional purpose. See Food Industry.

Beverage Industry – The group of product categories that includes Tea, Coffee, Cocoa, Still and Carbonated Beverages, Alcoholic Products, Vegetable Drinks, Alcoholic Industry, Alcoholic Mixers, Isotonic Beverages, Bottled Waters, Milk Based Beverages, and Bellywash (often split into the Dairy Industry where it is distributed). See Carbonated Beverages, Alcoholic Beverages, Coffee, Tea, Bellywash.

BHA – Butylated Hydroxy Anisole – An antioxidant. See Antioxidants and Chart 44 – BHA and BHT.

BHT – Butylated Hydroxy Toluene – An antioxidant. See Antioxidants.

Bias – Any factor than tends to skew a result or conclusion. In sensory testing, bias can cause errors of conclusion that could result in the wrong choices, potentially costing plenty. See Error of Habituation, Logical Errors, Stimulus Error, Halo Effect, Expectation Error, Order of Presentation Error, Mutual Suggestion Error, Motivational Error, Personality Errors (Capriciousness versus Timidity).

Bias Cut – See Knife Cuts.

Big – In wine, a strong flavor with high amount of acidity and alcohol. See Nomenclature, Industry Vernacular.

Bigstring – See Nettle.

Bilberry (Vaccinium myrtillus) – See Berry (Like) and Appendix 2 – Nutraceuticals Overview.

Biochemistry – The study of the chemical interactions within living organisms. This would include studies of enzymes, hormones, metabolism, such as the Krebs Cycle, photosynthesis, and other biological reactions. See Krebs Cycle, Enzymes, Hormones.

Biodegradable – Capable of decaying through the action of live organisms typically found in the soil. See Metabolism, Fermentation, GRAS, Propylene Glycol.

Bioflavonoids – See Flavonoids.

Biology – The study of plants and animals. See Chemistry, Biochemistry, Organic Chemistry, Genetic Engineering, Taxonomy.

Biopolymers – Naturally derived multimolecular groups. See Gums and Thickeners.

Biotech(nology) – The compound word combining biology and technology. Biotech means any use of technology on a biological organism for the purpose of manipulating that organism for an end use. The use of biotechnology would include genetic manipulation of microorganisms. See GMO, DNA, Asilomar Conference.

Biotin – See Vitamins – (B Complex).

Birefringence – The optical effect where polarized light shows a star pattern when shown through uncooked starch grains. See Starch.

Birch, Sweet (Betula lenta L., B. alba L.) – Present oil of sweet birch available on the marketplace seems altogether too much like pure methyl salicylate. Questions of authenticity and adulteration would obviously ensue. It is obvious with this oil and other similar natural sources, that you trust the integrity of your supplier. See Salicylates, Chart 62 Birch Sweet Birch, and Appendix 2 – Nutraceuticals Overview.

Bisabol Myrrh – See Opopanax.

Bisque – A soup that is thick and creamy like a chowder. Lobster bisque is a well-known food item made in this manner. See Culinary Arts.

Bitter –

1. The taste principle that is perceived in the back of the tongue. Because many toxic substances taste bitter, the position of the receptor sites for bitterness is accompanied with the reflex gag action as a protective mechanism designed early in our evolution. Many alkaloids in foods have bitter characteristics as do metallic compounds in foods.
2. A component either single or in combination with other bitter principles that produces a bitter taste. A blend of these is also referred to as bitters.
3. The three principal types of bitter flavor components are alkaloids, peptides, and glycosides. Although there have been identified over tens of thousands of potentially bitter compounds with great structural diversity.
4. Bitter has been identified as being expressed through the TAS2R gene. There are less than 10 bitter receptors in fish and over 25 bitter receptors in humans.
5. Grazing animals seem to be less sensitive to bitter compounds than are carnivores.
6. Aposematism is the characteristic of plants and animals that are toxic to display colorful pigmentation as warnings.
7. The vagus nerve is associated with the bitter receptors initiating a nauseous response.
8. Bitter receptors have been identified throughout the alimentary canal and in the lung tissue. See Bitter, Alkaloids, Taste, Tongue, Sweet, Salt, Sour, Umami.

Bitter Almond Oil – A natural source of benzaldehyde (+90%). See Almond, Bitter.

Bitter Ash – See Quassia.

Bitter Melon – See Balsam Pear and Appendix 2 – Nutraceuticals Overview.

Bitterness (EMC) – Caused partially by the peptide by-products of the enzyme reduction. Depeptidase can be used to break up these compounds, thereby ameliorating the problem. See Enzymes, Cheese.

Bitterness (General) – Bitterness is caused by a number of different albeit complex causes. Some metallic ions can cause a bitter taste, but the two most prevalent bitter classes of substances are the alkaloids and glucosides. The stimulus of bitterness is transported to the brain through the Glossopharyngeal nerve, also associated with the gag reflex. If bitter is an indication of potential toxicity, then why do we like bitter? This is an interesting question and what follows is why do we like extreme heat and spiciness to the point of pain? One theory is that the body releases endogenous opiates to relieve the pain and

bitter response and this natural feeling of well-being derived from those experiences is pleasant. Research is now underway to explore this and many other issues of flavor and psychophysics. See Tongue, Cranial Nerves, Brain.

Bitter Orange – See Orange (Citrus aurantium) or Bigarade Orange or Neroli, Neroli Bigarade, Orange, and Appendix 2 – Nutraceuticals Overview.

Bitter Wintergreen – See Pipsissewa.

Bitter Wood – See Quassia.

Blackberry Bark (Rubus spp.) – A fruit of a bramble relating to the same family as raspberry and the strawberry. The fruit can be black, red, or yellowish white. The flavor of the fruit is high in esters and green notes, typical of most fruits. Like raspberry, blackberry flavor is characterized by ionones. Blackberry is hybridized with raspberries to produce both varieties called loganberries and boysenberries. See Berry (Like) and Chart 63 – Blackberry.

Black Caraway – See Caraway, Black.

Black Cohosh or Cimicifuga racemosa – See Appendix 2 – Nutraceuticals Overview.

Black Cumin – See Caraway, Black.

Black Currant – Black Currant Seed or Ribes nigrum. See Currant Buds, Black, and Appendix 2 – Nutraceuticals Overview.

Blackened – A food product that is seared on a 'white hot' pan, covered with sugar, spices, and salt. This technique is characteristic of recent Cajun type dishes (New Orleans cuisine). See Culinary Arts.

Black Gram (Phaseolus mungo or Vigna mungo) – Black gram is a bean type that contains a black outside with a white hilum or eye. See Adzuki Bean, Beans, Buck Bean, Broad Bean.

Black Pepper or Piper nigrum (LINN.) – See Pepper, Black, and Appendix 2 – Nutraceuticals Overview.

Black Salsify (Scorzonera hispanica) – Also called scorzonera. Black salsify is lumped in as a member of the salsify-type vegetable family even though it is a different genus and species due to similarities in its flavor and textural profile. A starchy vegetable. The flavor has been characterized as being savory and fishy. See Salsify, Vegetables.

Black Salt – A mixture of salt and pepper. See Spice, Black Pepper.

Black Tea – A product derived when leaves of the tea plant, Camellia sinensis, are fermented in a especially moist area. See Green Tea.

Blackthorn – See Sloe.

Black Walnut – Black Walnut Hull or Juglans nigra. See Walnut Hull, Black, and Appendix 2 – Nutraceuticals Overview.

Black Walnut (Hull) – See Walnut Hull, Black.

Black Wattle – See Mimosa.

Bladderwrack or Fucus vesiculosis – See Appendix 2 – Nutraceuticals Overview.

Blanch – A quick pre-cooking. Often blanching is a technique used to begin a reduction of macromolecules and the activation of enzymes so that the subsequent main cook will be more easily facilitated. This is the case with blanching of French fried potatoes. Blanching can be achieved by precooking in either water, steam, or oil or in a microwave oven. Blanching of green vegetables helps eliminate the aromatic acids within the food that could degrade the brilliant green coloring of the chlorophyll. The technique of blanching vegetables therefore is to boil the food in an open pot for a few minutes and then transfer the food into an ice bath to cool. This technique will preserve the chlorophyll, allow volatiles acids to evaporate, and preserve the green color in foods. See Culinary Arts.

Bland – Low in flavor profile, having little or no flavor. The term bland can have either a negative or positive connotation dependent on the nature of the alternative descriptions (i.e., bland versus overflavored, or bland versus tasty). Alternatively, the flavor could be described as a vanilla flavor. In this sense it does not mean it tastes like vanilla or like vanillin, its active component, but that is has a bland flavor instead. See Rich, Mellow, Rounded.

Blaze – To cook in flaming alcoholic-based liquids. See Culinary Arts.

Blenders – 1. Mixers, typically for dry ingredients. 2. Additives to be added to alcoholic bases to minimize the harshness of the alcohol and eliminate the need for storage in, for example, oak barrels. See Toners, Harsh, Mellow, Masking Agents.

Blessed Thistle – See Thistle, Blessed.

Blood – Aroma of – It has been discovered by Matthias Laska of Linköping University that trans 4, 5 epoxy (E)-2 decenal represents the metallic bloody odor that develops during the breakdown of fats. See Meat and Savory.

Blood Pressure – The internal force exerted on the walls of the blood vessels measured in millimeters of mercury. Systolic pressure is that which is measure by the pumping of the heartbeat, and the diastolic pressure is that measured between beats or the resting pressure. Blood pressure health is of great concern as high blood pressure or hypertension is one of the greatest causes of secondary potentially disastrous health consequences including stroke, heart disease, and other complications. Certain herbs and nutraceuticals are considered useful in the control of high blood pressure as are flavor volatiles themselves. See

Aromatherapy, Nutraceuticals, Herbs, Volatiles, Brain.

Bloodroot or Sanguinaria canadensis – See Appendix 2 – Nutraceuticals Overview.

Blood Sugar – The level of glucose (dextrose) in the bloodstream. See Diabetes, Carbohydrates, Diet, Glycemic Index.

Bloom –

1. The measure of a gelatin's gel strength measured by an instrument developed by Bloom. Typical measurements range from 0 to 300 in 25-point increments.
2. The thin waxy coating on fruits like blueberries.
3. Sudden growth of an organism, usually a microorganism like a yeast bacterial or mold.
4. The unattractive grayish white film that appears on the surface of chocolate. Bloom can occur from a moisture loss (sugar bloom) or a poor crystallization of cocoa butter (fat bloom). Milk fat helps in the prevention of bloom in chocolate (approximately 2%).

See Gums and Thickeners, Microbiology, Conching, Chocolate.

Blotter (Perfume Blotter) – A thin strip of paper that is dipped into a mixture of volatiles to increase the surface area and then enhance the evaporation rate, facilitating the detection of the different odor profiles of the mix. See Gas Chromatography (GC), Paper Chromatography.

Blow Over Still – A distillation apparatus that provides for quick removal of light fractions, usually through the use of an evacuated environment. This apparatus is used for distilling simple oils and folding oils as well. See Distillation.

Blueberry (Vaccinium angustifolium and V. corymbosum) – The fruit grows naturally with a thin waxy coating called the bloom. The flavor of the unripened fruit is very green, however, upon ripening it develops a floralcy usually replicated by linalool, linalyl acetate, and related compounds. The flavor of cooked blueberries is quite different, developing many brown compounds. This character is known as the blueberry pie filling profile. Blueberry is related to the bilberry. This fruit is indigenous to the United States and is not well known in Europe or elsewhere. According to the USDA Human Nutrition Research Center on Aging (Boston, MA), blueberries have one of the highest antioxidant levels of the fruits. See Berries, ORAC (Oxygen Radical Absorbtion Capacity), and Appendix 2 – Nutraceuticals Overview.

Blue (Bleu) Cheese Ketones – See Ketones – Aliphatic, Methyl Ketones.

Blue Cheese (Bleu Cheese) – See Cheese.

Blue Cohosh or Actaea racemosa, Cimicifuga racemosa – See Appendix 2 – Nutraceuticals Overview.

Blue Chamomile – See Chamomile, Hungarian.

Boar Taint – An unpleasant odor observed in pork that is attributed to the presence of androstenone and skatole accumulated in the adipose. This development occurs when males are in rut. Androstenone is the one identified pheromone in humans as well. It is also found in dogs and truffles. See Androstenone, Pheromones.

BOD (Biological Oxygen Demand) – This has to do with effluent from manufacturing plants and local environmental laws. Because some types of microorganisms can metabolize hydrocarbons and other effluent materials, a bacterial bloom may occur in the presence of chemical- or nutrient-rich waste products. This bloom, unnatural as it is, will need much oxygen to flourish, taking away available oxygen from the fish. Therefore, a high BOD will usually result in a fish mortality event. See Environmental Laws, Effluent, Pollution, Microorganisms.

Body – Having a mouthfeel that elicits a thick or full impression. Body is associated with undissolved minute suspended particles that can be both flavored and felt. See Mouthfeel, Thickness, Suspension, Particles, Particulate Matter.

Boil –

1. The act of turning from a liquid to a gas.
2. To cook a food by exposing it to boiling water. See Broth, Culinary Arts.

Boiling Point – The temperature at which a substance's state changes from a liquid to a gas. See Boiling Point Elevation, Distillation, Condensation, Evaporation, Freezing Point Depression.

Boiling Point Elevation – The observation that the boiling point of a liquid can be raised by the addition of solid soluble compounds. Boiling points can also be lowered due to lower atmospheric pressures at higher altitudes. It is for this reason that 212°F might not be able to be reached in a plant in Denver, Colorado, making it difficult to cook out starches and kill microorganisms in ambient pressures. See Freezing Point Depression.

Bois De Rose (Aniba rosaeodora Ducke) – Bois de rose is also known as rosewood. It is a good source of natural linalool, and because of this finds limited use in WONFs. Bois de rose (rosewood) has a profile similar to linaloe. See Terpenes – Oxygenated and Related Compounds, Linalool, Linaloe, Chart 64 – Bois De Rose.

Bok Choy – See Chinese Cabbage.

Boldo Leaves – See Chart 65 – Boldo Leaves.

Boldo or Peumus boldus – See Appendix 2 – Nutraceuticals Overview.

Bone Black – A fine carboniferous powder made from oxidation of bones obtained from meat rendering. This product was used as a catalyst and reducing agent to bleach unrefined sugar. See Sugar(s) and Polyhydroxyl Compounds.

Boneset or Eupatorium perfoliatum – See Appendix 2 – Nutraceuticals Overview.

Borage (Borago officinalis) – An aromatic plant that can be made into a tea. Its flavor is reminiscent of cucumber. It can also be used in soups and is a main ingredient in Pimm's Number 1, a gin-based drink invented by the owner of Pimm's London restaurant almost a century ago. See Tea and Appendix 2 – Nutraceuticals Overview.

Bordelaise (Sauce) – A brown sauce made by reducing a mixture of wine, shallots, pepper, herbs, and bone marrow. See Gold Standard, Culinary Arts.

Border Inspections – See Export, Tariff, Customs.

Borecole – Botanical similar to collard. See Collard.

Boronia (Boronia megastigma Nees.) – A very good product for use in natural flavors, especially for use in berry flavors because of its woody, tea-like, leaf-vegetable aroma and taste. It works very well in fruit WONFs, like berry cordial flavors, and natural fruit flavors for yogurt and ice cream. Boronia was used to replace the character of black currants, thought to be otherwise a difficult task until the discovery of mercapto(thio) menthone in the early 1970s. See Sulfur Compounds (Thio Menthone) and Chart 66 – Boronia.

Bornyl Esters – Esters of borneol, a cyclic terpenoid exhibiting generally camphoraceous and piney/woody flavors. Warmth and earthiness are attributes that would describe the background characters of these higher molecular weight esters. See Earthiness, Warm, Cyclic Terpenoid, Camphoraceous, Piney, and Chart 45 – Bornyl Esters.

Boson – See Particle Physics.

Bostwick Consistometer – From the Bostwick site on the internet: 'The Bostwick Consistometer is the preferred choice for measuring consistency, flow rate and viscosity in a variety of products. You can use the Bostwick on any viscous material like sauces, salad dressings, paints, chemicals or cosmetics where you want to measure the distance a material flows in a given time interval. The Bostwick complies to Mill Spec R-81294D and ASTM F1080-93 and is made of stainless steel construction.' See Analytical Chemistry, Flow Rate.

Boswellia or Shallaki or Boswellia serrata, or Frankincense – See Appendix 2 – Nutraceuticals Overview.

Botanicals, Herbs, Barks, Roots, Florals, and Foods – Natural extracts represent a good part of the GRAS list. Natural ingredients are in themselves their own little flavors, often already balanced and blended. In the past, before the advent of the natural chemicals that are now prevalent, the flavorist used these ingredients much more often. The more experienced flavorists of today decry how creative we needed to be because we had fewer ingredients to choose from to make a natural flavor. Perhaps flavorists relatively new to the field would say that now there are more ingredients from which to choose and with diversity comes a greater creativity. It is true that natural ingredients have a myriad of non-GRAS chemicals, naturally made of course, and many non-volatile taste components and heavier molecules that certainly affect the flavor profile at least in the overall character. Trace chemicals often will elude gas chromatographic scrutiny and can only be detected by the trained nose. Naturals therefore can be used as confusing agents or obfuscators. In any event, to ignore the natural product wealth that is available is to ignore much of what nature presented to us in the beginning and also to ignore what flavors are all about – the duplication of natural food systems. Category assignments are generalized and should be used to isolate these botanical into classes. For instance, the brown flavor category will contain those that yield an aroma that would fall into the brown category like vanilla extract, fenugreek, St. John's bread, etc. Some are green and vegetative or vegetable like and would fall into the vegetable type category. Some are really non-flavorants and fall into the thickener category, emulsion stabilizer category, etc. We have tried to list these under their specific functionality or in the general category of GRAS ingredients that are non-flavoring ingredients (like algin, alginates, and annatto, or gums and thickeners, etc.). Sweet spices are those that contain anethole, eugenol, methyl chavicol, cinnamic aldehyde, caryophyllene, or other similar ingredients as typical or predominant aroma components. Phenolic spices contain chemicals called phenols like carvacrol or similar ingredients as their predominant character components (like oregano and thyme). Some others are bitter principles, florals, resinous products and berry and nut types. Terpene types are ones that contain terpenes and are reminiscent of pine, turpentine, rosin, and evergreen. Balsamic types usually have their characterizing aromas as a result of heavier molecules and are therefore background or heavy odors. Green types are not the types with profiles similar to vegetables, but those that have characteristics similar to green leaves. Sulfur types contain sulfuraceous materials and are therefore very garlicky or oniony, etc. Some aromatic types and camphor types are usually warm and cloying having both

a warm odor and feel on the nasal mucosa. These are called trigeminal responses. Linalool types usually contain linalool and/or linalyl acetate. Natural products of animal origin like ambergris, civette extract, castoreum, and Tonquin musk are also included here. Also included for reasons of cross-reference are foods in general. These are placed here so back and forth comparisons can be easily made and relationships between chemicals can begin to pique the creative imagination. Botanicals can be used in blends for non-caffeine beverages or Herbal Teas. Some often included flowers are cornflower, rose, safflower, hibiscus and calendula. See Natural Flavor, Extract, Essential Oil.

Bottler's Syrup – The sugar-based ingredient that oftentimes has both color and flavor. This product is usually diluted at a ratio of 1 + 5. This is often called a 'one plus five throw.' The sugar used was sugar syrup at a 66% solids rate, but recently corn syrup and high fructose corn syrup have replaced the beet sugar usage. With current alternative corn sweeteners, high fructose corn syrup, etc., the final beverage is roughly equivalent to a 16–17% sucrose dilution in water. The five parts of dilution can be still or carbonated water, depending on the desired final product. The final dilution is either made onsite at the soda counter, or into a bottle, can, or other suitable container at a bottling company. See Beverage, Soda.

Botulism – A rare but serious poisoning caused by ingestion of improperly canned or poorly preserved food. The toxin produced by Clostridium botulinum is one of the most potent poisons known to man. Spores of the organism are found in the soil and intestinal tracts of animals and fish, but are harmless to humans because the spores do not multiply unless they are in the absence of air (anaerobic). Floppy infant syndrome is a botulinum-related condition in infants that occurs when the botulism organism is ingested through foods like honey and colonizes in the intestine. The bacteria can enter the body from the soil through an injury in the skin. However, both of these types of poisonings, through honey or related foods and through the soil have been reported only 250 times in history and only five times in the United States. Sterilization of foods prevents the foodborne incidence. Foods that are preserved should be cooked in a pressure cooker to 120 °C (250 °F) for 30 minutes. If a food smells strange or a can is bulging, the product should not be taste tested but it should be either discarded and/or the incident should be reported to the health authorities. Typically, the organism Clostridium botulinum cannot survive below a pH of 4.6 (according to Sylvetsky, Food Product Design, June 1997). See Pasteurization; Sterlize, Sterilization.

Bouillabaisse – A stew made from at least two or more types of seafood products, in a highly seasoned broth.

Bouquet –

1. In flavors, the bouquet represents a positive description referring to the overall aroma profile.
2. In wine, it is the smell of the wine itself. The bouquet indicates the aromas that develop upon aging. These aromas are produced through interesterification, transesterification, oxidation, and leaching of aroma volatiles from the aging container, usually oak. The aged bouquet is also described as a wine's perfume. See Profile, Balance, Aging.

Bouquet Garni – A bunch of herbs and spices tied together or wrapped in cloth that can then be added to a soup or sauce to enhance its flavor. This mix usually includes a few sprigs of thyme, bay leaf, parsley, and peppercorns. Savory, fennel, rosemary, or sage can also be added.
See Culinary Arts, Sachet d'espice.

Bovine Spongiform Encephalopathy – See BSE.

Boyle's Law – The law that states that the volume of a perfect gas is inversely proportional to the pressure of that gas.

Boysenberry – A hybrid between blackberry and raspberry. See Blackberry.

Bracts – Fleshy vegetable parts as in the base of artichoke leaves.

Brain – The main organ located inside the skull cavity that controls most of the body's functions. The center of the frontal lobe is the location where processes such as abstract thinking, creativity, and individual personality occur. Hearing, smell, and the processing of nerve signals associated with taste occur on the sides of the brain in and around the areas under the ears called the temporal lobe. The sense of touch and pressure, pain, and chemical irritation are finally processed in the area called the postcentral gyrus. The postcentral gyri are symmetrical areas beginning at the top of the temporal lobe, just between the eyes and ears and meet together at the upper rear of the head. See Cranial Nerves, Cerebral Cortex, Synesthesia.

Brainstorming Session – A group of people who get together and 'throw out' ideas in the hope that a creative thought process will lead to positive and valuable insights. One of the important factors in this regard is that no idea is challenged or rebuked, but considered. 'Boss Pressure' has no place for this environment to be fully productive.

Braising – Cooking in a small amount of liquid, slowly, and at low temperatures, usually in a covered dish.

Meat can be braised in its own juices. Searing of meat to generate caramelization/Maillard flavors is often done first.

Braising Greens – Green leafy vegetables that cannot be eaten as is, but must be steamed, sautéed, or braised until they are tender. These include beet greens, collard greens, dandelion greens, turnip greens, mustard greens, kohlrabi greens, chard greens, amaranth greens, broccoli raab (rabe or rape), and kale greens. Endive and radicchio are salad greens that are often cooked although braised Romaine lettuce as well is a French side dish. See Braising.

Bran – The covering of the kernel or pericarp, which contains vitamins, minerals, and fiber.

Branched Chained Molecule – A branch chained molecule, also known as an iso molecule, is one with a non-linear configuration. 2-methyl butytic acid is a branch-chained version of the straight-chained normal pentanoic acid, or 1-pentanoic acid. See IUPAC, Normal Chained Molecule, Isomers, Iso, Chemical Structure.

Brazil Nut (Bertholletia excelsa) – The Brazil nut is one of the toughest of the popular nuts to crack. The inner nutmeat has a buttery, fatty character reminiscent of both a peanut and a macadamia nut. The nuts grow in a coconut-like structure called a capsule. For this reason, workers do not venture into the forest on rainy or windy days, because if these capsules fall down, a fatal injury might result. Commercially, the nuts are first soaked, then boiled to assist in shell removal. See Nut(s).

Brazilian Ginseng – Suma. Not a ginseng. See Appendix 2 – Nutraceuticals Overview.

BRC – British Retail Consortium – BRC Global Standards. One of the approved audit systems within the GHS (Global Harmonized System) or GFSI (Global Food Safety Initiative supported by the World Health Organization of the United Nations. See SQF, Iso 9000, AIB.

Bread –

1. To coat a food with bread crumbs or crustless bread.
2. A food staple made from a ground grain such as wheat, triticale, or rye, or a mixture of other grains and one of those mentioned to produce either a bread that will rise, or any grain to produce flat bread. Some flat breads include tortillas (corn and flour), pitas (pocketed and pocketless), chapati, naan, and many others. Bread is made in the following manner: Water is mixed with the flour or ground grain then kneaded until the mass becomes spongy rather than tacky. At this stage, the gluten is developed and can sustain and entrap gases that will develop in the second stage. The second stage consists of a gas formation. These gases are derived either by the inoculation of baker's yeast (also known as Saccharomyces cerevisae), a sough dough culture, or an artificial leavening agent. The gas is formed and is trapped in the dough mass. The mass is baked. The escape of the entrapped gases by heat further raises the dough mass, and as the dough cooks, the starch molecules change, undergoing browning reactions, crystallization, cross linking, etc. The bread is then cooled. Examples of bread throughout the world are:
   - Focaccia – Flat bread made with pizza or bread dough served for example as plain or topped with onions, zucchini, eggplant, or cheese.
   - Chapati – Chapati or chapatti is a type of roti or Indian bread. It is made from a dough of atta flour (from whole grain durum wheat). Water and salt are then added. The bread is made by rolling the dough out into discs and browning it on both sides on a very hot, dry frying pan (tava). It is then held very briefly (about half a second) into an open flame, causing the dough to puff up like a balloon from the steam built up inside the dough.
   - Crispbread – Crispbread (Swedish: knäckebröd, spisbröd or hårdbröd; Finnish: näkkileipä) is a very flat and dry bread from Scandinavia. The bread contains mostly rye flour so little gluten is formed.
   - White Bread – Bread made with finely ground and usually bleached wheat flour.
   - Pumpernickel – Pumpernickel is a dense sourdough-type bread from Germany. Pumpernickel uses rye flour, rye meal, and molasses or cocoa powder helping to give pumpernickel its dark color.
   - Panettone – A tall, fat cylindrical egg-rich sweet yeast cake/bread made with raisins, citron, pine nuts, candied fruit, and anise and baked in a tall cylindrical shape. It originated in Milan, Italy, and is traditionally served at Christmastime, or Easter, but also for celebrations such as weddings and christenings. Panettone can be served as a bread, coffeecake, or dessert.
   - Rye – Any of various types of breads made either entirely or partly of rye flour.
   - Fougasse – A flatbread from France that was once served sweetened with sugar and orange water. It is now more commonly seen as a bread eaten with savory dishes where it would be typically brushed with olive oil and sprinkled with herbs or salt before baking.

- Ciabatta – An Italian style crispy flat bread, usually baked on rocks in a bakery oven. Its name is derived from the Italian word for slippers, which the bread resembles when baked.
- Naan – An Indian flat bread made from wheat and baked in a flue-like open-topped oven called a tandoor. The bread is baked by slapping the dough to the sides of the oven and by the cooking and forces of gravity often develops a teardrop-shaped effect.
- Baguette – French stick bread. Distinguishable by a much greater length than width.
- Pita – A flat bread made in Greece and the Balkan countries. Pitas can be either pocketed or pocketless, depending on the style of cooking and the moisture trapped within the two layers of bread. See Cereals and Grains.

Breakthrough Phenomenon – The stage in a creative process where a new idea or collection of formerly unrelated ideas comes apparently and suddenly to the conscious. See Creativity, Intuition, Insight.

Breed –

1. In wine terminology, the complexity of profile and ultimate balanced character typical of a grape of a certain variety.
2. A race of animal or plant organisms such as in a breed or variety of cattle that shows very similar specific traits like coloration, size, stature, shape, etc. See Genetics.

Brewer's Yeast – A secondary yeast or by-product yeast that is obtained as a by-product of the beer industry. The strain of yeast is typically Saccharomyces cerevisiae. Brewer's yeast is rich in vitamins, minerals, and potential precursors. It also has a nutty aromatic flavor. The nuttiness comes from the yeast, which is derived from proteins, amino acids products, and volatiles (mostly fatty alcohols). The aromatic character comes from the hops used to flavor the beer. Compounds called humulenes are some of the aroma components found in hops and hop extracts, which are responsible for this character. See Baker's Yeast, Hops, Yeasts, and Appendix 2 – Nutraceuticals Overview.

Bridging Principles – as Excerpted from the OSHA guidelines available online:

'Bridging principles are an important concept in the GHS for classifying untested mixtures. When a mixture has not been tested, but there are sufficient data on the components and/or similar tested mixtures, these data can be used in accordance with the following bridging principles:

Dilution: If a mixture is diluted with a diluent that has an equivalent or lower toxicity, then the hazards of the new mixture are assumed to be equivalent to the original.

Batching: If a batch of a complex substance is produced under a controlled process, then the hazards of the new batch are assumed to be equivalent to the previous batches.

Concentration of Highly Toxic Mixtures: If a mixture is severely hazardous, then a concentrated mixture is also assumed to be severely hazardous.

Interpolation within One Toxic Category: Mixtures having component concentrations within a range where the hazards are known are assumed to have those known hazards.

Substantially Similar Mixtures: Slight changes in the concentrations of components are not expected to change the hazards of a mixture and substitutions involving toxicologically similar components are not expected to change the hazards of a mixture.

Aerosols: An aerosol form of a mixture is assumed to have the same hazards as the tested, non-aerosolized form of the mixture unless the propellant affects the hazards upon spraying.' See OSHA, CFR, HAZCOM 2012, Regulations.

Brigade – Brigade de Cuisine – A recognized system of hierarchy in the restaurant business where each Individual is assigned a task in which they specialize. The top of the hierarchy is the Chef de cuisine or Executive Chef, followed by the Sous Chef, and then each of the specialists; The saucier (Sauces), Garde Manger (Pantry Supervisor and salad Maker), Patissier (Pastry Chef), and others. See Culinary, Restaurants.

Bright – In tea terminology, having a clear color and a good degree of hue intensity. Early in the season, teas are typically orange, taking on a more reddish tone later on.

Brilliant Blue – See Colorings, Blue #1.

Brine – A salt solution added to foods often for preservation purposes. Typically, sodium chloride or table salt is added at a maximum level of about 25% in water at room temperature.

Briny – Reminiscent of the aroma associated with seawater, somewhat fishy and seaweed like.

Brisk – Used in tea terminology, brisk means a sensation that simulates both the odor and taste senses. The term brisk also is associated with a certain degree of pungency of flavor.

Brittle Glass and Plastic – Part of the HACCP analysis, the presence, condition and treatment of brittle glass and plastic is a crucial consideration in food safety for the prevention of extraneous matter. A sieve of less than 7mm will handle most of the size particles the FDA considers hazardous. If temporary repairs are

done on brittle glass or plastic and duct tape is used for example, the tape should be dated and replaced as soon as possible. There should be an inventory of brittle glass and plastic, and this should be updated on a regular basis. Also there should be a glass and brittle plastic breakage policy which should include separate cleaning equipment, reporting system and remediation procedures. See Glass Policy, HACCP.

Brix – The general percent of soluble solids (usually sugars) in a liquid. This notation is reported in degrees. One 'degree Brix' is the same as 1% by weight of sucrose in the solution. Brix is usually measured by a device that charts solids content versus refractive index. Degree Brix therefore relates to specific gravity but unless the solids in the system are only sucrose, Brix is only an approximation of soluble solids. The Baumé Scale is another system from measuring soluble solids. See Baumé, Specific Gravity.

Broad Bean (Vicia faba) – The broad bean was the only variety of legumes known to Europe until the green bean was brought to Europe by Spanish conquistadors in the late 16th century. However, a very serious intolerance disease to the broad bean has developed in the European genetic strain, called favism, whose resultant effect is a breakdown of red blood cells. See Favism, Food Intolerance, Adzuki Bean, Beans, Buck Bean, Black Gram.

Broccoli – (Brassica oleracea var. italica) – The color of broccoli is usually green, but it can be white or purple. It has a unique green/sulfury flavor. Cauliflower broccoli (var. botryitish) is a cross between broccoli and cauliflower. See Sulfur, Broccoli Rape (Broccoli Rabe), and Appendix 2 – Nutraceuticals Overview.

Broccoli Raab, Broccoli Rape, or Broccoli Di Rape – See Italian Broccoli.

Bromelain or Pineapple Protease Enzyme – See Enzymes, Proteases, and Appendix 2 – Nutraceuticals Overview.

Brominated Vegetable Oil – A halogen treated (Bromine) vegetable oil that is used as a weighting agent. Adverse toxicological data became known, and subsequent restrictions on its use were implemented. It is a generally accepted fact that the maximum levels allowed fall below its effective use rate. Therefore, it is considered ineffective at legal limits. See Weighting Agents.

Bronchiolitus Obliterans – The degenerative lung disease in which the bronchioles of the lungs can be irreparably destroyed or obliterated. One possible cause is constant exposure to an irritant. Diacetyl inhalation at consistently high temperatures has been purported to have caused this in production workers at a popcorn plant. However it is not clear that it was the sole cause of the disease.

Broom (Absolute or Oil) – Known as broom because of the use of the stems of the plant and their usage in broom whisks in Europe. Genet is used in flavors where a green/brown flavor is appreciated. See Genet.

Broth – Any liquid substance extracted from a food such as a meat, vegetable, or grain, which has a nutritive profile. Broths are usually associated with savory characters.

Brown (Compounds) – The terminology brown is somewhat vague in that it connotes many different types of characters, some chemical and some physical as follows:

1. Possessing a character that is typical of one that has undergone a non-enzymatic browning reaction or has a character typical to the brown group
2. Colored brown
3. Browned, as a characteristic of a product that went through a browning reaction; or
4. A state of having gone through an enzymatic or table browning. Chemicals that fall into this category are varied. Vanillin (enzymatic), ethyl vanillin (chemical similarity to vanillin), furanones (caramelization), aldehydes (Maillard–Strecker degradation), pyrazines (Maillard–Amadori rearrangement), phenolic chemicals (oxidation), and thiazoles (Maillard Reaction sulfur containing amino acids).

See Non-Enzymatic Browning; Enzymatic Browning; Table Browning; Bruising; Searing; Fermentation; Caramelization; Oxidation; Maillard Reaction; Roast, Roasting; Toasting; Braising; Charring; Burning; Barbecuing; Broiling.

Brownian Movement – The observed random movement of particles observed under the microscope in an emulsion. The reason for the effect is due to the repulsion of like electrostatic charges of the micelles. See Emulsion, Micelle, Electrostatic Attraction/Repulsion Electrostatic Charge, Tyndall Effect, Tyndall Cone, Emulsifying Agent.

Browning –

1. Non-Enzymatic or Maillard browning, i.e., the act of sugars on amino acids and proteins forming typical brown-type compounds like pyrazines, cyclic polyols, thiazoles, pyrrolidines, pyrroles, and phenols.
2. Enzymatic or table browning. The production of volatile aroma compounds similar to fermentation breakdown products of sugars, producing cyclic and non-cyclic polyols, simpler alcohols, esters, and acids through the action of endogenous enzymes.
3. The act of turning brown in color. This could include simple caramelization of sugars forming cyclic polyols.

Browning Reaction (Enzymatic) – The reaction occurring with bruising of fruit and during the ripening process. This browning is in part due to the reaction of polyphenyl oxidase found within the food.

Browning Reaction (Non-Enzymatic) – See Maillard Reaction.

Brown Rice – Hulled or unmilled rice is a whole grain rice with a nutty flavor. Fixed oils are still present so shelf life is shortened due to potential oxidation and rancidification. See Rice, Cereals and Grains.

Brown Sugar – Brown sugar was originally unrefined sugar. Today most people think that it still is the way most of the brown sugar is produced. However, due to the presence of filth such as insect parts and microbiological contaminants, most sugar is now first refined, and then molasses is added to produce brown sugar. Some specialty brown sugars are safe and are available today.

Bruise (Bruising) – When a food is impacted or crushed, a discoloration will often form. In fruits, this is an enzymatic degradation called table browning. An example of this is in the bruising of apples and bananas. The enzyme responsible for this is polyphenyloxidase. Ethylene seems to catalyze this reaction. So ripening fruits in a closed environment can help ripen other products (as in a refrigerator). See Non-Enzymatic Browning, Maillard Reaction, Caramelization.

Brunoise – See Knife Cuts.

Brush Border Enzymes – Those enzymes found in the epithelia of the small intestines producing the enzymes of digestion including; glucoamylase (Maltase), Sucrase – Isomaltase, Lactase and Peptidase. See Digestion.

Brussels Sprouts (Brassica oleracea var. gemmifera) – The vegetable resembles small cabbages, and the flavor is somewhat similar to cabbage as well. The difference between the two is that Brussels sprouts have a slightly green bitter pungent overtone similar to the character of horseradish and mustard. This is due to the presence of trace isothiocyanates. See Cabbage, Sulfur.

Bryonia – See Chart 67 – Bryonia.

BSE (Bovine Spongiform Encephalopathy) – According to USDA and FDA reports, BSE is a degenerative disease otherwise known as 'Mad Cow Disease,' that has been linked to the presence of animal proteins within the ruminant animal feeds. BSE is a Transmissible Spongiform Encephalopathy (TSE). TSE is a family of similar diseases that may infect certain species of animals and people. Examples of these are scrapie in sheep and goats, BSE in cattle, chronic wasting disease (CWD) in deer and elk, and the variant Creutzfeldt–Jakob Disease (vCJD) in people. The Center for Veterinary Medicine (CVM) has conducted tests to determine the presence of these proteins in animal feeds. It is a slow, degenerative, progressive, and fatal disease where the cow in the later stages acts strange, hence the name 'Mad Cow.' It is caused by a protein-like structure called a prion. Creutzfeldt–Jacob Disease (CJD) is a similar disease to BSE in humans and is believed to be caused by eating tainted meat. There is a type of Creutzfeldt–Jacob Disease (CJD) that is not spread through consumption of tainted meat products. However, the variant strain vCJD is the organism that is the root cause of the human version of 'Mad Cow Disease.' Studies indicate that a BSE-infected cow does not pass the disease on through the milk, however. BSE in cattle was first reported in 1986 in the United Kingdom (UK). The exact origins of BSE remain uncertain, but it is believed that cattle initially may have become infected when fed feed contaminated with scrapie-infected sheep meat and bone meal (MBM). Scrapie is a similar disease to BSE that affects both sheep and goats. One author claims that Scrapie is directly a result of feeding rapeseed oil to livestock in the 1980s. When this was discontinued, Scrapie disappeared. See Prion, Rapeseed Oil, Canola Oil.

BTU (British Thermal Units) – The amount of heat needed to raise 1 pound of water 1 °F. See Calorie(c), Calorie (C).

Bubba Panel Testing – An affectionate term used for a panel selection using non-urban type of panelists.

Buchu (Barosma betulina Bartl. and Wendl and Other Species) – A very popular oil for use in top noting natural tasting citrus products and other fruits. Buchu oil, which contains a significant amount of para thio menthane 3 one, has been described as having a cat uriney or currant odor. Because of this, it is very important in the development of tropical fruit flavors. The oil is used mostly in tart flavors usually at low levels due to its potency. It is characterized by the presence of para menthane thio 3 one, or thio menthone. This chemical is therefore also known as buchu mercaptan. This is the same chemical that is found in blackcurrants, used in Europe to make cassis. Buchu is used in many fruit flavors for its natural-tasting sulfury contribution, especially in soft fruits like berries (blackberry, blueberry, raspberry, strawberry), tropicals (mango, passion fruit, papaya), and benzaldehyde fruits (apricot, peach, cherry). See Sulfur Compounds (Thio Menthone), Currant, Passion Fruit, Guava, Raspberry, Berry (Like), Cat Uriney, Chart 68 – Buchu, and Appendix 2 – Nutraceuticals Overview.

Buck Bean – See Chart 69 – Buck Bean.

Buckthorn or Sea Buckthorn or Hippophae rhamnoides – See Appendix 2 – Nutraceuticals Overview.

Buckwheat (Fagopyrum esculentum and F. tartaricum) – Actually a fruit, not a grain, but it is still grouped in with the grains because of physical similarities. Roasted buckwheat is called kasha. It contains no gluten and does not rise. Therefore, in order to be used in certain baked applications, it must be first mixed with other gluten-containing grains (like wheat as in buckwheat pancakes, or Japanese sobas). Buckwheat flour is used to make blinis, a Russian crepe. Bees are fond of this fragrant white flower, and the dark honey derived from buckwheat flowers is called buckwheat honey. See Honey.

Buerre Manié – Kneaded Butter. An equal mixture of butter and flour. The butter allows the flour to be evenly dispersed in the liquid, thickening without causing lumps. It is for the most part an uncooked roux. See Roux, Culinary Arts.

Buffer – The addition of a salt of an inorganic or organic acid is added to the non-salted acid to produce a more stable system. In flavors, the effect is to produce a more rounded flavor profile, similar to that found in nature. Buffers have the tendency to resist changes in pH. See pH, Solution.

Bulb – Structures that appear as globular forms, either rounded or elongated and contain fleshy leaves, a bud, which is the potential plant stalk, roots at the base, and some protective coating. Bulbs can usually be planted to produce the parent plant. Examples of vegetables that generate bulbs are onions shallots, chives, leeks, and garlic. See Onions, Shallots, Leeks, Chives, Garlic.

Bulgar (Wheat) – Bulgar wheat is wheat that has been partially cooked and then toasted. See Wheat, Triticale, Grains.

Bulk Density – The weight per volume of a powder. One method in the determination of bulk density is to weigh the net difference between a known volume of powder, both not tamped and tamped. Example: – If a powder is filled to the liter line of a graduated cylinder and the net weight is 500 grams, the bulk density is 0.5 grams per cubic centimeter. Bulk density is important when powdered flavors are mixed. A mixture of heterogeneous particles (weight, size and bulk density can cause separation problems when passed through filling, mixing or conveying systems that have vibrations. See Specific Gravity, Mixers, Blenders.

Bulk Density Adjustment – It is often a requirement for a food product to have a different bulk density than it had originally. This could be due to material flow requirements, packaging, esthetics, or another requirement. Bulk density can be adjusted by agglomeration, pan-coating, addition of liquids, waxes, or other solids, or semi-solids, or other similar methods of increasing or decreasing the bulk density. See Density, Flowability, Packaging.

Bulking – The process of mixing together acceptable lots of materials so that small batch-to-batch inconsistencies are averaged out.

Bulk Labeling Statement – Although the actual flavoring ingredients in a flavor are protected under the trade secret regulations, and are considered intellectual property, the following statement or a modification thereof must appear on flavoring products; 'All ingredients contained in this product are approved for use by the Food and Drug Administration or appear on an F.D.A. approved Industry list'. See FDA, FEMA, Labeling.

Bupleurum or Bupleurum chinense – See Appendix 2 – Nutraceuticals Overview.

Burdock (Arctium lappa) – Burdock is a starchy vegetable with a slight earthy flavor. See Earthy and Appendix 2 – Nutraceuticals Overview.

Burnet – Also called garden burnet, lesser burnet, and salad burnet, has a faint cucumber-like flavor. The herb is used in salads and sauces. See Leafy, Green.

Burning –

1. A sensation that simulates an apparent raise in temperature without a true rise in heat. Capsaicin is the heat principle of capsicum peppers. Here, the perceived 'heat' is really a chemical burn sensed by the trigeminal nerves.
2. Oxidizing – Combining with elemental oxygen. See Oxidation.

Burning Nettle – See Nettle.

Burnt or Burned –

1. Generally, the flavor character associated with the production of phenolic substances, trace acids, and sulfur compounds, yielding an aroma profile reminiscent of tar or burning materials. Smoke flavor is similar in character to burnt, however it oftentimes contains a profile made up of a smoky character and usually is accompanied by a warm brown nuance as opposed to a high percentage of simple phenols in burnt aromas.
2. In coffee or tea or other roasted products of similar nature, burnt characters are derived from an over use of roasting perhaps beyond desirable Maillard products. See Oxidized; Tar-Like, Tarry; Smoke; Smoky; Brown (Compounds); Nuance; Trace; Acids; Sulfur Compounds; Phenol; Roast, Roasting; Coffee.

Butcher's Broom or Suscus aculaetus – See Appendix 2 – Nutraceuticals Overview.

Butter – A flavorful product made by churning cream until it thickens and then separates. The beating enables fat globules to coalesce producing a liquid known as buttermilk to separate. The buttermilk is removed, and salt or coloring can then be added to the 'butter' at this point. The butter is then churned and packaged. Springtime develops the best-flavored butter due to the cow's diet during this season. Roux made from butter and flour is a flavorful product. The two types of butter are lactic butter and sweet cream butter. Sweet cream butter is aged in a cream-aging tank for around 12 hours. It is not soured like lactic butter. Lactic butter has a lactic acid producing culture added to the cream before churning. Butter is mostly made from separated cream, usually soured to better hold up to its conditions. Organisms that are involved in the process are Streptococcus lactis, S. cremoris, Leuconostoc citrovorum, and L. dextranicum. Butter oil is made from whole milk or fresh pasteurized cream. Cream that contains about 35% butterfat is further concentrated by phase inversion to 99.6% fat and then further dried down to the 99.9% fat level. See Butter Starter Distillate, Starter Cultures, Roux.

Butter Acids – Derived by the acid hydrolysis of butterfat. See Dairy, Butter Derivatives.

Butter Beans – See Lima Beans.

Butterbur or Petasites hybridus – See Appendix 2 – Nutraceuticals Overview.

Butter, Cocoa – See Cocoa Butter.

Butter Derivatives – Butter is a product that is widely consumed. Some by-products and derivatives of butter and butter process have also found use as flavor ingredients as listed below. Butter acids are derived by chemically treating butter to split the acid fractions from the fat molecules (acid hydrolysis). The esters are then derived from these. Lipolized butter is an enzyme treatment of the butter oil. See Butter and Chart 422 – Casein Casienates.

Butter Esters – See Butter Derivatives.

Butter Starter Distillate – See Butter.

Butterscotch – Whether the Scotch part comes from Scotland or a derivation of scorch, the basis of the recipe comes from a combination of butter and caramelized sugar. The flavor of butterscotch has been simulated with brown, buttery, and often ester top notes with traces of acid character. See Brown, Butter, Top Note, Caramel.

Buttery – Having a flavor reminiscent of butter, containing diketones, and lactones with organic acid top notes.

Butyl Esters – See Alkyl Esters and Chart 146 – Alkyl Esters Grouped by Alcohol Moiety.

Butylated Hydroxy Anisole Antioxidant – See BHA.

Butylated Hydroxy Toluene Antioxidant – See BHT.

Butyric Acid – One of the most important acids in flavors and is mostly used and found in dairy flavors. Butyric acid and lactic acid are found in many meats and vegetables. It is also produced during the ripening process through the enzymatic hydrolysis of carbohydrates by polyphenyloxidase. It is derived as a by-product of oxidation and production of general microbial growth. Butyric acid is found in cheeses, butter, and to a lesser extent, in most other dairy products. As a by-product of fermentation, it is one of the main acids contributing to the flavor of ripening fruits (fermentation and reaction of exogenous molds and yeasts through the skins of fruits and the action thereupon of their enzymes on the sugars in the fruits). Therefore, it is found in the flavor profile of beer, wine, and cheese and other fermentation products. It has a sharp pleasing aroma at lower levels and a pungent rancid character at higher levels. It is an ionizing acid; therefore, it affects the pH as well as the olfactory. Because it has a burning effect on the mucosa, it is one of the four acids (formic, acetic, propionic, and butyric) that represent three sensory stimuli: taste (pH effect through ionization), aroma (volatile), and trigeminal (burning of the mucosa). Selective partitioning can occur in a food system that contains both oil and aqueous phases. This is seen in any compounds that have both an ionic and non-ionic structure and can solubilize in both phases at the same time. Although this can take a considerable time to equilibrate, flavors that contain aromatics of this type must be allowed to undergo this process to represent a true shelf profile. Also, as the flavor can change through this process, it must be allowed to go to completion before adequate sensory analyses can be made. At low levels it can contribute pretzel-salt like effect and can therefore be used as an aroma that contributes to salt enhancement. See Sharp, Partitioning, Salt, Acids, Chart 4 – Acids All Types.

C

CA (Chemical Abstracts) – See Chemical Abstracts.

CAA (Clean Air Act) – See Clean Air Act.

Cabbage (Brassica oleracea) – Cabbage belongs to a large family of vegetables that derive a sulfuraceous flavor upon cooking. Cooked cabbage develops the unmistakable aroma of methyl mercaptan and other sulfurous compounds. This family is known as cruciferae and includes broccoli, Brussels sprouts, collard greens, Chinese cabbage, kale, kohlrabi, and savoy. Varieties of cabbage include green cabbage, savoy cabbage, white cabbage, and red cabbage. Cabbage is an intrinsic part of coleslaw (raw shredded cabbage, which is pickled, salted, and seasoned and added to milk) and sauerkraut (which is salted, pickled, and boiled). See Sulfur, Cole Slaw, Sauerkraut.

Cacao (Cocoa) (Theobroma cacao L.) – See Cocoa, Chocolate.

Cacciatore (Meaning hunter style) – Cacciatore is an original Italian dish of chicken with tomatoes, onions, garlic, wine, and vinegar, which is stewed. See Culinary Arts.

Cacoguesia – Persistent or intermittent unpleasant tastes in the mouth. See Anosmia, Agustia.

Cacosmia – Persistent or intermittent unpleasant odors. See Anosmia, Agustia.

Cade Oil (Juniper Tar) (Juniperus oxycedrus) – The product was delisted. THIS PRODUCT IS NOT FOOD GRADE.

Caesar Salad – A salad using mixed lettuces and greens, olive oil, and spices, and whose main ingredient for flavoring is anchovy. See Worcestershire Sauce™.

Caffeine – A stimulant found in coffee beans, tea leaves, cocoa beans, and Kola nuts. Besides the naturally occurring form, caffeine is also added to beverages like colas. The four major food sources of caffeine in the United States are tea, cola beverages, coffee, and chocolate. It is often seen when the consumption of one is diminished, the craving for another type increases. It is almost similar to the body titrating to a specified level of caffeine as being optimum. It is a misnomer that there is no caffeine in tea. Actually caffeine in tea is called theine, which is the same compound. There is a legal limit to caffeine in the United States. It is 6 mg per liquid ounce as consumed in beverages. November 17, 2010 the FDA ruled that caffeine is not to be used in alcoholic beverage products. See Alkaloids, Coffee, Theobromine, Chocolate, Tea, Guarana.

CAIR (Comprehensive Assessment Information Rule) – Reports must be made for toxicological data to the government. See Toxicology, Food Safety.

Cajeput (Cajuput or Melilotus) (Melaleuca leucadendron L. and other Melaleuca sp.) – Also called melaleuca. Melaleuca has been cited for its beneficial healing properties. Melaleuca alternifolia is Tea Tree. See Nutraceuticals, Tea Tree or Ti Tree, and Appendix 2 – Nutraceuticals Overview.

Cajeput – See Chart 72 – Cajueput.

Cajeta – Mexican version of Dulce de Leche with a hint of cinnamon. See Culinary.

Cajun – A group of French Canadians from Acadia, whose name is derived from Acadian, were exiled from the area during conflict with the English. They settled in the French area of New Orleans and blended with the local residents. Cajun cuisine is a dominant influence on the eating style of New Orleans and combined with Spanish and Creole influences makes up the flavor of Louisiana. See Cuisine.

Dictionary of Flavors, Third Edition. Dolf De Rovira, Sr.

Cake –

1. A blend of flour, sugar, flavoring, milk, toppings, fruits, fillings, eggs, and a leavening agent representing a complex Maillard Browning, fermentation, and caramelization reaction. The popular flavors are vanilla and chocolate, but a wide variety of other flavors abound. Cakes are often glazed, iced, or otherwise coated. These coatings can have flavors as well.
2. Hard particles or a hardened mass, usually due to hygroscopicity.
3. The pressed mass of an extraction, filtration, distillation, or other process used to derive or otherwise treat flavoring materials, juices, or other food products. One such cake is the final step of the cocoa/chocolate production. This cake can them form cocoa powder, chocolate or other confections. See Baked Goods, Anticaking Agent, Filtration.

Caking – The process of absorbing water and/or subsequent accumulation of hard particles or clumps in a dry material. See Anticaking Agent, Clumping, Humectancy, Silica and Silicates, Cake, Friable.

Calamus (Acorus calamus L.) – Previously approved, but currently PROHIBITED FOR USE IN FOODS. Was CFR 189.110 and as the botanical CFR# 8817 and as the oil 8818. The CAS# is 8015-79-0.

Calciferol – See Vitamins (D-1 [D1]).

Calcium – A vital mineral needed for healthy teeth and bone growth and continued structure. Calcium is also important in the sequence of reactions needed in the clotting the blood. See Minerals, Vitamins.

Calendula or Calendula officinalis, or Garden Marigold, Pot Marigold – See Marigold – Pot and Appendix 2 – Nutraceuticals Overview.

California Buckthorn – See Cascara (Sagrada).

California Pepper Tree – See Schinus Mole.

California Poppy Eschscholzia californica – See Appendix 2 – Nutraceuticals Overview.

Calorie (C) – Kcal, or kilocalories, the common and usual designation for food energy. Diet considerations for the energy produced when food is burned as a pure measurement of how much weight a given food 'will put on' is only a general rule of thumb. Generally speaking, 1 gram of fat yields 9 calories, 1 gram of protein yields 4 calories, and 1 gram of carbohydrates also yields 4 calories. However, in some discussion with customers, it is noticed that there is no room for flavors, i.e., flavoring chemicals and solvents, and there is usually no consideration for the alcohol within flavors, which is almost as caloric as fat (1 gram of alcohol yields 7 calories). See Temperature, Heat, Cooking.

Calorie (c) – Scientifically, the amount of energy needed to raise 1 gram of water 1°C. In foods, this amount is measured in terms of kilocalories. The accepted abbreviation for kilocalories is Kcal or Cal. Recent diet fads such as the Atkins and other diets that ignore calories are successful even on a limited basis and for a short time because the body is a dynamic system, and enzymes and other metabolic considerations go into the accumulation of fat and not just the pure physics of burnable material in energy out. See Calorie (C), Temperature, Heat, Cooking, Food energy.

Calumba (Jateorhiza palmita [Lam.] Miers) – See Bitter.

Calumba – See Chart 73 – Calumba.

Calyx – Thin membrane covering some vegetables like a tomatillo and Chinese lantern (Alkekengi fruit). See Membrane.

Cammomile – See Camomile.

Camomile (Chamomile) – Hungarian (or German) chamomile (Matricaria retutica) and Roman (or English) chamomile (Chamaemelum nobile). The bright blue and green hues are from azulenes contained within the oil. The main colorant in chamomile is called chamazulene. The Roman oil is less intense in the background flavor and is more tea-like than the Hungarian (aka German) varieties. It is used in tea flavors and in seedy/woody fruits like berries (strawberry, raspberry, etc.). It also finds use in the creamy lactonic type fruits like peach, apricot, banana, and pineapple, as well as vegetable flavors for its obvious herbal and vegetable contributions. See Tea, Herbaceous. (Hungarian or German = Matricaria chamomilla L.) (Roman or English = Anthenus nobilis L.) See Chart 74 – Camomile and Appendix 2.

Camphor (Cinnamomum camphora L. Nees and Ebermeir) – There are many varieties and grades of camphor oils:

- True camphor oil – Steam distilled from the woody portions of the botanical.
- White camphor oil – Colorless, cineole-like odor.
- Brown camphor oil – Brown safrole-like odor.
- Yellow camphor oil – Yellow to brown with characteristic camphor-like aroma.
- Blue camphor oil – Dark blue to bluish brown viscous material, the heaviest of the fractions of the oil, containing azulenes.
- Chinese camphor oil (Apopin Oil) – White color with furfural, camphor, and other terpenes, safrole.
- Ho Leaf Oil – White good source of linalool, with cineole, safrole.
- Ho Wood Oil (Shiu Wood Oil) – Colorless (white) to pale yellow, camphor is the main constituent

followed by linalool, cineole, and safrole. Its use in spice blends is obvious, although somewhat limited due to its power. However, it can lend itself to contribute a pungent aromaticity to mint blends, health care products, as well as root beer, ginger ale, and other pungent beverages. See Terpenes, Chart 75 – Camphor, and Appendix 2 – Nutraceuticals Overview.

Camphoraceous (Camphoric) – Having a flavor similar to that of camphor, that is, aromatic, and heavy with a slight irritating trigeminal component. See Aromatic.

Camu camu or Myrciaria dubia – See Appendix 2 – Nutraceuticals Overview.

Canadian White Pine – See Pine.

Cananga (Cananga iterate Hook and Thomas.) – Cananga was thought previously to be a poorer grade of ylang-ylang, it is now thought of as being a different species altogether. See Benzyl Esters.

Cananga – See Chart 76 – Cananga.

Canape – A small piece of fried or toasted bread with a seasoned or flavored topping. See Culinary Arts.

Candelilla Wax – See Non-flavoring GRAS Approved Products.

Candida utilis (Torula Yeast) – For commercial food use, this yeast is often derived as a by-product of the paper industry, used for the purpose of reducing effluent sulfite liquor coming from the process. The yeast grows on the substrate and can be then sold as such, flavored with smoke or other substances. Candida utilis was the organism that was researched in the making of gasohol (blend of gasoline and alcohol) and conversion of organic contamination (spills, etc.) in the 1970s to 1980s period. However, this usage has been viewed as impractical. Currently, the process used to grow Candida in this manner mostly supplies the food industry using non-oil substances as substrates. Another Candida sp. strain is found on the scalps of babies and has been thought to be responsible for the production of lactones and therefore the positive remarks of the 'smell of baby scalp,' an interesting possible imprinting mechanism for the maternal bond. See Autolyzed Yeast, Lactone, Aroma(s), Imprinting.

Canning – Developed by Nicholas Appert in 1809. See Preservation (Non-Chemical), Pasteurization, Low Acid Canned Foods, Food Safety, HACCP.

Canola Oil – Canola oil is derived from the rapeseed plant. It is derived from a low erucic acid rapeseed. Developed first in Russia and then developed for commercial use in Canada. The plant is related to the Brassica family of which rapa and mustard are found. See Vegetable Oils and Appendix 2 – Nutraceuticals Overview.

Canthaxanthin – Derived from alfalfa and other natural sources and used in feeds. When poultry consumes this extract, it absorbs the oil-soluble colorant in the fatty tissues including the adipose and the egg yolks. Many consumers generally perceive both of these visual characteristics as positive attributes. See Color (Colorants).

Capers (Capparis spinosa L.) – Capers are used in fancy style dishes. Its use as a food ingredient goes back to biblical days. The flavor of capers is described as spicy green with a vegetable-like flavor and a piney nuance. The flavor imparted to the foods in which they are used is quite characteristic. See Culinary Arts.

Capers – See Chart 77 – Capers.

Capillary Action – A perceived effect of a liquid on a substrate. An example is when a liquid is pulled across a solid due to attractive forces between the two. This effect is what produces the meniscus in a graduated cylinder and what draws a liquid up a perfume blotter. Colors can be identified by this manner. In a few days or hours, a blotter dipped in a mixture of colors will draw the liquid up the blotter and separate the colors so that they can be identified. The name for this technique is paper chromatography and is used for separating water-soluble components like food colors. See Meniscus.

Capricisousness versus Timidity – In sensory analysis an error that can occur due to a personality trait often seen in Hedonic scores. See Sensory Evaluation, Psychometrics.

Caproic Acid – See Hexanoic Acid.

Capsaicin – Isodecenoic acid vanillymide. The active constituent in capsicum frutescens, the capsicum pepper. It provides the burning sensation that is perceived first in the tip and middle of the tongue and then travels to the back of the tongue. This response is a trigeminal response rather than a true flavor or aroma response. A trigeminal response is one that elicits the responses to chemical irritation. FEMA GRAS# 3404, CAS# 404-86-4 Capsaicin enables the body to release additional neurotransmitters that inhibit pain nerves, although this effect is temporary. The result is felt to be a positive one on overall health. Figure 8. See Trigeminal Nerves, Nutraceuticals, and Appendix 2 – Nutraceuticals Overview.

Capsicum – Oleoresin of capsicum contains the trigeminal sensed heat principle, capsaicin. Species are capsicum minimum mill, capsicum annum, or C. frutescens. See Green Bell Pepper; Pyrazine; Pepper, Sweet; and Chart 78 – Capsicum.

Caralluma fimbriata – A cactus in the same family as hoodia, which is purported to exhibit similar fat-reducing and appetite-suppressing characteristics.

Capsaicin, Theaspirane, Caffeine & Theobromine

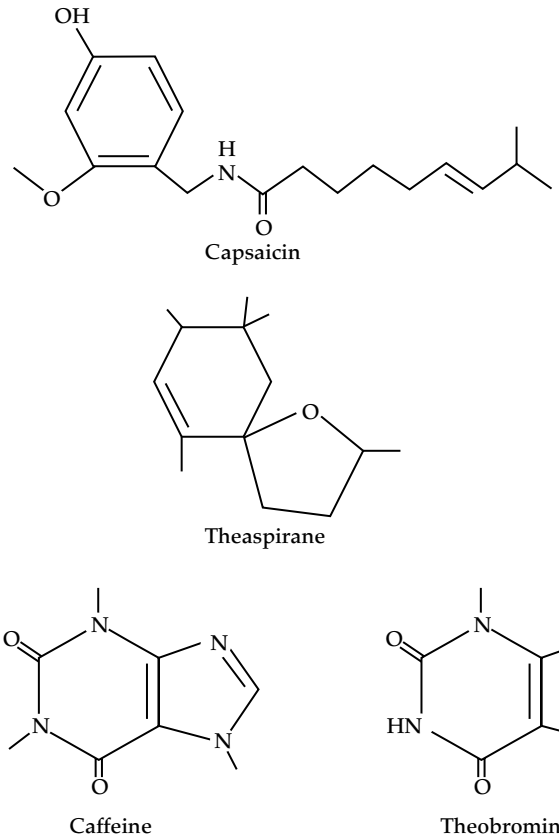


Figure 8

See Nutraceuticals and Appendix 2 – Nutraceuticals Overview.

Caramel – Unlike a 'carmel,' which is a generic name for a caramel or other similar flavored confections, caramel flavoring is produced by heating sucrose in water in the presence of citric acid. Some of the aromatics isolated in caramel are or can be simulated by diacetyl, substituted saturated, and also unsaturated acids, furyl compounds, furfural, ethyl maltol™, and furyl esters. See Brown (Compounds), Color (Colorants).

Caramel Color – The brown color used in beverages and other flavor applications produced by the caramelization process. There are four different classes of caramel color widely accepted by the UN Joint food and Agriculture Organization and the World Health Organization. They are: (1) Class I – Plain Caramel – no ammonium or sulfite is used only heat derived. (2) Caustic Sulfite Caramel – Sulfites can be used but not ammonium compounds. (3) Ammonia Caramel/Bakers Caramel/Beer Caramel – Ammonium compounds used but no sulfites used. (4) Sulfite Ammonia Caramel/Acid Proof Caramel/Soft Drink Caramel – both sulfite and ammonium compounds are used. See Caramel, Allergens.

Caramelization – Caramelization was claimed to have been discovered in Turin before the 18th century. It is the process whereby sugars undergo similar reactions as in the creating of caramel forming brown-type aroma compounds. Caramelization is a non-enzymatic browning as is the Maillard reaction, but unlike the Maillard reaction is a pyrolysis of sugars rather than a reaction between amino acids and proteins. It is a misnomer in the Culinary World when speaking of the caramelized bits in the sauté pan. These are actually products of the Maillard Reaction. Caramelization does not occur until approximately 340 degrees Fahrenheit. See Caramel, Sugar(s), and Polyhydroxyl Compounds.

Caraway (Carum carvi L.) – The seeds are used in breads. The seeds can be made into a tisane or herbal tea. Caraway is characterized by a chemical, carvone, which displays a dramatic difference between its optical isomers. The D (isomer) of carvone is present and characteristic of caraway and the L carvone is present and also characteristic of spearmint and dill. Similar dramatic differences in chiral compounds are now being actively studied, where previously, it was thought that only carvone exhibited differences of such magnitude. See Terpene – Oxygenated and Other Related Compounds, Stereo Isomerization, Optical Rotation, Chart 79 – Caraway, and Appendix 2 – Nutraceuticals Overview.

Caraway, Black (Nigella sativa L.) – Black caraway is also called black cumin. See Cumin, Caraway, and Chart 79 – Caraway.

Carbohydrates – A group of substances that provide the body with one of the main sources of energy (the other is fat). Carbohydrates include sugar and starch. Glucose, fructose, and galactose are monosaccharides or mono sugars. Sucrose, lactose, and maltose are disugars or disaccharides. Multiple sugars are named according to their average molecular weight and to their type characteristics. From lower molecular weight ingredients to higher polysaccharides, they range from dextrins, maltodextrins, starches, and cellulose, and other soluble and insoluble fibers. Amylopectin and amylose are two polysaccharides that make up starches. In the body, polysaccharides are broken down into monosaccharides by the presence of enzymes. The enzyme that breaks down starch is called amylase. Cellulose and other complex polysaccharides such as gums pass through the body unabsorbed. Unlike some ruminant animals that can digest cellulose due to the presence of a fore stomach, allowing the animal to chew its cud, humans cannot digest cellulose due to the absence

of cellulases and the necessary organ structure. Polysaccharides that dissolve in water but are not digestible are called soluble fibers. Soluble fibers are important in aiding the digestion process, and aid in good absorption of nutrients and bowel health. Monosaccharides are absorbed through the intestinal wall into the bloodstream and subsequently are distributed throughout the body. Brain cells and blood cells must have glucose, a common monosaccharide, to survive. Cells burn the glucose, immediately generating energy and heat. The unused glucose is distributed to the liver, fat cells, and muscle tissues and is converted into glycogen (animal starch) or into fat for storage. Insulin secreted by the pancreas takes high levels of glucose in the blood and converts it to glycogen and fat. When needed, the glycogen can then be reconverted to glucose at a later time to then be metabolized as described above. When blood sugar level is low, glucagon, also produced by the pancreas stimulates glycogen conversion again to glucose and is then introduced into the bloodstream. Other factors, such as stress, epinephrine, and corticosteroids have the same effect as glucagon. Galactose and fructose are converted into glucose in the liver. See Sugar(s) and Polyhydroxyl Compounds; Gums and Thickeners; Non-Nutritive Sweeteners; Dextrin, Maltodextrin, Cellulose, Fat.

Carbon – An element whose typical atomic weight is 12 and atomic number is 6. Carbon is the building block of all life on earth. Although some species can metabolize other elements (such as the sulfur metabolizing worms found at the bottom of the sea), their DNA is still carbon based. Isomers of carbon 13 and carbon 14 are also found in nature. These have an extra neutron or two respectively in their nuclei. Compounds that contain carbon are called organic compounds, and the study of organic compounds is called organic chemistry. Carbon has four valence points and can bond in four single places, each around a tetrahedron or pyramid structure. Carbon can also develop other types of structures. The second type is a triangular planar structure where each carbon atom has one double bond and two single bonds. If two bonds on opposite carbons contain hydrogen, and the others do not, there is a chance for 'on the same side or on the opposite side' isomerization known as cis/trans isomerization. The third type of bond shape is linear. Here it can occur if two carbons bond as either two double bonds on either side of one carbon or more likely one triple bond between two carbons. See Isomer, Valence, Atomic Weight, Atomic Number, Atom, Molecule, Double Bond, Triple Bond.

Carbon 12 – The usual and most common isotope of carbon. See Carbon 13, Carbon 14, Natural Certification.

Carbon 13 – The isotope of carbon that contains one extra neutron. Carbon 13 accumulates in carboniferous materials that are exposed to the sunlight. It is therefore useful as an indicator of naturally derived ingredients and is a measure of so-called natural flavor materials. Isotopic verification of so-called natural flavoring ingredients has been a recent topic of research and an active program of FEMA. See Carbon 12, Carbon 14, Natural Certification.

Carbon 14 – Like carbon 13, an isotope of carbon, which is useful in determining the authenticity of a natural source as a verification of a certain metabolic pathway for some ingredients. Vanillin developed by the vanilla orchid is unique in this regard. These findings were the basis of an interesting comparison of the carbon 14 ratios in many vanillin sources including natural eugenol-derived vanillin, vanillin ex vanilla, vanillin found naturally in other natural products, vanillin ex lignin, and purely synthesized vanillin. See Carbon 13, Carbon 12, Natural Certification.

Carbonated Beverages – Sodas, soda pops, etc. Those flavored drinks that use the development of solubilized carbon dioxide to form carbolic acid in water. See Sodas, Ounce Goods, Sugar, Syrup.

Carbonation – The addition of carbon dioxide to water or another liquid. See Sodas.

Carbon Dioxide (CO_2) Extraction – The process of extracting aroma materials from a substrate in a less destructive manner, using carbon dioxide's ability to exist as a gas at room temperature. This extraction takes place under pressure at, below, or just above the critical pressure of CO_2. See Supercritical Extraction, Subcritical Extraction, Critical Extraction, Sublimation.

Carbonyl – A structure made up of carbon and oxygen where the oxygen is attached alone to the carbon through a covalent double bond. The carbonyl group is an important structure in aldehydes, ketones, and acids. If a carbonyl group is inside a molecular chain, it is a ketone (CO or C=O). If it is at the end of a chain, it is an aldehyde (CHO). If a carbonyl group is at the end of a chain and instead of the hydrogen it is attached to a hydroxyl group, it is an acid (COOH). If an oxygen is linked between two carbons through a single bond or (C-O-C), it is not a carbonyl but an ether group. See Acid – Aliphatic, Acid – Aromatic, Ketones – Aliphatic, Ketones – Aromatic, Chart 186 – Ketones Aliphatic, and Chart 187 – Ketones Aromatic.

Carbowax™ – A type of chromatographic packing that responds well to flavor compounds. See Column, Gas Chromatography.

Carboxylic Acid – An organic acid is which has a COOH group. The OH moiety is easily ionized into a COO– and H+ in many of the smaller molecular weight acids making them acidulants as well. An example is acetic acid. See pH, Chart 4 – Acids all Types, Chart 6 – Acidulants, Acid, Acids.

Carcinogen – A substance that promotes the development of a cancerous growth. Some of these substances include tobacco smoke, asbestos, and radiation. Aspergillus flavus, a fungus that contaminates stored grain and peanuts, produces the poison aflatoxin. Aflatoxin has been cited as a causative agent in liver cancer, and is therefore a known carcinogen. See Select Panel, Ames Test, FEMA GRAS, Food Grade, Food Safety, Delaney Clause.

Carcinogenicity, Carcinogenic – The potential for a substance to produce a carcinoma, or one that has been identified as a potential carcinogen. See Delaney Clause.

Cardamom (Elattaria cardamomum Maton) – A very popular spice in European cooking, but used little in the United States. It finds its way into breads, pickles, sauces, and seasonings in much of the recipes overseas. Also, cardamom is one of the essential ingredients of Indian curry. Malabar cardamom (Elettaria cardamomum var. minuscula) and Sri Lankan cardamom (e.c. var. major) are two cardamom varieties. Cambodian cardamom (amomum kravanh) is a related plant from Cambodia and Viet Nam that has been recently introduced into the United States due to the influx of those cultures. Grains of paradise (Melegueta pepper) are a spice related to cardamom and has a flavor similar to cardamom. Cardamom is mixed with pistachio and almond to flavor an ice cream known as kulfi in Pakistan. See Grains of Paradise, Chart 80 – Cardamom, and Appendix 2 – Nutraceuticals Overview.

Cardamom Seed (Erroneous) – See Grains of Paradise, Cardamom.

Cardboard – Reminiscent of the flavor of cardboard. Cardboard flavor is usually a result of trace monoenals and dienals of the C-8 to C-12 variety present at low levels. One cause is the oxidation of un-saturated fats; produced through auto-oxidation, light catalyzed oxidation, heat, or enzymes. In nature, these green compounds can form through action of indigenous enzymes, an example of which is pea flour (lipoxygenase) and beer. Cardboard-like flavor is attributed to E-2 nonenal development. Cardboard character has also been described as a trigeminal dryness due in part to tannins present. A third type of 'cardboardyness' is a result of trace pyrazines. One example is the sulfur types such as thiopyrazine. See Papery.

Cardoon (Cynara carduncunculus) – A member of the thistle family, and a relative of artichoke, cardoon looks like celery and tastes like a combination between artichoke, salsify, and celery. It has been described as having a sulfury, green, even fishy character. For the first few weeks, the plant is kept out of the sun before harvesting to keep the shoots tender. This treatment is similar to the forcing of chicory to produce endive. See Chicory.

Carmel – A candy flavor typically with a buttery fruity brown sugar type flavor profile unlike caramel which is either caramelized sugar or the caramel coloring. See Caramel, Brown, Caramelization, Non-Enzymatic Browning, Enzymatic Browning.

Carmine – See Color (Colorants).

Carnitine – Responsible for the transportation of long-chain fatty acids groups into the mitochondria. Here the chemicals are converted into energy thereby aiding in enhanced fat metabolism. See Nutraceuticals and Appendix 2 – Nutraceuticals Overview.

Carnuba Wax (Carnauba Wax) – Used as a coating or anticaking agent. See Anticaking Agent.

Carnuba – See Chart 81 – Carnuba.

Carob Bean (Ceratonia siliqua L.) – Carob bean is also called St. John's bread. The solid extract is derived from beans in the pod of the locust tree. When the beans are roasted, then extracted, the powerful brown flavor becomes even more intense. St. John's bread solid extract is one of the four most popularly used solid extracts in flavors. The others would be fenugreek solid extract, cherry bark solid extract, and walnut hulls solid extract. St. John's bread is used in tobacco flavors, nut flavors, rum flavors, caramel flavors, and all brown-type flavors (cocoa, chocolate, vanilla, butterscotch, maple, etc.). Carob or St. John's bread solid extract is generally mixed with other solid extracts as used in flavors like fenugreek, cherry bark, etc. The seeds can be roasted and ground and used as an extender for cocoa powder, especially when low caffeine blends are desired. The gum is extracted from the young seeds. This gum is called locust bean gum. See Solid Extracts, Gums and Thickeners.

Carob Powder – The roasted seeds of the locust bean pod, which when pulverized, can be used as an "extender" to chocolate or cocoa without the presence of caffeine. See Replacements, Cocoa, and Chart 82 – Carob.

Carotene – Carotene is a multiple unsaturated compound classified as a terpenoid. Carotene is found in many plant products, especially carrots, and other yellow- or orange-colored vegetables. The presence of carotene or carotenoids yields colorations from yellow-orange to brick orange. Beta-carotene

is the more widely available product in the marketplace. Beta-carotene is converted to Vitamin A in the body by the liver. Therefore, it is both a colorant and a food additive with potential nutritive value. The overeating of carrots can result in a yellow discoloration of the skin called carotenemia. See Vitamins (A).

Carotenoid – Tetraterpenoids that are usually yellow to orange colored and are found in the photosynthetic tissues of many bacteria, algae, or higher plants. The photosynthetic tissues of plants are called chloroplasts. In photosynthetic bacteria, they are found in the chromophores. Chromophores exist as lipoproteins usually in close association with chlorophyll-type compounds. Canthaxain is a carotenoid. See Carotene.

Carrageenan (Extract) – See Gums and Thickeners.

Carrier – The base of the flavor. For example, starch, maltodextrin, flour, sugar, etc., are carriers for dry products. Propylene glycol, glycerine, alcohol, or water is a carrier for water-soluble liquid systems. Vegetable oil, benzyl alcohol, or triacetin are carriers for oil-soluble liquid systems. Emulsifying agents like polysorbates, or mixed mono- and diglycerides, can be used as carriers as well. See Solution, Strength, Usage Level, Application Rate, Suggested Usage Level.

Carrot (Daucus carota L.) – From the seed and root of plant. Carrot seed oil has an earthy, terpenoid type flavor. The oil is generally not representative of the flavor of the root, and is heavy and oily like parsley seed oil. Carotenosis comes from the overeating of carrots, where the skin turns a yellowish tinge. See Color (Colorants); Carotene; Vegetable, Vegetative; Chart 83 – Carrot; and Appendix 2 – Nutraceuticals Overview.

Cartilage – The connecting tissue of bones and certain physical structures (nose, fins, etc.). Cartilage cells are composed of a protein (collagen) and a mucopolysaccharide (chondroitin sulfate). See Protein, Muscle.

Carvone – Carvone is one of those compounds that exhibit strong optically specific isomers. The L (isomer) is very minty (spearmint or dill), while the D (isomer) is very woody (caraway). See Optical Rotation, Mint (herb), Spearmint.

Carvyl and Dihydrocarvyl Esters – Esters of Carveol (menthadienol) retain the mintyness of the corresponding ketone; carvone and ost carvyl esters also display a minty character. See Spearmint, Carvone, Caraway, Mint (herb), and Chart 86 – Carvyl esters.

Casava (Manihot esculenta, Bitter Casava) (Manihot dulce, Sweet Casava) – Used as a staple food in many parts of the world, casava is alternatively known as manioc, yuca (not yucca), and tapioca (root). The tuber resembles a sweet potato and contains a high degree of prussic acid. For this reason, the vegetable must first be washed, drained, and cooked. When the vegetable is washed, grated, and dried, the flesh forms little grains called pearls. Tapioca pearls are used to make tapioca pudding. The starch that is derived from tapioca can be used as such, processed or chemically modified as with cornstarch. Tapioca starch is valuable as it is a cleaner flavored thickener than regular or dent corn. Cooked tapioca granules can be differentiated from cornstarch granules under the microscope; they resemble little bell-shaped structures. Bitter Casava is vegetable-like in flavor, Sweet Casava is nutty. See Prussic Acid, Hydrogen Cyanide (HCN, Prussic Acid), Tapioca, Dent Corn, Waxy Maize, Amioca.

Cascara (Sagrada) (Rhamnus purshiana DC.) – Also known as California buckthorn, or chittembark and Sacred Bark. See Bitter, Chart 84 – Cascara, and Appendix 2 – Nutraceuticals Overview.

Cascade – A sequence of events and chemical reactions that occur in a complex reaction. Examples are the Maillard Reaction, Schiff Base Formation, Aldol Condensation, and others. The anaphylaxis allergy based physical reaction can be considered a cascade of adverse bodily reactions gone haywire. See Flavor Reactions and Inter-actions, Allergic Reaction, and Anaphylactic Reaction.

Cascarilla (Croton eluteria Benn.) – Cascarilla is used in tobacco flavors. See Tobacco Flavors and Chart 85 – Cascarilla.

Casein (Milk Protein) – Casein and its corresponding metallic ion forms, calcium casienate and sodium casienate, have many properties from binding abilities, emulsification stabilizers, and other properties as well. See Dairy, Cheese, Protein, and Chart 424 – Casein Casienates.

Cashew (Anacardium occidentale) – Related to the pistachio and the mango, the cashew tree bears fruit-like peduncles. These peduncles, called cashew apples, are quite interesting. They can be eaten directly and contain more vitamin C than an orange. Each apple contains one dicotyledonous nut. Between the nut and the coating, an oil called cashew balm is contained. This oil is extremely irritating and can cause blisters on the skin. The bark yields an exudate that can be used as a thickener. Careful treatment of the nut is important so that the balm is removed. There are industrial uses for this balm. The first roasting removes this corrosive oil; the second roasting develops the flavor. During this second roasting, the cashews can be treated by spraying a mixture of gum (like acacia), salt, and water. The dry roasted nut contains the

least fat of any other kind of nut. Its flavor is unique and has a creamy, lactonic but fatty character reminiscent of butternuts and macadamia nuts. See Nut(s).

Casing –
1. The semi-viscous coating that contains flavors to be added to tobacco for subsequent flue curing (flue drying). These might include solid extracts, sugars, thickeners, and other ingredients. The casing is coated on the tobacco leaf and then dried.
2. The tube made of animal (intestines) or synthetic in origin that holds the contents of sausages or hot dogs, or similar meat products. See Hunter List, Flue Curing, Meat, Seasonings.

CAS Number (Chemical Abstract Services Registry Number) – See Chemical Abstracts.

CASRN (Chemical Abstract Services Registry Number) – See Chemical Abstracts, Chemical Abstracts Services.

Casserole – A dish made by mixing meats, vegetables, and seasonings in a covered glass or ceramic vessel. Casseroles usually produce flavorful and soft textured dishes. Toughness of the meats and vegetables used is broken down by the hydrolysis of the polymeric carbohydrates in vegetables and the collagen to gelatin in meats. See Culinary Arts.

Cassia cassia or Cinnamomum aromaticum, synonym C. cassia – See Cinnamon and Appendix 2 – Nutraceuticals Overview.

Cassie (Acacia farnesianna L. Willd) – Is sometimes used in berry flavors like raspberry at low levels. It has a floral and somewhat piney character. See Berry (Like) and Chart 87 – Cassie.

Cassis – See Currant, Black Buds.

Castor – Genus of the beaver. Also used to describe the scent glands extracted to produce castoreum, as in beaver castors. See Castoreum.

Castor Oil (Ricinus communis L.) – A colorless or yellowish oil obtained from the castor oil plant. Castor oil comes from a tree grown in India and the United States. The oil contains hydroxy acids and develops lactones upon heating. It is reported that the peach flavor made by this method was discovered serendipitously. Later lactones as compounds were discovered, identified, and synthesized. Heated castor oil was one of the first sources of lactones due to the apparent presence of hydroxy acids. These hydroxy acids are produced when hydroxyl acids esterify producing ring structures upon heating. See Lactone, Chart 189 – Lactones, and Appendix 2 – Nutraceuticals Overview.

Castoreum (Castor fiber L. and C. canadensis Kubl.) – Dried glandular sacs from beavers in Alaska, Canada, and Siberia. The Siberian type is less desirable than the other two from a commercial standpoint. Liquid castoreum is available as tincture, as a resin, or as an absolute. Castoreum glands are preserved by occasionally smoking them over burning wood. The extracts that come from this treatment yield a smoky, phenolic profile on top of the sexy, musky animal smell. Non-smoky tinctures contain fair amounts of organic acids that along with trace sulfur compounds and other nitrogen/aminoid characters are reminiscent of uriney, gamy, and cloying odors. Castoreum is a less expensive alternative than civet and Tonquin musk extracts. It can be used as a modifier in vanilla flavors and as a useful background enhancer for many products contributing a warm, overall natural note that works well in natural fruit, meat, and vegetable flavors. Due to kosher regulations, however, there is no way to make this product acceptable for use in kosher-approved flavorings. Replacers are therefore useful. These often include benzyl or cinnamyl esters, cresyl compounds, or other phenolic substances, resinous products like bornyl derivatives and fatty acids (Butyric, Valeric, Caproic) both straight and branched chains. See Civet Absolute, Musky, and Chart 89 – Castoreum.

Catalyst – An ingredient that starts or aids a reaction, but does not become part of its results. See Flavor Reactions and Interactions, Enzymes, Immobilized Enzymes.

Catauba or Erythroxylum Catuaba – See Appendix 2 – Nutraceuticals Overview.

Catechol – An enzyme found in plant tissues. See Enzymes.

Catechu (Acacia catch Wild.) – There is another Catechu that is erroneously named and should be more properly described as Gambia catechu or pale catechu. This product is used as a colorant or bitter principle. See Gambir, Color (Colorants), and Chart 90 – Cathechu.

Cathepsin – The type of protease that is present in most animal tissue, aiding in the autolysis of cells in certain diseases and upon death. This enzyme is important in the curing of meat after slaughter. See Meat, Aging, Curing.

Cations – Positively charged ions. See Anions.

Catmint or Nepeta cataria (LINN.) or catnep – See Catnip.

Catnip – Catnip is an attractant to cats. The herb is a member of the valerian family. Another cousin to catnip is lamb's lettuce. See Lamb's Lettuce; Pet Palatability, Pet Attractants; Pet Food; Masking Agent; Pet Palatability Flavors; Sensory Analysis; Animal Feeding Studies; Valerian; and Appendix 2 – Nutraceuticals Overview.

Cat's Claw or Uncaria tomentosa – See Appendix 2 – Nutraceuticals Overview.

Cat Uriney – An odor that is reminiscent of cat urine. Although this is an unpleasant descriptor, it is used quite frequently in flavor description because of its prevalence. In trace quantities, substances such as buchu oil, thiomenthone, and thiogeraniol give this characteristic profile. These notes are found in berries, wines, and tropical fruits. See Tropical, Berry, Wine.

Caul Fat – Caul fat is a thin membrane of fat covering the intestines of a pig, cow or sheep. It is a lacy fat that is used in a variety of culinary preparations including Garde Mange or Culinary Meat Systems including force meats, sausages, hot dogs, etc. See Culinary.

Cauliflower (Brassica oleracea var. botrytis) – Cauliflower consists of a flower-like cluster of usually white (occasionally purple) structures called curds. The purple variety turns green when cooked, and tastes similar to broccoli. See Vegetable, Vegetative; Sulfur.

Cause, Assignable – A cause of a variation, or defect that can be attributed to a specific factor. The cause must be removed, modified, or otherwise addressed. See Cause, Chance.

Cause, Chance – A cause of a variation, or defect that cannot be attributed to any specific factor other than a random circumstance. These include defects or variations due to human intervention, natural source deviations or intricacies, machinery variations or malfunctions, or other random causes. See Cause, Assignable.

Caustic – Having the characteristic of causing a skin burn. An example is caustic soda, chemically sodium hydroxide (NaOH) also known as caustic lime. See Corrosive, Acid.

Caviar – Also known as roe. Caviar is fish eggs derived from certain species of fish. Caviar is consumed as a delicacy. One such example is the fish eggs from beluga sturgeon called beluga caviar. This is considered by many to be the finest variety. See Fish.

Cavitation – 1. The boiling of a liquid by decreasing the pressure rather than increasing the temperature. It is cavitation that turns frozen water to water vapor in the process of freeze drying. 2. It is sudden formation and subsequent collapse of bubbles in liquid created by a mechanical force such as a mixer propeller. Bubbles forming rapidly produce shock waves and are dispersed throughout the liquid. This helps the breaking up of hydroscopic powders such as gums that might otherwise form non dispersible masses. See Mixing, Vortex.

Cayenne Pepper – Capsicum annuum. See Capsicum and Appendix 2 – Nutraceuticals Overview.

CCP – See Critical Control Point(s).

Cedar, White (Thuja occidentalis L.) – Cedar leaf oil and cedarwood oil must be thujone free for use in food products. The flavor profile is dry and woody and finds use as a woody, pitty, pithy, seedy enhancer. See Terpenes – Oxygenated and Other Related Compounds, Chart 91 – Cedar.

Cedarwood, Red or Juniperus virginiana or American Cedar Cedrus atlantica – See Appendix 2 – Nutraceuticals Overview.

Celeriac (Apium graveolens var. rapaceum) – Similar to celery but somewhat harsher in flavor. See Celery.

Celery (Apium graveolens L.) – Celery is sometimes eaten as stalks. It also finds use in salads both as an ingredient and as a garnish. It is used in many culinary prepared sauces and is a main ingredient in Mirepoix. Sometimes the leaves are used. The flavor contains green aldehydes with a brown background. Isoalkylidene phthalides, like the two GRAS compounds isobutylidene phthalide and isopropylidene phthalide, are responsible for the background notes. These compounds are extremely brown when in pure form and are almost reminiscent of maple. They occur also in lovage and fenugreek, and for this reason, celery seed oil is often used to replace or adulterate the far more expensive lovage oil. White celery is obtained by growing the vegetable in the absence of light much the way white asparagus is developed or the process called forcing, which turns chicory into endive. See Phthalides, Chart 92 – Celery, and Appendix 2 – Nutraceuticals Overview.

Celery Cabbage – See Chinese Cabbage.

Celery Water – A pleasant drink made from fresh celery.

Cell – The simplest part of the living structure. It is the cell that undergoes either mitotic (or replicative) division as in normal growth, or miotic or split division for sex base cells, ready to combine with other halves to provide a new cell, the basis of a new organism. The mystery of cell growth is to determine what makes a cell form certain organs while others form other structures. These pre-differentiated cells are called stem cells. When cells are cloned, differentiation does not occur easily, and a multi-cell mass called a callus is first developed. Recent strides in cloning techniques have gone a long way to solve these dilemmas. See Replication, Metabolism, Growth.

Cell Membrane – The thin proteinaceous material that has a somewhat porous nature. The cell membrane provides a protective enclosure for the cell, and its porosity provides a bridge for nutrients and waste materials. The cell membrane is found in the cells of all living things. See Cell, Cell Wall, Autolyzed Yeast Extract.

Cellulase – Cellulase is an enzyme that breaks down cellulose. See Hydrolysis, Enzymes.

Cellulose – A polysaccharide that is very strong. It is the base material for wood and other natural hard materials. It provides for the structure of the cell wall, which is found in plant cells. It is the cellulose that is removed from autolyzed yeast to yield resultant autolyzed yeast extract. See Yeast, Autolyzed Yeast Extract.

Cellulosic – A term used for a chemical that is related to cellulose. See Cellulose.

Cell Wall – Found in plants, the cell wall is made up of cellulose-based material. It is for the most part insoluble in water, and makes up the woody portion of plant matter. See Cell, Cell Wall, Autolyzed Yeast Extract.

Celsius (Centigrade) – The scale that measures temperature based on 0 degrees representing the freezing point of water and 100 degrees representing the boiling point of water. The Celsius scale used to be called the Centigrade scale. See Temperature, Fahrenheit.

Centaur Erythraea centaurium (PERS.) – According to Greek mythology, the centaur Chiron cured himself using centaur from a wound obtained by a hydra poisoned arrow. It has also been used to treat fevers. See Nutraceuticals and Chart 91 – Cedar.

Centella or Centella asiatica Urban – See Gotu Cola, Appendix 2 – Nutraceuticals Overview.

Center for Science in the Public Interest (CSPI) – A somewhat controversial American not-for-profit corporation that focuses on issues relating to foods and the food services industry.

Centipoise – The measurement of viscosity, centipoise is one hundredth of a poise. One centipoise is one gram per centimeter per second. See Viscosity, Gums and Thickeners.

Centrifugal Head Atomizer – The part of a spray dryer that produces a fine 'shower' of spray media. The head goes at an extremely fast rate of speed (up to 20,000+ rpm) and is (1) costly to purchase and repair; but (2) it is claimed has the best encapsulation characteristics because of the extremely fine mist. See Spray Atomizer, Spray Drying.

CEPA (Canadian Environmental Protection Law) – The Canadian version of the U.S. EPA. See Regulations.

Cereal (Flavor) – A sensory perception and descriptor that implies that a flavor is reminiscent of a cereal or grain often ones that are uncooked, nutty, and dry. See Descriptive Terminology.

Cereal Grasses – See Appendix 2.

Cereals and Grains – Cereals and grains are the edible seeds of the grass family. Although some of the Items used in cooking and bakery as flours are sometimes otherwise categorized from a Taxonomical standpoint. These include the following and can be seen as their individual listings under; Barley, Buckwheat (Kasha) – a fruit, Bulgar, Cereals, Cornmeal, Couscous, Grains, Millet, Oats, Rice, Risotto, Rye Flakes, and Wheat, Quinoa, Rice Flour, Amaranth, Corn, Job's Tears (Hato Mugi), Indian Rice Grass, Brown Rice, Wild Rice, Rice Flour, Potato Flour, Teff (a grass), Garbanzo Flour, Arrowroot, Mesquite (pods), Millet (a grass), Ragi (contains Methionine), Sorghum (a.k.a. milo), Soy (legume) and Tapioca.

Cerebral Cortex (Cerebrum) – This largest area of the brain that is separated into two hemispheres. The areas of the cerebral cortex that are important to flavor chemistry are (1) the center of the frontal lobe, where creative thought processes, abstract thinking, and personality reside; and (2) the temporal lobe, where olfaction or the sense of smell is finally interpreted (it first travels to the limbic system). These are the subpoints:

Hearing: The nerve impulse that transmits stimuli for hearing travels to the temporal lobe as well. The occipital lobe is the area to which visual cues are transmitted.

Trigeminal: The senses of chemical stimulation, or trigeminal stimuli, such as cooling from menthol or the heat stimulus from capsaicin are transmitted to the pons, in the brain stem. Because of this more direct pathway, trigeminal signals are relayed more quickly. Quick responses such as these are unconscious responses, or reflexes. This reflex pathway is similar to muscle response to adverse or dangerous stimuli (fire, puncture, impact trauma, etc.)

Rear Third of Tongue: Bitter – Similarly, the taste of bitter as sent through the glossopharyngeal nerve is also associated with the gag reflex. As some trigeminal cues, like chemical irritation and bitter tastes come about by the ingestion of poisons, and bitterness, the reflex response can be lifesaving. Other nerve signals are slower. These responses need interpretation, and are more cognitive than reflexive. One interpretive type signal is that of odor recognition.

Front Two-Thirds of Tongue: Salt, Sweet, Sour, Umami – Similarly, the front two-thirds go first to the pons and/or medulla oblongata (although through separate nerve channels). These taste sensations finally travel to the cerebrum at the post-central gyri for interpretation.

Aromas: Odor cues travel from the nasal cavity through the olfactory nerve. Then the nerve signals go to the limbic system that stimulates basic mood and subconscious responses.

The limbic system has been indicated as the residence of our basic animal instincts. Here lies the center for our most fundamental emotions, sexual desire, hunger, fear, anger, embarrassment, jealousy, contentment, and other strong feelings. It is thought to be the center of Freud's id. It is likely then that the limbic system was responsible for our survival mechanisms and that odor cues that told us not to eat spoiled food were extremely important to our existence. After the stimuli of aromas goes to the limbic system, nerve impulses are sent to the cerebrum to the occipital lobes, then to the cognitive areas of the post-central gyrus and are recorded as memories.

Recent studies have indicated that because odor memories are the clearest and most stable memories, that reading or studying while eating a favorite food might accentuate memory retention. This memory download occurs during REM sleep. Studies show that because REM sleep is interrupted by the ingestion of alcoholic substances, studying followed by consumption of alcohol is the worst thing to do before a test. The fact that aromas take such a pathway might lend credence to aromatherapy. Certainly odors can have an important impact to our subconscious, such as the odor of perfume, subliminal body odors relating to sexual attraction, and the odor of food as it stimulates unconscious production of saliva from our salivary glands, etc. See Pheromones, Cranial Nerves, Taste, Aroma(s), Cranial Nerves.

Certificate – The legal document that as condition or requirement has or has not been met. See Certification.

Certificate of Analysis – The document describing the testing done on a specific batch of product. The C of A typically has organoleptic analysis, microbiological assay, Product Number, Product Name, and other pertinent data based on ranges documented on the Specification Sheet. See Batch Control, Regulations, Specifications – Specification Sheet.

Certification – The process of acknowledging the passing of a certain set of criteria. Example; Hazmat Certification, HACCP Certification, Research Chefs Association Certification, the Society of Flavor Chemists (Apprentice Member, Certified Member).

Certified Culinary Scientist – An individual who has met certain criteria and who has passed an examination developed and monitored by the Certification Commission affiliated with the Research Chef's Association and whose information can be found at www.culinology.org. See RCA, Certified Research Chef.

Certified Gluten Free – The Gluten Free Certification Program which was originally developed in Canada by the Canadian Celiac Association has been into the United States. It goes beyond the FDA requirement for gluten free listing for under 20 ppm to a level of only 10 ppm and the CSA Seal of Recognition falls even below that to a level of less than 5 ppm gluten. The 20 ppm level is also the level of the international standard published by the Codex Alimentarius. See Gluten Intolerance, Food Allergy.

Certified Member – A category of membership in the Society of Flavor Chemists that signifies approval by the membership as an active flavorist. See Society of Flavor Chemists.

Certified Research Chef – An individual who has met certain criteria and who has passed an examination developed and monitored by the Certification Commission affiliated with the Research Chef's Association and whose information can be found at www.culinology.org. See RCA, Certified Culinary Scientist.

CFR Title 7 – The Code of Federal Regulations that states laws under which crops are regulated. This is the publication that cites recent laws and definitions for organic products and organic labeling. See Organic.

CFR Title 9 – USDA – The Code of Federal Regulations that states the laws under which animal and farm products are governed. These regulations include flavors and seasonings and their introduction into meat-containing food products. Citations of note influencing flavor and seasoning usage range from Chapter III part 318 to part 320, specifically 318.7c(2). Generally, products that fall under the jurisdiction of the USDA are those that use 2% or more of cooked meat. See Regulations, Artificial Flavor, Natural Flavor, CFR Title 27, CFR Title 49, DOT.

CFR Title 15 – Commerce and Foreign Trade – Regulations pertaining to general business practices and foreign trade including tarrifs, importation and exportation of goods.

CFR Title 16 – FTC – The Code of Federal Regulations that states laws under which the retail sale of food not regulated by the FDA applies. This includes things like labeling practices not regulated by the FDA, truth in labeling and advertising and other related Issues. See CFR Title 21.

CFR Title 21 – FDA – The Code of Federal Regulations that states the laws under which flavors, foods, and drugs are governed. See Regulations, Artificial Flavor, Natural Flavor, CFR Title 27, CFR Title 9, DOT, CFR Title 49.

CFR Title 27 – TTB – The Code of Federal Regulations that states the laws under which alcohol, tobacco,

and firearms are governed. For flavors for alcoholic beverages, definitions of product potability, drawback, flavor approval, and other regulations are found in parts 1–30. Regulations concerning tobacco flavoring are now handled by the FDA, and regulations will probably be promulgated by the next CFR release. See Regulations, Artificial Flavor, Natural Flavor, CFR Title 9, DOT, CFR Title 49.

CFR Title 29 – OSHA – Occupational Safety and Health Administration – Concerns over worker safety issues.

CFR Title 37 – USPTO – Patents Trademarks and Copyrights – The Code of Federal Regulations that states the laws pertaining to patents, trademarks, and copyright.

CFR Title 40 – EPA – The Code of Federal Regulations that states the laws pertaining to the environment, waste, discharge, contamination, cleanup, and other environmental issues.

CFR Title 49 – DOT – The Code of Federal Regulations that states the laws under which the transportation of substances are governed. Flavorings usually go under the designation of Extract, flavoring liquid Hazard class 3 UN1197. Flavorings usually fall into the flammable class 3, packing group type II (flashpoint <73°F), or class 3, packing group III from 73–140°F. See Regulations, Artificial Flavor, Natural Flavor, BATF Title 27, USDA Title 9, DOT, Title 49.

cGMP –

1. Current Good Manufacturing Practices.
2. Cyclic Guanosine MonoPhosphate –

See Cyclic Guanosine MonoPhosphate, Good Manufacturing Practices, HACCP, Food Safety.

Chalky – Chalky means having a drying textural mouthfeel, oftentimes associated with a gritty component similar to chalk (calcium carbonate). See Dry.

Challenge Studies – The Food and Drug Administration has published a document outlining the Evaluation and Definition of Potentially Hazardous Foods (Chapter 6) Microbiological Challenge Testing. It defines the methods, protocols, selection of challenge organisms, inoculum level, inoculum preparation and method, duration of the study, formulation factors and storage conditions, sample analysis and data interpretation as well as pass/fail criteria. See Microbiological Testing, Flavor Safety Assessment, Risk/Care, Food Safety, HACCP.

Chamaedrys – See Germander.

Chamazulene – Chamazulene is the active colorant in chamomile oil, responsible for the oil's dark blue color. See Azulenes, Camomile.

Chamomile – See Camomile and Appendix 2.

Chanoyu – The ritual Japanese tea-pouring ceremony. See Tea.

Character –

1. The innate quality of a flavor that gives it its special attributes among and over others.
2. In wine and other complex flavor systems, a product with character is one where the profile is of a positive and interesting nature. It is one where its unique profile can be distinguished but in some cases cannot be precisely described.See Attribute.

Characteristic – The idea, the connotation, or the recognition of a flavor. The flavor characteristic of a chemical or natural product is its encompassing profile, all of the nuances that make up its aroma, taste, physical, sensory, and chemical properties. A flavor ingredient may be broken down into its effects. A flavor ingredient could characterize, modify, or differentiate the flavor. A flavor ingredient that characterizes a flavor represents to the observer that it is one flavor type among other products and that it stands out as being typical of all of those types and species for that flavor. For instance, the flavor of wintergreen is characterized by the chemical methyl salicylate. Without methyl salicylate, another salicylate, or something that smells and tastes very close to methyl salicylate, the character of wintergreen would not be achieved. Most root beers have a wintergreen top note with a sweet background. This sweet component could be composed of vanillin, Maltol™, heliotropine, or a furanone. Any or all of these are used to modify the initial characterization of the methyl salicylate. They are called the modifying ingredients. Modifying ingredients are necessary to give the overall impression of the flavor, but are not as crucial as individuals so that anyone can be neither replaced nor removed. In this instance, to make a root beer, a wintergreen note is needed, and any sweet note is needed after that. Once the modifying sweet background is accomplished, in this example, the flavor can take on uniqueness. One flavor may have a spicy, clove-like background, another may have a camphor-like background, still another may have an anise or anethole background, and finally another may be floral. These are all examples of differential characteristics in a root beer flavor. Differential, modifying, and characterizing characteristics vary greatly with the flavor type, and each flavor component is unique. See Modifier, Modifying Ingredients; Differential; Duplication; Flavor Modification; Nuance; Characterizing.

Characterizing – Excerpt from CFR Title 21 Foods and Drugs 101.22 5i: 'If the label, labeling, or advertising of a food makes any direct or indirect representations with respect to the primary recognizable flavor(s), by word, vignette, e.g., depiction of a fruit,

or other means, or if for any other reason the manufacturer or distributor of a food wishes to designate the type of flavor in the food other than through the statement of ingredients, such flavor shall be considered the characterizing flavor and shall be declared in the following way.…', Sections 101.22 5i to 5j(3). The regulations go on to describe the way the label should be depicted, type should be designed, and regulations should be interpreted. See Flavor Definition, Code of Federal Regulations.

Characterizing Ingredients – Flavoring components that contribute the basic flavor character either in part or in such a way so as to be recognizable. Example: Methyl salicylate, which can characterize the flavor of wintergreen by itself, may be used in combination with anethole, vanillin, and other ingredients to characterize a root beer partially. In a chewing gum flavor, it might be classified as a modifier, which rounds out the harsh flavor of the orange, lemon, and esters, and in a chocolate flavor, it might be considered a differential item, which makes the chocolate flavor in which it is used different from many others. See Modifying Ingredients, Differential Ingredients.

Charcuterie – The term for handling of meats, including bacon, ham, sausage, terrines, galantines, ballotines, pâtés, and confit, sausages, spiced and smoke meats, etc. See Culinary.

Chard (Beta vulgaris var. cica) – Slightly bitter and green with a flavor similar to spinach, it is interchangeable with spinach in most recipes. Swiss chard is the green variety and rhubarb chard is the red veined variety. See Spinach.

Charge –

1. To add ingredients to a distillation column, reaction vessel, extraction system, or other similar processing device.
2. The overall magnitude of electronic attraction or repulsion based on an electron having a minus 1 charge (1^-) and a proton having a positive 1 charge (1^+). A molecule can also deform or configure to develop an electrostatic charge within the molecule called a dipole moment. See Dipole Moment, Electrons, Ionization.

Charles's Law – The law in chemistry that states: The volume of a perfect gas at a constant pressure is proportional to the absolute temperature (°F + 459.7). See Boyle's Law.

Charm Analysis – A proprietary technique using a combination of a computer database and gas chromatography olfactometry (GCO), developed by the chemistry laboratory at the New York State Agricultural Experimental Station in Geneva. See GCO.

Charred, Char, Charring – To burn or oxidize to the point of carbonization (i.e., producing carbon). See Cooking, Burnt or Burned, Phenol.

Chartreuse™ – A green-colored cordial made of herbs and spices including hyssop and iva oil. See Benedictine™.

Chassis – The casing and structure giving support to an enfleurage process. See Enfleurage.

Chayote (Sechium edule) – Chayote is an edible gourd with a subtle flavor that is similar to squash. It was a principal food for the Aztecs and Mayans. See Squash.

Cheese (Products) – As Defined by the CFR Title 21 – Summarized as: cheeses differ in standard of identity. The source of dairy can be milk, non-fat dry milk, or cream or any combinations. These can come from any milk producing mammal, however Cow, Sheep and Goat are the main sources. Curds are formed by the addition of lactic acid-producing bacteria, hydrogen peroxide catalase, clotting enzymes, rennet, or other means. Pyrazines have been found in cheese; however, to date, no certain pathway has been presented to explain their formation. Nuttiness, from pyrazines, is a typical character of Gouda, some Swiss cheese, Cheddar, and therefore American blends that use Cheddar. Gouda is of particular note because it exhibits the mouth filling characteristic now described as kokumi. The way in which the cheese is handled after the curds are formed makes all the difference to the identity and the flavor. Green and blue color is usually added to counteract the yellow hue and make the cheese whiter looking. Enzymes, cultures (Penicillium roquefortii as in the blue [bleu] cheese, Stilton, Danish Blue, Gorgonzola, and Roquefort cheeses) are also added according to specifications. Antimold (antimycotic) agents can be added to prevent unwanted molds to grow. Salt is often added to the cheese's surface for the same reason, as is a paraffin coating. Minimum fat content and maximum water content vary from cheese to cheese. Manufacturing versions of the cheese usually differ whether or not curing or pasteurization is specified. Flavors, smoke, etc., are sometimes added and labeled as such. Mixtures of cheeses as in cold-pack cheese results in an American cheese if the blend is made with a specified combination of Cheddar, washed curd, Colby, or granular cheeses. Low sodium varieties usually mean there is less than 96 mg of sodium per pound of cheese. Soft interior ripening cheeses include Brie, Camembert, Mozzarella, Pont-l'Eveque, Munster, and Bel Paese. Hard cheeses include Emmenthal, Romano, Raclette, Gruyere, Parmesan, Jarlsberg, Edam, Cheddar, Monterey Jack, and

Gouda. Fresh unripened cheeses include cottage cheese, cream cheese, and ricotta cheese. The general procedure for producing cheese is (1) coagulation; (2) draining, shaping, or matting; (3) salting; (4) ripening; and (5) coloring can be added to counteract the yellow color of the curd. See Color (Colorants). The citations are as follows: CFR Title 21 Subpart B Sections 133.102 to 133.196. See Fermentation, Butter, Butter Starter Distillate, Starter Cultures, EMC (Enzyme Modified Cheese). Kokumi, Umami, Chart 485 – Cheeses.

Cheese, Enzyme Modified – A natural flavor as defined by CFR Title 21 Paragraph 101.22, NAS Number 6548. See Natural Flavor, Enzymes, and Chart 432 – Enzyme Modified Milk.

Cheesey – Having a flavor reminiscent of a cheese. See Cheese.

Chef – A highly creative individual trained in the culinary arts. The culinary method is based on learned and practiced techniques employing systems, equipment, and bases used to develop food products. The recent development of a category called a Research Chef™ as coined by the RCA (Research Chefs Association) defines an individual whose creative skills are founded with a scientific background. A Culinologist™ would be defined as the penultimate expert in both areas of expertise. They would have equal mastery of both the art and science of food product development. The alternate pathway for a food scientist to achieve the goal of Culinologist™ is to reach an intermediate level of Culinary Scientist by learning culinary arts skills. One goal of a research chef is to develop a gold standard, which is the ultimate food creation. Because this product, typically approved by marketing in concept is typically too costly or infeasible to produce in quantity, it is the goal of the research chef and/or food technologist to develop a product that can be produced for the mass market. Here, gums, flavors, emulsifying agents, preservative, colors, and a host of food additives and adjuvants are needed to achieve the end goal. See Gold Standard, Food Technology, Culinary Arts.

Chef Ladder – The hierarchical levels in the kitchen. Although some may disagree as to the exact order, it is relatively as follows:

- Certified Master Chef (CMC) – A tested level of chef group within which very few can achieve. As of February 2005, there are only about 60 CMCs in the United States.
- Chef de Cuisine – There are differing opinions about this title. Some say it is the ultimate celebrity chef, while others say it is equivalent to a sous chef or executive chef.
- Sous Chef – Like the vice president of the organization. The sous chef shares in some of the administration and development of the executive chef. In larger restaurants, there can be more than one sous chef.
- Pastry Chef – The pastry chef is like the sous chef in that they are in command of the pastry area.
- Expediter – Often duties handled by the sous chef, the expediter is the one who works as liaison between the kitchen and wait staff.
- Chef de Partier, Line Cooks/Chefs, or Station Cooks/Chefs – These include specialists such as the sauce chef or saucier, the fish chef or poissonnier, vegetable cook or entremetier, roast cook or rotisseur, pantry chef or chef de garde de manger (cold kitchen), and finally the relief cooks and swing cooks who help the others out.

Chelating Agents – Substances that hold metals in a non-ionizable form. An example is the use of sodium gluconate in bottle washing solutions to prevent the precipitation of metallic salts. Another is the addition of EDTA to prevent the red color complex between iron ions and polyhydroxyl substances like maltol. See Sequestants.

Chemesthesis – The stimulation of trigeminal nerve endings to effects such as warming, cooling, tingling, stinging and burning. See Trigeminal, Odor, Taste, Brain.

Chemical –

1. A substance that is made up of atoms (i.e., that which is not energy, but matter).
2. In a broader sense, the mineral part of animal, mineral, and vegetable.
3. A descriptive terminology albeit imprecise, which describes an odor characteristic that seems too high, out of place, or reminiscent of solvents or other industrial chemical odors.

See Natural (Flavor), Chemical Structure, IUPAC, Chemistry, Organic Chemistry.

Chemical Abstracts (Chemical Abstracts Services, Chemical Abstracts Services Registry Number) – The same chemical can be described in various different ways. With the issuance of the toxic substances control act (TSCA), the Environmental Protection Agency (EPA) approached the Chemical Abstracts organization to assign numbers to chemicals. This assignment was proposed and supported by the chemical industry to minimize redundancies in nomenclature and grouping due to the confusion of chemical terminology. It was to be used to provide references for toxicological information and other data. The assignment of numbers to chemicals called the CAS registry or CAS numbers system is an ongoing process as new chemicals are developed

or identified annually. The publication that lists all of the known hazardous materials so far identified is the Toxic Substances Control Act, Chemical Substances Inventory Volume I to V. These books are available through the U.S. Government Printing Office in Washington, DC. CAS numbers are reported on a form called an MSDS (Material Safety Data Sheet). This provides information for both handlers of hazardous substances and firefighters as a source of quick reference to HAZMAT (hazardous materials) data. In the case of a fire, this data can be relayed back to the firehouse so that the firefighters can equip themselves properly in the case of a hazardous emergency. See MSDS, Hazardous Materials.

Chemical Derivation – The process of developing a chemical or affecting a substance in such a way as to provide another or improved material through the use of chemicals. This concept excludes items for acceptance under the natural flavor guidelines. However, to be considered a natural flavoring substance it must follow the following guidelines:

1. All of the chemicals used in a system must occur in nature
2. All of the processes used are processes that occur in nature
3. All of the parameters of temperature, time, etc., are considered to be minimal processing conditions, falling within the guidelines and recommendations of FEMA's Select Panel, and recommendations by FEMA's Processed Flavor Committee; and
4. All of the ingredients, processes, and systems fall into the definition of the FDA as specified in the CFR Title 21 101.22 standards. Then the product is not chemically derived, but can be considered a natural flavoring substance. See Natural Flavoring.

Chemical Diversion Trafficking Act of 1988 – If a company manufactures, distributes, imports, or exports any of a group of specified ingredients, they come under the jurisdiction of the Drug Enforcement Administration. The rules for mixtures are currently being reviewed, and chemical purity is also a question (for purities less than 90% and down to single digit percentages). The list of GRAS ingredients is provided in Chart 425 – Chemical Diversion Act List DEA List, Chemical Diversion Trafficking Act – DEA list. See Regulations.

Chemical Nomenclature – The word description of the structural makeup of a chemical. See Chemical Structure, IUPAC.

Chemical Reactions – A process involving the change of the structure and energy content of an ion, atom or molecule, including the rearrangement of the molecular or ionic structure, as opposed to a physical reaction (change of color, texture, state, shape or temperature) or nuclear reaction (change in the nuclear make up of an atom). Examples of reactions are: oxidation reduction reactions, polymerization reaction, enzymatic reactions, the Maillard Reaction, Schiff Base reaction, and metallic complexation. See Enzymes.

Chemicals Used In the Flavor Industry – See Flavor Ingredients.

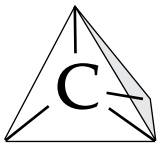
Chemical Sensitivity – See Multiple Chemical Sensitivity.

Chemical Sources Association (CSA or Chemical Sources) – Established in July of 1972, the organization was formed to supply its membership with sources, information, samples, and suppliers of hard to find chemical substances. The association was originally formed to meet the needs of companies engaged in producing food flavoring and perfumes. Today however, the membership and meetings are largely directed to flavor substances only. See Society of Flavor Chemists and Appendix 1.

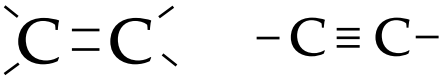
Chemical Structure – The makeup of a chemical, including the elements, the shape, the bonding types, the molecular configurations, charges, etc. The nature of the chemical's structure has much to do with the chemical's stability, reactivity, and physical and chemical properties. The structure can be shown as a three-dimensional representation of spheres and shapes, by stick figures, and by chemical shorthand. Some of the accepted shorthand methods are as follows:

- The Empirical Formula – Example: $C_4H_{10}O$. This shows which atoms are present and the total of the atoms present. However, it does not show whether the substance is an aldehyde, alcohol, or ether.
- The Molecular Formula – Example: C_4H_9OH. This form shows that the compound above is butyl alcohol. It does not necessarily show any branched chains. Similarly, a phenyl group could be designated as C_6H_5-, like C_6H_5CHO (benzaldehyde).
- The Structural Formula – Example: CH_3CH_2 CH_2CH_2OH. This form shows that the compound is not only butyl alcohol, but also that it is a straight chain or n-butyl type. Another designation for the same molecular formula might be a stick figure type. Alternatively, the branched chained variety called 2 methyl- or iso-butyl alcohol could be designated as $CH_3(CH_3)$-$CHCH_2OH$. Here, the parenthetical (CH_3) designation shows that there is another methyl group attached to the #2 carbon.
- The Condensed Structural Formula – Example: $CH_3(CH_2)_3OH$. This is the same as the structural formula above, but it links like groups (CH_2) together in a parenthesis. See Natural (Flavors), IUPAC, Chemistry, Organic Chemistry, Formula. See Figures 9, 10, 11, 12, 13, and 14.

Elements and Bonds



Carbon - Each Carbon atom ties up with four bonds. In space it forms a tetrahedron when they are single bonds.

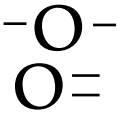


Double and triple bonds - both planar.

Figure 9a

Hydrogen - Each Hydrogen atom links up with one other atom.

Figure 9b



Oxygen - Each Oxygen atom links up with one other atom in a double bond or two atoms in two single bonds.

Figure 9c

Nitrogen - Nitrogen can form planar single double and triple bonds.

Figure 9d

Figure 9

Structures of Some Important Chemicals

The R Designation means any other structure (moiety)

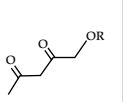
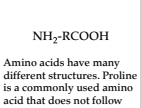
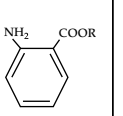
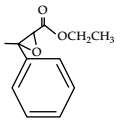
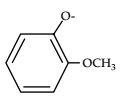
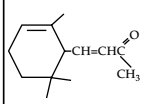
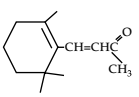
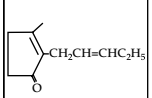
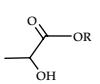
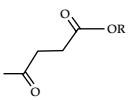
 Aceto Acetate	 Amino acids have many different structures. Proline is a commonly used amino acid that does not follow the above structure. Amino Acid	 Anthranilate	 Ethyl Methyl Phenyl Glycidate
 Guaiacyl	 Alpa Ionone	 Beta Ionone	 Jasmone
 Where R1 and/or R2 have a C=O Ketone group. Keto Ester	 Where R1 and/or R2 have an OH Alcohol group. Hydroxy Ester	 Lactate Ester	 Levulinate Ester

Figure 10

Structures of Important Heterocyclic Molecules Where R is any other chemical structure (moiety)

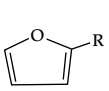
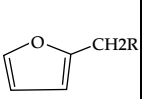
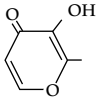
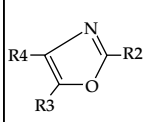
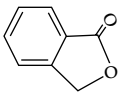
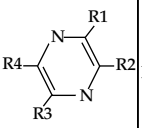
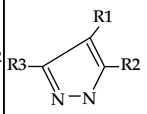
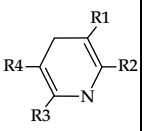
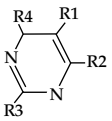
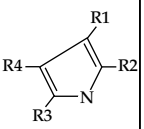
 Furyl	 Furfuryl	 Maltol (TM)	 Oxazole
 Phthalide	 Piperidine	 Pyrazine	 Pyrazole
 Pyridine	 Pyrimidine	 Pyrole	 Pyrollidine

Figure 11

Structures of Important Heterocyclic Molecules Where R is any other chemical structure (moiety)

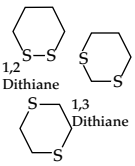
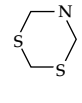
R1-S-S-R2 Disulfide	 1,2 Dithiane 1,3 Dithiane 1,4 Dithiane Dithiane	 Dithiazine	R-N=C=S Iso thiocyanate
R- SH Mercaptan (Thiol)	R1 - S - R2 Sulfide	 Sulfoxide	 Thiazole
 Thiazoline	 Thiene/ Thiophene	R1 - S - S - S- R2 Trisulfide	 Trithiane

Figure 12

Structures of Alcohol and Acid Moieties
Where R is any other chemical structure (moiety)

Alcohol type components are typically R-OH. When they are part of another molecule as in an ester, they lose the hydrogen and become R-O^{-1}. The general designation is then ...yl as in propyl being the alcohol combining group of propyl alcohol.
For acids it is much the same, although here a hydroxyl group is removed (combining with the hydrogen from the ester to form water) yielding an ate designation as in ...yl acetate from the combining group of acetic acid.

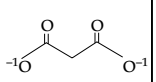
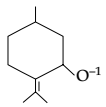
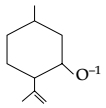
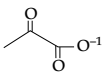
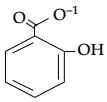
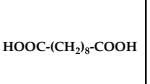
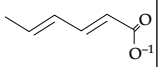
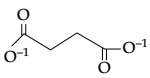
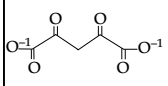
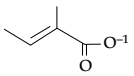
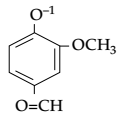
 Malonate	 Propylene Glycol -	 Pulegyl	 Isopulegyl
 Pyruvate	 Salicylate	 Sebacate	 Sorbate
 Succinate	 Tartrate	 Tiglate	 Vanillyl

Figure 13

Common and Chemical Names for Alcohol and Acid Groups

Carb#	Alcohol Common	Alcohol Chemical	Acid Common	Acid Chemical
1	Methyl	Methyl	Methyl	Methyl
2	Ethyl	Ethyl	Acetate	Ethanoate
3	Propionyl	Propionyl	Propionate	Propionate
4	Butyl	Butyl	Butyrate	Butyrate
5	Amyl	Pentyl	Valerate	Pentanoate
6	Hexyl	Hexyl	Caproate	Hexanoate
7	Heptyl	Heptyl	Oenanthate	Heptanoate
8	Octyl	Octyl	Caprylate	Octanoate
9	Nonyl	Nonyl	Pelargonate	Nonanoate
10	Decyl	Decyl	Caprate	Decanoate
11	Undecyl	Undecyl	Undecanoate	Undecanoate
12	Lauryl	Dodecyl	Laurate	Dodecanoate
14	Myristyl	Tetradecanyl	Myristate	Tetradecanoate
16	Palmityl	Hexadecanyl	Palmitate	Hexadecanoate
18	Stearyl	Octadecanyl	Stearate	Octadecanoate

Figure 14

Chemistry – The study of matter, its reactions, composition, and properties. See Flavor Chemistry.

Cherimoya (Annona chrimola) – Cherimoya is an interesting fruit. The scent of the flowers of the tree are so fragrant that insects are usually not attracted to it; therefore, in order to propagate more fruit, the plants need to be hand pollinated. It is related to the soursop and sweetsop. These three fruits belong to a family called the custard-apple family. The reason for the name of the group is due to the creamy consistency of the inner pulp of all three. The skin of the cherimoya is bitter and inedible. The flavor of the pulp is sweet, juicy, fragrant, slightly acid, and slightly grainy in texture like that of a pear. The aroma of the cherimoya reminds one of a green apple, kiwi, or the green fatty character of a watermelon rind. This is probably due to the presence of unsaturated aldehydes and dienals. The fruit over ripens easily and subsequently spoils quickly. See Pear.

Cherry Bark (Wild Cherry Bark) (Prunus serotina Ehrh. and P. canadensis Poiret) – A commonly used solid extract. Cherry bark extracts are useful to impart a dryness with a rich background character. Usually used in combination with fenugreek and St. John's bread solid extracts in many flavor systems both artificial and natural. See Solid Extracts and Chart 94 – Cherry Bark.

Cherry Laurel (Prunus laurocerasus L.) – The water, oil, and leaves are not to exceed 25 ppm of HCN (prussic acid). See Benzaldehyde and Chart 95 – Cherry Laurel.

Cherry Pits (Prunus avium L. and P. cerasus L.) – The product is not to exceed 25 ppm of HCN (prussic acid). As a fruit, cherry is related to the plum, apricot, and peach. They are divided into three categories:

1. Sweet cherries (P. avium), which include the Bing cherry, the bigaroon cherry, and the gean cherry. Varieties of the gean cherry are used to make the alcoholic beverage Kirsch.

2. Sour cherries (P. cerasus), which include the Montmorency and the Morello varieties. Because of their tartness, they are used more for cooking than for eating raw.
3. Wild cherries (P. avium) have a sour astringency. See Benzaldehyde and Chart 96 – Cherry Pits.

Chervil (Anthriscus cerefolium L. Hoffm.) – Also known as the rich man's parsley. It has a reminiscence of anise. It can be used sprinkled on a salad. See Sweet Cicely and Chart 97 – Chervil.

Chestnut (Castanea dentata [Marsh.] Brokh.) – The chestnut grows throughout the world and has been eaten since prehistoric times. The inside nut is edible as long as the bitter membrane coating the nut is removed; however, the nut is not very tasty and is very difficult to digest unless it is fully cooked. The nut should be heated, broiled, roasted, or otherwise treated and then it takes on a green vegetable, nutty sulfury character. Horse chestnuts of the aeculus genus are a different genus and are inedible. See Nut(s) and Chart 98 – Chestnut.

Chewing Gum – Typically complex, the formula is usually held proprietary to the chewing gum companies oftentimes based on chicle, latex, plasticizers, and other functional ingredients to which flavors are added. The flavors used must be designed so the chewing quality of the gum base is not affected. Usually oil-soluble flavors are suitable for this purpose. For this reason, ester blends with citrus oils like tutti fruity, mint oils, and other oil soluble fruit flavors seem to work the best. Tutti fruity flavors are based on an orange/vanilla blend with esters like ethyl butyrate, ethyl caproate, and spice notes added. The pink gum counterpart is similar with a greater amount of esters and less spice character. The allowable ingredients in chewing gum are found in the CFR Title 21 Paragraph 172.615. See Tutti Fruity, Fantasy Flavors.

Chicken – A widely eaten poultry product whose flavor is characterized by a meaty overall profile with a considerable amount of fatty background character. This profile comes from sulfur components as well as polyunsaturated aldehydes and alcohols. Trans (E,E) 2,4 decadienal is one such compound, and it and many similar homologues are found in and characterize the flavor of the fat. Some chicken flavors are based on an accepted and learned association with chicken bouillon. The flavor of chicken bouillon is varied; however, they usually employ a garlic and onion combination with celery, pepper, sage, and thyme. A dry seasoning of this type is often used to simulate that recognized profile of a chicken broth. Hydrolyzed Vegetable Proteins (HVP) are used here as a building block. To produce a good chicken broth character, the lighter hydrolysates are preferred over the darker more roasted ones. The right combination of salt, sugar, and other taste components and enhancers does the trick. See Meat and Savory Industry, Fats – Dienals.

Chicken Fat – The lipid deposits underneath the skin of the chicken. The public prefers chicken fat with a yellowish cast, and for this reason some chicken feeds are colored with marigold, whose yellow pigment collects in the adipose layer of the animal. Chicken fat has a significant amount of dienals. (E)2 (E)4 undecadienal and other such dienals are a characterizing flavor of the cooked fat of chicken. See Dienal, Rendering, Lard, Tallow.

Chickpea (Cicer arietinum) – Often yellow, bumpy roundish, and almost heart shaped, these peas are quite flavorful with a creamy/sulfury character. Near Eastern foods such as hummus (a cold purée) and falafel (fried balls or patties) are popular dishes made from chickpeas. See Adzuki Bean, Broad Bean, Black Gram, Buck Bean.

Chicory (Cichorium intybus L.) – The roasted powder is used to extend or partially replace coffee solids or flavor. It is brown in flavor and provides for a useful solid extract. Chicory solid extract is similar to St. John's bread in character. Flavorings derived from the roasted powder are useful in any brown-type flavor like vanilla, chocolate, maple, butterscotch, coffee, malt, all nuts, etc. Examples: C. intybus = wild chicory, C. endiva var. crispa = curly chicory, C. endiva var. latifolia = escarole. When the wild leafy chicory is grown in a special manner, bitterness is minimized and it becomes crisper. The process is known as forcing. The forcing process is a two-step process. First, the young plant is grown and then it is transplanted just as the buds form. It is placed in a warm dark environment. This minimizes the greening of the plant and retards the development of bitter components. The final product is then cultivated and sold in the supermarket as endive. It is given this different name to show that it has a very different character from chicory that has not been so treated. Endive, or witloof as it is also called, should not be cooked because it loses its delicate, yet distinctive flavor during the cooking process. See Chicory Powder, Extenders, Brown, and Chart 99 – Chicory.

Chicory (Chickory) Powder – The pulverized roasted seeds of the chicory plant used to extend coffee. It is also the basis upon which some non-coffee non-caffeine replacement coffee products are developed. See Replacements, Coffee, Solid Extracts.

Chiffonade – See Knife Cuts.

Chile – General name for a pepper. Alternative spellings are chili or chilli.

Chile Peppers – A chile pepper is the fruit of the plant capsicum frutescens (also indicating any variety of capsicum). The orange-red powder used as a coloring agent from which the pungent principles are removed is called rosenpaprika or simply paprika. The heat principle known as capsicum oleoresin is obtained by the solvent extraction of the pungent heat principle called capsaicin. See Cap-sicum, Rosenpaprika, Paprika, Capsicum, Capsaicin.

Chili Pepper (Capsicum spp.) – Used in Thailandese hot sauce (nam prik) and used in an Indonesian hot relish (sambal). Both countries have recipes that use not only chili peppers but sweet peppers as well. Harissa is a hot sauce made with chilies from Tunisia. Some varieties are Serrano chilies, hot green chilies, Anaheim chilies, Habanera chilies, bullet chilies, smoked chipotle chilies, roasted ancho chilies, pickled jalapeno chilies, guajillo chilies, tepin chilies, negro chilies, lombok chilies, and piquin chilies. Some of the more popular ones are:

- Poblano – Elongated green, variable heat.
- Ancho – Dried form of Poblano.
- Habanero – Bright red bell shaped, short, smaller type.
- New Mexico Green – Elongated tapering shape.
- New Mexico Red – Elongated tapering shape.
- Anaheim – A mild version of the New Mexican pod type.
- Rocoto – Yellow beige crenulated short type.
- Aji – Thin orange-red long type.
- Pasilla – Dark green to purple green thin type.
- Chipotle – A smoked jalapeno.

See Chart 100 – Chili Pepper.

Chilli – See Chile and Chili.

Chimaphila – See Pipsissewa.

Chinchona (Cinchona succirubra Pav. and Related Species) – Used in alcoholic beverages for its bittering potential. See Bitter; Capsicum; Trigeminal Nerves; Pepper, Red; and Chart 101 – Chinchona.

Chinese Artichoke – See Crosne.

Chinese Broccoli – See Chinese Cabbage.

Chinese Cabbage (Brassica rapa) – Also called Chinese Kale. Like most of the brassica species, Chinese cabbage possesses a flavor that is characterized by a sulfury, vegetable profile dominated by a pungency. This pungency is due to isothiocyanates and other sulfur components.

Brassica rapa var. Pekinensis – Celery cabbage or petsai.

Brassica rapa var. Chinensis – Bok choy or pak-choy.

Brassica rapa var. Alboglabra – Gai-lohn or tsai shim or Chinese Broccoli. Also called Chinese Kale. See Cabbage.

Chinese Coriander – See Vietnamese Coriander and Coriander.

Chinese 5 Spice Powder – A mixture including star anise, cloves, fennel, fagara, and cassia. See Hoison Sauce.

Chinese Ginger – See Galanga.

Chinese Restaurant Syndrome – A temporary illness claimed by a small segment of the population from the ingestion of monosodium glutamate (MSG). Symptoms are pressure in the head and face and burning in the neck and trunk. Only about 5% of the population claims susceptibility, and recent findings by FASEB verified this claim. The FDA has accepted the fact that the syndrome is real; however, due to the lack of the severity of the findings and the infrequency of verified respondents, the FDA feels it does not classify as a true health hazard. Nonetheless, added MSG must be declared to alert those sensitive to the chemical to be aware of potential ingestion. Glutamic acid, the necessary amino acid found in tomatoes, beef, chicken, and many other foods is the non-solubilized version of MSG. See MSG.

Chinese Stock – The preparation of stock in Asian cooking is somewhat different from the French style. First the items are simmered until a scum appears on the top of the stock as with the French style, but this liquid is soon discarded and the stock is reextracted with new liquid. This yields a more mellow and subtle end product. See Culinary Arts.

Chiral – See Chirality.

Chiral Columns – Gas chromatographic columns that have been recently developed to split out stereoisomers. See Optical Isomers.

Chirality – The characteristic of being optically active (i.e., able to rotate polarized light). In other words, having an asymmetrical carbon. See Chiral Columns, Enantiomer, D (Isomer), L (Isomer), DL (Isomer), Dextrorotatory, Laevorotatory, Optical Rotation, Asymmetrical Carbon, Polarized Light, Racemic, R, L (Isomer), Diastereomers, Stereoisomers.

Chirata (Swertia chirata [Roxb.] Buch.-Ham.) – See Bitter and Chart 102 – Chirata.

Chittembark – See Cascara (Sagrada).

Chives (Allium schoenoprasum L.) – Chives are members of the onion family of which it is reminiscent, but with a greener character and not as sulfury. The Chinese chive has a flatter, wider stem. Long cooking resulted in a significant lessening of the flavor. See Onions and Chart 103 – Chives.

Chlorophyll – The green-colored chemical that catalyzes the life-sustaining reaction called photosynthesis. The name chlorophyll is made up of the Greek word Chloro, which means yellowish green and phyllos, which means leaf. It is found in the chloroplasts within the green leaf cells. The central ion is

magnesium based. In the photosynthetic reaction, carbon dioxide is reduced by water; in other words, electrons are transferred from water to carbon dioxide. Sugars are first formed, and as they are not used up, they are stored in the form of starch. Chlorophyll is similar to hemoglobin in the sense that the central ion, magnesium, like the central ion in hemoglobin, iron, chelates with other molecules and initiates a catalyzed electron transfer. Both ions are surrounded by a porphyrin ring. Chlorophyll 'a' is the one responsible for photosynthesis. Chlorophyll 'b' is found in green algae. Chlorophyll reacts with bases and copper and turns a brilliant green. A base will turn the food mushy and unpalatable, and the copper can be toxic. The best way to capture the green brilliant color is to blanch the greens in a quick boil then immediately cool. It is the acids within the foods that usually catalyze the color change to a dull army green. See Blanch, Boil, Simmer, Culinary Arts, Vegetables.

Chocolate – As defined by the Code of Federal Regulations Title 1, chocolate is made up of ingredients whose standards of identity meet the following general rules (edited excerpts) from the CFR:

1. Chocolate Liquor (CFR Title 21 Paragraph 163.111) (a) Description – (1) Chocolate liquor is the solid or semi-plastic food prepared by finely grinding cacao nibs; (2) Optional alkali ingredients…may be used; (3) Optional neutralizing agents may be used; (4) Chocolate liquor may be spiced, flavored, or seasoned with one or more of the ingredients listed in paragraphs (b)(4), (b)(5), and (b)(6) of this section. (b) Optional ingredients – (1) Cacao fat and cocoas (breakfast cocoa, cocoa, or low fat cocoa); (2) Alkali ingredients; (3) Neutralizing agents. Phosphoric acid, citric acid, and l-tartaric acid, added as such, or in aqueous solution; (4) Spices, natural and artificial flavorings, ground whole nut meats, ground coffee, dried malted cereal extract, and other seasonings that do not either singly or in combination impart a flavor that imitates the flavor of chocolate, milk or butter; (5) Butter or milk fat; or (6) Salt.
2. Milk Chocolate (CFR Title 21 Paragraph 163.130) (a) Description – (1) Milk chocolate is the solid or semi-plastic food prepared by intimately mixing and grinding chocolate liquor with one or more of the optional dairy ingredients and one or more optional nutritive carbohydrate sweeteners, and may contain one or more of the other optional ingredients specified in paragraph (b) of this section; (2) Milk chocolate contains not less than 10% by weight of chocolate liquor. (b) Optional ingredients. The following safe and suitable ingredients may be used: (1) Cacao fat; (2) Nutritive carbohydrate sweeteners; (3) Spices, natural and artificial flavorings, ground whole nut meats, ground coffee, dried malted cereal extract, and other seasonings that do not either singly or in combination impart a flavor that imitates the flavor of chocolate, milk or butter; (4) Dairy ingredients; (a) Cream, milk fat, butter; (b) Milk, concentrated milk, evaporated milk, sweetened condensed milk, dried milk; and (c) Skim milk, concentrated skim milk, evaporated skim milk, sweetened condensed skim milk, non-fat dry milk; or (5) Emulsifying agents which does not exceed 1.0% by weight.
3. Other citations of note, Sweet Chocolate (CFR Title 21 Paragraph 163.123) – The mixing the above ingredients, namely chocolate liquor, cocoa butter, and sugar, makes chocolate. A popular milk chocolate has a fermented or digested sour milk type character added to it. When the chocolate is smelled, the fatty acids, butyric, valeric, caproic, etc., can easily be detected. The conching process assures the smooth blending of the cocoa powder, fat, and sugar, three ingredients that are otherwise difficult to make into a smooth homogeneous mass. White chocolate is flavored with vanilla extract, vanillin, ethyl vanillin, or another approved flavor additive. See Cocoa Butter, Cocoa, Brown (Compounds), Code of Federal Regulations, FDA.

Chocolate Liquor – NAS# 6451. See Chocolate.

Chocolate Manufacturers of America – The CMA is an organization made up of producers of chocolate. See Cocoa.

Chocolaty – Having a chocolate-like character. This is typical of some coffees, like the Antigua™ variety of Guatemalan coffees. See Brown (Compounds); Coffee; Roast, Roasting; Maillard Reaction.

Choke – The inedible stiff needles at the bottom of the artichoke heart. See Artichoke, Cholecalciferol, Vitamins (D2).

Cholesterol – A fat-soluble waxy substance that is found in animal-derived foods. Humans can generate cholesterol or it can be derived from ingesting foods containing it. Serum cholesterol, the amount of cholesterol in the blood, has been linked to deposits in the vascular linings and can cause circulatory blockage and subsequent coronary thrombosis (heart attack). Stanols and sterols have been seen to lower cholesterol. See Fat, HDL, LDL.

Chondrus Extract – See Gums and Thickeners, Carrageenan (Extract).

ChooseMyPlate – The true name of the MyPlate program developed by the USDA. See Food Guide

Pyramid. It is an expanded program of education that includes informative topics such as; Healthy Eating on a Budget, Weight Management, Physical Activity Recommendations, and has a section so consumers can ask experts for advice. See Nutrition.

Chowder – A thick soup made of a vegetable or seafood and milk or tomatoes. Some examples are corn chowder and clam chowder. New England Clam Chowder is made using clams, seasonings, and cream. New York Clam Chowder is made from clams and tomatoes seasoned with pepper, garlic, onions, and other vegetables like celery, etc. See Culinary Arts, Bouillabaisse, Soup.

Christophine – See Chayote.

Chroma – Chroma is the intensity of the color's light waves. A low chroma red is a grayish red, a high chroma red is an intense bright red. See Color (Colorants).

Chromatid – A chromatid is one copy of a duplicated chromosome. Two chromatids are joined at a point called a centromere to form a chromosome. See DNA.

Chromosome – A chromosome is the structure found within a cell that is a structure containing coiled DNA. A chromosome also contains genes, genetic instructions and other nucleotide sequences some of which whose purpose is still unknown.

Chromatography – The separation of a mixture of ingredients into their corresponding separate parts. Paper chromatography is used to separate and identify color mixtures, gas chromatography is used to separate volatile ingredients, and high pressure or high performance liquid chromatography is used to separate non-volatiles. The concept of chromato-graphy was first introduced by Tswett in 1906 when he separated plant pigments by passing an extract through a column of chalk. See Paper Chromatography, Gas Chromatography (GC), High Pressure or High Performance Liquid Chromatography.

Chronic Wasting Disease – See CWD, CJD (Creutzfeldt–Jakob Disease).

Chrysanthemum – A flower that has been in use as the base for a tea in many parts of Eastern Asia for a great number of years and is a part of many ceremonies throughout Southeastern Asia. It is a subtle flavor with floral tea like and vegetable characteristics. See Tea, Chrysanthemum Chart 497 – Chrysanthemum.

Chutney – A combination of fruits, meats, sugar, acid, or spices and used as a condiment. See Condiment, Spice.

Chymosin™ – A genetically produced natural version of the active enzyme ingredient in rennet. Because it does not come from an animal source, kosher considerations are more favorable. See Enzymes, Rennin, Rennet.

Cibol – See Scallions.

Cicely – See Sweet Cicely.

Cigarettes – A smaller version of a cigar usually wrapped in paper and is the most popular version of smoking tobacco in the United States. Historically flavors have been added to tobacco for a number of reasons not the least of which Is to provide a distinction between brands. Historically these flavors are added to what is known as the casing subsequently flu cured. See Casing, Flu Curing, Hunters List, E-Cigarettes, Safety.

Cilantro – See Coriander Leaves.

Cinnamates and Related Compounds – Cinnamic aldehyde is one of the most identifiable of aromatics. It is a chemical that can be used alone to produce artificial cinnamon flavors. Other single chemicals that can be used in their single or pure form are amyl acetate, anethole, menthol, and perhaps methyl salicylate. Cinnamates and cinnamic-based aldehydes tend to retain the warmth of the simple aldehyde. Larger molecular weight alcohols tend to become more warm and resinous. Cinnamyl esters are typically floral. Some of the cinnamyl esters are found prevalent in nature and occur in solid extracts. Cinnamic alcohol is relatively floral as well. See Spice, Spicy, Cinnamon. Note – Cinnamyl anthranilate has been delisted, formerly FEMA Cinnayl Anthranilate. Also, see Chart 113 – Cinnamates and Cinnamyl Compounds and Chart 424 – Cinnamyl Anthranilate.

Cinnamon – Cinnamon is a widely used spice. It is used as a modifier with benzaldehyde in cherry flavors for candy, liqueurs, and beverages. It is used directly in chewing gums, dentifrices, mouthwashes, and other similar products. It is used as a major spice along with fruits, especially apple. It is used mixed with many nut and other brown flavors in cookies, syrups, cocoa products, confections, frozen desserts, baked goods, etc. It is mixed with sweet vegetables like pumpkin. It can be mixed with other spices, such as clove, garlic, dill, and parsley to make a sweet gherkin-type flavor. The ground powder is sprinkled on top of whipped cream, and over pies and cakes. The non-cassia oils (cinnamon leaf, bark, and stem oils) contain phellandrene, caryophyllene, isoeugenol, eugenol, and their acetates, and make for a well-rounded product. Authentic oils have sulfurous brown top notes and warm resinous background notes. These oils can be used in many different product types, chocolate flavors, vanilla flavors, cherry, raspberry, and prune, along with pickling spices, ketchup spice blends, hot dog spices, and other spice blends, other meat seasonings, and many other flavors where a warm background can be appreciated. Pieces of cassia sticks are called quills. Cassia oil is

almost entirely cinnamic aldehyde (94%+). See Aldehydes – Unsaturated, Chart 104 – Cinnamon.

Cirata – See Chirata.

Circulatory Maceration – See Maceration.

Circumvallate Papillae – The large papillae forming a chevron near the back of the tongue. The circumvallate papillae contain many taste buds. See Tongue, Taste Buds, Supertasters, PROP.

Cis (Isomerism) – An isomer form positioned across a double bond. A double bond between two carbon atoms exists in a two-dimensional plane. If the two carbons each have attached to it only one hydrogen, and have other complex groups attached to opposite carbons usually designated as R1 and R2, cis trans isomerism can exist. If the R1 and R2 are situated on the same side of the molecule, it is called a cis configuration. The cis configuration is often a more crowded condition than an across-the-molecule transformation. Cis configuration is often associated with a degree of chemical instability (steric hindrance). See Steric Hindrance, Isomer, Trans (Isomerism), (Z), (E).

Cistus – See Labdanum.

CITES – The Convention on International Trade in Endangered Species of Wild Fauna and Flora) – also known as the Washington Convention); From the internet 'is a multilateral treaty to protect endangered plants and animals. It was drafted as a result of a resolution adopted in 1963 at a meeting of members of the 'International Union for Conservation of Nature (IUCN)'. 'See Endangered Species, Rosewood'.

Citral – Citral is the characteristic chemical of lemon, having a lemon peel/furniture polish-type odor. In fact, the odor of citral is crucial in the make-up of a good lemon flavor and is solely characteristic of lemon. The chemical exists in nature made up of two terpene aldehyde isomers, neral and geranial. It is quite reactive and prone to oxidations. Rags that are used to wipe up citral spills if left unattended have been seen to auto ignite from built up oxidative internal temperatures. See Lemon, Terpenes, Terpene – Oxygenated and Other Related Compounds, Characterizing, Peely, Oxygenated Components.

Citric Acid – The most common of fruit acids. It is found in a significant amount in lemon and lime, and also found in all other citrus including tomato, tropical fruits, berries, pomme fruits, etc. Citric acid is produced commercially by the fermentation of Candida spp. or Aspergillus niger. See Acidulant(s).

Citric Acid Cycle – See Krebs Cycle.

Citridic Acid – See Acidulant(s), Aconitic Acid.

Citron (Citrus medica) – In Judaism it is the citron, not the apple that is thought of as being the fruit of knowledge eaten by Adam. The skin is strongly flavored and is often candied, preserved, or otherwise used in pastries, beverages, and other preparations. See Citrus.

Citronella (Cymbopogon winterianus and Rel. Species) – A warm, aromatic flavor with a medicinal background, useful in flavoring toothpaste, mouthwash, and mint-type preparations. Used at lower levels as a modifying note. Citronella can be used in berries such as cranberry, currants, and others, and also is useful in citrus and other tropical fruits. Although it has been used in mosquito repellants, recent research has indicated that it has questionable effects on repelling the insects. See Terpenes – Oxygenated and Other Related Compounds, Chart 327 – Terpenes and Related Compounds, Chart 328 – Terpenes Oxegynated etc.

Citronellyl Esters – See Floral Terpene Esters.

Citrus – Pertaining to the group of citrus fruits. Citrus fruits are characterized by the same structure. A flavorful outside covering (rind) containing the essential, a pulpy inner layer containing some bitter principles and alkaloids, and an internal fleshy juicy inner fruit segmented into radial segments or slices where the fruit pulp and juice reside. Seeds are usually located at the straight center sections of these slices orbiting the center of the globulous fruit. Examples of these types of fruits are, lemon, grapefruit, mandarin, tangerine, orange, lime, and tangelos. See Corresponding Fruits/Oils.

Citrus Greening Disease – A devastating disease that has recently plagued the citrus industry throughout the world and poses a very serious threat to the survival of citrus crops. Originally beginning in Brazil the Huonglongbing disease (HLB) brought about by the bacterium Candidatus liberibacter from the insect vector – the Asian citrus psyllid is a disease typified by yellowing of the leaves, premature and excessive fruit drop and the appearance of lopsided and small fruit. Once a tree is infected it must be isolated and destroyed lest it infect neighboring trees. See Plant Diseases, Horticulture.

Citrus Oils – The non-water phase of the citrus fruit derived usually by expression. In the case of lime oil, the bulk of the oils are produced by distillation. Due to terpene instability, the citrus oils typically develop rancid off notes over time. These off notes are partially attributed to peroxide breakdown products of the terpenes and partially attributed to the para cymene level of the oil. One pathway of this degradation is the conversion of gamma terpinene to para cymene. See Corresponding Fruits/Oils.

Civet Absolute (Civet cats, Viverra civetta Schreber and V. zibetha Schreber) – A phenolic, acidic, musky character used sparingly in natural flavors as it is a very powerful product. It is impossible to get kosher certification on this product. The production yield of this material seems to be enhanced by the mistreatment of the animals; therefore, animal rights activists have championed the civet cats' cause. Use of this material is much more widespread in fragrances than in flavors. See Castoreum, Tonkin Musk, and Chart 107 – Civet.

CJD – See Creutzfeldt–Jakob Disease.

Claims – Comparative, descriptive or general statements made by a product. Examples are; No Fat, Gluten Free, New and Improved, Contains no artificial preservatives. These claims can be supported by analysis, or by standard sensory techniques. See FTC, FDA, Nutritional Claims

Clair – In flavors, the term clair is relatively obsolete. It was originally derived from the French word, meaning clear or clarified. It indicates a primary simple extraction followed by a number of subsequent extraction and clarification steps, some possibly including a charcoal filtration. The ultimate product in this process is a very clear extract. See Extraction.

Clarified (Clarification) – A product that has been made clear.

Clarified Butter – In culinary terms to remove fat from a stock or proteins from butter. Clarified butter has a higher smoke point due to the removal of proteins that can brown. Browned butter is known as ghee. See Ghee, Culinary Arts, Smoke Point.

Clarify – To remove suspended or otherwise insoluble particulates. See Filtration.

Clarity – The absence of turbidity. See Transparent, Transparency; Translucency; Opacity, Opaque.

Clary (Clary Sage) (Salvia sclarea L.) – Clary sage contains a good amount of linalool and linalyl acetate. See Sage and Chart 108 – Clary Sage.

Clean –

1. Microbiologically speaking, devoid of microbiological contamination or within low or stringent microbiological specifications.
2. Flavor-wise, a clean flavor is one without taints or off notes or unwanted nuances.
3. Clean label is one that is usually devoid of artificial ingredients, MSG, HVP, or I+G™. See Microbiology.

Clean Air Act (CAA) – The legislation passed that mandates procedures and defines the criteria for the reduction of pollution into the atmosphere.

Cleaning Procedures – Cleaning Program – Cleaning Schedule – In a well-run food plant, proper cleaning is essential. Use of temperature controlled water, chlorine and a quarternary ion cleaner helps assure that this is done. Drains should be cleaned routinely and listeria testing done on a regular basis. Periodic walkthroughs by the HACCP team with reports, confirm the protocols are being followed. Environmental monitoring, allergen swabs and similar verification is also necessary. Allergen cleaning equipment should be different from non-allergen cleaning equipment and so marked as to be recognizable as such. Quantitative results for allergens verify cleaning. In systems where curves, corners or elbows occur, a rigorous cleaning should be developed, monitored and verified. See Prerequisite Program, GMP, Pre-Operation Procedures, Post-Operation Procedures, Environmental Monitoring, Microbial Monitoring, Verification versus Validation, HACCP.

Clostridium botulinum – A gram-positive anaerobic organism that produces an extremely potent toxin. This organism does not multiply at low pH (for example, below 4.2 pH); therefore, appropriately acidified products will prevent the organism to take hold. Also fortunately, the toxin is very sensitive to heat and can be neutralized by cooking a food to a sufficiently high temperature for a specified period of time. See Pathogenic (Pathological) Organisms – Clostridium botulinum.

Clostridium perfringens – An organism related to the clostridium, a botulinum bacterium that also causes food poisoning. This organism's spores are also very heat resistant. See Microbiology.

Cloud –

1. A flavoring ingredient that imparts a turbidity or cloudiness. An emulsified oil in water provides a stable flocculation to a food system.
2. Clouds can be provided in a number of ways – suspended particles (titanium dioxide), emulsified fats (vegetable oils or fractions), emulsified terpenes (this is the most prevalent), or vegetable oils. So that the cloud does not ring (separate at the top of the final liquid food product), care must be taken to provide that the dispersed phase (the oil phase in the case of a liquid water-based cloud) is close in specific gravity to the continuous phase (the water in this same case). For this, a weighting agent is used, like BVO (brominated vegetable oil), ester gum, or sucrose acetate isobutyrate, etc.

See Brominated Vegetable Oil, Ester Gum, BVO, Weighting Agents, Gums and Thickeners, Emulsifying Agent, Emulsion, Turbidity, Flocculation, Separation, Solubility, Suspension.

Cloudiness – The attribute of possessing a flocculent appearance or of being translucent and cloudy. See Cloud.

Clove (Eugenia caryophyllata Thunb.) – Clove oil is a popular spice oil. It is used similarly to that of the cinnamon non-cassia oils because it contains many of the same components. The name clove is derived from the Latin term clavis meaning nail, as the unopened flower buds of the spice resemble nails. It is a powerful oil, and should be used sparingly in fruit flavors as it tends to dominate the flavor profile. However, it is very useful as a background character, especially in vanilla products. Its main uses are in cola blends, root beer, sweet pickle seasonings, and sweet spices in general. It also finds a use as background notes in brown flavors, chewing and bubble gum blends, catsup seasoning, ham seasoning, and as fruit flavor modifiers. See Spice and Chart 109 – Cloves.

Clover, Sweet – (Melilotus officinalis or Sweet Clover) – See Appendix 2.

Clover (Tops), Red Clover (Trifolium pretense) – Used in the past as a natural source of green vegetable character in WONFS, it is currently not used often for that purpose. Its usage as a nutraceutical is being explored. Clover is important in that it contains nitrogen fixing bacteria in bundles at the base of its root system. See Nutraceuticals and Chart 110 – Clover, Nitrogen Fixing Bacteria.

Clovey –

1. Reminiscent of clove.
2. Containing eugenol, or a combination of eugenol or eugenol-like compounds. See Clove, Eugenol, Eugenyl Esters.

Cloying –

1. Having a warm, pungent, or irritating effect on the mucosa. A cloying odor would have a particular nasal sensation, characteristic of the effect of both aroma and trigeminal stimulation.
2. A taste sensation that yields stimulation well beyond the point of saturation. See Odor, Satiation, Saturation.

Clumping – Another description for the process of caking wherein larger balls of product are formed. See Caking, Anticaking Agent, Drying.

CMA – See Chocolate Manufacturers of America.

CO_2 Extraction – Carbon dioxide's unique character of sublimating directly into a gas at atmospheric conditions, while being able to turn into a liquid at higher pressures, allows for many unique and useful extraction techniques. The extraction of essential oils can be accomplished through the use of the CO_2 process. These would be considered pseudo-folded citrus products. The resultant pseudo-folded oil produced without the use of heat and vacuum as during normal distillation retains the oil's subtle and heat fragile top note and character. See Distillation, Concentrated or Folded Oils, Folding of Extracts and Essences.

Coacervation – A process developed by National Cash Register, which produces a microencapsulate. This process is used mainly in the ink encapsulated pressure-sensitive carbonless papers. Fragrance encapsulation using this process is seen in the Scratch 'n Sniff™ products often seen in ads and in magazines. Flavors similarly encapsulated are sometimes used in children's books. However, the cost of the process has limited flavor use to these examples. See Spray Drying, Drying.

Coagulation – Turning a liquid into a semi liquid or gelatinous mass by the action of an enzyme, heat, acid, or other means. Coagulation of proteins is an important consideration in culinary arts. Initial coagulation of proteins is achieved by boiling temperatures. This can result in rubbery textures. At higher temperatures in the absence of moisture, this protein coagulation can relax, but with the addition of continuous higher temperatures, the proteins can undergo a permanent coagulation resulting in dried-out tough meats. See Cheese, Precipitation.

Coalesce, Coalescence – The process of two like particles forming a larger particle by combining. Two oil droplets can coalesce in an emulsion. If this process continues, larger and larger oil droplets will form, and ringing can occur. In more problematic situations, the emulsion will totally split. See Splitting, Ringing, Emulsion.

Coarse –

1. Generally an undesirable profile that lacks smoothness, roundness, or general desirable and balanced qualities.
2. A description of the particle size of a blend. Coarseness is a general term usually meaning a more granular appearance, or a powder blend that is nonhomogeneous, or one that has a particle size roughly that of approximately 3/16 inch or greater in size. See Round, Homogeneous, Agglomeration, Smooth.

Coating(s) – Any of a number of external substances that form a film on the outside of a food system. This approach could be used to improve a product's shelf life, provide for protection during processing, shipping or handling, for aesthetic reasons, etc. Coating substances include waxes, dextrins, and other similar materials. See Anticaking Agent.

Coban – A Guatemalan coffee variety. See Coffee.

Coccus – Bacterium that is globular in shape. Coccus bacteria that form chains are called streptococcus. Those that form irregular bunches are called staphylococcus. Single coccus structures are called

micrococcus, and those that form in pairs are called diplococcus. See Pathogenic (Pathological) Organisms.

Cochineal – See Color (Colorants).

Cocoa Leaf (Erythroxylon coca Lam. and Other Species) – Extracts and concentrates must be decocainized for use in foods. See Cocoa Powder, Chocolate, and Chart 111 – Cocoa Leaf.

Cocoa (Powder) – The pod of the cacao plant contains large seeds or beans. The beans contain a bitter tasting nib, the seed coat (tegument), and the germ. To create cocoa powder, the nibs go through many stages. These include fermentation, sorting, cleaning, breaking (winnowing), roasting, cooling, crack grinding, pressing, pulverization, cake formation and production. The production stage can include the processing into cocoa powder, chocolate, instant cocoa products, and many more. First the nibs are kept at a moist warm environment to aid in the fermentation. This type of fermentation reduces some of the bitter alkaloids, proteins, and other precursors, and breaks proteins and carbohydrates down into simpler amino acids, sugars, etc. Three microorganisms are involved with this stage: yeasts, lactic acid-producing bacteria, and acetic acid bacteria. Pulp sugars are metabolized into ethanol. Then a culture of Acetobacter sp. dominates the flora turning the alcohol into acetic acid. The excess of acetic acid kills the bean. Enzymes then turn anthocyanins (glycosidases) into reducing sugars. Invertases convert sucrose to fructose and glucose, and proteases convert storage proteins into peptides. Free amino acids are formed, all of which may provide starting materials for the Maillard browning reaction. The beans are then sorted, dried, and roasted. The roasting process brings on the characteristic flavor, and Maillard-based compounds are then formed. The nibs are then cooled and crack ground. Crack grinding is the process of sending cocoa between rollers at high temperatures. Temperatures here are between 170–190°F. After the crack grinding, the final mass is then pressed. This is called the press cake. The press cake is then separated from the fat (cocoa butter) and ground again. The percent fat left in the ground powder is from 10 to 25%. This powder is cocoa powder. Cocoa powder, as such, is not very soluble in water. A process of solubilizing the cocoa powder was developed by C.J. Van Houten (Netherlands) in 1828. The process was novel in that it used alkali. The process was called the Dutching process, and the resultant cocoa is called Dutched cocoa. The Dutching process develops a more bitter, darker chocolate. The first chocolate bar was developed in 1847 mixing chocolate liquor, cocoa butter, and sugar. Chocolate liquor or chocolate is produced in the following manner: Cocoa powder is first pressed to remove the cocoa butter. Chocolate liquor is then made by adding sugar and other ingredients. Cocoa butter, additional cocoa powder, and sometimes other ingredients can be added as well according to the FDA and the standards of identity for cocoa products. (See CFR Title 27, Chocolate Definition and Standard of Identity, FDA Regulations.) This mixture is then heated and constantly agitated until smooth, and then cooled. This process is called conching. Cocoa butter goes through a number of different phases in the conching process. These phase changes are represented by a complex melting point curve. The conching process enables the crystals of the cocoa butter to change into a stable fatty or microcrystalline phase through this process. When the chocolate is old or undergoes a cool thaw, whitening occurs on the surface. This is called crazing, and represents a separation of the cocoa fat that has gone through an undesirable phase transition. Cocoa has been studied as a chemical production factory powerhouse. One ounce of cocoa (30 grams) contains 617 mg of theobromine, 72 mg of caffeine, and many other alkaloids including one similar to estrogen. Perhaps the study where some women said they would rather have chocolate than sex (done in 1995 and 1996) is based on some kind of hormonal response or substitution. See Chocolate and Chart 71 – Cocoa.

Coconut (Cocos nucifera) – The coconut is classified as a fruit or a drupe. It contains a very hard outside shell that is protected further by a fibrous green pericarp. The outside shell provides the coconut with buoyancy and provides it floating ability to pollinate across large bodies of water. Inside the rounded shell, the white coconut 'meat' is attached. The coconut water, a subtly flavored liquid, is contained inside the rounded shell as well. Coconut milk is defined as a combination of the coconut water and the meat that is crushed into pulp. The basic flavor of the coconut is lactonic, although the water inside has a significant character of dimethyl sulfide. As far as the lactone profile, it is the gamma lactones that dominate the profile. The coconut has three eyes making it look like a tiny bowling ball. These eyes are where holes can be made to drain the coconut water from inside the shell. Coconut is a very popular food product. It can be shredded and used in salads, baked items, and confectionery preparations. It is also used in beverages, like the well-known piña colada mix with pineapple and many other food products. See Nut(s), Piña Colada, Lactone.

Code of Federal Regulations (CFR) – The publication produced by the United States Government Printing Office that outlines the rules and regulations pertaining to different governing bodies. These different governing bodies like the Food and Drug Administration, United States Department of Agriculture, Department of Transportation, and the Bureau of Alcohol Tobacco and Firearms (now partly known as the TTB) have different title numbers associated with them. See CFR Title 7, CFR Title 9, CFR Title 21, CFR Title 27, CFR Title 37, CFR Title 40, CFR Title 49, Federal Register.

Codex Alimentarius – The international equivalent of the Food Chemicals Codex in the United States. The Codex Alimentarius which means 'Book of Food' in Latin is the document that sets standards for the World Trade Organization for the safety of the food supply. See European Community (EC), European Union (EU), International Regulations. The Codex Alimentarius Commission overseen by the World Health Organization and the Food and Agricultural Organization of the United Nations reviews specifications and food safety issues of food and food ingredients. See GHS, Food Safety.

Cod Liver Oil – A pale yellow oil obtained from the liver of fresh cod. It is a natural source of Vitamins A and D. See Fish.

Co-elute – When two or more chemicals enter a detection device in a Gas Chromatograph, the description of what is occurring is that they co-elute. See Gas Chromatography, GC Olfactometry.

Coffee (Coffea arabica L. and Other Coffea Species) – White flowers yield green cherries that turn red during ripening. In each cherry is usually a pair of seeds with a parchment covering (endocarp). Caffeine content is from 1 to 2%. There are just two major species. These are coffea arabica and coffea robusta. The world production is approximately 3 to 1. Robusta is more disease resistant, however. Most people feel that the taste of the robusta variety is not as good as its arabica cousin. Hence, it fetches a lower price in the marketplace. The roasting of the bean is a complex series of chemical reactions. As the bean undergoes a pyrolysis, the water within expands and makes an audible cracking sound. The pyrolysis or Maillard Reaction is the reason for the presence of the roasted 'brown' type of chemical compounds in the roasted bean as well as furan-based products due to the caramelization of sugars found within the bean. After the first cracking, the bean goes through an intermediate stage of endothermic (heat absorption) phase. As the temperature continues to rise, a burning or secondary pyrolysis occurs. Then, when much of the water left inside the bean's cellulosic structure is eliminated at these high temperatures, again an audible crack is heard. Beyond the second crack, a secondary flavor development occurs. Here the developments of the roasted or burned characters are developed typically, and the presence of phenolic components increases. This treatment is called a city or French roast. The bean undergoes a color change from green to gray to brown to darker brown depending on the degree of final roast. A carefully picked graded and separated bean is considered specialty coffee and sells at a higher premium. Solublized coffee can be spray dried to make an instant coffee, or freeze dried to make a more flavorful instant. Some larger coffee roasters add condensed coffee aromas back into the can to introduce a quality although fleeting aroma as the vacuum packed can or glass jar is first opened. The character of coffee is quite variable, and this author is working very closely with the Specialty Coffee Association of America to define the aroma compounds and descriptors that are characteristic of the different geographical, climatic, and regional qualities, and hopes to eventually trace back resultant aroma compounds due to precursor development, which might be geographically or climatically dependent. Decaffeinated coffee has been accomplished via a few different techniques. Solvent methods necessitate removal of the solvent. The Swiss method that uses the water-based decaffeinating technique might be thought of as better from a natural, purist standpoint. However, increased costs versus the classical extraction method is another consideration. Coffee has been prepared in a variety of ways; steeping is a simple infusion then followed by the removal of the grounds. Percolation is a method by which water is forced up a tube by steam pressure and then flows down through the coffee, extracting flavorants as it falls. The drip method channels water downward from a reservoir. The espresso coffee maker uses a steam and water extraction method. A piston coffee maker, otherwise known as French press, is a glass pot that has a fine net attached to a piston. This piston is pressed downward allowing the soaked grounds to be compressed at the bottom, yielding flavorful liquid as it is squeezed. The resultant drink from a French press contains minute particulates that greatly enhances the textural and flavor sensation of the drink and is considered by many experts to be the best way to drink the finest specialty coffees. See Chart 112 – Coffee.

Coffee Profiler – Coffee Profile Method – A procedure and corresponding computer program used to describe the flavor of roasted coffee. This system,

used in collaboration with the Flavor Dynamics, Inc. Coffee Cupper's Kit, plots magnitude estimation values on a radial graph according to predesigned flavor characteristics such as Roasted, Earth, Salt, Bitter, Fruit, Floral, Terpene, Peanut, Herb, Wine, Grass, Caramel, Chocolate, Nut, Sour, Spice, and Sweet. See Sensory Evaluation, Dynamic Flavor Profile Method.

Coffee Varieties and Individual Listings – The following observed attributes are unique characteristics that might help identify the source of the coffee. Note however, that roasting degree and speed, as well as differentials in climactic conditions for the year, might alter these nuances significantly. See Specialty Coffee, Specialty Coffee Descriptors, Climate, and Chart 114 – Coffee Varieties.

Cognac Wine (Lees or Dregs) – Chromatographically, some green cognac oils appear as a homologous series of ethyl esters. This observation leads one to believe that it is possible to adulterate cognac oil, and one must be wary as to the source of natural material. As one has seen the old Lie de vin whose character was very complex, but it is no longer readily available, lends doubts as to the authenticity of some present versions of highly estery oils. See Fermentation, Fusel Oil, Alcohols – Amyl Alcohol, and Chart 120 – Cognac Oil.

Cola – See Kola.

COLA – Certificate of Label Approval – See TTB, Formulas Online.

Cola Beverage – Cola beverage is a good example of a fantasy flavor. The companies who produce these products claim that the formulas are of the utmost secret. Organoleptically, the aroma of cola is a citrus spice, typically lime, lemon, cinnamon, and clove. The differential items are the trace components that make each character unique. See Differential, Lime, Lemon, Cinnamon, Clove.

Cold Finger Trap – A condensing unit that is immersed in a gaseous/liquefied or fine particle stream and cooled. Volatiles that pass by are condensed onto this mechanism for purposes of recovery, condensation, and/or reintroduction into a food system. Coffee manufacturers often use this methodology to produce the coffee essence or add oil back to the coffee. The initial aroma presented to the housewife upon opening the container is therefore pleasant, albeit fleeting. Because these compounds are quite volatile, subsequent opening and closing of the can dissipates the aroma and therefore its effectiveness. See Distillation, Condensation.

Cold Pressed (Oil) – The procedure for extracting oils by direct compression without the use of heat or distillation or any other extraction method. See Single Fold Oil, Distillation, Distilled Oil.

Coliforms – A group of microorganisms, the most well-known of which is Escherichia coli, or E. coli. E. coli is present in the large intestines and aids in the digestive process. However, some mutations of E. coli such as the strain E. coli O157:H7 can be lethal. As a group, coliforms occasionally appear in dairy products and are found in the soil. For this reason, total coliforms is often one of the categories reported in a typical microbiological assay. See Microbiological Assay, Pathogenic (Pathological) Organisms, HACCP, Food Poisoning, Toxins.

COLIPA (Cosmetics Association of Europe) – See Appendix 1.

Collagen – A tough fibrous protein that is the most common protein in the body. It is the major structural protein making up tendons, cartilage, and bones. It is insoluble in water but can be converted into gelatin with moist heat. See Protein, Hydrolyzed Meat Proteins, Protease.

Collard (Brassica oleracea var. viridis) – Collard has a pronounced green flavor reminiscent of spinach with a sulfury bitter almost mustard character in the background. Borecole is a related vegetable with an even more pronounced flavor. See Vegetable, Vegetative; Sulfur.

Colloid – A suspension of different phases. A heterogeneous mixture where smaller particles (the dispersed phase) are finely distributed throughout the continuous phase. Examples are particulates in a liquid (paint), water trapped in silion (an opal), or a solid or gas (dust particles in the air). The phases can either be liquid solid or vapor, oil or water soluble. An emulsion is a particular type of colloid where oil and water are dispersed in a colloidal system. Another term used is a colloidal suspension. See Suspension, Emulsion, and Chart 51 – Colloids.

Color (Colorants) –

1. The products approved and regulated by the FDA. Dyes that are approved for foods and drugs and cosmetics are designated as FD&C dyes.
2. The visual attribute of a flavor or food product.
3. The positive attribute of certain food products, like teas. Example: This tea has color means that it is bright red and clear with little or no visible turbidity. Colors can occur accidentally. These are usually uncontrolled and difficult to reproduce. Oftentimes they occur when trace quantities of metal, like iron, are leached from drums by acids, and are complexed in the presence of reactive compounds. One example seems to occur when butyric acid or another ionizable acid leaches iron from a drum, and reacts with maltol™ or ethyl maltol™. This coloration is apparently due to an iron complex that manifests itself as a very bright orange. Addition of acid,

carbon filtration, or ion chelation (EDTA) can be successful approaches. Additionally, Schiff base reactions can produce unwanted colors. This reaction can occur when anthranilates or other amines react with aldehydes. This author observed a bright green coloration once in a project using mint, alcohol, and saccharin. It was impossible to eliminate until the switch was made away from the saccharin to the sodium form. Note: The designation of naturally derived coloring agents is quite specific. Although the product may be derived from natural sources, unless the product is named as annatto flavor, etc., a coloring agent derived from a naturally derived source is still considered artificially colored by the FDA. An alternative to this somewhat negative designation would be to split the ingredient out as to its common or usual name. Example: 'Annatto as coloring agent. Regulations that apply to colors that are oleoresins and extracts are – listed in the Code of Federal Regulations under 'labeling' CFR 101.22 and 'ionizing radiation' CFR 179.140. Excerpt from Code of Federal Regulations Title 21 Paragraph 101.22 (4): (4) The term 'artificial coloring' means any 'color additive' as defined in Paragraph 70.3(f) of this chapter. All colorings must be labeled accordingly. FD&C dyes must be specified as to each of the identities used in a product. Naturally derived colorants may be stated as using 'artificial coloring added' or their common or usual name can be used alternatively. See Natural (Flavors); Artificial, Synthetic, or Not Natural, Code of Federal Regulations.

Colorings – See Chart 115 – Colorings, Figure 15, and Figure 16. (For color see also www.flavordynamics.com.)

Colorings Naturally Derived Versus Hues – A list of some naturally derived coloring versus their hues are as follows:

Red – Carmine
Red Orange – Paprika, Carotenal
Orange – Carotene
Orange Yellow – Annatto
Yellow – Turmeric
Green – Spirolina Extract, Chlorophyll (Approval Pending)
Blue – None (although the azulenes in Chammomile are naturally occurring cost is prohibitive)
Indigo – Anthocyanins, Elderberry Concentrate, Enonciannina
Violet – Beet Juice Concentrate.

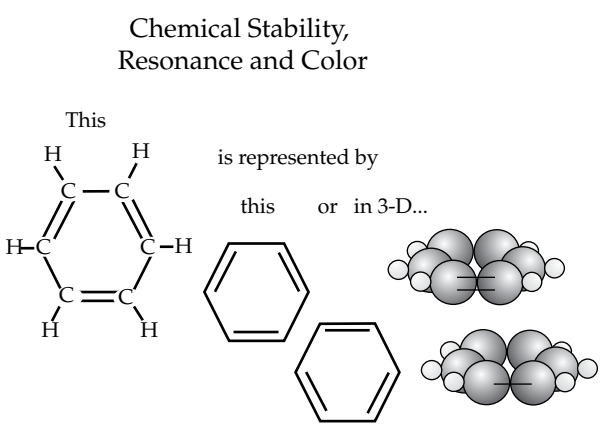
Color Value – A measurement that is used especially with colorant spices like paprika. See Color (Colorants).

Colombian Coffee – A variety of coffee considered to be one of the heartiest, and is one of the more popular types. Some regional varieties are Narino and Huila. See Coffee.

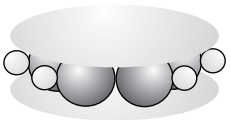
Column –

1. A long tubular, semi-rigid, albeit flexible structure within which a substrate or packing material is placed. This type of item is used in instruments that are designed to separate materials as in a GC, HPLC, etc. Very thin columns are called capillary columns and are useful in enhancing the separation or resolution between eluted peaks.
2. A distillation column. See Gas Chromatography (GC), Distillation.

Combination Cooking Techniques – Cooking procedures that employ both dry and moist heat cooking. Often the food is seared to set up the caramelization and Maillard Reactions and then placed in a water-based liquid. Combination cooking techniques are used for the toughest of meats with a high collagen



Actually, the electrons at any carbon can resonate back and forth between any atom, or even flow as a continuous field as such. This gives the molecule of benzene for example a stability called resonant stability. This is true whenever there are double bonds one away from each other in a molecule or if there are heteroatoms rich in electrons (oxygen for example).



When there are many double bonds across a large molecule, the molecule can be activated by either ultraviolet radiation or visible radiation within the electromagnetic spectrum. This is why molecules such as these absorb well in a UV/Visible spectrophotometer and are often colored to us as observers. When we see a chemical colored red, it absorbs all the visible spectrum but red. (Reflection) When we see a direct light source of a certain color, it is either giving off that wavelength or it has had a filter to filter out all but what it is transmitting.

Figure 15

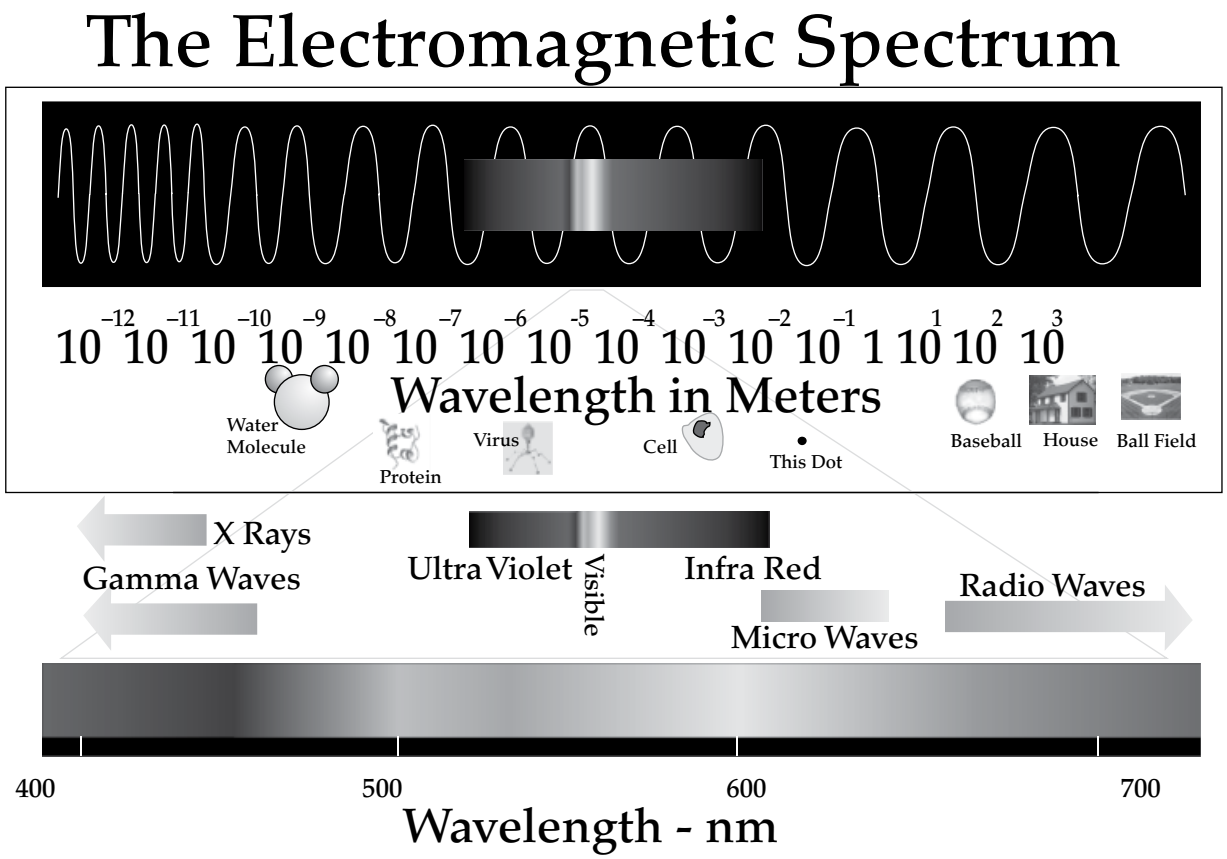


Figure 16

content. The gelatin that forms from the hydrolysis of the collagen yields a very flavorful outcome. Osso Bucco is one example of this technique. Combination cooking methods include stewing and braising. See Culinary Arts, Maillard Reaction, Dry Heat Cooking, Caramelization.

Comminuted (Material) – Pulverized or chopped finely. Material is first comminuted to allow for a more efficient extraction during maceration. See Maceration, Extraction.

Common Mugwort (Artemisia vulgaris) – See Thyme.

Communication – The transference of ideas or data from one point or person to another. One of the most difficult things to accomplish is the accurate communication of sensory descriptions from one person to another, due to likes, dislikes, biases, characteristic intensity perception differences, language problems, acuity differences, etc. For this reason, many have tried to develop standard vernacular for use in describing flavors. One such attempt is the Flavor Dynamic's Flavor Nomenclature Workshop. Companies such as Arthur D. Little, McCormick, and other organizations have also developed approaches. ASTM developed a flavor nomenclature lexicon. The Society of Flavor Chemists is working on a project to more accurately define the flavor lexicon according to more precise chemical standards and terms. See Acuity, Bias, Language, Flavor Nomenclature Workshop.

Compared or Comparison Tests – Those sensory examinations that look at two or more items and set a measurement used to compare the two. Hedonic testing, paired comparison testing, triangle testing, and duo-trio testing are a few comparison types of tests. See Attribute Tests, Sensory Analysis, Triangle Test, Duo-Trio Test, Comparative Tests.

Comparative Flavor Chemistry – The discussion of differences of flavor characteristics versus chemical structure. In this book, we have grouped homologous structures so that comparisons can be more easily made. See Chemical Structure.

Comparative Tests – Comparative tests are meant to describe the similarities and differences between two or more products. They include:

1. Simple difference test
2. A-not-A test
3. Duo-trio test

4. Triangle test
5. Difference from control test
6. Two out of five test.

See Simple Difference Test, Duo-Trio Test, Triangle Test, Difference from Control Test, Two-out-of-Five Test.

Compensation (masking) – When two or more stimuli are mixed, the resultant effect is less than the individual effect alone. See Masking.

Complex (Flavoring Complex) – A description of a mixture of many Items.

Complex Organic Substances – Ingredients whose components consist of many items. This could include extracts, essential oils, distillates, and other natural GRAS substances. See Extract, Essential Oil, Distillate, Natural Flavor Definition.

Complex Sugars – See Polysaccharides.

Compliance – In HACCP terms compliance means following the rules of Good Manufacturing Practices in the production of safe, legal and quality driven products. See Non-Compliance, HACCP, Corrective Actions, Non-Conformance.

Composed Salad – An artistic presentation of an assortment of contrasting tastes, textures and colors based on greens, herbs, nuts, meats, seafood, fruits and other possible Ingredients. The dressing can be a vinaigrette, or another type of dressing drizzled on top rather than tossed to improve the aesthetics. See Culinary.

Compote – A dish made from fruits that are slowly cooked in syrup. The syrup may be spiced or otherwise flavored. The fruits, cooked slowly, usually retain their original shape. See Culinary Arts.

Compressed Oil – See Expressed Oils, Expression.

Concassé – Dicing tomatoes without the skin. The procedure is as follows: Make a shallow star cut with paring knife at the point of a plum or similar hard tomato. Take off the hard part where the tomato was attached to the vine. Place in boiling water until the skin starts peeling off. Throw into an ice bath to stop the tomato from turning to mush. Peel off the skin and cut. Then remove the seeds. See Culinary Arts.

Concentrated Fruit Juices – See Fruit Juice Concentrates.

Concentrated or Folded Oils – Flavor oils that usually include many essential oils that can be enhanced by concentration. These products would typically contain an ingredient that was great by percentage but weak by flavor strength. By removing this component, greater overall flavor strength is achieved. One example is limonene found in citrus, mints, and some spice oils. See Folding of Extracts and Essences.

Concentration –

1. Any of several methods to increase the strength of a material. Concentrated fruit juices are an example of products using this approach.
2. The degree of strength. A dilution of ethyl acetate that is 10 parts ester and 90 parts alcohol has a concentration of 10%. See Concentrated or Folded Oils.

Conching – The tempering of chocolate liquor (cocoa powder plus cocoa butter) by mixing it slowly under heat. The melting curve of chocolate is quite complex consisting of at least six different identifiable forms. This conching process turns the fatty acid profile within the cocoa butter to the smooth consistency we all know and love. See Cocoa, Chocolate, Melting Point Curve.

Concrete – Petroleum-based solvent extraction of a botanical, usually a floral. The concrete is then extracted a second time by alcohol to produce the absolute de concrete, otherwise known as the absolute. See Absolute.

Condenser (Condensing Column) – A column of glass that is used to turn vaporous chemicals into liquids for the purpose of refluxing, distillation, or reclamation. See Cold Finger Trap, Theoretical Plate Count, Reflux, and Distillation.

Condensation – Changing the phase of a liquid to a gas. Condensation can occur by exposing a gas to a cooler solid. The gas then adheres to the cooler solid in liquid drops. The drops collect, and the liquid is then diverted. This process is the one used by a distillation column. See Condenser, Distillation, Theoretical Plate Count.

Condiment – A seasoning or blend of spice that is used in the kitchen, a strong herb. See Spice.

Conditionally Essential Amino Acids – Amino acids that the body produces when under stress. See Amino Acid.

Conduction Heating (As opposed to convection or radiation heating) – Conduction heating is accomplished through the transfer of kinetic energy by the movement of a substance. Conduction heating therefore is done in systems where two substances are in contact or in close proximity. See Convection Heating.

Confectionery – The class of food products where sugar is used including sweets and candies. See Sugar(s) and Polyhydroxyl Compounds.

Confidentiality Agreements – Non Disclosure Agreements – Secrecy Agreements – Contracts agreed upon by two parties. For example, a confidentiality agreement would be developed between a flavor supplier and a food product manufacturer to protect proprietary information and costs

incurred through the R&D process. A confidentiality agreement typically states that any information that is divulged by the customer is the property of the food product manufacturer. This agreement is developed to assure that the proprietary information developed by the food manufacturer is kept away from his competition. This is a crucial contract and must be honored to its fullest. Dependent usually on local state regulations and statutes, the wording can be quite different. However, on the supplier side, issues to avoid are:

1. Wording in the agreement that is open ended including such wording as 'hold-harmless' terminology. Here, these types of agreements imply that the supplier is fully liable for any or all frivolous lawsuits, including the obligation to pay the total burden of all costs for all parties' legal fees.
2. There must be an acknowledgment of any existing knowledge that is not included in the agreement. This includes knowledge that the supplier already had in its possession prior to the agreement and information that is deemed to be in the public domain. If this were not the case, the food product manufacturer might be able to mistakenly claim a violation on information that is already known by the supplier, or on information that is already 'out there' in the industry.
3. The flavor formulation must remain the property of the flavor company's exclusively. Note: The above information, as any legal type information contained in this book, is not meant to be legal advice but merely a guideline. Each individual should consult with their attorney as to the accuracy and validity of the above statements. See secrecy Agreements, Intellectual Property, Public Domain.

Confit – Meat cooked and preserved in its own fat. See Culinary, Garde Manger, Charcuterie.

Conformance – In HACCP terms, to be in agreement with acceptable safe practices. See Compliance, Non-Compliance, Non-conformance, HACCP, GMP.

Congeal – To change from a liquid to a semisolid. See Solid.

Conjugated Double Bonds – Two or more double bonds that are separated by a single bond as in the structure benzene (C_6H_6) or Maleic Acid (O=C—C=C—C=O). In benzene, each carbon can exist in either of the states (double or single), and can switch back and forth as either type. This is called chemical resonance. This resonance results in a dissociated mass of electrons that can occur at any carbon at any time. This dissociated mass is called an electron cloud and usually results in added structural stability. See Aromatic Compounds.

Consistency – 1. Quality of firmness viscosity or flow, the measurement of this can be done with a Bostwick Consistometer. 2. Reproducibility of quality. Issues of raw materials can be daunting. Some essential oils are historically very consistent, while others are extremely inconsistent. Some suppliers will blend lots to iron out these deviations. 3. The aspect of sustainability that assures future supply. See Bostwick Consistometer, Consistometer, Viscosity, Crop to Crop Deviation, Shortages, Alternate Supply.

Consistometry (Consistomer) – Usually measured by a Bostwick measuring device. This measures flow rate and not viscosity, although they are generally related. See Bostwick.

Consommé – A high quality flavorful liquid made by a clarification technique using meat and egg whites. A meat stock that has been cooked until concentrated, flavored or seasoned, and then clarified. A consommé is made by adding a mixture of ground meats or mousselin with Mirepoix, tomatoes, herbs and spices, other flavorful ingredients, and egg whites into either bouillon or stock. The liquid is then slowly brought to a simmer. As the liquid continues to simmer, proteins from the meat and eggs coagulate on the surface soaking up fat and other particulates. The coagulated mass called a raft on the top of a consommé is removed when completed. See Culinary Arts, Sauces, Stock.

Consorzio Di Bergamoto – An organization established in Italy that assures the integrity and authenticity of the essential oil of bergamot that is produced in their country. See Adulteration.

Consumer Testing – The sensory analysis technique that analyzes consumer responses by geographic, demographic, ethnic, and other criteria. These might include preference tests and hedonic tests. See Sensory Test.

Consumption Pyramid – The actual consumption of food types versus the theoretical best diet Food Guide Pyramid. See Food Guide Pyramid.

Consumption Ratio – The concept originally introduced by Dr. Jon Stofberg. The consumption ratio is the amount of a food additive consumed by the population from ingestion of foods not containing food additives or in their natural state versus the amount of the same ingredient that is consumed via food additives. Example: The amount of carotene consumed by the American population by eating fruits and vegetables far exceeds the amount of beta-carotene consumed by virtue of its direct addition to foods by humans. Therefore, the consumption ratio will be very high. If there is no addition of a substance to the food supply via an artificial source, the consumption ratio is defined as >999,999.

The compound d-limonene is added into our food supply in great amounts through oils of mints, citrus, spices, etc. But d-limonene has no significance because it is mostly derived from the terpenes of a natural source, and not as a synthesized chemical. On the other hand, chemicals that are not found in nature like ethyl vanillin and ethyl maltol have a very low consumption ratio. See Toxicology, Food Safety.

Contact Surfaces – Areas defined within a HACCP plan and GMP protocols as those which will come in contact with the food product. Contact surfaces should be cleanable and should be smooth avoiding harborage of product. See HACCP, GMP.

Contact Zones – A general area in a food plant that has a unique food safety characteristic. A contact zone in a mixing room is different from a contact zone in a packaging room. See HACCP, Sanitation, GMP.

Contagious Diseases – As opposed to infectious diseases that must be transmitted through inoculation, ingestion (food-borne illnesses), or injection (mosquitoes), contagious diseases can be transmitted from one organism to another by contact or otherwise. Categories of contagious diseases are the airborne types. Some diseases, like colds, can be transmitted through touch (shaking hands, kissing, etc.). See Infectious Diseases.

Contamination – The addition of a foreign substance that causes a lessening of the integrity, safety, stability, or appearance of a food product. See Adulteration.

Continued Supply – One of the most frustrating things facing a creative flavorist is the desire to use ingredients, using them in a new formulation, getting the approval the sale and then the supplier alerts the flavorist that the product is discontinued because they have not gotten enough sales on the product. In my humble opinion this is a very disturbing issue that I have seen all too often, and see no clear resolution to the problem. There are other reasons for discontinuity of an ingredient such as; political issues being one of them, weather, or regulatory changes, but pure economic reasons is a different issue. See Marketing, Purchasing Issues.

Continuing Guarantee Letter – Guarantees by a supplying company to a producing company stating that the products that they supply are not adulterated or misbranded, and are fit for human consumption. Oftentimes, a continuing guarantee letter also states that it complies with all of the Department of Transportation statutes, the flavor labeling laws, and if there is a natural claim that all the flavors used are natural according to definitions stated in the Code of Federal Regulations Title 21 of the Food and Drug Administration. See Natural Certification.

Continuing Improvement Procedures (Practices) – CIPs are a part of a HACCP plan that identifies areas that could be enhanced improved or modified to lessen the likelihood of anticipated issues of non-conformance. See CCP, Corrective Action, Non-Conformance, HACCP.

Continuous Phase – The bulk of the ingredient in an emulsion. The continuous phase is the ingredient that is the 'solvent' or the phase environment around the dispersed micelle. In a bottler's emulsion, the continuous phase is usually water. In butter, the continuous phase is milk fat. See Emulsion, Disperse (Non-Continuous) Phase, Colloid.

Continuous Process – As opposed to a batch process, a system of production that does not need to stop unless for maintenance, problems, order completion, or other reasons. See Batch Process, Production Issues.

Controlled Atmosphere Packaging/Modified Atmosphere Packaging – Newly designed packaging type systems include; MAP (modified Atmosphere Packaging and CAP (Controlled Atmosphere Packaging). Both of these techniques are used to improve food quality and extend shelf life. One technique is to lower the oxygen content of the package to reduce oxidative rancidity of fats, other oxidative reactions and to slow the growth of aerobic organisms. Carbon dioxide can be added which lowers the pH further enhancing microbiological quality, Nitrogen, can be added as an inert gas and Carbon Monoxide can be added to improve the color of the meat retaining its redness. Certain plastic films can be used that might breathe, and inserted packets might be used as scavengers. Another technique is called EMAP) or Equilibrium Modified Packaging, using Carbon Dioxide on fresh vegetables slowing down the respiration and enhancing photosynthetic processes. EMAP films might also control Humidity and are called MA/MH Films. Ethylene is given off as fruits ripen and acts as a catalyst to hasten further ripening by other fruits nearby. Therefore, the control of the production of this gas can be seen to hold the ripening process until the package is received by the consumer and opened. These packaging concepts are also called Active Packaging, Intelligent Packaging or Smart Packaging. See Packaging.

Convection Heating – The transference of a higher temperature by the movement of heated particles within a fluid substance like a gas or liquid usually by virtue of a change in the density of the heated substance. See Conduction Heating.

Convection Oven – A cooking instrument with a built-in fan that provides a good mixing of air or convection within the box. See Culinary Arts.

Convergence – The tendency of a test sample to be seen as close to the target, without a reference to any standard, and that seems to be close to previously encountered products. The concept is that some odors or tastes last in the mouth or nose. This is also called the halo effect. See Halo Effect.

Conversion – The process whereby a grain, such as rice, or whereby a starch is so treated as to hydrolyze the proteins to amino acids. See Hydrolysis.

Conversions and Definitions –

- kilograms – The standard for 1 kilogram is the mass of a cylinder of an alloy of platinum and iridium kept at Paris, France. 1 kilogram = 2.2046 pounds (avoirdupois)
- grams – One thousandth of a kilogram. The original mass was defined as being that of 1 cubic centimeter of water at 25°C. 1 gram = 0.0022 pounds (avoirdupois)
- degrees Celsius (Centigrade) – This scale was developed using 0 degrees as the freezing point of pure water and 100 as the boiling point of pure water at 1 atmosphere, and then divided into 100 equal segments. Degrees Celsius = 5/9 (degrees Fahrenheit −32) degrees Fahrenheit. This scale was developed using 32 degrees Fahrenheit as the freezing point of pure water and 212 degrees Fahrenheit as the boiling point of pure water at 1 atmosphere.
- degrees Fahrenheit – degrees Fahrenheit = 9/5 (degrees Celsius +32)
- pounds – 1 pound (avoirdupois) = 453.592 grams
- ounces – 1/16 of a pound (avoirdupois) or 28.3495 grams.

See Weights, Balance.

Converted – Changed in physical form as in converted grains (converted rice, converted starch). To be reduced in molecular weight or to hydrolyze.

Cooking –

1. The process of administering heat to a food product by virtue of roasting, boiling, frying, microwaving, or baking.
2. Ceviche is considered by some to be a 'cooking technique' as well. Here acid denatures proteins. See Culinary Arts.

Cool(ness), Cooling, or Mintyness – The trigeminal-based property observed by some ingredients that have a negative heat of solution in the saliva (mannitol, sorbitol) or a cooling effect on the mucosa (menthol, carvone, methyl salicylate). Cooling effects are also associated with some burning effects. Peppermint is oil that exhibits both a cooling effect and a chemical burning or irritation, both of which are transmitted through the trigeminal nerve. See Trigeminal Nerves, Mintyness.

Copaiba (Copaifera sp.) – Used in essential oil replacements and unfortunately, as an adulterant in essential oils as well. Gurjun balsam is another balsam used in this manner (gurjun is not food grade). See Balsam and Chart 121 – Copaiba.

Cordials –

1. Sweetened alcoholic beverages (liqueurs) that are usually 40 to 60 proof. These are often used to make mixed drinks, or consumed as desserts, aperitifs, or after dinner drinks. Some examples of the divergence of cordial types follow:
   - Crème de Menthe, Peppermint Schapps™ or Spearmint Schnapps™ – Mint Types
   - Crème de Cacao, Cointreau™, Kaluah™, Fra Angelica™
   - Coffee and Cocoa Types
   - Sloe Gin, Peach, Apricot, and other fruit Schnapps™
   - Chambord™ (raspberry)
   - Fruit Types
   - Amaretto™, Crème de Almond
   - Almond and Nut Types
   - Benedictine™, Chartreuse™
   - Specialty Herb and Spice Types
   - Anisette™, Ouzo™, Pernaud™, Sambucca™ – Anise Types
   - Galliano™ – Vanilla Types
   - Drambuie™ (Scotch and Honey)
   - Grand Marnier™ (Brandy and Orange)
   - Southern Comfort™, Kentucky Bourbon and Spices
   - Curacao™ – Multiflavored Sweetened Rum/Bitter Orange Bases

Sweetened confections made from soft or liquid candy centers, usually enrobed in chocolate. See Alcoholic Beverages.

Coriander (Coriandrum sativum L.) – This botanical is a seed-like structure, but botanically it is classified as the fruit of the coriandrum plant. It was used in older tobacco-type flavorings. Coriandrol is a terpene alcohol endogenous to coriander. The green herb is used in ethnic dishes such as some Mexican foods. This herb is called cilantro. Cilantro is used in guacamole, chili dishes, and added directly as a garnish in Mexican and Tex-Mex dishes. The seeds are produced in Morocco and India. Indian seeds are more oblong, with a pointed end, the Moroccan seeds are rounded. Both have ridges that run longitudinally. Thai curries use the root that is rich in character. The character is similar, but more intense than that of the leaves. Other types of so-called coriander are used extensively throughout the world. One addition to the recent GRAS list is Vietnamese or Chinese Coriander FEMA 4736. See Tex-Mex,

Terpenes – Oxygenated and Other Related Compounds, Floral Terpene Esters, Chart 122 – Coriander.

Corked – The taint or off odor in wine called 2,4,6 trichloroanisole. This chemical is a bi-product of yeast contamination and is also seen in the off-flavor of coffee that has had too high a moisture and subsequent yeast contamination as well. As this was first reported in coffees produced in Rio De Janiero the off character was described as Rioy. See Trichloroanisole, Earthy, Yeast and Mold, Coffee, Off Odor.

Cork Oak (Quercus suber L. or Q. occidentalis) – Cork oak can be used as an enhancement to alcoholic beverages to simulate the aging process in wood caskets. See Woody and Chart 425 – Cork Oak.

Corn (Zea mays) – Corn is considered to be the only native American grain. It has been widely cultivated and is now a major crop whose use as a food ingredient surpasses its use as a foodstuff. Genetically it has been proven to have been derived from the grass teosinte from Mexico and was probably propagated about 4 millennia ago. Sweet corn is a variety that is sold mostly as ears. Popcorn, Z. mays var. everta, is a harder-shelled type that explodes as trapped gases form while being heated. Corn is processed in many other ways: as corn flakes for cereals, corn chips, and corn meal called masa harina for corn curls. These corn curls, also called collets, are formed by extrusion. Corn chips or tortilla chips can be flavored with a variety of seasonings. One of the largest selling flavors or seasoning is the nacho cheese product that goes onto tortilla corn chips. A process of drying, soaking, cooking, and removal of corn from the husks make hominy from flint or dent corn. Hominy grits or simply grits are made from ground hominy. Masa harina used to make tortilla chips is also made in this manner. Corn meal is used to make a porridge-like dish called polenta. Although some ear corn is eaten as such, cornstarch and its modified versions based off of flint or dent corn and other varieties, is now a mainstay ingredient in the food industry. Cornstarch is extracted from corn through a process known as corn wet milling. Besides the starch, there are also by-products formed in this process. Among these are corn oil, gluten, and the chaff. The latter is sold mostly for feed. See Grains, Teosinte, Hominy.

Cornmeal – In the U.S. finely ground corn kernels is called cornmeal or corn flour. However, there is confusion in Europe where that is called corn flour and the grittier type (Grits) is called Polenta. Corn meal is further processed into cereals, corn snacks, corn bread, as a release agent in pizzas, and in Mexican wraps. Tacos, Enchiladas, Grits, Nixtamalization, Polenta.

Cornmint Oil (Mentha arvensis) – See Mentha arvensis L. and Chart 480 – Mint Varieties.

Corn Syrup – An enzyme-derived sweetener made from cornstarch using enzymes found in the following cultures: Streptomyces rubiginosus, Actinoplanes missouriensis, Streptomyces olivaceus, Streptomyces olivochromogenes, or Bacillus coagulans. CFR citations Title 21 Sections 168.120 (glucose syrup), 168.121 (dry), 168.180 (table syrup), 182.1866 (high fructose), 184.1865 (corn syrup). See Sweeteners (Nutritive); Sweeteners (Non-Nutritive); Sugar(s) and Polyhydroxyl Compounds.

Corn Syrup Solids – Corn syrup solids are commonly used food ingredients derived from corn syrup. Percent hydrolysis is rated as DE (usually between 10 and 100). Corn syrup solids are sold as fillers, plasticizers, humectants, sweeteners, and substrates. See Sweeteners (Nutritive); Sweeteners (Non-Nutritive); Sugar(s) and Polyhydroxyl Compounds.

Corrective Action – The documented response to a non-conformity in a HACCP plan. A corrective action plan is a crucial part of the HACCP plan and in compliance with the FDA requirements. The corrective action form should have a description of the non-conformity, an identification of the root cause of the non-conformity, steps taken to correct is and also avoid it in the future, and a procedure to verify that the actions taken place have resulted in an elimination of that and future non-conformities. See FSMA, HACCP, Critical Control Points, Third Party Audits, Continuing Improvement Practices, FDA.

Corrosive – A hazardous condition that is defined by the ability of an ingredient to alter or eat away at the surface of a metal, plastic, the skin, or other surfaces. Certain acids are corrosive to the skin, metals, and even glass. Certain solvents or esters are corrosive to plastic. A corrosive material is considered a hazardous material and would generate the need for an MSDS. See MSDS, Hazardous Material, OSHA, Worker's Right to Know Act, Flammability, Flashpoint.

Cos – See Lettuce.

Costa Rican – Costa Rican coffee from the named country is a product that has a mild flavor and a balanced profile. Tres Rios coffees are lighter-flavored products, and Tarrazus are fuller flavored with a fermented, winey character. See Coffee.

COSTHA (Conference on Safe Transportation of Hazardous Materials) – Establishes rules and procedures for the handling of hazardous materials in accordance with OSHA, DOT and the EPA. See OSHA, Regulations.

Costmary (Chrysanthemum balsamita L.) – Used in alcoholic beverages to provide a minty character. It has been suggested that it is one of the products

used in Chartreuse™. See Benedictine™ and Chart 124 – Costmary.

Cost of Goods – Consideration must be given to the actual cost of each raw material that goes into a flavor including: (1) Raw Material Cost; (2) Shipping Costs; (3) Hazmat Charges; (4) Testing and Verification costs; (5) Handling Costs (refrigeration etc.); (6) Spray drying or other procedures; (7) Minimum Quantities and warehousing; (8) Kosher and other similar costs; (9) Expiration (if quantities are kept in stock and must be destroyed because they are expired).

Costus (Saussurea lappa Clark) – Contains sweet, woody, and harsh oily notes. High boiling sesquiterpenes and sesquiterpene alcohols necessitate distillation conditions to be more stringent than for most botanicals. The combination of woodiness and oiliness makes it an obvious candidate for use in nut flavors. See Heavy, Earthy, and Chart 125 – Costus.

Cottonseed Oil – Used as an adjuvant for many purposes including anticaking, humectancy, lubrication, etc. See Fats and Oils and Chart 126 – Cottonseed Oil.

Coulis – A fine puree served either hot or cold that is made from either fruit or vegetables or shellfish. See Sauces, Culinary Arts.

Coumarin Derivatives – These products contain the coumarin structure (i.e., a benzene ring attached to a delta C-5 lactone forming a six-membered heterocyclic oxygenated ring). Dihydrocoumarin (benzodihydropyrone) and 6-methyl coumarin are quite effective in contributing a sweet brown, vanilla, coconutty character, and can be used at higher levels for their characterizing effects. Lower levels of vanillin, ethyl vanillin, the maltols, cyclotene, and the furanones round out flavor systems as well. Coumarin products can be used in coconut flavors, tobacco flavorings, nut flavors, chocolate, and any other brown-type flavor. These classes of compounds also contribute a ripened effect to fruit flavors as well as the rounding out effect as mentioned above. See Brown (Compounds), Rounding Out, Characterizing, Vanillin, Maltol, Benzodihydropyrone, Ethyl Vanillin, Cyclotene, Furanones, and Chart 117 – Coumarin Derivatives.

Coumarin Replacements – Because coumarin was such a popular character in flavor types developed in the first half of the century, and was then banned in the United States, flavorists strived to replace the warm, sweet character so beneficial in vanilla compounds. Hence, coumarin replacers have found a niche in the industry. Some obvious coumarin replacer compounds that are GRAS approved are dihydrocoumarin and 6-methyl coumarin; however, the following also includes some coumarin-like compounds such as naphthalenones, etc. See Replacers, Extenders, and Chart 118 – Coumarin Replacers.

Coupage – A French terminology that usually means a blend of materials designed to extend, cheapen, or adulterate costly natural products. See Extenders, Replacers, Adulteration.

Court Boullion – Literally a short broth. Court boullion is used in poaching and typically contains an acidic substance like wine or vinegar. See Culinary Arts.

Couscous – A traditional North African dish made from steamed ground durum wheat (semolina) with meat or vegetable stew added. In Western Sicily it is served with fish. See Culinary.

Covering Agent – See Masking Agent.

Crab (extract) – A natural flavor used as a base for many seafood flavors. See Fish, Crustaceans, and Chart 429 – Crab Extract.

Crack – See Hard Candy Manufacturing, Sugar, Spray Drying.

Crackling – When pork skin has the fat or lard extracted from it, the resultant spongy substance is called pork rind or pork crackling. See Snacks.

Cramer Ford Hall Decision Tree – Published originally in Food Cosmetics Toxicology (1978) ed. 16 pages, 255–276. This is the chemical structure decision tree that is the basis of much of the FEMA expert panels decision on food chemical safety.

Cranberry (Vaccinium macrocarpon and V. oxycoccos) – Mostly an American fruit, it is relatively unknown in Europe. They grow in bogs that are flooded. When the berries are ripe, they are mechanically detached. The berries are tart with an aromatic fruitiness. Buchu leaf oil and other sulfur components, salicylates, and other chemicals that would typically be used in berries are used to make effective cranberry flavors. See Berry (Like).

Cranial Nerves – Twelve pairs of nerves that emanate from the brain to the head and other parts of the body directly as opposed to the body through the spinal nerve are:

1. Olfactory nerve – Relays the sense of smell to the limbic system, then to the cerebral cortex.
2. Optic nerve – Relays visual cues through the thalamus to the cerebral cortex.

3., 4., and 6. – Oculomotor, trochlear, and abductor nerves control eye movement.

5. Trigeminal nerves – Facial sensations and jaw movements, associated with chemical irritation in the inside of the mouth.

7. Facial nerves – Facial expressions and the sensations of taste from the front two thirds of the tongue.
8. Acoustic (vestibulocochlear) nerve – Hearing and balance.
9. Glossopharyngeal nerve – Taste and throat sensations, the rear third of the tongue, bitterness, and the 'gag' reflex.
10. Vagus nerve – Breathing, circulation, digestion.
11. Spinal accessory nerve – Neck movements and back muscles.
12. Hypoglossal nerve – Tongue movements. Therefore, the nerves that are responsible for some aspect of the sensory/flavor stimulation are the olfactory nerve = smell; facial nerve = front two-thirds of the tongue; trigeminal nerve = chemical sensation; and glossopharyngeal nerve = rear two-thirds of the tongue.

See Physiology.

Cream (Flavor) or Crème (Flavor) – Unlike the flavor of cream derived from milk, a cream or crème flavor is more closely associated with a vanilla with milky or butter notes. A cream flavor of this sort, whose roots go back pre 1950s in the development of cream soda, is based off of vanillin, ethyl vanillin, heliotropine, or another light vanilla character with the addition of butter notes (diacetyl, butyric acid) and some esters (ethyl butyrate, ethyl acetate, ethyl caproate) as examples. See Creamy.

Creamy –

1. Like cream.
2. Having a flavor similar to creamy foods.
3. Having an aromatic component that elicits a creamy response, like lactones.
4. A characteristic of a food where fat and particle size is less than 3 microns, and the viscosity is sufficient enough to impart a creamy texture. See Lactone, Cream.

Creatinine – A breakdown product of creatine phosphate in muscle tissue. Creatinine is produced by the body regularly and is excreted through the kidneys. One alternate reaction where creatinine's dihydro intermediates might react to form HCAs was of concern. Particularly those processed flavors that used meat extracts as a flavor precursor source. However, concentration of HCAs in foods normally versus that added from flavor sources lead governmental bodies to ignore their introduction through flavor routes. See HCA, Carcigenicity, Processed Flavors, FEMA.

Creative – To possess the ability to think in a novel manner. See Breakthrough Experience, Lateral Thinking.

Creativity –

1. The act of being creative.
2. The talent to develop from unrelated ideas, a third idea that was unknown previously.
3. The ability to be creative is within all of us given a minimum or average intelligence. Some people seem to have a greater propensity toward creative thinking. However, it is not yet clear whether this is genetic, environmental, or because of some innate biological 'talent' for insightful thought that manifests itself in this manner. Most anyone can be taught to think inductively rather than deductively, to think in a creative manner rather than to deduce logic from all sensory input. Some feel that the ability to be able to flex mental muscle from (1) scientific reasoning to (2) creative development back and forth quickly correlates to extreme intelligence, but this is also not yet proven. Insight (from Latin meaning inner vision) and inspiration (from Latin meaning inner breath), are two creative aspects of thought. A way of looking at the creative process is to recognize the steps needed to achieve a breakthrough. A sound creative approach employs (whether consciously or not) the following steps:

Steps in Creation

Preparation – To be able to tell whether or not something that one thinks of or observes is a breakthrough, one must have some knowledge in the arena the breakthrough is being made. Whether purposeful or information gained through life experience, a modicum of knowledge in the area is essential.

Incubation – There is a time, be it very long or of short duration that the knowledge gained and observations made stimulate no breakthrough. This is the fact and observation time period.

Illumination – As in a light that now shows, the period of illumination is the time frame in which the postulation or hypothesis is made. The idea is being generated and becomes focused in the mind.

Verification – For a good creative idea to be valid, a mental checklist or period of playing the devil's advocate must transpire so that the idea is validated as to its worthiness.

Implementation – Finally the idea must be proven out in a practical manner. If it is purely a theory of logic or an insight that really cannot be proven in the near future, the period of implementation is postponed, and the verification process goes on. A breakthrough of this type might just be a belief. As an example, a religious belief might not be able to be proven but

remains a concept of faith. See Insight, Intuition, Breakthrough Phenomenon, Lateral Thinking.

Creeping Origanum – See Thyme.

Crème Fraiche (pronounced kremm fresh) – A mixture of heavy cream and buttermilk cooked under a gentle heat. The mixture is then set at room temperature to culture into a sour cream-like end product. See Culinary Arts.

Creole – The type of cuisine that is typical of the mixture of native West African, French and Spanish foods found in the New Orleans area. Often using local proteins and thickened with okra, gumbo is usually seen on the menu of a Creole menu. Local proteins can include nutria (a type of large rodent), crawfish, alligator, as well as some more common types like chicken and pork. See Culinary Arts.

Crepe – A very thin layer of dough, which is produced by mixing eggs and flour and then fried. See Culinary Arts.

Cress (Nasturtium officinale = Watercress) (Lepidium sativum = Garden Cress or Pepper Grass) – Both varieties of cress exhibit a peppery, pungent flavor. See Pepper.

Creutzfeldt–Jakob Disease (CJD) – Described by H.G. Creutzfeldt in 1920, CJD is a rare and fatal neurodegenerative disease causing spongiform encephalopathy in humans. It is thought to be caused by eating meat tainted with the 'Mad Cow' disease prion or BSE. The accurate name is variant Creutzfeldt–Jakob Disease or vCJD. There is also a new variant nvCJD. See BSE, Prion.

Critical Control Point (s) – The point at which a failure, non-conformance or 'out of compliance' could occur in the standard operating procedure (SOP). This failure can result in a condition injurious to health or business. Example a Critical Control Point in the restaurant business is the amount of the time and temperature meats are held. Examples of generally accepted safe conditions are: Poultry – 165 degrees F (74 degrees C) for 15 seconds and ground meat – 155 degrees F (68 degrees C) for 15 seconds. Other critical points could be controlled by a sieve protocol, allergen cleaning protocol, labeling protocol, temperature protocol, or other such protocol. See Food Safety, Out of Compliance, HACCP, Hazard, Seven Step Analysis, Food and Drug Administration, FSMA, Thermal Kill Step, Allergens, Microbial Assessment of Raw Materials, Safety Assessment of Flavors, GMP, cGMP, GHS, WHO, BRC, SQF, ISO.

Critical Extraction – The extraction of a substance by an extractant at critical conditions. See Critical Temperature, Critical Pressure.

Critical Failure – The point at which a failure, non-conformance or 'out of compliance' occurs in the standard operating procedure (SOP). This failure can result in a condition injurious to health or business. The HACCP Plan should address this potential and put in place Critical Control Points to address this potential failure, prescribe limits of acceptance and a monitoring system to assure continued compliance. See HACCP Plan, Critical Control Points, Food Safety.

Critical Limits – 1. Food Chemical Codex Definition – A criterion which separates acceptability from unacceptability. 2. A range of values or circumstances where a physical, biological, or chemical food hazard must be controlled at a CCP to prevent, eliminate, or reduce to an acceptable level a non-conformance of an identified food safety hazard. See HACCP, Critical Control Point (s), Food Safety.

Critical Pressure – The pressure at which the liquid and the gaseous phase of a substance are identical, and the separation between the two phases disappears. See Critical Temperature.

Critical Temperature – The maximum temperature that a substance can be liquefied by pressure alone. Above this temperature, the substance can only exist as a gas. See Critical Pressure.

Crocker Henderson Odor Classification System – An overly simplified system relying on a concept called the odor square; Fragrant, Acid, Burnt and Caprylic. Another approach is the Zwaardemaker Smell System (1895) listing; Ethereal, Aromatic, Fragrant, Ambrosiac, Alliaceous, Empyreumatic, Hiccine, Foul and Nauseous as the main categories. Also Henning's smell prism of; Flowery, Foul, Fruity, Spicy, Burnt, and Resinous attempts the similar categorization. With current knowledge indicating that the odor 'alphabet' is represented by thousands of chemical types or odorivectors, these systems would logically fall apart upon close scrutiny. See Dynamic Flavor Profile Method™, Flavor Lexicon.

Crocus – See Saffron.

Crop Shortages – Occasionally natural substances fail to meet the demand of the industry and consuming public. Reasons are varied. Some are environmental, meteorological, political or disease related. Often products that would normally be off-grade for direct consumption by consumers are used for industrial processing. But as a supply becomes scarce, these grades are shipped directly to market. In this way, product availability for industrial processing can be severely restricted, and prices go up. The reasons for these shortages are often weather related, but some shortages have been a result of

economic trends, insect or other biological contamination, chemical contamination, and other reasons. Occasionally, it seems that an artificial stockpiling of supplies is purportedly to adjust supply and demand. In this manner prices are driven up due to greed or other intentional factors. See Fertilization.

Crop Calendar – A chart indicating the months that natural materials are harvested and are readily available. This can be used to determine the best times to purchase natural ingredients. See Natural Flavors, Crop to Crop Deviation, Purchasing.

Crop to Crop Deviation – Typical with natural products, the nature of its components – sugar, nutrients, salt, minerals, vitamins, flavor, color, etc. – varies with seasonal fluctuations. Because of this there is an expected difference between crops from year to year and in some instances from month to month. Bulking is one way to round out inconsistencies of processed materials. Distillation and other legally approved treatments are accepted ways to avoid gross deviation. See Consistency, Quality Control.

Croquant – French for crispy or crunchy, used in candy terminology to mean a crispy or crunchy layer or piece.

Crosne (Stachys spp.) – Mostly used in the orient, and first cultivated in France, the flavor of crosne is a cross between artichoke and salsify (i.e., sulfury and fishy). See Artichoke, Salsify.

Croutons – Croutons are small bits of toasted bread usually made into cubes, and often seasoned with cheese, garlic, or other spices. See Bread, Toast.

Crown – The base root of the asparagus plant from which more shoots can grow. See Asparagus.

Crude Fiber – Water insoluble, indigestible substances including cellulose and lignin. See Fiber, Gums and Thickeners.

Crude Sulfate (Sulphate) Turpentine (Terpentine) – A by-product of the wood and paper industry heavily affected by the housing market and a subsequent driver of synthetic terpene and terpene derived prices. See Flavor Ingredients.

Crustaceans – In the family of shellfish, there are the mollusks and crustaceans. Crustaceans are invertebrate animal species that carry a chitinous external shell. They mostly live in the sea, with the exclusion of the crayfish, some shrimp and crabs. They can elicit severe allergic reactions, and are one of the categories that need species disclosure according to the Allergen Labeling Act. All of these animals are not considered kosher to eat. The following list outlines the commonly eaten crustaceans:

- Shrimp (Pandalus spp.) – Including deep-water shrimp (Pandalus borealis), and the giant tiger prawn also known as black tiger shrimp (Penaeus monodon).
- Lobster (Homarus americanus) – (American species) and H. vulgaris (European species).
- Crab (Cancer spp.) – Including common shore crab (Carcinus maenus), Atlantic common crab (Cancer pagurus), velvet swimming crab (Portunus puber), spider crab (Maia squinado), snow crab (Chionoectes opilio), Pacific common crab (Cancer magister), and blue crab (Callinectes sapidus) (also known as the Atlantic blue crab). Soft-shell crabs are blue crabs that have shed their shells and have not yet replaced them.
- Scampi (Nephrops norvegicus) – Also known as Norway lobsters or Dublin bay prawns. (Not to be confused with the garlic-containing seafood dish).
- Crayfish (Astacus spp. and Cambarus spp.) – Freshwater species that live in the Southeastern U.S., especially around Louisiana. Varieties include red-clawed crayfish and white-clawed crayfish. Also called crawfish or as a slang, crawdads.
- Spiny lobster (Palinurus spp. and Jasus spp.) – According to allergen labeling, these ingredients should be specified by name. Example: Allergen Declaration: Crustacean Shellfish – Crab. See Fish, Mollusks, Allergies.

Cryptosmia – A diminishment of olfactory acuity due to a physical obstruction in the olfactory area. Example: polyps, etc. See Anosmia.

Crystallization – 1. The change in state from a liquid to a solid in a non-amorphous or structured form. Some powders like salt often are found in cubic crystalline structures. Some salts are treated so they are amorphous and then attain different physical properties. 2. The defect result of solubilized flavoring ingredients coming out of solution due to changes in temperature, evaporation, reaction, or other effects that result in a precipitation of flavor solids. 3. Development of the glass phase transition state. This can occur in candies, spray drying and many other products, typically containing polysaccharides. See Glass Transition, Precipitation.

CSA – See Chemical Sources Association.

Cubeb (Piper cubeba L. f.) – The botanical is distinguished from Litsea cubeba. Often a short piece of the stem is left on the fruit, therefore explaining the term 'tailed pepper.' Cubeb oil with a bluish cast (presence of azulenes similar to that found in chamomile) indicates that the distillation was carried through to the higher boiling constituents. The botanical is all but unknown in Western cooking today. Piper longum is another related species that

does not usually find its way into Western cuisine. It is used in India and Indonesia in curries and pickles. See Pepper, Black, and Chart 127 – Cubeb.

Cucumber (Cucumis sativus) – Usually large and elongated with a green smooth skin, the American cucumber is used in a multitude of salads and other products. The pickling process can use any food product, but generically the word pickle means pickled cucumbers. The gherkin is a smaller variety of the species C. anguria and is often pickled, then sweetened and has added spices like clove, anise, onion, cinnamon, garlic, and pepper to make a sweet spicy pickle. The gherkin can be used in cocktails, dips, etc. It is also chopped to produce sweet pickled relish. Russian-type dressings are French dressings (mayonnaise and tomato/ketchup blends) plus sweet pickle relish. The green cucumber contains a wide variety of unsaturated mono and dialdehydes. Trans 2 cis 6 nonadienal is often called cucumber aldehyde because it is so reminiscent of the green vegetable. Cucumbers are related to the melons, and it logically follows that this aldehyde is also found in watermelon rinds. See Aldehydes – Unsaturated, Fatty/Green, and Chart 14 – Aldehydes Unsaturated.

Cuisine – A style, variety or characteristic of food typical of a region, ethnic constituency or geographical area. There are many types of cuisines throughout the world. Spanish cuisine might be thought of as a wider variety using olives, rice, fish, and pork, while Mexican cuisine might be more specific employing corn and flour based products, i.e. tacos, enchiladas and tortillas. Asian cuisine is quite varied and Indian, Thai, Mandarin, Japanese and Viet Namese cuisines are much more specific. Some cuisines might also include 'Truck Stop Cuisine', 'Insect Cuisine' (entomophagy), Cajun and Creole Cuisine, and many others. See Marketing, Trends.

Culinary – Culinary Arts – The creative practice of cooking. One who engages in the culinary arts, or a culinarian, is either called a cook or a chef depending on their level of expertise. The many stations in today's modern brigade system include varying degrees of difficulty and experience. A cook can climb the ladder from simple preparation of cut meats and vegetables and works the prep station practicing their knife skills, then climbing up the ladder to fryer, sauté station, sauces, and eventually to Sous Chef or assistant chef and then Executive Chef or Chief Chef. The employment of chefs in the industry has become widespread, and the marriage of culinary arts and food science into a practice known as Culinology™ (a trademark of the Research Chefs Association of which the author is an active member) has been growing. See Gold Standard, Roux, Knife Skills, Knife Cuts, Sauces, Stock, Dry Heat Cooking Techniques, Moist Heat Cooking Techniques, Chef Ladder, Research Chefs Association, Research Chef, Certified Research Chef, Certified Culinary Scientist, ACF (American Culinary Federation), Garde Manger, Charcuterie, Brigade.

Culinary Thickening Techniques – The thickeners employed by classical culinary methods include:

- Flour and Cornstarch, etc. – Used as thickeners. It was the famous chef Escoffier that predicted that 'one day we will go away from flour as a thickening agent because pure starch in the form of arrowroot, cornstarch, or potato starch would accomplish the same purpose but give a better result.' (Note: This is not a direct quote.) We will include bread and other similar items here as well.
- Purees – Addition of thick vegetable or fruit purees.
- Reduction – Cooking down the water to increase the solids.
- Rice and Other Grains – Can be used as a thickener as well.
- Roux – Lighter roux have better thickening properties than darker ones. The flour in the roux thickens the liquid. See Arrowroot, Cornstarch, Potato Starch, Culinary Arts, Culinology® – The trademark of the Research Chefs Association, which represents the combination of the two studies of science (Food Science) and art (Culinary Arts).

Cultivation –

1. The purposeful growing of crops to achieve a desired effect.
2. The training of an individual, such as a trainee becoming a flavorist. See Training.

Cultural Differences – As varied as the world is with all the differences in food supply, customs, religious taboos, etc., there are many aspects to the foods eaten in one population which could be found to be abhorrent, strange, horrifying, immoral, or repulsive in others. Because of the limited supply of proteins, native tribes in rain forests eat insects as a standard source of proteins; the consumption of dog meat, horse meat, monkey brains, snakes, and other animals would be seen by some to be a less than desirable experience. Because of religious reasons, the prohibition of consuming cow meat, alcohol, pigs and other hoofed animals, insects, and shellfish is instilled in the written culture and religious laws set forth prohibiting their consumption.

Cultural Restrictions – Besides well-known religious restrictions (Jewish = no pork, Moslem = no alco-

hol), there exist cultural restrictions as well. Some are subtle and have to do with learned tastes and dislikes because of environmental factors, exposure to foods, etc. The use of horsemeat in some European countries and not in the United States is an example of this. See International Food.

Cumin (Cuminum cyminum L.) – Cumin oil is a highly characteristic oil that contains a significant amount of cuminaldehyde (di-hydroperilla aldehyde). Cumin is the most important ingredient in the varied blends of spices known as Indian curry. It is used in pickle spice blends as well as a major ingredient in chili blends used in Mexican cooking. See Curry and Chart 128 – Cumin.

Cumin, Black – See Caraway, Black.

Curacao (Peel) (Citrus aurantium L.) – Also called bitter orange peel. Called curacao because of its use in making the popular liqueur of the same name. See Orange, Bitter Orange and Chart 129 – Caracao.

Curcuma – See Turmeric.

Curcumin – The colorant in turmeric, a portion of which has been cited for clearing brain plaque caused by Alzheimer's disease. See Turmeric.

Curd –

1. The spongy-looking florets in the head of the cauliflower.
2. The resultant spongy mass when a milk product is treated to curdify. A microorganism or culture, enzyme treatment, or acid treatment can be used, often depending on the standard of identity of the product to be produced. Curds will be compressed into the cheese mass and contain a significant amount of moisture, but contain mostly the protein and fat part of the milk. Whey, on the other hand, contains some protein, but mostly the water and sugar (lactose) portion of the milk. See Cheese, Whey.

Curds and Whey – See Curd, Whey.

Curing Agent – An ingredient that enhances a flavor, or is used to hydrolyze a food by action of enzymes or acid. See Hydrolysis.

Curing Salts – The need for antimicrobiological additives in meat has brought on the technique of adding curing salts. These include sodium chloride, and nitrite and nitrate salts. Nitrite can affect the flavor of the meat and produces a red color in the final product. This is due to a combination of nitrogen oxide and myoglobin. Textural effects are also observed. See Meat, Emulsion Meat, Seasonings, Microbiological Stability.

Curly Chicory – See Chicory.

Currant, Black Buds (Ribees nigrum L.) (Cassis) – The absolute of cassis has a powerful spicy, woody odor and can be used in flavors where a woody note can be appreciated (i.e., berries, barrel-aged alcoholic beverages, etc.). The main character ingredient of cassis is para menthane thio 3 one, or thio menthone, otherwise known as buchu mercaptan. This product is used in many different fruit flavors to give the characteristic sulfury top note typified in the natural fruits, especially berries and tropical fruits. The pulp is fragrant, tart, and juicy with a sulfury character similar to that of the tropical fruits. See Buchu Oil and Chart 130 – Currants.

Curry (Curry Powder) – Also known as Indian curry powder. This is a blended spice, the main constituents of which include cumin seed and or leaf (cilantro) with a mixture of other seasonings including cardamom, clove, cinnamon, nutmeg, mace, fenugreek, saffron, coriander, onion, turmeric, garlic, black pepper, chili pepper, asafetida, ginger, or allspice. See Seasonings.

CUSUM (Cumulative Sum) – In attribute testing, the cumulative sum sampling plan. See Statistical Analysis, Sensory Evaluation.

Customs – 1. Individual differences in eating habits are often determined by customs and vice versa. Environmental issues affect the sources of food supply. Areas that are devoid of available protein can often force the consumption of items other cultures would eschew and consider disgusting. The tea ceremony is an example of the consumption of a food or beverage that is steeped (No pun intended) in religious cultural and historical importance. 2. The borders of countries. Often Customs can result in delays, tariffs/duties, analyses or taxes dependent on the relationship to the shipping country, the paperwork required and regulations regarding the ingredient. It is important to understand the requirements of each country to which you are exporting to minimize delay and costs. Issues of IT disclosure are often aspects of international trade with which a company that needs to contend. See Intellectual Property, Export, Duty, Tariff Code.

Cut (Cutting) –

1. A term that means adulterated, extended, cheapened, or diluted.
2. A specific group of materials associated with a crop lot, a variation of a crop, lot, or species.
3. A removal of a portion of a material (usually the top note or lower boiling volatiles) by distillation. See Adulteration, Crop-to-Crop Deviation.

CWD (Chronic Wasting Disease) – A transmittable spongiform encephalopathy found in deer. Originally found in mule deer in Northern Colorado and Wyoming, it has spread to other states, and has even been reported in Korea. See BSE.

Cyanide – Prussic Acid, Benzaldehyde, Bitter Almond Oil, FFPA. A poisonous substance which is found in nature at very low levels. It is formed by the action of amygdalase on the gluscoside amygdalin to form HCN (Hydrogen Cyanide), benzaldehyde and glucose. See Toxins, Paracelsus, Bitter Almond Oil, Benzaldeyde, Enzymes.

Cyanocobalamin – See Vitamins (B12).

Cyanosis – The poisoning by cyanide where HCN molecules replace the Fe (iron) components of the hemoglobin molecule, retarding the exchange of oxygen, thereby suffocating the individual organism exposed. In humans, blue lips typify cyanosis and bluish coloration in the undersides of the eyelids, indicating the active hemoglobin (red) has been altered. Carbon monoxide acts in much the same way. In this way, the term 'cyanotic' means the general condition of being oxygen starved. See Prussic Acid, Benzaldehyde, Bitter Almond Oil, FFPA.

Cyclamate – A synthetic non-nutritive sweetener, like saccharin, which imparts a much cleaner flavor than saccharin. Cyclamate was discovered in 1937. Unfortunately, as a result of toxicological studies whose results were concluded by some to be questionable, it was banned for use in the United States. It is currently still in use in many other countries throughout the world. See Non-Nutritive Sweeteners.

Cycle – See Food Product Cycle.

Cyclic Compounds – Any compound whose structure is characterized by one or more rings of atoms. For example, rings of 5 and 6 carbon atoms make for the most structurally stable compounds. When rings are not made up entirely of carbon atoms linked together, but of a non-carbon atom or heteroatom, the ring is described as a heterocyclic ring or simply a heterocycle. The benzene ring is the most stable of all rings due to a dissociation of the electrons resulting in an electron cloud. The benzene ring's structure is based on alternating double and single bonds of a six-membered carbon molecule. See Chemical Structure.

Cyclic Guanosine MonoPhosphate (cGMP) – A second messenger in the biological response to a hormone. It is therefore used by the body to regulate certain metabolic processes. Enzyme-modified quercitrin has been seen to elevate levels of cGMP. Also involved in the ability to see in the dark. See Nutraceuticals, Isoquercitrin, cGMP.

Cyclic Terpenoid – A terpenoid-type compound with a closed ring. An example is menthol. See Terpenes.

Cyclodextrin – A specialized arrangement of dextrins forming a hollow tube. The inside of the tube is lypophillic and can entrap a 'guest' of a chemical inside.

Cyclohexyl Esters – Esters of cyclohexyl alcohol produce somewhat varied effects from fruity to fruity floral. Although from a vapor pressure standpoint, one would think the esters would be similar to hexyl esters, but it seems that the cyclohexyl equivalents in molecular weight are lighter and fruitier than their hexyl counterparts. The allyl cyclohexyl esters are useful for pineapple flavors. See Vapor Pressure, Alkyl Esters – Grouped by Alcohol Moiety, Fruity, Floral, Hexyl Esters, and Chart 119 – Cyclohexyl Compounds.

Cyclohexyl Compounds – See Chart 119 – Cyclohexyl Compounds. (includes Cyclopentyl and Cycloheptyl Compounds as well).

Cyclotene – Methyl cyclopentene ol one that can tautaomerize into a cyclic diketone structure whose burnt sugary character is reminiscent of a licorice, maple, or caramel. It is a widely used ingredient for the development of brown character, ripened fruit notes, sugary enhancement, etc. It is available naturally, which makes it a useful compound in a wide variety of WONFs. See Brown (Compounds).

D

D (Isomer) – The designation meaning dextrorotatory, or an asymmetric molecule that has the ability to rotate polarized light in a clockwise direction. A chiral compound is one having a positive optical rotational characteristic. Recent designations are 'R' for Latin rectus or right (or dextrorotatory) and 'S' for Latin sinister or left (or laevorotatory). A 'dl' designation means the product is racemic (a blend of 50:50 of d and l). One of the most common D (isomers) in nature is d-limonene. See Laevorotatory, Optical Isomers, Racemic, Enantiomer.

Daidai (Citrus aurantium L. subspecies cyathifera Y) – The daidai is an Asian variety of bitter orange. The fruit can stay on the tree for many years if not harvested, hence the name daidai, which means several generations. The daidai fruit is very bitter, and not usually eaten, but its dried peel is used as an expectorant and a digestive tonic.

Daidai Peel Oil – See Chart 469 – Daidai Peel Oil .

Daikon – Daikon is also known as mooli or Japanese radish. It is a white winter radish with a peppery taste. It is useful in salads and in stir-fried dishes. See Radish, Pepper.

Daily Reference Values – Same as RDI, DRV. See RDI.

Dairy (Industry) Products – A category of foods and a food industry that encompasses all products derived from milk or eggs. The general dairy product category includes milk, cream, egg nog, chocolate milk, yogurt, ice cream, cream cheese, and all other cheese products, imitation cheeses, and dairy spreads, eggs, refrigerated desserts, variegates for yogurts, fruit juices sold in the dairy counters, nondairy creamers, etc. Often this also includes bellywash drinks because they typically are sold in dairy stores in the United States, and are produced by dairy manufacturers. See Cheese.

Dal – Dal is a spiced lentil dish popular in India. See Lentil.

Dalmation Sage – See Sage.

Dalton's Law – Given the same temperature and volume, a mixture of gases each exerts the same pressure as they would have if they were alone. The individual pressure of the gases individually in the mixture is called the partial pressures of that substance. See Boyle's Law, Charles' Law.

Damascone, Damascenone – These ionone-like structures are potent woody/berry notes found in nature (damascenone = raspberry, tobacco, apple). See Ionones, Methyl Ionones, Irones, Pseudo Ionones, and Ionols; Ketones (Aliphatic).

Damiana (Tumera diffusa Willd var. aphrodisiaca [Desvaux] Ward.) – Damiana is used effectively in cordial flavors. See Alcoholic Beverages.

Damiana – See Chart 136 – Damiana.

Dandelion (Taraxaum officinale Weber and T. laevigatum DC.) – Used in salads and also made into wine, the dandelion plant finds its way into rural-style cooking recipes. See Wine and Chart 137 – Dandelion.

Danger Zone – See Food Danger Zone.

Dasheen – See Taro.

Date (Phoenix dactylifera) – Dates grow from the date palm, known from the Bible as the tree of life. Each tree can produce 1,000 dates per year. Varieties are the Deglet Noor, the Medjool, the Zahidi, the Halawy, and the Bardhi. The small stone in the center is not a cellulose-based pit but a corneous albumin. See Raisins, Plum (Prune).

Davana (Artemisia pallens Wall.) – Davana oil possesses a unique flavor character. Its flavor profile

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can be described as a rounded, background note with tea-like drying character and a rich woody profile. It is one of the more unique oils, like patchouly (patchouli) whose character ingredients, patchoulinol and davanol, can be found in these and only these oils. Davana can be used in a number of WONFs especially tea, berries, cocoa and chocolate, and colas, and can provide an interesting character to fruits like black raspberry in cordials. Blended with osmanthus, it is reminiscent of popular blackberry brandies. See Cola and Chart 138 – Davana.

DE – See Dextrose Equivalency.

DEA Regulations – See Drug Trafficking and Diversion Act.

Debitterase™ (Depeptidase) – Debitterase™ is an enzyme that breaks up peptides, the ingredients that often are responsible for the bitter-tasting background character in enzyme-modified cheese. See Cheese, Enzymes, Natural Flavor.

Decalepis – Decalepis hamiltonii Wight and Arn – See Nutraceuticals.

Decanal – One of the aldehydes responsible for the peely character of the orange rind. Aldehydes are used at lower levels in fragrances to impart a clean character, and both nonanal and dodecanal are used in this manner. See Nonanal, Dodecanal, Citrus, Rindy, and Chart 13 – Aldehydes Aliphatic & Keto Aldehydes & Cyclic Ald.

Decision Tree – Also Known as the Kramer Ford Hall Decision Tree – The decision tree approach for the determination of preliminary GRAS status is a logical flow chart for predicting food safety. The premise of 'similar chemical compounds are metabolized similarly in the body' and 'those compounds which are safe should have homologues which are safe and vice versa' is used in this flow chart. Toxicologists and others on FEMA's Flavor Expert Panel used this technique to save a tremendous amount of time and money in the evaluation of substances for GRAS approval. See FEMA, FDA, Food Safety, Toxicology.

Decyl Esters – See Alkyl Esters and Chart 146 – Alkyl Esters Grouped by Alcohol Moiety.

Deep – A flavor that has a rich long-lasting quality, or one that has good background flavor, is considered to have a deep flavor. See Flavor Profile, Top Note, Background.

Deertongue (Liatris odoratissima) – Deertongue is mentioned here only because of its previously wide use as a source of coumarin until use of coumarin was banned in 1952. Deertongue is still allowable in tobacco products, but most tobacco companies have voluntarily discontinued its use. See Chart 428 – Deertongue.

Defect – A defect is a characteristic that does not fall in compliance with accepted specifications. Defects can be classified as minor, major, severe, or critical. See Rejection, Quality Assurance, Defect Action Level.

Defect Action Level – The FDA has published a handbook of levels of naturally occurring or unavoidable defects in foods. These include an acceptable amount of filth and insect fragments, as well as other contamination. See Insects, Edible Insects, FDA.

Deficiency Diseases – An adverse condition in the human body that develops as a result of a lack of a vitamin or other necessary substance. See Vitamins.

Defoaming Agents – A defoaming agent is an ingredient that reduces foaming after it has developed, unlike an antifoaming agent that would prevent foaming from occurring in the first place. See Antifoaming Agent, Foam, Emulsion.

Deglaze – A technique used in culinary arts whereby the fond and other flavorful bits are removed and used in a sauce. The deglazing is done while the pan is still hot. The deglazing liquid can include, for example, water, wine, stock, vinegar, or any other suitable liquid. See Culinary Arts, Sauce.

Degree –

1. A measuring device, usually regarding temperature. Common temperature measuring ranges are degrees Kelvin (using Absolute 0 as 0 = –273°C); degrees Celsius (Centigrade) (using 0° as the freezing point of water and 100° as the boiling point of water; and degrees Fahrenheit (using 32° as the freezing point of water and 212° as the boiling point of water. See Scales, Temperature.
2. A title bestowed upon a student upon completion of a minimum set of requirements in a certain subject concentration. Although there are no degrees in Flavor Chemistry that are available to the author's knowledge, most flavor chemists have a background in the sciences. However, this is not a requirement for entry into the Society of Flavor Chemists.

Degree of Difference – A sensory method that analyzes the magnitude of the non-likeness of one sample versus another. This method typically employs a procedure called magnitude estimation on a line scale. The most commonly used line scale is a 10-cm line scale, but others are also used. The left hand of the scale is usually marked as 0 or no difference, and the right hand side can be marked as 100, 10, Extremely Different, not labeled, or some other designation. The degree of difference is usually analyzed using the ANOVA technique (Analysis of Variance). See Sensory Evaluation, Discrimination Test.

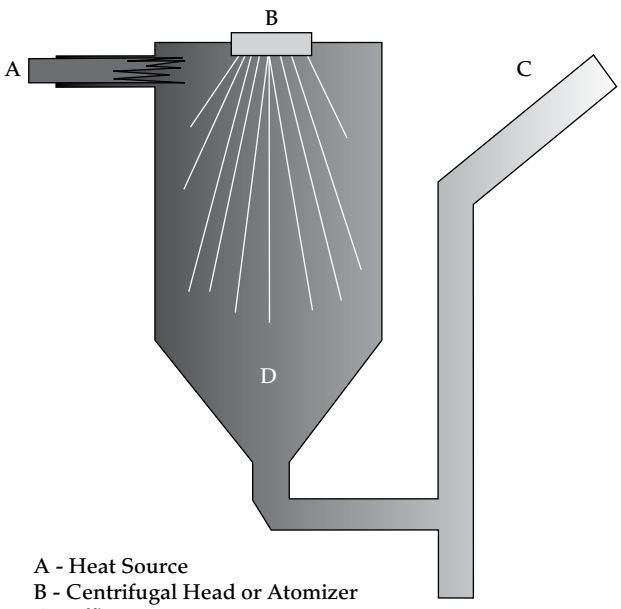
Dehydration –

1. The purposeful removal of water from a food product, usually by the action of heat and/or vacuum.

2. The accidental or ancillary loss of water developed upon standing or in contact with another substance, packaging, environmental, or chemical influence. See Spray Drying, Drying Techniques, Syneresis, Crazing, Cracking, Surface Oil, Fixed Oil, and Figure 17.

Delaney Clause – The Delaney Clause was issued first in the Food Additives Amendment of 1958. The ruling was promulgated as a clarification to the Food Drug and Cosmetic Act of 1938, regarding the safety of the food supply. The clause stated that any substance that has been shown to cause cancer at any level is not permitted in the food supply. Since the implementation of the act, the ability of current instrumentation to find very small amounts of ingredients has led most people to rethink the concept of 'at any level.' Pesticides, which were previously under the Delaney Clause, are now not considered food additives, and are now under the regulations as cited in section 408. The flavor industry lobbied for a 'de minimus' consideration, meaning the amount really used in the food product must be considered, and came up with concepts like the consumption ratio (developed by Dr. Jon Stofberg). The Senate has proposed bills that would refine the concept of Delaney, but none of these efforts have come to pass yet. See Food Safety, Ames Test, Toxicology.

A Simple Spray Drying Unit



A - Heat Source
B - Centrifugal Head or Atomizer
C - Effluent emmission
D - Chamber
E - Collection by-pass

Figure 17

Delay – Product Delay – When developing a new flavor, it is important to consider minimum quantities, product availability, minimum and maximum order size and delays. See Sustainability.

Delicate – A delicate flavor is one that is light (contains a significant amount of low molecular weight compounds with higher vapor pressure) and also pleasant. See Flavor Descriptors.

Delicatessen Meats – Delicatessen meats are also known as seasoned meats or emulsion meats. These products are formulated usually by combining meat and fat products, with seasonings, flavorings, or smoke systems. They are often inoculated with cultures of lactic acid-forming bacteria or other curative agents. Deli meats are usually developed for the sandwich trade. The main types are included in Chart 131 – Deli Meats. See Meat, Spice, Culinary Arts.

Delisting – When the Flavor Expert Panel selected by FEMA deem that an ingredient that was considered previously approved for use in foods and on the GRAS list is no longer safe for human consumption, the product can then be delisted. Example is cinnamyl anthranilate because it was shown to be potentially carcinogenic in laboratory animals. Other examples of a delisted material are; musk ambrette, ethyl acrylate, quinoline and acetamide. See GRAS List, Food Safety, Expert Panel, FEMA. Also, items specifically prohibited from use by the FDA as cited in Title 21 Part 189 Subpart B are found in Chart 132 – Delisted Items.

Delta, d (Greek, Δ, δ) –

1. A Greek letter whose lowercase form reminds one of a stylized script lowercase 'd,' and whose uppercase designation is a triangle.
2. Structurally, a delta designation is used in describing the size of the ring of a lactone. Delta means a six-membered lactone ring structure.
3. A scientific/mathematical notation that designates change.
4. A chemical reaction notation that symbolizes the application of heat to the system. In the case of a minus delta, the symbol represents the removal of heat. In another case, a minus delta can also signify an endothermic reaction, which is one that absorbs heat from its surroundings.

See Gamma, Epsilon, Alpha, Beta, Chemical Structure, Isomer.

Demersal Fish – Demersal means bottom or near bottom. Demersal fish are those such as clams, cod, crabs, flounder, fluke, haddock, halibut, lobster, oysters, perch, shrimp, tilefish, or whiting. See Fish.

Demi-Glace – The most common derivative of the Espagnole Mother Sauce. A demi-glace is usually formed by first reducing an espagnole to half its

volume then adding a brown stock usually veal or beef, then reducing a second time to half the volume. The demi-glace has been replaced by bases in many restaurants due to time and cost restraints but is still adhered to by chef purists.

De Minimus – A level below which some effect does not seem to happen. For sulfites the allowable de minimus level is 100 ppm in the final food as consumed. See Toxicology, Toxicological Threshold of Concern.

Density – The measure of the mass per volume of an item. The bulk density describes the density of a powder. The gravity represents the density of a liquid. Specific gravity is the gravity of a liquid divided by the density of water at a given temperature. See Bulk Density, Specific Gravity, Bulk Density Adjustment.

Deodorization – The removal of trace organic odiferous compounds. One example of this is the deodorization of fatty oils. Often trace odor substances can develop in an oil due to oxidation of unsaturated fatty acid groups in the fat molecule. Injecting high-temperature or high-pressure steam removes volatile contaminants and the oil is therefore rendered deodorized. See Steam Distillation.

Depeptidase – See Debitterase™.

Depth – A flavor profile that has depth is rich in middle to background characters. Depth is a term used to represent a flavor profile having many interesting nuances or layers. See Nuance, Profile, Deep.

DE Rating – See Dextrose Equivalence.

Derivative –

1. Any new substance made from another.
2. A starch derivative is a substance made to possess certain functional properties by reacting the base starch with FDA-approved chemicals. See Modified Food Starch.

Descriptive Analysis – Descriptive analysis is used to describe the attributes of a system. A typical procedure is to first identify the attributes present, and then rate these attributes. Magnitude estimation can be used to correlate each of the attribute's relative contribution to the final system. One way to achieve this is to use preset or agreed upon conditions or terminologies. See Dynamic Flavor Profile Method, Comparative Flavor Chemistry, Attribute Tests, Quantitative Descriptive Analysis™ (Tragon), Quantitative Flavor Profiling™ (Givaudan), Flavor Profile Analysis.

Descriptive Terminology – Descriptive terminology is the flavor descriptive vernacular common to a group. It could vary from company to company and certainly does from industry to industry. It is important to try to standardize the flavor descriptive terminology throughout the industry. The Flavor Nomenclature Workshop developed by the author addresses the need for standardization by using 10 different major aroma categories as follows:

1. Acids – Fatty acids representing the odors of fermentation, and cheese.
2. Esters – The fruity aromas.
3. Green compounds (green fatty) – the continuum of unsaturated compounds, which vary from green and unripened to fried, to fatty, to vegetable and floral green.
4. Terpenoid – The terpene-based compounds that are quite varied including mints, pine characters, citrus, earthy, beety, and balsamic.
5. Spicy – The complex structures that include cinnamic aldehyde, eugenol, methyl salicylate, anethole, myristicin.
6. Floral/aldehyde – Those oxygenated terpenoids and aliphatic aldehydes that give the citrus products their peely or rindy character, including decanal, citral, alpha terpineol, thymol, camphor, etc.
7. Brown – The compounds derived through thermal means, some fermentation browning, oxidation, enzymatic browning, etc., including furanones, thiazoles, pyrazines, complex phenolic, and ketone products (vanillin, cyclotene), etc.
8. Woody – Terpenoid-based products like cedrol and ionone types like ionone, damascone, etc.
9. Lactonic – The lactones that are interesterified hydroxy acids and whose flavor character is creamy, coconutty, peachy, etc.
10. Sulfur – (also miscellaneous like the musks, anthranilates, etc.) – The group is derived by enzymatic conversion and some Maillard degradation of sulfur containing amino acids. It is noted that umami, aminoid, musky, and other terms are avoided. This list does not represent the infinity of all aromas. But it is a good working list because it groups similar odors by common chemical structure. By doing that, odor types are definable, reproducible, and supported by reference materials. See Alkyl Esters – Grouped by Alcohol Moiety, Acid, Green, Terpenes, Aldehydes (Aliphatic, Keto Aldehydes, and Cyclic Aldehydes), Spicy, Woody, Brown (Compounds), Maillard Reaction, Sulfur, Lactone.

To this must be added the sense of taste: salty, sweet, bitter, and sour; and the trigeminal sensations of cool: hot (capsaicin), astringent, etc. See Sensory Evaluation.

Descriptive Trend Analysis – The process by which attributes are plotted to see whether or not there seems to be a trend over time or by changing a specific parameter to see its effect on that set of attributes. See Shelf-Life Testing.

Desiree Potato – See Potato.

Destruction – If a product is non-conforming or out of compliance and cannot be reworked, or otherwise treated, the product needs to be destroyed. It is important that the mode of destruction be identified, tracked and verified by competent personnel. See Recall, Rejection, Food Safety.

Detectors – Detectors present in an instrument, such as a gas chromatograph (GC). Flame ionization detectors (FID) and thermal conductivity detectors (TCD) are the two common types in a GC. TCDs are less sensitive than FIDs. FIDs destroy the eluent aroma chemicals and cannot be used to smell out from the exit port. Also FIDs do not see water. FIDs are far better, however for capillary column. See Charm Analysis. Micro Electron Capture detectors are far more sensitive than either FID (10-100X) or TC detectors (1 Million Times), however it detects high electronegative ions such as Halogens, and is therefore relegated mostly to the identification of Halogenated compounds. See SNIF, Mass Spectroscopy, Gas Chromatography – GC, GC Olfactometry, SNIF NMR.

Deviation – Any variation from a previously specified norm or average. See Standard Deviation.

Dew Point – The temperature at which a gas forms a liquid. See Condenser, Distillation.

Dextrin – A polysaccharide molecule with an average molecular weight between a starch and a maltodextrin. Dextrins can be modified to be good film-forming agents and can also be used as protective coatings for candies. Usually dextrins have virtually no sweetness (low DE). Dextrins can add crispness to batters and breadings. See Dextrinization, Carbohydrates, DE Rating.

Dextrinization – The production of dextrins from larger molecules. One example of the dextrinization process is the acid catalyzed heating of starch. The dextrinization method takes larger polysaccharide (starch) molecules and produces smaller molecules through the dual action of heat and acid. The resultant product has an average molecular weight that falls within the dextrin range. Some processors use a drum dryer to accomplish this, others could use enzymes. See Dextrin.

Dextrorotatory – See D (Isomer).

Dextrose – Dextrose is also known as glucose. A simple monosugar that has a dextrorotatory (d-) optical rotation. It is a simple reducing sugar and reacts with amino acids through the Maillard Reaction. Being a relatively low sweetness sugar, it can be used in a seasoning for its bulking ability. However, it is reasonably hygroscopic, and the use of dextrose in dry systems that might have an appreciable amount of water or potential moisture pickup could pose a problem for caking. Dextrose is the most commonly occurring natural monosaccharide and the most common of reducing sugars and is the least expensive starting material for the Maillard Reaction. In the blood, glucose is transformed into glycogen that is stored by the liver. The liver converts glycogen into glucose when needed. Because glucose is necessary to maintain body energy, temperature, and bodily functions, this regulation system assures that the blood level of glucose is approximately 0.1% at all times. See Reducing Sugar, Maillard Reaction, Caking, Dextrose Equivalence, Dextrorotatory, Laevorotatory, Optical Rotation, Optical Isomers, Invert Sugar, Hygroscopic or Hygroscopicity, Moisture, Water Activity, Bulking, Levulose (Fructose), Sucrose, Sugar Beet Extract Flavor Base, Sugar Cane, Dextrose Equivalence, Carbohydrates.

Dextrose Equivalence (DE) – A rating scale that measures sweetness versus dextrose. DE measures the degree of starch hydrolysis of reducing sugars. Pure dextrose has a DE of 100. See DE Rating; Sweetness Rating; Sugar(s) and Polyhydroxyl Compounds; and Chart 472 – Non-Nutrative Sweeteners.

DFISA (Dairy and Food Industries Supplier Association) – An association of producer companies that organizes an annual convention, now called IAFIS (International Association of Food Industry Suppliers). See Dairy, Cheese.

DFPM – See Dynamic Flavor Profile Method.

DHS Chemicals of Interest Appendix A Part 27 – Published by the Department of Homeland Security, certain GRAS chemicals have appeared on this listing. See Chart 491 – DHS Chemicals of Interest.

Diacetyl – Butyl diketone. Diacteyl and its related diones usually have an intense yellow color. Diacetyl is the characterizing chemical of butter, but it is found in many other foods. In fact, it was first discovered in nature in ripened strawberries. It was then realized to be the important component of butter. Although it was perceived in butter well before that, this is yet another example of the nose's ability versus that of current instrumentation. Diacetyl is responsible for an off flavor in beer. Recently diacetyl has been blamed for a lung disease in production workers in a buttered popcorn plant. See Butter, Strawberry, Bronchiolitus Obliterans, OSHA.

Dialcohols – See Alcohols, Aliphatic.

Dialysis – The process of separating smaller molecules in a mixture from larger ones by enabling then to travel through a parchment or other semi-permeable membrane. One use of this method in food systems is to remove salts from sugars and proteins in solution. See Membrane Separation.

Diastereomer – An optically active or chiral substance having more than one optically active site (chiral center). A meso compound is defined as a diastereomer that has at least one structure able to be superimposed on the mirror image of another diastereomer. In this case, the number of chiral compounds is less than the maximum possible (2 to the nth power where n is the number of chiral centers). See Optical Activity.

Dienal – An aldehyde with two sites of double bond unsaturation. Dienals are usually fatty tasting compounds. Trans, trans dienals are typical of fixed oils (like nut oils), vegetable oils (like rancid oils), or animal fats (like chicken fat), and trans cis dienals are usually typical of florals (violet leaf absolute) or leafy or green vegetable parts (like celery, watermelon). See Aldehydes (Unsaturated Alkenals, Alkadienals, Alkynals, and Cyclic Non-Aromatic Aldehydes).

Dienol – An alcohol with two sites of double bond unsaturation. The alcohols are similar to the corresponding aldehydes in character yet weaker or milder. See Dienal, Alcohols – Unsaturated Non-Aromatic, and Chart 10 – Alcohols – Unsaturated Non Aromatic.

Diet –

1. The normal course of eating habits of an individual.
2. To go on a diet – The purposeful change in eating habits to affect a reduction in overall body weight. See Glycemic Index.

Dietary Fiber – A dietary fiber is an indigestible food ingredient. Dietary fiber can come in many forms. Polysaccharides, cellulose, hemicellulose, gums, pectin, and lignins make up the more common dietary fibers. Fibers can absorb water thereby adding bulk to feces so that they can pass through the alimentary canal quickly. However, some fibers can remain in the digestive tract and act as substrates for fermentation causing gas and acid. Fiber is available as well from eating natural foods like whole grain bread, cereals, grains; root vegetables; and fruits. See Nutrition.

Dietary Supplement Health and Education Act of 1994 – A regulation that bypasses the lengthy regulatory process for approval of certain claims. This regulation has allowed the expansion of the product category called nutraceuticals. It is an offshoot of the Orphan Drug Act of 1983. Before then only 30 drugs were approved in 30 years and since then over 200 drugs are now approved. The regulation puts the burden of proof of any claims on the manufacturer/supplier of a product and ingredient. One fact that enabled the use of nutraceuticals would be a documented, clear, and established history of safe use. If there is no history, self GRASing is possible. The actual question is whether these claims are real as substantiated. An act was presented to Congress in 1994 called the Nutraceutical Research and Education Act to provide funds to prove the efficacy and reality of nutraceutical claims. See DSHEA, Nutraceuticals, Self GRAS.

Difference From Control Test – A sensory methodology that determines whether or not one product is different from another one. It is possible then to estimate the size of the difference. See Discrimination Test, T-Test.

Differential Ingredients – Flavoring substances that make one type of flavor distinguishable from another. This character is often the obscure note that would be considered non-obvious or proprietary to a flavor company's product. See Characterizing; Modifier, Modifying Ingredients.

Digestion – The process of absorbing nutrients in the body by breaking down foods into absorbable components. The digestive system is complex indeed. Digestive enzymes, stomach acids and other similar systems work in concert to provide this break down. However, taste and odor seem to be intrinsically involved with this system. Pleasant food aromas stimulate stomach secretions and saliva. Sugar sensors known as the KATP channel monitor glucose levels and trigger insulin release, and taste buds are fond throughout the digestive tract. See Taste Buds, Taste, Taste Receptors.

Digestive Enzymes and Agents – Chemicals that break down macronutrients for easier ingestion. Amylase in the saliva converts starches to maltose for further use by the body. Amylase is found in both the mouth and pancreas. Furthermore, sucrase, maltase, and lactase produced by the pancreas and small intestine break down vegetable and milk sugars into glucose, fructose, and galactose. Hydrochloric acid and pepsin produced by the stomach, trypsin produced by the pancreas, and peptidase produced by the small intestine assist the break down of proteins into polypeptides, peptides, and amino acids. Lipase in the pancreas, and bile salts and acids first produced by the liver and then stored in the gall bladder, break down fats into glycerine, glycerides, and fatty acids. See Enzymes.

Diglycerides – A fat-based structure wherein the base glycerine molecule is attached to only two fatty acid moieties and the third is linked to a hydroxyl group. It usually comes commercially mixed with monoglycerides, where the base structure contains only one fatty acid and two hydroxyl groups. See Fat.

Diketone – An example of a diketone is diacetyl. Diacetyl is responsible for buttery-type aromas. The color of the actual liquid is usually yellow. The most used example is diacetyl found in butter and ripened fruits. See Ketones – Aliphatic.

Dill (Anethum graveolens L.) – The oil of dill seed is very much like the use of oil of carrot seed and parsley seed. They all impart a heavy, woody, and oily character to the flavor in which it is used. The oil of the dill weed is very much like that of the herb – green and fresh with a combination of a terpenoid and a carvone character. Dill is a popular spice in Sweden where it is added to breads. Dill is used in flavoring pickles and other condiments. It is used in salad dressings, soups, and other savory applications. See Terpenes – Oxygenated and Other Related Compounds, Optical Rotation, Chart 139 – Dill.

Dill, Indian Seed (Anethum sowa Roxb.) – Dill is a spice with a fresh green character, used in pickle spices. Dill has l-carvone as does spearmint. It also contains green terpene-like top notes that impart a fresh green note to many WONFs. Dill is used in many eastern cuisines. See Carvone, Optical Activity.

Dimer – Any chemical made of two chemicals. See Polymer, Monomer.

Dimethyl Poly Siloxane – An antifoaming agent. Also used as the stationary phase in a gas chromatographic column. See Antifoaming Agents, Gas Chromatography (GC), and Chart 37 – Antifoaming Agents.

Dimethyl Sulfide – One of the most commonly used sulfur compounds in flavors. It is responsible for a wide variety of characters at different levels. At the highest of levels it is perceived as purely sulfury and is reminiscent of asparagus, artichoke, and many other green vegetables. At lower levels, it becomes definitely corn-like. At lower levels still, the compound takes on a fruity molasses aroma and is reminiscent of raspberry juice. When the level of concentration is reduced to a point where it becomes more subtle, the normally sulfuraceous compound becomes decidedly reminiscent of cream and milk, and for this reason it is a very important contributor to the characteristic of milk and cream flavors. At very low levels, it is useful in the development of serumy, meat juicy, and brothy aromas. It is found in some of the top note of protein hydrolysate and in good meat flavor systems. The greatest abundance of dimethyl sulfide occurring as a natural source is in bourbon geranium oil, molasses, and distilled mint terpenes. See Sulfur; Vegetable, Vegetative.

Diols – See Alcohols, Aliphatic.

Diones – See Ketones – Aliphatic, Ketones – Aromatic.

Dioxanes – Glyceryl Acetals – See Ethers, Acetals.

Dioxin – An extremely potent toxin that by the Stockholm Convention was agreed upon to limit the sources of the substance. It is unfortunately a by-product of the incineration of PCBs. It is a class called Persistent Organic Pollutants (POP). See PCB.

Dioxolan – See Ethers.

Dioxolanes – Similar to tetrahydro furan with one more heteroatom of oxygen within the five-membered structure. The structure is commonly seen as acetals. See Acetals.

Dipentene – Two isopentene groups together, ergo a terpene; dipentene is the most common of terpenes, otherwise known as limonene. See Limonene, Essential Oil, Citrus Oils.

Dipole Moment – A dipole moment is the development of an electronic charge in a molecule by virtue of it structure and components. The dipole moment affects molecular stability, reactivity, etc. See Chemical Structure, Charge, Ionization, Electrostatic Attraction/Repulsion Electrostatic Charge, Repulsion, Non Polar (Non-Ionic), Polarity, Water Solubility.

Directional Paired Comparison Test – Comparative tests that pit two or more components, comparing the magnitude of an attribute against each other by direction (i.e., greater, lesser, equal). In this test, the panelist is asked, 'Which sample is more (fill in the blank)?' The randomized design is AB, BA. See Sensory Evaluation.

Directional Testing – See Directional Paired Comparison Test and Three Alternate Forced Choice Test.

Dirty – Reminiscent of dirt. Often associated with a combination of dry, moldy, earthy notes. See Flavor Description.

Disaccharide – A di-sugar, a molecule made up of two saccharide molecules. Examples of sugars that are disaccharides are sucrose, lactose, and maltose. See Monosaccharide, Sugar Beet Extract Flavor Base, Sugar Cane.

Discharge, Prevention, Containment and Countermeasure (DPCC) – The in-house procedure necessary to handle hazmat spills. See Environment, DEPE, EPA, OSHA, Regulatory.

Discontinuous Phase – See Dispersed Phase.

Discrimination Test – A class of examinations used to measure the perception of small differences. Used for label concept claims, cost reduction alternative

evaluation, quality improvement analysis, quality control, and sample screening. Types of tests include:

1. Triangle test – Overall difference.
2. Duo-trio test – Overall difference.
3. Two-out-of-five test – Overall difference, attribute.
4. Simple Difference test – Overall difference.
5. Difference from Control test – Overall difference, attribute.
6. 3 AFC (Alternate Forced Choice) test – Attribute.
7. Ranking test – Attribute.

Example: Triangle Test – Choose the odd one out of three choices. In a duo-trio test, two unknowns versus a third. The choice is, out of the two, which one is closer to the third. Two-out-of-five tests choose two that are the same out of five. This test is more exacting than a triangle test. However, due to fatigue, it is not feasible for flavor systems. The alpha of the test is the odds of declaring a sample as being different when they are not. The beta of a test is the opposite, which is the odd of not being able to declare a sample different when they really are. The Pd is the maximum proportion of a given population that is tolerable to truly differentiate the samples.

See Triangle Test, Threshold Determination, Product Difference Test, Label Concept Claims, Point of Sale Testing, Kiddie Panel Testing, Bubba Panel Testing, UDS Testing (Up and Down the Street), Pd (Proportion of Discriminators), Numb Tongues, Supertasters, Alpha, Beta, Sensory Analysis, Duo-Trio Test, Two-out-of-five Test, Simple Difference Test, 3 AFC Test, Ranking Test.

DISCUS (Distilled Spirits Council of the United States) – An organization made up of companies that produce alcoholic beverages. See Appendix 1.

Disease(s) – See Pathogenic (Pathological) Organisms.

Disgust – The reflex action to spoiled food. The nerve center for this response possibly resides in the caudate nucleus of the brain. This area is responsible also for cognitive thinking and movement. See Revulsion.

Disjointed –

1. A flavor profile that is not smooth or rounded.
2. In a time intensity curve, a profile that has many peaks, valleys, off notes, jagged edges, drop-offs, and/or sharp slopes.

See Rounded, Time Intensity Curve, Flavor Profile, Balance, Balanced (Flavor Profile).

Dispersed (Discontinuous) Phase – The micelle ingredient of an emulsion. In an oil-in-water emulsion, like a bottler's emulsion, it is the flavor or essential oil. See Emulsion, Emulsifying Agent.

Dissociated (Molecule) – A molecule that has had a part of its structure break off from the main part. Ionization is a dissociation of an electron from one molecule to another. The molecule that loses the electron is now a positively charged ion and the other is now a negatively charge ion. See Benzene Ring, Chemical Structure.

Distillate – A product that is the result of distillation (i.e., that which is evaporated during the distillation process). The following are some commonly used distillates. See Distillation, Essences, Distillates, Chart 134 – Distillates.

Distillation – The volatilization and collection of a liquid product by subsequent condensation. The product is collected directly (blow over still), refluxed in a condensing column or separated by removing materials depending on their different boiling points. When a distilling system has been evacuated it is called vacuum distillation. See Column, Sublimation, Still, Theoretical Plate Count, Steam Distillation, Vacuum Distillation, Condensing Column, Blow Over Still, Topping, Rectification, Essential Oil.

Distilled Oil – An essential oil that has been produced by the process of distillation (usually steam distillation). See Cold Pressed Oil.

Dittany and Dittany of Crete – See Chart 140 Dittany and Dittany of Crete.

Diterpene – A chemical compound made up of two terpenes or four isopentene molecules, the empirical formula of which is usually C20H32. See Chart 327 – Terpenes and Related Compounds.

DL (Isomer) – A 50:50 or racemic blend of optical isomers where the resultant rotation is 0, or non-active. Another variation of this would be RS (more recent terminology). See Racemic, Optical Isomers, D (Isomer), L (Isomer), Chirality.

DNA (Deoxyribonucleic acid) – A building block of the genetic structure whose molecule has encoded in it the blueprint for a specific trait of the organism in which it resides. The manipulation of a genetic structure is known as recombinant DNA technology. This science which has made vast strides in our knowledge base and continues to uncover astounding new discoveries probably well into the end of this century. See Recombinant DNA, Genetically Engineered Foods and Flavors, GMO, Asilomar Conference.

DOC (Discreet Organic Chemicals also referred to as Discreet Organic Substances) – Items that have been identified by the CWC (Chemical Weapons Convention) to be precursors to or reactants of dangerous substances capable of mass destruction (poisons, etc.). Some of these substances include heliotropine, benzaldehyde,

anthranilates, phenylacetates, and phenylacetic acid. The threshold for benzaldehyde mixtures is 30%, and the other chemicals are 20%. See DEA, Chemical Diversion Trafficking Act of 1988.

Dockering – Dockering is the addition of holes to a cracker to allow moisture to escape during the baking process. The shape, the amount of holes, the size, and the configuration of the holes are all very important factors. See Baking.

Dodecanal – One of the aldehydes that contribute to the rindyness of orange oil. Dodecanal, as well as decanal and similar aliphatic aldehydes, are also used in fragrances at low levels because they connote an odor of cleanliness. See Aldehydes (Aliphatic, Keto Aldehydes, and Cyclic Aldehydes).

Dodecyl Esters – Esters of dodecyl (lauryl alcohol) are quite high in molecular weight and would therefore have little flavor in comparison to their lower molecular weight, high vapor pressure ester counterparts. See Molecular Weight, Vapor Pressure, and Chart 146 – Alkyl Esters Grouped by Alcohol Moiety. Chart 135 – Dodecyl Esters

Dog Grass, Doggrass (Agropyron repens) – A grass-like herb that is used more for its nutraceutical benefits than for flavor. See Nutraceuticals and Chart 141 – Doggrass.

Dog-nettle – See Nettle.

Dolichos Bean (Vigna spp. or Dolichos lablab) – Dolichos means long in Greek. These beans are not like broad beans that are a member of the vicia genus. The main types of dolichos beans are black-eyed peas, yard-long beans, and lablab beans. They resemble navy beans in taste. Descriptions of these beans follow:

- Black-eyed peas (Vigna unguiculata or V. sinensis) (cowpea) with a dark spot like hilum that gives it its name. Comes in 7,000 different species of many shapes and colors.
- Yard-long beans (Vigna sesquipedalis, which means foot and a half) with a flavor like navy beans and asparagus.
- Lablab or hyacinth bean (Lablab purpureus or L. niger, L. vulgaris or Dolichos lablab).

See Botanicals – Broad Bean, Buck Bean, Beans.

Dollop – A dollop is an imprecise measurement in cooking meaning a small drop of viscous material like a dollop of margarine or a dollop of mayonnaise. See Measures (Pinch, Dash, Dollop, and other not very accurate amounts).

Doneness – The degree of cook. Doneness usually has to do with meat cooking and corresponds to the times listed in Chart 70 – Temperature Chart. See Culinary Arts, Food Safety.

DOT (Department of Transportation) – The governmental agency whose authority it is to regulate traffic, highway safety, transportation of hazardous materials, etc. See Regulations, OSHA, Hazardous Materials, Flashpoint, HAZCOM 2012, Shipping.

Double Basket Method – See Frying Methods.

Double Blind Study – Double and single blind studies are conducted to remove the placebo effect and observer biases. In single blind studies, the subjects do not know they are members of an experiment. In a double blind study, the testers also do not know who is receiving the actual stimulus or question and who is receiving the placebo or null stimulus. In this way, all data is collected after and the analyses are made on the results. See Sensory Analysis.

Double Bond – Also known as double covalent bond, a double bond is the sharing of two electrons between two atoms. See Chemical Structure.

DPCC (Discharge, Prevention, Containment and Countermeasure) – The in-house procedure necessary to handle HAZMAT spills. See Pollution Control, Environment, EPA.

Dragon's Blood – See Chart 142 – Dragon's Blood.

Drawback – Drawback is the amount of allowable refund of prepaid alcohol tax. This refund is monitored and regulated by the BATF. See Flavor Unfitness Worksheet, Potable, Potability; Non-Potable; BATF. (Restrictions on Use)

Dredge – To sprinkle a powder (e.g., flour or icing sugar) or lightly coat a food item. The standard breading procedure (SBP) includes a dredging of the food items in breading. This helps retain moisture, add a browning flavor, and add to eye appeal. See Culinary Arts, Frying Methods, Standard Breading Procedure.

Dropper – A laboratory utensil made of glass or plastic with a malleable material that creates a vacuum for sucking up. Then a positive pressure is used for pushing the filled substance down (plastic or rubber). A typical dropper purchased for a lab has an average diameter that produces a drop size weighing approximately 0.02 to 0.03 grams. Calibrate droppers by weighing 100 drops in a beaker, then weighing the total and dividing by 100. Therefore 1 drop of a 1% solution in 250 grams of base yields approximately 1 ppm. See Dropper Method of Flavor Development.

Dropper Method of Flavor Development – Each drop (being approximately 0.025 grams) of a 1% dilution added to 250 cc of a liquid comes out to 1 ppm. Knowing the level at which each single ingredient is functional (by drop), a final flavor can be developed. This is a good starting procedure, but due to masking, synergism, and base effects, final adjustments and modifications must be made to perfect the blend. See Creativity, Training, Edisonian versus Newtonian.

Drug Precursor List – See Chemical Diversion Act and Chart 423 – Chemical Diversion Act List DEA List.

Drug Trafficking and Diversion Act (DTDA) – The DTDA regulates the sale, importation, and use of certain precursor chemicals that can be used in the manufacture of controlled substances. Some of these controlled substances are commonly used flavor ingredients including benzaldehyde, heliotropine, phenyacetic acid, phenylacetates, and others as listed below. Mixtures are handled separately. Minimum concentrations for mixtures are listed next to each chemical. If the concentration of an ingredient falls below the threshold, it does not fall under the regulations. If a mixture is greater than the threshold or a pure substance is bought or sold, disclosure and possible licensing might be required. See Regulations, Chemical Diversion Trafficking Act of 1988, Chemical Diversion Act, and Chart 423 – Chemical Diversion Act List DEA List.

Druplets – The small juicy fruits that make up the compound fruit typical of the blackberry, raspberry, or strawberry. See Raspberry, Blackberry, Strawberry.

DRV (Daily Reference Values) – Information is based on data related to reference foods. See RDI.

Dry –

1. A combination of taste and trigeminal stimuli that yield a perception that is reminiscent or similar to the reduction of moisture in the mouth. Dryness is usually associated with the presence of tannins and/or acids as in wine, tea, etc.
2. A characteristic of tea that is typical of a postponement of discharge of the tea from the drying chamber.
3. In wine, the complete absence or significant lowering of sweetness.
4. A verb that means to dehydrate. See Mouthfeel, Trigeminal Nerves, Astringent.

Dry Down or Dry Out – The last character that is left after most of the other volatile ingredients have evaporated off a fragrance blotter. This is usually achieved after one day's standing. See Blotter.

Dry Heat Cooking – A group of cooking techniques that includes sauté, stir fry, pan frying, deep frying, grilling, broiling, roasting, and steaming (the water is not in a liquid form), as opposed to moist heat or combination cooking methods including braising, stewing, poaching, boiling, and simmering. Microwaving does not tenderize meats, so naturally tender cuts are necessary for microwaving and is considered its own class of cooking technique by some. See Microwave Oven, Moist Heat Cooking, Combination Cooking Techniques.

Dry Ice – The solid form of CO_2 used as a refrigerant or aerating agent. Dry ice forms at –78.5°C at normal atmospheric pressures. See Supercritical Extraction, Sublimation.

Drying Techniques – The many types of dehydration methods follow:

- Sun Drying – Dehydration by direct use of the sun. Manna is produced in this manner.
- Solar Drying – Dehydration by the heating of air surrounding a food to remove moisture.
- Air Drying – The circulating of dry air to remove moisture from a food.
- Oil Drying – Drying by immersion in hot oil. The hot oil drives off moisture in the food product.
- Partial Heat Drying or Frying – This includes a partial removal of water as in canned sardines.
- Salt or Sugar Drying – Salt or sugar coated on the outside of foods can absorb the moisture within by a process of osmosis. The product can then be vacuum dried to remove the rest.
- Vacuum Drying – Usually taking longer than air drying, vacuum drying is more effective than the simple use of heated air.
- Drum Drying – A slurry spread on a rotating metal drum. Temperatures are quite high, and the risk of burning or scorching the product is high. Spray Drying – The dehydration of a sprayed slurry of oil in gums or starches along with plasticizers like maltodextrins.
- Ultrasonic Drying – Useful in dehydrating heat-sensitive food products.
- Foam Drying or Puff Drying – An inert gas that foams up under vacuum enabling a gentle heat to be introduced into the system removing water from the product.
- Freeze Drying – Using the concept of sublimation; that is, the removal of solid material directly into a gas by the use of a vacuum.
- Solvent Drying – The addition of a solvent that forms an azeotrope with moisture and enables the evaporation of that moisture at lower temperatures and higher pressures.
- Combination Methods – Methods that are mixtures of the above technologies. See Spray Drying, Pan Drying.

DSHEA – See Dietary Supplement Health and Education Act – 1994.

DSL (Domestic Substances List) – The DOCs or discreet organic substances that apply to products imported to the United States according to the Chemical Weapons Convention (CWC). See Regulatory, DTA (Drug Trafficking Act), DEA, DOC.

Dulse – See Gums and Thickeners.

Duo-Trio Test – A sensory method that pits two samples versus a third control or target sample. One variation of the duo-trio test is one done where all three are different. The sensitivity of the test is not as good as a straight triangle test, and not as good

as a two-in-five test. The same consideration should be used as in the positional setup of other tests to maintain randomness. The set-up is as follows: There is a target to the left, and two other items A and B to the right. The question asked is which of the two are closer to the target. This concept is called a forced choice. Statistical analysis applies to the answers to determine if there is a significance. Random numbers can be used and the A and B should be varied by position. The Letters L K and M have been used in the past. The Internet can be a source of random non-bias numbers as well. One way to make this test more robust as in a duplication is to set it up as above and have a section where comments can be added, this would enable the tester to describe what difference are seen to guide in the project. Additionally, a 10 cm line scale can be added to have the tester measure the difference to the target. See Triangle Test, Discrimination Test, Simple Difference Tests, Attribute Tests, Discrimination Tests.

Duplication – The simulation of a product's profile, both physical and chemical, and in the case of flavors, more importantly, sensory. Flavor duplication can be time consuming or simple depending on the complexity of the target, its availability (pure versus needing extraction and concentration), and the experience and capability of the flavorist. Straight GC duplication can be somewhat frustrating and can lead the duplicator down wrong tracks. Smelling eluting odors out of the exit port (Thermal Conductivity Detector) helps in identifying components too small even to detect by instrumental means (SNIFF NMR). Another example of a technique is charm analysis. The use of an internal standard would further aid in the evaluation. In the past, a Kovats series of hydrocarbons whose elution time is defined or an esther series whose acid moiety is defined as the carbon number are two examples of internal standards. A known amount of a substance is added to the sample, and the amounts reported can then be corrected by this known amount's reported percentage. This is called a correction factor. However, with mass spectroscopic identification and the advent of computerization, the use of MS libraries has opened up the accuracy of the testing methodologies. One point must be considered however. Because of all of the ingredients, including natural substances, non-elutors, and a myriad of other considerations, it is always the flavorist who needs to bring the project to fruition. See Gas Chromatography (GC), Replication, Duo-Trio Test.

Durian (Durio zibethinus) – A fruit resembling the jackfruit in appearance with a strange flavor that is a combination of an aromatic acidic, almost fecal flavor combined with nuances of pineapple and onion. In fact, in Singapore and Malaysia, where this fruit is grown, many people have said that the aroma from the durian fields during the summer months is a memorable first impression. It is a large fruit, about the size of a football, with horn-like protuberances growing from the surface. See Tropical Fruits.

Durum (Wheat) (Triticum durum) – Also called macaroni wheat. It is considered a hard wheat and is high in gluten; therefore, it is good for pasta and bread. Yellow durum is grown for human consumption; red durum is grown for feed. Semolina is the ground endosperm and is isolated for use in premium pastas and breads. See Semolina, Endosperm, Gluten, Bread, Pasta, Wheat.

Dust –

1. To sprinkle a fine powder on the outside of another powder, food, or solid.
2. The particulate matter that is the by-product of powdered flavor production and can be irritating to the lungs or in some cases potentially explosive. Dust or bag collectors or equivalent devices accomplish removal of dust. Also, masks should always be worn while working with dusting products for obvious reasons. See Dust Collectors, OSHA, Anticaking Agent.

Dust Explosions – The often-severe effect of combustible fine matter in the air reaching a critical point where static charges ignite a very heavy atmosphere of suspended particles. This is why a dust collector must be used in environments where this potential exists. See Flammability, Hazardous Substances.

Duty – See Tariff, Export.

D-Value –

1. In microbiology, the time it takes to destroy 90% of the spores or vegetative cells of a particular microorganism at a specific temperature.
2. The number of minutes for the survivor curve (cells remaining) to conclude one cycle. See Microbiology; Sterilize, Sterilization; F-Value.

Dynamic Flavor Profile Method – The Dynamic Flavor Profile method was developed by the author and published in 'Food Technology Magazine,' 'Food Product Design,' and 'Food Product Development.' It is part of the Flavor Nomenclature Seminar conducted by the author to countless numbers of industry professionals to date. The author also has developed a computer program to facilitate data entry, data manipulation, storage, and graphical representation. The DFPM is a process by which an ingredient is described in a time intensity format using predetermined standards. These standards are taste and odor representation of odors and tastes

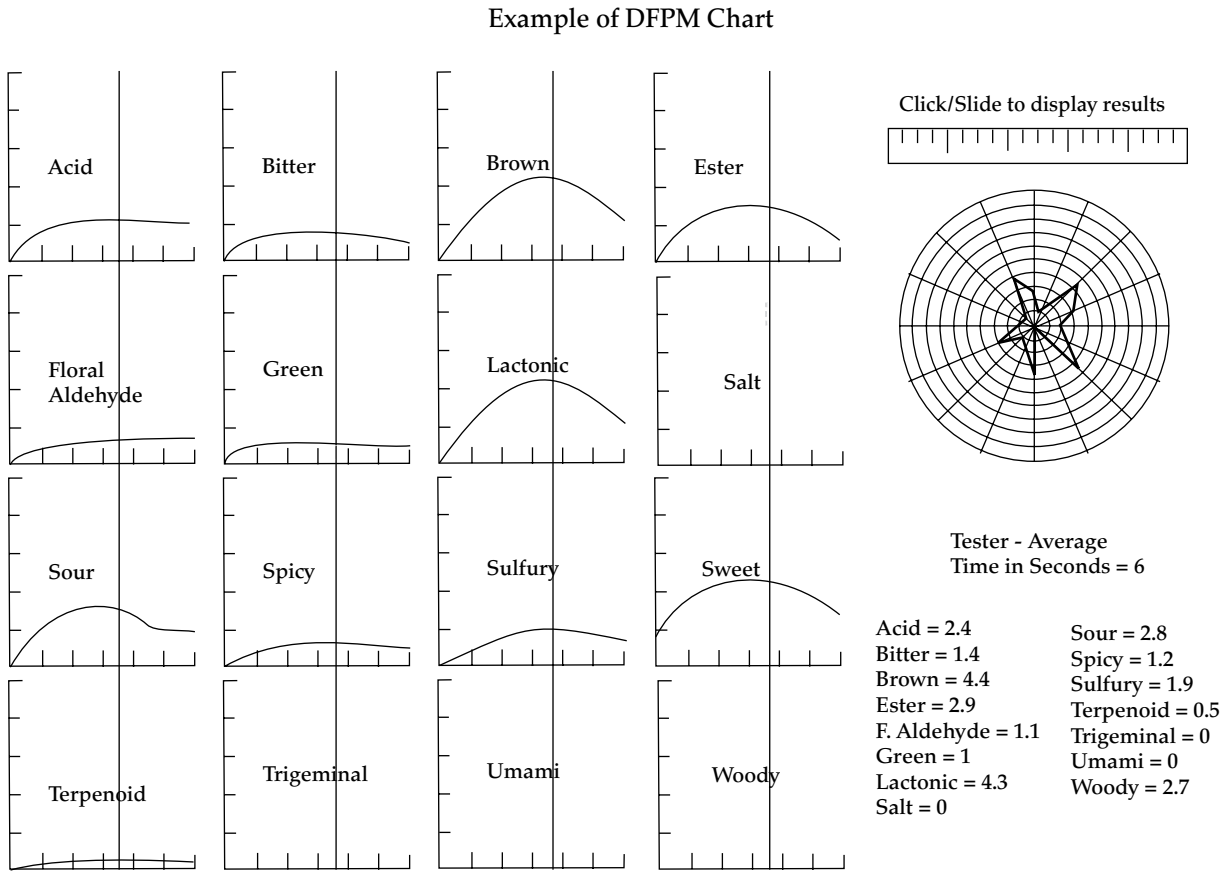


Figure 18

referenced by chemical similarities. These standard traits are then described in a time-oriented sequence. Fourteen parameters measured as intensity versus tasting time is then plotted. The tangential slice of these time curves then becomes an attribute or spider web type curve at that given time. Therefore, the Dynamics Flavor Profile Method is the integration of ever changing attribute curves versus time plotted in a 3-D type representation. See Attribute Tests, Comparative Tests, and Figure 18.

Dysosmia – Dysosmia is the difficulty in one's ability to smell. Dysosmia is an uncommon condition. It is an accepted fact that most of the population can become good tasters and smellers through training, and that very few people are sensorily hindered in either their taste or odor acuity. See Anosmia, Agustia.

E

(E) – A designation for trans-type structural isomerism. See (R), (Z).

EAFUS – Everything Added to Foods in the United States (Database) – This database is maintained by the FDA. Recent question by the Center for Science in the Public Interest is that it is not kept up to date with the recently delisted ingredients by the FEMA Select Panel. See FDA, NGO, Safety, GRAS.

Earthy –

1. Closely akin to moldy, beety, and dirty. Each of these descriptors defines a complex combination of odors produced by the microbial action on proteinaceous material. The products of decomposition and microbial metabolism include higher molecular weight ketones, fatty acids, and terpenes. Fenchyl alcohol and even more so ethyl fenchyl alcohol are extremely beet-like and earthy.
2. In wine, a mineral or organic taste that has manifested itself from minerals or tastes in the soil in which the grapes were grown. For the most part, whether or not this character is a positive or a negative in wine is usually intensity and level specific. Corkiness is attributed to Trichloro Anisole and is also reminiscent of mold or earth. See Wine, Corky.
3. Reminiscent of freshly turned soil. In fragrances, ambergris tincture is used in blends to impart an 'earthy' fragrance. See Beets, Microbial Fermentation.

Eastern White Pine – See Pine.

East Indian Geranium – See Palmarosa.

East Indian Sandalwood – See Sandalwood, White.

EC (European Community) – The industrial organization of European countries. See International Regulations, Regulations.

E-Cigarettes – The components of an e-cigarette are superficially pretty much the same as an ordinary cigarette, although they vary as to style and proportions of the liquid phase. The e-cigarette has a battery, heating element and a cartridge that can hold nicotine, water, glycerine or propylene glycol and possibly flavoring. The cartridge is heated to the point where the liquid vaporizes or 'Vapes'. This brings to the lungs the nicotine and other substances. It resembles a cigarette and often even glows when inhaled. The proponents of e-cigarettes claim it is safe versus normal cigarette smoking, although the knowledgeable experts on the subject admit it is just a lesser of two evils. Many of the e-cigarette manufacturers claim that the flavorings used in e-cigarettes are GRAS and are therefore safe. Here is where the problem lies. The GRAS process is based on ingestion, not inhalation. An example is that cinnamic aldehyde the active component of cinnamon is perfectly safe to consume but is prohibited for use in cosmetics because of skin irritation issues. GRAS is for ingestion only and there have been no studies to prove the safety of inhaling any flavorings published by FEMA or the FDA. The Tobacco Industry have done their own studies over the years and many years ago there was a list published called the Hunter List which outlined some safety data done on individual flavoring components, but the list is not used any longer according to people I have interviewed. There is a cautionary statement on the FEMA website, as well as on the FDA website on the safety of e-cigarettes. See Tobacco, Cigarettes, Casing, Flu Curing.

E. coli – The coliform bacterium that resides in the intestines and helps form fecal material, aiding in

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digestion. Harmful mutations of the coliform bacteria, such as strain O157 – H7, can be lethal. The presence of this bacterium signifies fecal contamination of some sort and can be indicative of the presence of rodent or other macrobiological contamination. For this reason, the absence of E. coli is a necessary standard and appears on most specification sheets as such. Other strains of E. coli have been recently identified as having pathogenic responses. These strains include other serogroups such as O26, O103, O45, O111, O121, O145 and O104, specifically O104:H4. The strains O104 and O157 from shigatoxins that with other pathogenic organisms such as Shigella dysenteriae are responsible for dysentery. These pathogenic forms of E. coli are not only found in beef but in other foods such as seeds. Although not fully understood, they could be responsible for a much wider cause of disease than O157. See Microbial Assay, Pathogens, HACCP, Food Safety.

ECRA (Environmental Cleanup Responsibility Act) – Passed by the State of New Jersey, it simply states that upon the transfer of title of a business, that business must assure that the environment in which it has impacted is returned to an environmentally sound state. See Environment, Regulations.

EFFA (European Flavor and Fragrance Association) – See International Regulations, Nature Identical.

Effluent –

1. That which comes out of something else.
2. The effluent at the exit port of a GC is the mixture of volatiles that comes out of the column at the open end.
3. The waste stream of a business. See GC, BOD.

Egg – An egg is an ovoid structure, which can be fertilized or unfertilized, and contains the genetic code of the parent organism. The poultry egg that is a commonly consumed product typically has a white, tan, or light brown colored shell. The shell is a calcareous (chalk-like) substance. It houses the egg white, which is mostly protein (albumin) at around 12.5%, mixed with water at around 87%. It also contains a yellow colored yolk. The yolk, which is high in cholesterol, obtains its coloration from layers of yellow colored vitellus. The yolk is protected from damage by what is called the vitelline membrane. The color of the yolk varies, and is determined by the diet of the bird. A diet high in wheat produces lower colored yolks, and a diet high in corn produces more yellow colored yolks. Because the U.S. public seems to favor highly yellow colored yolks, some coloring additives like marigold extract or xanthophyll can be added to feedstock to further enhance the intensity of the color. Inside the shell is a filamentous membrane connecting the yolk to either side of the egg's ends. This is called the chalaza. Eggs are useful in many food systems. Egg whites are used as a protein-binding source in baked goods, quiches, and other products. Whites are also used as a whipping agent in meringue and soufflé. Yolks are used in Hollandaise sauce and other preparations. Approximately 1 in 1 million eggs might be contaminated with salmonella, so this consideration must be taken when developing an HACCP plan in a plant using eggs. See Culinary Arts, Protein, Binding, Emulsion, Whipping.

Egg Nog – The use of egg in egg nog is less prevalent than in original recipes, but the base product is usually a heavy cream, sweetened and spiced with nutmeg, cinnamon, and/or cloves. This product is usually a holiday drink served and sold in the United States from Thanksgiving to New Year. See Crème Brulé, Seasonal Foods.

Eggplant (Aubergine) (Solanum melongena) – Comes in many varieties: Asian long eggplant (purple and elongated), white eggplant (yellowish white and elongated), Thai eggplant (green and spherical), western eggplant (rounded and purple), and common eggplant (purple and kidney shaped). When cooked, the eggplant develops a fatty, green slightly pungent flavor. See Sulfur, Zucchini.

Elasticity – The ability of a substance to resist distorting physical forces. These forces include compression, expansion, tension, torsion, and shearing. The addition of some gums and other moisture retention aids (humectants) can result in a more elastic food material. Also, as in chewing gums, a host of elasticizing and plasticizing substances can be introduced according to the Code of Federal Regulations (CFR). See Chewing Gums, Gums and Thickeners.

Elder Flowers (Sambucus nigra L.) (Flowers and Leaves) – Elder flowers can be used in floral compounds like honey, blackcurrant, strawberry, raspberry, and cherry flavors. Elderflower products are also useful in some of the exotic tropical flavors like mango, passion fruit, and guava. See Tropicals, Floral, and Chart 151 – Elder Flowers.

Elecampane (Inula helenium L.) – Elecampane has a woody flavor with a slightly fatty, sweet oily tenacity reminiscent of calamus oil. Contains many alkaloids like inulin, alantol, alantic acid, and helenin (alcoholic beverages only). See Woody and Chart 152 – Elecampane .

Electronic Attraction and Repulsion – See Electrostatic Attraction/Repulsion Electrostatic Charge.

Electronic Nose – An instrument that mimics the nose by using specific sensor-conducting polymers. Some types of electronic noses are the e-NOSE™ by Neotronics Scientific Limited, and the AromaScanner™ by Aromascan Inc. The

general consensus about the electronic-type noses is that they are extremely good at doing a routine analysis over and over again. However, it takes some time to standardize both the results and the sensors, and to determine a set of data versus a trend using analysis of variance techniques or computerized packages. Recently, Internet-based companies have introduced Internet odor presentation-type concepts. They are in their formative stages as this is being written, and it will be interesting to see how complex odor systems can be presented through a computer. See Electronic Tongue, Internet.

Electronic Tongue – An equivalent approach to an electronic nose, in that, sensory perceptions corresponding to taste perceptions are measured with a device containing taste-type sensitive chips. Because salt, sweet, and sour are more closely related to specific defined chemistry (i.e., pH, sodium ions and the presence of polyhydroxyl groups), these three might be far easier to sense than the electronic nose would be. The fourth (bitter) and perhaps umami (savory) tastes would pose different issues. As Internet-based odor systems are now being produced, taste-based Internet systems are currently being developed as well. It seems far easier to replicate taste systems via the Internet than odors, and this presentation might hold better promise toward realism. We shall wait and see how this develops. See Electronic Nose, Internet.

Electrons – Electrons are negatively charged atomic particles that are mostly energy, and therefore have no substantial mass. Recent discoveries in quantum technology have thrown some further insight into the subatomic nature of these atomic particles. Previously, thought to be primary building blocks, recent indication is that the electron might be made of three subatomic particles (quark, meson, and antiquark). For this reason, when calculating the total atomic mass, only the numbers of neutrons plus protons are added. See Protons; Neutrons; Atom; Elements; Gluons, Quarks, Antiquarks, and Mesons.

Electrostatic – The term 'electrostatic' has to do with charged systems whose nature has been introduced by outside influences, and not through the transmission of moving charged particles. An example is the alignment of metal atoms in iron to create a magnetic field by moving another magnet over the surface in a repeated motion.

Electrostatic Attraction/Repulsion Electrostatic Charge – This term, which applies to the repulsion or attraction of charged molecules, is basically an electrostatic effect due to dipole moments, ionization, or direct static effects. See Dipole Moment, Electrostatic, Ionization, Molecule, Tyndall Effect, Brownian Movement, Electrons, Charged Particles.

Elemi (Canarium commune L. or C. luzonicum Mig.) – Elemi contains elemicin, phellandrene, and dipentene (limonene). Its profile places it in the turpentine group. The gum has been used to increase the heat stability of citrus products. This effect is due to the presence of high boiling terpenoid compounds along with a peppery-citrus and woody-balsamic character. The flavor-characterizing ingredient is a terpene alcohol called elemol. See Resinous, Terpeny, and Chart 153 – Elemi.

Elution – The process of moving through a column like that of a gas chromatograph. See Gas Chromatograph (GC), Illusory Elution.

EMC (Enzyme Modified Cheese) – A flavor produced by the inoculation of an enzyme (mostly lipolytic) to unripened or green cheese, to produce aroma compounds (mostly fatty acids). Because proteolytic activity may also be present, amino acids and sulfur compounds derived from proteins also add to the overall flavor. The normal cheese-aging process produces a clean flavor. However, as nature is being rushed, off flavors like bitter peptides are formed in this manner. Depeptidase can solve this problem. The development of processed cheese is an interesting historical story. When the hamburger-based fast food industry was in its infancy, it became obvious that a strong, aged flavored cheese was needed without the dry flaky characteristics of typically aged cheese products. An answer was to add a lipase enzyme to young cheese, thereby enhancing its flavor. This product, called enzyme-modified cheese, is deemed a natural flavor and can be added to young cheese at a controlled amount to yield a highly flavored soft and sliceable product. This final product is called processed cheese as defined by the Code of Federal Regulations. See Natural, Enzyme, Fermentation, Processed Flavors, Cheese, Enzyme Modified Milk, Enzyme Modified Cheese.

Emollients – Substances that maintain or increase the wetness of a product. See Fats and Oils, Emulsifying Agent, Humectants.

Emulsification – The process of mixing and shearing until the particles are of sufficient size to be stable in an emulsion or colloidal suspension. See Emulsifying Agent, Emulsion.

Emulsifying Agent – An emulsifying agent is a product that aids in emulsification. Usually containing a molecule that has both a polar and non-polar structure and therefore has properties that can stabilize or deterge a system. The introduction of an emulsifying agent to a two-phase system forms micelle structures.

These structures are electrostatically stabilized. Imagine a sphere where a droplet of the dispersed phase, for example a droplet of oil, appears in the center. The drop of oil attracts the non-polar portion of the emulsifying agent's molecule. The other ends of the coating molecules have a dipole moment charge and by electrostatic attraction form an outer coating of an ionically charged film. This film therefore covers each of the micellular structures. The ionic charges of each micelle bear its polar side to the water in this example. Because the charge of each cell is the same, repulsion takes place. It is this constant repulsion of particles that produces a vibrating effect (Tyndall Effect) and makes the emulsion somewhat stabilized. Example: Tween™ (Polysorbate), Pluronic™, Sucrose Octaacetate. See Emulsion, Polarity, Non-polar, Polar, Emulsifying Agent, Non-Flavor GRAS Ingredients, Film Forming Agents, Coatings, Plasticizers, Surfactants, Lipids. Note: In the following list are ingredients that show some emulsification properties. They also can be used as film forming agents, coatings, encapsulating additives, plasticizers, and surfactants. See Tyndall Effect and Chart 143 – Emulsifying Agents, Chart 164 – Gums and Thickeners, Chart 247 - Non-Flavor Ingredients.

Emulsion – A mixture of two different phases. An emulsion is one that has a dispersed phase (for example, terpenes in a cloud) that is dispersed in a continuous phase (water) and weighted so the specific gravities are similar (ester gum) and emulsified by a film forming thickener (gum arabic). It is necessary that the two phases be normally immiscible in order to have a stable emulsion. Under the microscope, you can see emulsified particles that show the Tyndall effect. (particles vibrate). The Tyndall effect occurs because of the stabilizing influence of the electronic charges within the system. An oil in water emulsion (for example, a bottler's emulsion) is designated O/W, a water in oil emulsion (for example, margarine) is designated W/O. See Emulsifying Agent; Gum Acacia, Gum Arabic; Weighting Agent; Tyndall Effect; Colloid; Microemulsion, Stokes Law.

Emulsion Meat – Emulsion meats are defined as those using finely chopped protein and fat blends, often with seasonings, stabilizers, gums, and starches. Examples of these include bologna, salami, hot dogs, head cheese, bratwurst, liverwurst, and other sausages. See Curing Salts, Microbiological Stability.

Emulsion Stability – The characteristic that describes the ability of an emulsion to resist coalescence, or to resist falling out or ringing. See Coalesce, Ringing, Fall Out.

Enantiomer – A molecular isomer that differs by optical activity properties. See Optical Isomerization, Racemic, D (Isomer), L (Isomer).

Encapsulating Agents – Blends of gums, starches, and other carbohydrates that will entrap flavoring 'oil' in a spray dried or other dehydrated medium. Polar substances dry better using maltodextrins, non-polar substances dry better with gum arabic or a modified food starch like Capsul™, or other equivalent products. Some matrices have been modified or cross-linked using aldehydes like acetaldehyde, glutaraldehyde or other reactive substances. See Spray Drying, Starch, Encapsulation.

Encapsulation (Process) – The process of entrapping a liquid into a solid by some physical means, the purpose of which is to protect the liquid from oxidation, evaporation, or other detrimental alteration. The processing of material in such a way surrounds it with a protective coating. See Spray Drying, Microencapsulation, Extrusion, Encapsulation, Plating, Emulsifying Agent.

Endangered Species – A list of plants or animals established by either the Fish and Wildlife Service of the US Department of the interior or alternatively CITES that indicates those that are close to extinction and are therefore considered endangered and must be treated specially. See CITES, Rosewood.

Endive – See Chicory.

Endocarp – The endocarp is the internal layer or shell. The terms endocarp and mesocarp are interchangeable. See Nut(s).

Endocrine Disruptors – Many foods contain natural chemicals that can affect our endocrine system. Some have a positive affect and are usually marketed as phytochemicals or phytoestrogens. Foods that contain these items include soybeans, alfalfa shoots, flaxseed, cranberries and mung-beans. They can promote desirable effects when wanted. However, in younger people or males, phytoestrogens might not be desirable. In these cases, they could be classified as endocrine disruptors. See Hormones, Nutraceuticals.

Endocrine System (Glands) – The group of glandular organs that regulate the hormonal balance in the body. See Exocrine System.

Endocrine Glands – As opposed to exocrine glands, those bodily structures that produce hormones introduced directly into the bloodstream. These include the pituitary gland, the pancreas, the adrenal glands, the sex glands, and the thyroid glands. See Exocrine Glands, Hormones.

Endogenous – Endogenous means that which comes from the inside. Examples of endogenous enzymes are those that are found within yeast cells. These

enzymes, which begin the autolysis or self-hydrolysis process, are responsible for the development of autolyzed yeasts. Similarly, the enzymes inside onion cells also begin the process of producing sulfur compounds once the cells are injured. See Yeast; Enzymes; Ripe, Ripening; Autolysis; Vanilla; Cocoa; Coffee; Onion.

Endorphins – The group of substances that relieve pain. These substances have been recently studied as to their overall effect on mood, metabolism, ability to cope with stress, and overall well-being. The consumption of pleasurable flavors can stimulate endorphin production and can be correlated with potentially overall positive results. This result shows the potentially positive effects of flavors. This concept might go toward explaining both the potent effect of odor imprinting on the psyche and the circumlocuitous route of flavor cognition – first to the limbic system, then to the occipital lobe, then to the cerebral cortex for odor memory. See Hyperactivity Study, Imprinting, Brain, Odor, Hormones.

Endosperm – The kernel or major portion of a grain that is composed of a complex mix of carbohydrates, starch, etc. See Grains.

Endothermic – A chemical reaction that absorbs heat from its surroundings and appears cool. See Exothermic, Reaction.

Endotoxins – Poisons released from the inside of dead bacteria. See Exotoxins, Enterotoxins.

Energy –

1. Energy is all that exists that is not matter. Energy can exist in many forms as in latent or potential energy (energy that can transfer itself into kinetic energy), and kinetic energy, the energy of motion. The potential heat energy of foods is measured in calories. The heat being given off by a burning match is kinetic energy.
2. Energy is the personal feeling of wellness. This can be a positive state of consciousness brought about by pleasing flavors, environment, health and other factors. See Calorie (C), Calorie (c).

Enfleurage – The process of extracting a floral in a fat and the subsequent removal of the active aroma principles from the fat. Lard was used exclusively in the enfleurage process of jasmine absolute in France until recently. Now it is typical to use other fat systems. The reason for the success of this technique is that some florals still produce their volatiles even after being cut. See Jasmine, Extract, Absolute, Concrete.

English Oak – See Oak.

English Sage – See Sage.

Enhancers – Those ingredients that synergize or enhance the perception of the existing ingredients. Example: Monosodium glutamate is an enhancer to most savory-type products. Monosodium Glutamate and Chart 144 – Enanhcers. Recently a number of ingredients have been added to the GRAS lists which can enhance flavors. Collectively they are called Flavors with Modifying Properties and are now included as a separate list. See Synergism, Masking, Nucleic Acid, Kokumi, Flavors with Modifying Properties.

Enocianina – See Grape, Color (Colorants).

Enolides – See Lactones.

Enologist – An enologist is a wine specialist. See Wine, Fermentation, Beer.

Enology – The study of wine and wine making. See Wine, Fermentation, Beer.

Enrichment – The addition of nutrients to a food system. See Vitamins, Minerals, Nutrition.

Enrobe – To coat a food product. See Plating.

Enterotoxins – A poisonous substance that inflames the lining of the intestine causing diarrhea and vomiting. A staphylococcal infection in foods is one example of microbial generation of pathogenic enterotoxins by staphylococcus bacteria. Because the staphylococcus toxin is resistant to heat, it is not destroyed upon cooking and therefore makes this bacterium quite lethal. See Exotoxins, Endotoxins.

Entomophagy – The eating of insects. In areas where protein sources are rare, the eating of insects has become a necessity. Some recent trends have seen this behavior translate to avant garde restaurant cuisines. See Trends.

Environmental Monitoring – Part of the HACCP System but not the HACCP Plan, environmental monitoring is a crucial step in verifying all of the prerequisite programs are running well and sufficiently addressing the potential hazards identified in the HACCP plan. Cleanliness indicators such as APC (average plate count), Yeast and Mold and E. coli are typically run. A quantitative analysis of allergen cleaning is prescribed by many audit protocols to verify the cleaning is done properly. See GMP, Microbiological Assessment, Cleaning Protocol, Microbial Monitoring.

Environmental Protection Agency (EPA) – The governmental agency that regulates laws pertaining to the environment, pollution, dumping, etc. See Environmental Regulations, ECRA, Effluent, Waste Management.

Environmental Regulations – Those laws promulgated to protect the environment. Some of these regulations of note that have passed in the last 10 years on both federal and state levels are ECRA (the Environmental Responsibility Cleanup Act) (New Jersey), the Clean Air Act (U.S.), the Hazard Communications and Control Act (U.S.), the Superfund law (U.S.), etc. See Clean Air Act.

Enzymatic Browning – Also known as table browning. When a banana or apple, for example, turns brown in the air, particularly in spots that have been bruised. Aroma-wise, brown-type compounds are produced similar to compounds produced in fermentation. The reaction of table browning can be considered a crucial step in the ripening process, where complex precursor molecules are changed into smaller molecules suitable for the nurturing of the potential seed. The common indigenous enzyme to fruits and specifically the brown color of tea and cocoa are due to the action of polyphenyl oxidase. See Non-Enzymatic Browning, Ripening.

Enzymatic Conversion – The change of one molecule to another by the use of enzymes. Enzyme conversion has an advantage over typical chemical reactions because it can occur at much lower temperatures. See Enzymes.

Enzymatic Derivation of Flavoring Materials – The use of enzymes to develop source materials for Maillard Reactions, desirable breakdown components of larger molecules (fatty acids from fats), to simulate ripening in fruits (sugar conversion), and to produce useful results. Enzyme-based oxidation can occur naturally. An example is the formation of hexanal, an active flavor component in tomatoes or cucumbers derived from the lipoxygenase activity on methyl linoleate. See Enzymes, Fermentation and Enzymatic Development of Natural Flavors and Chemical Flavors.

Enzyme Modified Cheese – See EMC (Enzyme Modified Cheese).

Enzyme Modified Milk – See Milk.

Enzyme Modified Milk and Swiss Cheese – See Chart 432 – Enzyme Modified Milk .

Enzyme Modified Swiss Cheese – See Cheese, Enzyme Modified Cheese.

Enzymes – An enzyme is a protein based catalyst that causes a reaction but does not change itself. Enzymes are widely used in the food industry. Most enzymes are considered GRAS substances and are therefore not considered food additives. Furthermore, they are likely to be considered incidental additives because they react with foods on a cellular basis. There are many different types of enzymes that perform a host of functions that can develop flavor, improve flavor, or change the physical or chemical characteristics of a food product. Pectinases react with fruit pectin making the development of fruit juice concentrates more efficient and clarification easier. Corn syrup is an enzyme reduction of cornstarch to simpler sugars. Lipases convert fats. For example, in cheeses, lipase enzymes are used to develop fatty acids from base fat systems. In an EMC, enzymes are used to curtail an otherwise necessary aging process. Rennet is usually used, but as this is an extract of cow's stomachs, the prohibition of mixing dairy and meat makes most EMCs not kosher. Chymosin™ is fermented non-animal rennet and therefore can be used in this application for kosher systems. Proteolytic enzymes are used to make tough meat more edible. They are also used on by-product meat called meat digests. These digests are developed to yield nutritious and flavorful products and are used in animals' feeds and as enhancers for pet palatability. Enzyme activity usually takes place under optimum conditions of moisture, temperature, and pH. The temperatures needed for enzyme reaction are usually far less than for other more typical chemical reactions. Due to this fact, some chemicals are being developed at low temperatures via this method. Fungal enzymes work in lower pHs (approximately 4.5), while bacterial enzymes are effective at a higher pH. Some enzymes require calcium and other metallic salts to be present for activation. Chelating agents like EDTA (ethylene diamine tetra acetate) can tie up these salts, inhibiting enzyme reaction. Immobilized enzymes are those that are bound to an insoluble GRAS medium. One such enzyme is the insoluble glucose isomerase enzyme, CFR 184.1372. See Catalyst, Protease, Lipase, Bromelain, Papain, Ficin, Pregastric Esterase, Rennet, Rennin, Microbial Protease, Microbial Lipase, Debitterase™ (Depeptidase), EMC, Bitterness, Amylase, Hemicellulase, Lipoxygenase, Chymosin™.

Common enzyme processes follow:

- Oxidation – Reduction of enzymes.
- Sulfhydryl oxidase (SH oxidase) – Links mercapto groups as in gluten molecules to achieve better binding (i.e., retards softening in breads).
- Glucose oxidase catalase – Oxidizes glucose to gluconic acid. Decreases time needed for dough to develop and improves dough consistency. Obtained from Aspergillus niger.
- Lipoxygenase – Oxidizes unsaturated fats to corresponding aldehydes and acids.
- Ethanol dehydrogenase and alcohol oxidase – Oxidation of primary and secondary alcohols into aldehydes and ketones.
- Polyphenoxidase and lactase – Development of aromatic flavor and fragrance compounds. Polyphenoxidase is the enzyme responsible for the browning of fruits.
- Oxireductase – Glucose oxidase derived from Aspergillus niger, as is catalase. The latter is also derived from bovine liver or Micrococcus lysodeikticus.

- Isomerase – Glucose isomerase is derived by a number of different microorganisms such as Actinoplanes missouriensis, Bacillus coagulans, Streptomyces olivaceus, S. olivochromogenes, and S. rubiginosus.
- Protein Cross Linking.
- Transglutaminase – Cross links proteins for more stable doughs and larger volumes.
- Hydrolases – See separate listings for amylases, proteases, lipases, hemicellulases.
- Mixed carbohydrase and protease enzyme product – CFR 184.1027 derived from fermentation of B. licheniformis.
- Amylase and General Carbohydrases – A hydrolase that breaks down starch molecules. Coupled with glucoamylase and glucose isomerase, it is used in the development of high fructose corn syrup. Alpha amylase is used as a dough strengthener. Alpha amylase is derived from Aspergillus niger and oryzae, Rhizopus oryzae, Bacillus subtilis, barley malt, or Bacillus licheniformis. Beta amylase is derived from barley malt. Cellulase is derived from A. niger, and Trichoderma reesi. Beta glucanase is derived from A. niger, and B. subtilis.
- Glucoamylase (or Amyloglucosidase) – Derived from A. niger and A. oryzae, and Rhyzopus oryzae. Hemicellulase is derived from A. niger. Invertase is derived from Kluveromyces.
- Pectinase – Derived from A. niger or R. oryzae.
- Cellulase – Breaks the complex polysaccharide into simpler sugars. Used with pectinases to improve fruit juice yields. Fiber can be added after the processing of juices to improve the healthfulness of the juices.
- Pullulinase – Hydrolyzes specific sites of the glucosidic branch for easy hydrolyzation by glucoamylase to glucose.
- Hemicullulase – A hydrolase that breaks down hemicellulose into simpler sugars.
- Lipase – A hydrolase that breaks down fats into glycerine and fatty acids and mono and diglycerides. Used in many applications from development of EMCs, development of savory flavors through fat hydrolysis, production of mono and diglycerides as emulsifying agents in food systems, and in the modification of palm oil fat with the subsequent interesterification with stearic acid for use in confections like chocolates. Fractionated stearic or lauric fats can be used in chocolate-based products (compound coatings) where the heat sensitivity of fats in cocoa butter can be avoided. The enzyme is derived from three major sources: (1) The edible forestomach of kids, calves, and lambs. (2) Animal pancreas tissue. (3) Aspergillus spp. (oryzae or niger).
- Protease – A general hydrolase that breaks down proteins into simpler amino acids. Used to break down scrap muscle meat (meat digest) for use in pet foods as both a nutritional supplement with positive palatability enhancement. These enzymes are also used in the development of non-acid catalyzed HVPs and modified wheat gluten for more nutritional supplements for vegetarians. Bromelain is derived from pineapples (Ananas comusus and A. bracteatus). Ficin is derived from fig (Ficus spp.). Papain is derived from papaya (Carica Papaya). Pepsin is derived from porcine or other animal stomachs. Rennet is derived from the fourth stomach of ruminant animals, from Endothia parasitica or Mucor miehei and M. pusillus. Microbial proteases are available and are typically derived from cultures of aspergillus or bacillus species like A. niger, or A. oryzae, or Bacillus subtilis or B. licheniformis.
- Peptidase – Hydrolysis of casein and other proteins by attacking peptide linkages. Peptidase eliminates starchy taste by peptidolysis of oligopeptides in starch with peptidase derived from Lactococcus lactis.
- Endo and Exopeptidase – From Aspergillus oryzae, Flavorzyme™ and alkaline serine protease and Alcalase™. Able to hydrolyze many types of protein-based food products to develop enzyme-derived hydrolisates to replace HVPs, including gelatin, an otherwise difficult protein to hydrolyze. Also useful for the debittering of lactic acid by fermentation.
- Actinase – Removal of off flavors from old rice grains (hexanal and hexanol).
- Pectinase – Hydrolyzes pectins into simpler saccharides (sugars), increasing the yield of fruit juice.
- Lactase – Reduction of lactose in dairy products for people with specific lactose intolerance. See Immobilized Enzymes, Catalyst, Chemical Reaction.

Enzyme Hydrolysis –

1. The act of a hydrolyzing enzyme on a substrate.
2. The process of solubilizing macro molecules into simpler, more water soluble substances through the use of enzymes like amylases, proteases, lipases, pectinases, etc. See Enzymes, Hydrolysis.

EPA (Environmental Protection Agency) – The U.S. governmental agency that regulates the maintenance of the environment. Local governing state agencies such as the New Jersey Department of Environment Protection and Education are also quite active. See Environmental Regulations.

Epidemic – A large recurrence of a disease usually spread over multiple states or over a larger area than with an outbreak, but not as large or widespread as a pandemic.

Epimer – Two isomers that are different in only one site.

Epazote or Chenopodium ambrosioides – A leafy herb that is usually associated with Mexican bean dishes. Also called Mexican Tea. The herb is thought not only to add a pleasing flavor to the dish, but also to control stomach gas caused by the beans. The best way to control gas by the beans is to make sure the beans are cooked fully and not al dente. See Al Dente, Beans, Herbs.

Ephedra or Ephedra vulgaris (RICH.) – See Appendix 2.

Epoxy – A chemical structure made from an atom of oxygen attached to two other atoms that are also united to other atoms. An example is the ether group, wherein the R1-O-R2 structure is present. R1 or R2 represents two carbon-based structures (equivalent or not). One such structure is a glycidate or epoxy butanoate, where the oxygen is attached to two different carbons forming a three-membered ring structure. See Glycidate.

Epsilon, e (Greek, E, ε) –

1. The Greek letter.
2. The uppercase of the letter resembles the English capital E and is used to designate an isomeric structure to have a trans configuration.
3. The lowercase of the letter resembles the English lower case e and is made by a semicircle and a horizontal central bar.
4. Epsilon is also a positional structure designation. In a lactone, the epsilon signifies a seven-membered ring structure. See Delta, Gamma, Omega, Trans (Isomerism).

Equilibrium – A state in which a balance has been achieved. In chemical equilibrium, the reactants equal the products, which means that no further results will be achieved until the concentration of the reactants is increased or some of the products are removed. This technique is called driving the reaction. See Flavor Reactions.

Equilibrium Relative Humidity (ERH) – The percentage of free moisture equilibrated in a closed system or container designated as percentage. The ERH is 100 times the water activity. See Water Activity.

Equipment – One of a number of items in the production inventory which handles, or processes flavoring materials. Equipment can include mixers, dryers, agglomerators, sieves, cutters, homogenizers, product transporters, heaters, pasteurizers, compressors, filters. An equipment maintenance program, spare parts list and overall equipment program is essential in a well-run flavor operation. See HACCP, GMP.

Equipment Cleaning/Equipment Maintenance Program – Part of the overall HACCP system but not the HACCP plan, equipment maintenance is essential to the safety of food products. The surfaces must be cleanable (Usually stainless steel), and of a food grade material. Spare parts should be available and inventoried. A maintenance program should be periodically specified, using food grade greases, cleaners and other food grade materials. See HACCP, GMP.

Equisetic Acid – See Acidulant(s), Aconitic Acid.

Ergot – The toxin produced from Claviceps purpurea, a mold that grows on grains, and specifically on rye. Symptoms are mental disorder and seizures brought on mainly by the production of lysergic acid-type alkaloids. Even though this type of food poisoning is serious, some good has come out of its research. Useful psychotropic drugs have been developed from ergot such as ergotamine and ergonovine. One interesting scenario was proposed by Dr. Robin Cook in his 1994 book *Acceptable Risk*, which poses the possibility of strange behavior during the Salem Witch Trials being derived by ergot poisoning of stored rye. See Pathogenic (Pathological) Organisms.

Ergotism – The state of being poisoned by the ergot toxin. See Toxicology, Diseases.

Ericalciferol – See Vitamins (D2).

Erigeron (Fleabane) (Erigeron canadensis L.) – Erigeron grows as a weed along with many crops. Also known as fleabane. Erigeron has a complex odor, with a spicy, basil-like odor, and a brown herbaceous background similar to chamomile. See Basil and Chart 154 – Erigeron.

Eriodicton – See Yerba Santa.

Error of Habituation – The tendency of subjects to give the same answer to unknowns with similar attributes. See Logical Errors, Stimulus Error, Halo Effect, Expectation Error, Order of Presentation Error, Mutual Suggestion Error, Motivational Error, Personality Errors (Capriciousness versus Timidity), Stimulus Error.

Errors – See Errors of Analysis.

Errors of Analysis – See Logical Errors, Stimulus Error, Halo Effect, Expectation Error, Order of Presentation Error, Mutual Suggestion Error, Motivational Error, Personality Errors (Capriciousness versus Timidity), Error of Habituation.

Erythorbic Acid – An antimicrobial additive whose salts are often used for meat products. FEMA GRAS# 2410, CAS# 89-65-6. See Meat, Preservatives.

Escarole – See Chicory var. latifolia.

Escherichia coli – The organism that resides in the intestines aiding in the formation of waste products in the body. However, some strains of E. coli can generate gastrointestinal distress from serious to potentially fatal reactions such as hemorrhagic colitis. The latter has made the strain E. coli O157 – H7 a target of concern. In fact, there are four classes of pathenogenic E. coli. See Pathogenic (Pathological) Organism; Disease; Sterilize, Sterilization; GMP.

Escofier (Auguste) – (October 28, 1846–February 12, 1935) A prolific chef and writer, Escoffier was one of the most important chefs in the development of what we today known as the Modern French Style of Cooking. He wrote *Le Guide Culinaire* containing over 5,000 recipes. He is credited with standardizing many techniques including the use of roux. Many of his works were based on the previous writings of Antoine Carême. Escoffier remarked, 'Starch being the only one from the different constituents of flour which really affects the coherence of sauces, there would be a considerable advantage in preparing roux from a pure form of it, or from substances with kindred properties such as fecula [potato starch], arrowroot, etc. It is only habit that causes flour to be used as the cohering element of roux, and indeed, the hour is not far distant when the advantages of the changes I propose will be better understood – changes which have already been recommended by Favre in his dictionary.' (Joseph Favre founded The Academie Culinaire de France in 1883. He was the author of *The Universal Dictionary of Cooking and Food Hygiene*.) See Culinary Arts, Roux, Recipe, Starch, Culinary Thickening Techniques.

Espagnole – A Mother Sauce that is used to produce a demi-glace. The espagnole sauce has components of pincaged tomato, brown stock, mirepoix, and brown roux. This is reduced and then more brown stock is added. This is further reduced to obtain a demi-glace, the basis of many other sauces. See Mother Sauces, Culinary Arts.

Essence –

1. The top note of a concentration process, as in juices, which can be further concentrated and added back. This product is called a fruit juice essence.
2. The recovery oil of the orange juice process (other citruses could be involved [lemon, etc.]). This is the oil that is a by-product of the squeezing of fresh juice.
3. A distillate, top note, or light fractions of a flavored food product or flavoring material.
4. The heart of the flavor, in general terms, the true nature of a desired character. Example: In order to achieve the essence of a pineapple flavor, one should use some caproate esters and a sulfur containing compound like a thio ester. The essence of mint oil is the menthol; the character of mint oil is its sulfur containing compounds and trace compounds.

See Essential Oil.

Essence Oil – An oil that is collected in the water phase during the production and the subsequent concentration of the juice in the citrus juice industry. The oil is then separated from the water phase using simple phase separation techniques. See Essence, Essential Oil, Fruit Distillates.

Essence Recovery – The process of reclaiming the aroma of fruit products, and specifically fruit juice concentrates by fractional distillation. The folds are usually standardized in 100-, 150-, or 200-fold strengths. Greater strength products have come on the marketplace; however, the accurate relationship between fold and flavor strength becomes less reliable at the very highest essence fold strengths. See Distillate and Chart 145 – Essences and Distillates.

Essential Amino Acids – Nutrients (amino acids) that the body cannot produce and are usually obtained by ingestion of foods are called essential amino acids. Some essential amino acids found typically in meat products are not found in all vegetables. Therefore, vegetarians, and especially vegans, must be careful to consume certain vegetable products like legumes, etc., to provide themselves with the proper nutrition. See Vegetarian, Vegan.

Essential Elements (or Minerals) – Those minerals or elements that are necessary to maintain proper bodily function. Some of these elements like iron, copper, zinc, manganese, selenium, molybdenum, and iodine are necessary at trace levels; others like sodium, potassium, and magnesium are needed at higher levels. See Nutrition, RDA.

Essential Fatty Acids – Also known as Vitamin F. Polyunsaturated fatty acids that the human body needs but cannot produce. Fatty acids like linoleic, linolenic, and arachidonic acids that cannot be made by the human body and must be ingested through our food supply. Linoleic acid can be converted into arachidonic acid in the presence of pyroxidine. Also, vitamin E or other antioxidants are needed as antioxidants to protect these highly unsaturated fatty acids from bodily degradation (oxidation). See Nutrition, Vitamins, Minerals, Fatty Acids.

Essential Oil – The volatile aroma portion of odiferous plant material produced by physical means, either by distillation or compression. The distillation process can take many forms. Direct steam distillation in a blow over still uses a very short condensation column. In this process condensed product is collected

directly. A vacuum distillation is one in which the internal system is evacuated to lower the temperatures necessary for distilling off heat-sensitive volatiles, thus limiting their degradation. Columns can be very sophisticated indeed and designed with a high degree of theoretical plates. The products of extraction, recrystallization, or chemical derivation are not considered essential oils. Lime oil is an essential oil because it can be derived by distilling the fragrant aroma from crushed limes (producing alpha terpineol, the characteristic green lollipop flavor) or by expression or crushing of the flavedo of the peel. See Distilled Oil, Compressed Oil, Expressed Oil, Flavedo, Peel Oil, Lime Oil, Recrystallization, Chemical Derivation, Theoretical Plate Count, Blow Over Still, Vacuum Distillation, Reflux, Distillation, Extract, Volatiles, Non-Volatiles, Fixed Oil, Vegetable Oils, and Chart 396 – Vegetable Oil.

Ester (Aliphatic) and Ester Chart – Aliphatic esters are responsible for the fruity characters. The esters, particularly the ethyl esters, occur ubiquitously in nature. The esters are somewhat interchangeable by number, that is, ethyl caproate, which has two carbons from the ethyl group and five carbons from the caproate group would total C-8. Therefore, amyl propionate (C-8) would have a vaguely similar flavor profile, vapor pressure, and solubility. Propyl butyrate (C-7) is similar to amyl acetate. If there are any characteristic differences, it is the result of the alcoholic moiety, less than the acid part. The lighter esters are usually reminiscent of nail polish (C-3, C-4) and are used to give lightness or lift to the flavor. The next series tend to be fresh fruit like and can be used in numerous products. These, the C-5, C-6 types can be used in cherry flavors, apple flavors, and most any other products where more nondescript fruit flavors are useful. These esters are important when mixed with citrus (mainly orange), sweet notes (mainly vanilla types), and spice notes to develop bubble gum and chewing gum flavors. The next group of the C-7, C-8 types tend to be more characterizing and tend to be much stronger on a strength per usage basis. These products usually develop a characteristic pineapple or grapey nuance when used in a blend. The C-9, C-10, C-11, and so forth tend to be heavy odors, background characters, typical of products whose molecular weight dictates lesser solubility in the saliva, ergo higher vapor pressure in aqueous media. They are reminiscent of the alcoholic beverage cognac and cognac oil and are collectively called the cognac esters. The esters of the C-12 and higher weights tend to be very weak and are used less as flavor character ingredients. It must be noted that often heavier compounds contribute an overall mellowing or rounding effect, and also come with trigeminal characteristics such as cloying, throat burning, drying, etc. Perfumers would argue that these products could therefore have a fixative property, but this aspect seems less useful to this writer in flavor systems. The maximum molecular weight for esters beyond which there tends to be no appreciable aroma is around C16H34 or 225. See Chart 146 – Alkyl Esters Grouped by Alcohol Moiety and Figure 19.

Ester Gum – Also known as glycerol esters of wood rosin. This product is used as a weighting agent for emulsions to avoid the problem of ringing (NAS #7723). The maximum allowable amount is 100 ppm in the final product. Sucrose acetate isobutyrate (SAIB) is a recently approved weighing agent. It does have a better taste than ester gum, but it is also very hard to handle and must also first be dissolved in a solvent system like terpenes. Another weighing agent, brominated vegetable oil, is approved for use, but most agree it is ineffective at the regulated maximum of 15 ppm in the final beverage. See Ringing, Emulsion, Weighting Agent, and Chart 472 – Ester Gum .

General Organic Chemistry, Esters

Esters are a group wherein an acid and an alcohol combine and water is removed forming a COO group within the molecule.

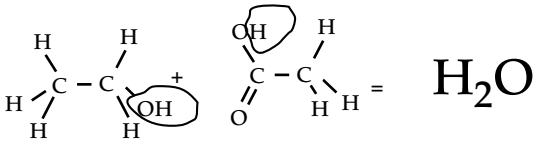

Fig 19a
Alcohol
Ethanol
C_2H_5OH
ROH

Fig 19b
Acid
Acetic Acid
CH_3COOH
or $C_2H_4O_2$
RCOOH

+

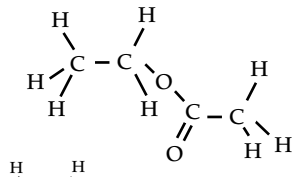

Fig 19c
Ethyl Acetate
$C_2H_5COOCH_3$
or $C_4H_8O_2$
R1COOR2

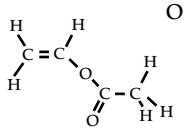

Fig 19d
Unsaturated
Ester - R has a
Double Bond
Ethenyl Acetate

Fig 19e
Aromatic Ester -
R has a benzene
ring.
Benzyl Acetate

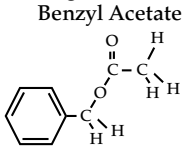

Figure 19

Esterification – The action of an alcohol on an acid yields an ester. Specifically, when the atom of hydrogen in an alcohol is removed by catalysis and combined with the hydroxyl moiety of a carboxyl group, the resultant is water and an ester. When more than two types of esters are present in a flavor system, transesterification might occur. Example: If there is ethyl acetate and amyl butyrate in a system, ethyl butyrate and amyl acetate might also be formed upon standing. When an acid and an alcohol are present in a flavor, an ester might also form upon standing, especially in a low pH medium. The interesterification of a hydroxy acid forms a lactone, which is a cyclic ester. See Alcohol, Acid, pH, Lactone, Cyclic Compounds, and Figure 19.

Ester Index – An ester index is an equiweight mixture of ethyl esters. Numbers are ascribed to each ester according to the carbon length of the acid moiety. This index sets the unit one for ethyl formate (C-1), two for ethyl acetate (C-2), three for ethyl propionate (C-3), etc. An ester index is used as an internal standard in a gas chromatograph (GC). It is usually mixed with the unknown mixture and injected. The numbers are interpolated to calculate the ester-based retention index or relative retention time. When compared against a previously calculated list, easy identification can then be made versus elution time. This method was particularly useful before the advent of mass spectroscopy (MS) and MS database referral systems. See Kovats Index.

Estoufflade – A slowly stewed dish. See Culinary Arts.

Estragole – See Tarragon.

Estragon – See Tarragon.

Ethanol (ethyl alcohol) – Ethanol is the second simplest alkane alcohol; methyl alcohol is the simplest. The use of alcohol is widespread either directly or indirectly in flavors. It is one of the best solvents and extractants. It is fundamental in the standard of identity of vanilla extract and is used in many other procedures (washed oils, tinctures). Alcoholic beverages use alcohol for its biological effects on humans. Alcoholic beverages, called liquors, are usually obtained by fermentation of molasses (rum), grains (rye, whisky, scotch), or other natural products that provide a fermentable source, such as potatoes (vodka) and saki (rice). Other beverages are obtained from grapes (wine, champagne) or malt and barley (beer). Also flavoring can be added to alcohol blended with water, sugar, or any combination thereof. These include products called cordials or liqueurs. Alcohol is tax prepaid, despite its end use. The flavor is then applied for to the BATF and if it is deemed to be non-potable, the alcohol is then considered non-beverage alcohol and is applicable for a tax refund or drawback. See BATF, Drawback, Potability, Vanilla, Solvent, Extraction, Tincture, Cordials, Liqueurs.

Ethers – As a compound class, ethers are fairly variable in flavor type. Diphenyl is a rosy character, beta naphthyl ethyl ether is sweet, aromatic, and grapey. Tetrahydropyrans are six-membered oxygen-containing heterocyclic rings. Dioxanes are six-membered heterocycles with two oxygens para to each other. Structures like pyrazines are their nitrogen-containing counterpart. Oenanthic ether is not really an ether but is a complex mixture of esters and other trace compounds. See Ester (Aliphatic) and Ester Chart and Chart 147 – Ethers, Chart 146 – Alkyl Esters Grouped by Alcohol Moiety.

Ethnic, Ethnicity (Ethnic Foods) – The characteristic of a culture, the properties that make up the foods typical of a style or region. Examples follow:

- Caribbean – Highly spiced dishes using allspice, cinnamon, cloves, ginger, nutmeg, thyme, garlic, onion, dill, bay, oregano, and cilantro are typical. These spices are mixed with meats, marinades, and fruits. Annatto sauces, chili, and even curry are present. Taro, or dasheen, okra, yam, pigeon peas, plantain are staples to many dishes. The leaves of the dasheen called callaloo are often used. Cassareep is a flavoring made from the juice of the cassava root, and boiled in sugar, cinnamon, and cloves. Foofoo is a hot buttered corn bread.
- China – Due to the expanse of the country and the many cultures that have lived in isolated regions of the varied terrain, Chinese cooking has a few distinct varieties. Cantonese, cooking of the southeastern region, uses many fruits, fish, and vegetables. Rice is a major staple. Spices used include ginger, garlic, cilantro, chili, clove, tangerine peel, star anise, and sesame seeds. Steaming is often used. Pekingese-style cooking (from Peking, now Beijing) centers around the north of the country. Having a harsher climate than in the south, leafy vegetables do not grow as well. Cucumber, celery, cabbage, rice, and soybeans are mainstays. Noodles are important. One of the most popular dishes of the Peking style is duck that is boiled, soaked in honey, and then hung in a windy area to let the fat drip down. This dish called Peking duck is then sliced and added to scallions, and a sauce and placed in a pancake. The sauce called plum sauce is distinctly flavored with garlic and soy sauce. Szechwan cooking and the neighboring Hunan province is typified by a hot style. The western mountainous regions represent the area. Salty yellow bean sauce, with chili, blended with sweet, and sour tastes are the taste layers for which Szechwan chefs strive.

In Eastern China, Shanghai cuisine typically includes seafood, gelatinous rice soup, smoky Lapsang Souchong tea, jasmine tea, oolong tea (fruity and spicy), bean paste, pickled cabbage, and marinated mushrooms.

- Greek and Turkish – Olives and olive oil mixed with vegetables, lamb, feta cheese, lemons, and honey. Spices include dill, oregano, mint, onion, basil, bay, thyme, allspice, cinnamon, and nutmeg. Shish kebab-style meats are usually found in recipes. Garlic and olive oil (skorthalia in Greece; tarator in Turkey) is used often. Hummus is made from olive oil, sesame paste, chickpeas, and lemon juice. Fish is common, including shrimp, lobster, tuna, and red mullet. Eggplant, tomatoes, onions, pepper, beans, olives, and grape leaves are used in most dishes.
- Hungarian – Paprikashes (chicken veal or pork with paprika and dairy sauces) and goulash (meat and vegetable stews) are typical. Vegetables like peas, asparagus, and parsley roots are mixed with pork or mutton. Transylvanian dishes contain veal kidneys, beef, and mushrooms.
- India – Halva made from sesame seeds ground with sugar and flavorings are popular. One such type is gajar halva, a carrot halva. Other sweets are zafrani chawal made from sugar, rice, and saffron. Lentils, spices, and rice are common combinations. Ghee or clarified butter is used as the main cooking fat in Southern India. Creamy sauces with yogurt, nuts, saffron, and fruit are called kormas. Koftas are spicy meatballs. Garam marsala (warm blend of spices) is popular in the north.
- Japan – Wasabi, a sharp horseradish cousin, is used often, as is ansho, a dried chili pepper. Dashi is a unique flavor made from konbu kelp and dried bonito flakes. Shoyu, the Japanese version of soy sauce, is sweeter than the Chinese type. Miso is fermented soy paste. Tofu is soybean curd. Sushi is the meeting place for the food products that we call generically sushi in the United States. They are a mixture of seaweed, rice, fish, shellfish, and wasabi. Kelp and wakame seaweeds are often used as wrappers for these sushi products. Kobe and matsuzaka are beer-bred beef kept in painstaking conditions.
- Korea – Kimchi, a pickled vegetable, is served at every meal. A mixture of barley tea and mung beans is called poricha, Korea's national drink. Sweet potato liquor is called soju. A pancake of mung beans, vegetables, and meat using poricha as an ingredient make pindaettok or Korean pizza. Koreans use ginkgo leaves to garnish many dishes. Korean barbecue is a popular presentation. Here, many tasty items can be used to mix and match with meat cooked in front of the guests. Finally, a sandwich is made by placing it between two lettuce leaves.
- Mexican – Mexican dishes are usually quite spicy, using some kind of chili pepper, onion, garlic, corn- or wheat-based flat breads, olives, olive oil, tomato, beans, cilantro, cumin, bay leaves, annatto (anchiote), anise seed, allspice, cinnamon, and chocolate. Tex-Mex is a U.S. culinary trend based on an Americanization of Mexican cuisine.
- Middle East – Mixes of spices like cumin, cardamom, anise, caraway, clove, dill, fennel, marjoram, sesame, allspice, mint, parsley, rosemary, sage, cilantro, fenugreek, turmeric, thyme, and ginger are mixed with rice, fruits, duck, and almonds. Baklava and kadaif are honey-drenched sticky pastries. Jordan has a blend of spices called Zahtar (marjoram, thyme, roasted sesame seeds, and sumac red berries). Yemen has a blend of cardamom, cumin, garlic, and chilies called Zhug. Tahini made from sesame paste is used often. Nuts like almonds, pine nuts, walnuts, and hazelnuts often find a place in dishes. Pickled vegetables (for example, beets and turnips) called torshi are often found in many kitchens. Charcoal grilling, rose water, orange flower, and honey are often added flavors. Bulgar wheat is used in breads.
- Northern Africa – Chai tea is originally a mint-type tea product unlike the spicy (clove-based) chais on the market today. Ras-el-hanout or 'top of the shop' is a mixture of a couple of dozen spices including cardamom, cassia, mace, chili, clove, cumin, fenugreek, nutmeg, lavender, and dried rose. Chermoula is also typical, which is a blend of onion, garlic, cilantro, chili, paprika, salt, pepper, and saffron. La kama is black pepper, turmeric, ground ginger, cumin, and nutmeg. Harissa is a very hot paste used in couscous and tabil (garlic, cilantro, and caraway seeds). Meats include mutton, lamb, goat, and rabbit. Fruits are often used like prunes, figs, and dates with honey. Stews are called tajines.
- Northern Italian – Northern Italian differs from Southern Italian in the use of veal, butter, cream sauces, garlic, risotto, light marinara sauces, seafood, and similar spices to the Southern styles, and less cheese but still using the same varieties.
- Russian – Spices such as caraway, mint, parsley, cilantro, pepper, paprika, cumin, and dill are added to vegetables such as cabbage, beets, potatoes. Dairy items like sour cream and yogurt are used often. Butter, herb, and garlic sauces with

lamb, fish, and meats are combined. Breads with charnuska seeds are common fare.

- Southern Italian – Tomatoes with garlic, oregano, onion, basil, parsley, and fennel. Cheeses like mozzarella, ricotta, Parmesan, or Romano are added to most dishes. In Southern Italian cuisine, vegetables like eggplant are also added. Anchovies, capers, and citrus are used.
- South African – Chili peppers with ginger and cinnamon. Also stews with cardamom, cloves, coriander, fennel, and fenugreek. Berber is a mixture of chili peppers, ginger, black pepper, cardamom, ajowan, and other spices (Ethiopia). Periperi is a popular but extremely hot chili sauce. Palm oil is used often in West Africa. Roots like cassava, yams, and sweet potatoes are found in many modern African dishes.
- Spanish – Tomatoes and olive oil with rice, garlic, onion, paprika, bell peppers, and saffron. Thyme, bay leaves, parsley, lemon, almonds, sherry, and peas are typical additives. Paella is a common seafood mixture; arroz con pollo a typical chicken dish.
- Thai – Thai is not only a mixture of ingredients but a mentality. The dish must combine as many different flavors and tastes as possible and should be blended in a cohesive and balanced 'message.' Typical Thai includes lemongrass, roasted nut oils, fish, cilantro, coriander, garlic, shallots, ginger, wasabi, tamarind paste, kaffir lime, chili pepper, cumin, cardamom, turmeric, basil, dill, and pepper. Soy sauce is a staple with fish sauce (nampla). The essence of Thai food is a mixture of many tastes including sweet, sour, hot, spicy, and bitter. See Marketing.

Ethyl Acetate – Ethyl acetate is a very commonly used ester. It is prevalent in a wide variety of fruits and other natural food products. Because it is one of the lightest esters, it is responsible for the fresh, light, fruity character of ripening fruits. It is an important ester in the top note of ripe peaches. It is also a good solvent in its own right, but its flavor strength prohibits it to be a solvent for flavor materials (non-flavor grade ethyl acetate is used in nail polish remover, for instance, and yields similar light flavor lift in flavors). It is extremely important in the development of a rum flavor, butterscotch, peach and apricot, most berries, pineapple, and many other flavors where a clean light top note is desirable. See Alkyl Esters – Grouped by Alcohol Moiety, Ethyl Esters, and Chart 146 – Alkyl Esters Grouped by Alcohol Moiety.

Ethyl Butyrate – Ethyl butyrate is perhaps one of the most commonly used esters. It is small enough in molecular weight to yield a significant vapor pressure, ergo a good lift and impact. It is significantly sweet, so it typifies the esters. Also it is not particularly characterizing of any one type of fruit as ethyl caproate would characterize more of a pineapple than most other fruits. It is therefore used in many sweet products as an important aroma chemical. Ethyl butyrate finds its most usefulness in cherry flavors, rum and butterscotch flavors, apple flavors, and chewing gum flavors. See Ethyl Esters, Vapor Pressure, Lift, Impact, Characterizing, Ethyl Caproate, Cherry, Rum, Butterscotch, Apple, Chewing Gum Flavor, and Chart 146 – Alkyl Esters Grouped by Alcohol Moiety.

Ethylene – An unsaturated hydrocarbon with an empirical formula of C2H4 or $H_2C=CH_2$. It is a colorless flammable gas and considered a plant hormone as it is responsible for the ripening of fruits. See Ripe Ripening, Hormones.

Ethylene Oxide – A highly reactive substance used to chemically sterilize substances like spices. Its use has waned lately in favor of low-level irradiation and other sterilization techniques. See Preservatives, Irradiation, Microorganisms, Plate Count, Pathogenic (Pathological) Organism, and Chart 148 – Ethylene Oxide.

Ethyl Esters – See Alkyl Esters and Chart 146 – Alkyl Esters Grouped by Alcohol Moiety.

Ethyl Fenchyl Alcohol – A terpene alcohol with a very earth, beety flavor. See Earthy.

Ethyl Jasmonate – Not only is it a major component in jasmine, but recent studies show that it might have some effect as a plant growth hormone. See Jasmine.

Ethyl Maltol (Hydroxy Ethyl Pyrone) – Ethyl maltol is a complex alcoholic heterocyclic compound with a very brown character. Although its chemical counterpart maltol is found in nature typically as a by-product of burning wood, the ethyl version has not. Ethyl maltol has been reported to be at least 3 to 8 times the strength of maltol, depending on the usage. It has a typical butterscotch-like, strawberry jammy, brown sugar character and works well as does vanillin in rounding out a flavor profile. See Brown (Compounds), Malt, Cotton Candy, Enhancers, BATF.

Ethyl Vanillin (Ethoxy hydroxy benzaldehyde) – This complex phenol/aldehyde is similar to vanillin, but has a definite brown nuance. It has a more marshmallow-like, chocolate-like sweetness, and is often used in combination with vanillin, ethyl maltol, maltol, or other brown characters to enhance most any sweet flavor. See Brown (Compounds), Chocolate, Enhancers, BATF.

EU (European Union) – The organization made up of governing interests of all of the participating European countries. See Nature Identical, International Regulations, World Health Organization.

EU Labeling – The EU Labeling Regulations 1169/2011 no longer considers the category of Nature Identical among other modifications to the labeling law. See Chart 489 – EU Labeling Changes.

Eucalyptus (Globulus) – As a flavorant, eucalyptus is used much like citronella as a background flavor and modifier to fruits, especially citrus, tropicals, and berries. An extremely varied botanical, the varieties follow:

- E. australiana – Cineole-rich oil used in pharmaceuticals.
- E. australiana type 'B' (E. phellandra) – From Australia and Belgian Congo (peppery camphoraceous).
- E. citriodora – Started in Australia and is now grown worldwide. With a rosy citronella odor, it is the main source for citronellal.
- E. dives – Similar to first type, but has less l-piperitone and more phellandrene.
- E. globulus – The older variety of eucalyptus in use in pharmaceutical preparations. The globulus variety is a eucalyptus oil that is high in cineole. It is the most widely grown of all varieties.
- E. leucoxylon – Really a combination oil of the species E. globulus, E. macarthuri, E. polybractea, and E. smithii.
- E. macarthuri – One of the oils that produces the high cineole content eucapharma oil.
- E. numerosa – Not one of the oils that produce the high cineole content eucapharma oil, although the yield is good. The content of cineole is not particularly high.
- E. numerosa – Same as E. dives.
- E. phellandra var. 'A' (E. australiana type 'A').
- E. polybractea – One of the oils that produce the high cineole content eucapharma oil.
- E. sideroxylon – One of the oils that has growing potential to produce the high cineole content eucapharma oil and compete with E. globulus, etc., in worldwide markets.
- E. smithii – One of the oils that produce the high cineole content eucapharma oil.
- E. staigeriana – An oil that contains citral in enough quantity to make it less useful as a eucapharma oil.
- Eucapharma oil – Really an oil made from diverse sources and varieties of high cineole content including E. globulus, E. macarthuri, E. polybractea, and E. smithii.

Eucalyptus Oil – Really white camphor oil, Formosa. See camphoraceous, Medicinal, Chart 155 – Eucalyptus, and Appendix 2.

Eucapharma Oil – See Eucalyptus.

Eucommia or Eucommia or Eucommia ulmoides Oliv. – See Appendix 2.

Eugenol – The aromatic compound that is typical of cloves. It is used in the dental practice for its multi-function purpose of being a pleasing aromatic, a partial anesthetizing compound, and a phenolic substance that will retard microbial growth. See Clove.

Eugenyl Esters – Esters of the spice alcohol, eugenol, which is the active constituent of cloves are for the most part, all warm and spicy as well. Heavier compounds border on the balsamic, being reminiscent of some of the heavier balsam extracts (Balsam Peru, Balsam Tolu, Myrrh, Olibanum, Labdanum, etc). See Warm, Spicy, Spices, Balsam, Eugenol, Clove, and Chart 149 – Eugenyl Esters.

Euodia ruticarpa – See Ewodia rutaecarpa.

European Pennyroyal – See Pennyroyal.

Eutectic Effect – When two dissimilar fats area mixed, melted, and recrystallized, the resultant fat has a lower melting point than either of the two. This is similar to the effect of freezing point depression as seen in salts added to water. The result is bloom (crystallization) and the loss of surface gloss. See Freezing Point Depression, Boiling Point Elevation, Azeotrope.

Evaporated Cane Juice – The FDA released a draft guidance indicating that the term evaporated can juice is Incorrect as it implies it is derived from a juice. This as any draft guidance might eventually result in a ruling. See FDA.

Evaporation –

1. The loss of volatiles, specifically water.
2. The volatilization and drying of a liquid. See Loss on Drying.

Evening Primrose or Oenothera biennis (LINN.) – See Appendix 2.

Everlasting – See Immortelle, Helichrysum.

Ewodia rutaecarpa or Euodia ruticarpa – (A. Juss.) Benth. Or (Wu Zhu Yu) – See Appendix 2.

Exocrine Glands – Glands that secrete their substances outside of the skin and not directly into the bloodstream. Examples are the tear duct glands, salivary glands, and sebaceous glands. See Endocrine Glands.

Exocrine System – The array of glands that secrete their substances outside the skin and not into the bloodstream.

Exothermic – A reaction that gives off heat when it occurs. See Endothermic Reaction.

Exotic Fruits – See Tropical Fruits.

Exotoxins – A poison released from the surface of a live bacteria. See Enterotoxins, Endotoxins.

Expectation Error – Expectation errors come about by knowing a little too much about the test and having a preconceived idea about what is being tested or

what attributes exist. Also called testing bias. See Sensory Evaluation, Discrimination Test.

Expert (Select) Panel – The board of selected individuals that consults for FEMA on the safety of flavor ingredients and reports their findings periodically as updates to the FEMA GRAS list published in 'Food Technology Magazine,' which is published by the Institute of Food Technologists. See FEMA.

Expressed Oils – Essential oils derived by the physical compression of flavorful parts of a food. An example is the process of expression. Here, flavor buds of the citrus peel are pulverized and then compressed. Water is then added as a fluidizer and then the oil is collected. The immiscible water and oil stream is then separated and the oil is collected to yield the expressed oil. See Fats and Oils.

Expression –

1. The realization of a single trait or group of traits by direct genetic manipulation or by hybridization techniques.
2. The artful and creative demonstration of lateral thinking by one such as a flavorist.
3. The production of an essential oil by squeezing an oil-rich food product. The extraction, usually by crushing of a food, usually citrus, to produce an essential or fixed oil.
4. The crushing of fruits to produce a fruit juice product. See Creativity, Juices, Fruits, Concentrate, Protein Expression.
5. The production of proteins by DNA encoding. See DNA, Protein, RNA, Fixed Oils, Essential Oil, Citrus, Peel.

Extenders – Products specifically designed to be added to an existing product of the same or similar function to provide a decreased raw material cost, greater availability, or another desired attribute. Roasted chicory powder has been used to extend coffee for some time. Roasted carob powder has been used for the extension of cocoa powder. Another food product that has been extended due to either short supply or escalating costs is the tomato. See Marketing, Replacers.

Extract –

1. A product derived by the process of extraction.
2. To derive flavor-valued ingredients from a source material.
3. A specifically defined product, like vanilla extract.

See Extraction, Solid Extract, and Chart 150 – Extracts.

Extractant – The substance used for extraction; alcohol, hexane, isopropyl alcohol, supercritical CO_2, etc. See Extraction, Distillation, Absolute, Concrete, Solid Extracts, Fluid Extracts, Natural Flavor.

Extraction – The process follows:

1. Take a botanical or other flavor-rich source and grind to a fine mesh size. This is known as comminuting.
2. Apply a solvent selected for solubilizing a specific profile of ingredients from the source material.
3. Let the system steep, percolate, or mix in the solvent for a given time. This process is called maceration. Heat can be used.
4. The liquid is then removed and the solvent is discarded, recovered for future use, or replaced with a different solvent.
5. The subsequent extract (noun) is then tested, standardized, and/or diluted for use. If an oleoresin or similar oil-phase result were desired, ethylene dichloride, acetone, hexane, or methylene chloride would be used. These must be removed and cannot have a residue of greater than 20 ppm. If more polar solvents are used like alcohol, proylene glycol, glycerine, isopropyl alcohol, water, or a combination thereof are used, the results would generate a solid or fluid extract as two examples. The FDA specifically defines vanilla extract. It is the only flavor so regulated.

See Solid Extracts, Absolute, Concrete, Liquid Extracts, Fluid Extracts, Vanilla, and Chart 238 – Extraction Solvents for Flavorings.

Extrait – The substance to be extracted. See Distillation, Absolute, Concrete, Solid Extracts, Fluid Extracts, Natural Flavor.

Extraneous Matter – Listed under the FDA's Defect Levels Handbook, unavoidable extraneous matter that presents no health hazards for humans is different from brittle plastic, glass and metal shards which should be handled under GMP and handled in the HACCP Plan. The FDA considers a product adulterated if it contains a hard or sharp foreign object that measures 7 mm to 25 mm in length. This consideration implies that anything bigger than 25 mm would be very noticeable and anything less than 7 mm seems to be generally harmless. This is thought by some to be inaccurate. See HACCP, Food Safety, GMP, Sharp Metal Objects, Brittle Glass and Plastic.

Extraneous Matter Protocol – The section within the HACCP plan that deals with Extraneous Matter and how to address the hazard it represents. See HACCP, Extraneous Matter, Food Safety.

Extrusion – The process that forces a plastic food product through a specially shaped die. The die can be heated so that the mass coming out is cooked. Also, due to the rapidly expanding gases at the exit orifice, the extruded piece can expand greatly. Flavors that will survive high temperature extrusion are limited to oleoresins and solid vola-

tiles. Cheese curls or collettes are produced in this manner. The extruded pieces can then be flavor coated by spraying a solid in fat slurried seasoning into a helical-designed cylinder. The helix that rotates and moves the product forward tumbles and coats the slurry on the outside (plates) of the extruded piece (collette). See Snacks, Processes, Collettes, Cheese.

Exudate – A secretion from cells. Plant exudates can contain complex polysaccharides, which when dried can be harvested. Some of these exudates called gums can be used as thickeners due to their swelling nature upon rehydration. Examples of two plant exudates are from the acacia tree called gum arabic and the horn-shaped gum tragacanth from the astragalus tree. See Gums and Thickeners.

Export – The transportation of products outside the originating country. The rules of export are varied according to trade agreements of the two countries. It also can include intermediate countries that are between two countries in ground transportation. Fees, delays and other issues need to be contended with oftentimes when shipping out of the country. See Tariff, Shipping.

Extrinsic versus Intrinsic Properties – The difference between that which is an attribute of something versus that which is the description of the something as it exists. Example an apple being red is intrinsic to that variety while the weight and size of the apple varies and is extrinsic to that apple. Intrinsic effects to an organism are genetic effects whereby extrinsic affects can be environmental.

Eyebright or Euphrasia officinalis (LINN.) – See Appendix 2.

F

Facial Nerve – The seventh cranial nerve. Starting at the pons and medulla oblongata at the base of the brain and then branching to the ear, tongue, salivary glands, and muscles of the neck and face. The facial nerve transmits sensations of taste from the taste buds located on the front two-thirds of the tongue and some pressure and textural effects by food products in the mouth and sensations of pressure in the jaw. Nerve impulses sent through the facial nerve stimulate salivary secretions in the submandular and sub-lingual salivary glands. See Trigeminal Nerves, Olfactory Nerve Area.

Facultative Anaerobes – Microorganisms that can grow in either in an oxygen-rich environment or not.

Fagara – The dried berry of a Chinese type, which is a small variety of prickly ash tree. It is also called Szechwan pepper. The herb has a spicy aromatic odor with a woody character and a peppery, tingling taste. See Chinese Five Spice Powder.

Fahrenheit – The scale of temperature measurement wherein 32 degrees represents the freezing point of water and 212 degrees represents the boiling point of water. See Temperature, Celsius, Absolute Zero.

Fair Trade – An organized social movement that considers the equitable treatment of workers, the environment, and social policies in developing countries so security, lifestyle quality, and economic self-sufficiency can be enhanced and maintained. The fair trade concept is thought to have an effect on the quality and price of raw materials.

Fall Out – The process of a solid coming out of solution, suspension, or emulsion. See Emulsion, Emulsion Stability.

False Ginger Oil – See Galanga Root.

False Unicorn or Chamaelirium luteum (A. Gray) – See Appendix 2.

Fantasy Flavors – Some flavors do not have a natural counterpart. These are called fantasy flavors. Pink bubble gum flavor, cola flavor, tutti fruity flavor, root beer, and barbecue flavors are examples.

FAO – Food Additives Organization.

Farina – A refined cereal made from wheat and that has been ground and sifted.

Farm to Table – The trend towards fresher products, more direct local supply eaten directly, and the consideration of healthier eating practices as perceived by some authors such as Michael Pollan ('The Omnivores Dilemma'). Sustainability, Organically Grown, non-GMO, and community supported concepts are related to this trend. Critics raise the issues of microbial contamination by using unwashed food crops, unpasteurized milk and unduly increased costs as side effects of this endeavor. See GMO, Food Safety, Microbial Contamination.

FARRP (Food Allergen Research and Resource Program) – FARRP maintains a database of food allergen information on unique proteins of known and putative allergens (food, environmental, and contact) and gliadins that may cause celiac disease. Other resources for information on allergy issues are the American Academy of Allergy, Asthma and Immunology Society, The European Academy of Allergology and Clinical Immunology, and the Food Allergy and Anaphylaxis Network. See Food Allergy.

FASEB – (The Federation of American Societies for Experimental Biology) – See MSG.

Fast Green – See Colorings, Green No. 2.

Dictionary of Flavors, Third Edition. Dolf De Rovira, Sr.

Fat – A group of compounds that have the same general structure (i.e., a molecule of glycerine esterified with three fatty acid chains). The nature of the fatty acids determines the nature of the fat. Fatty acids that are unsaturated yield an unsaturated fat. Fatty acids that have two or more sites of unsaturation are called polyunsaturated fats. Fatty acids with no unsaturated sites are saturated and make up totally saturated fats. Fats are a storage of energy in the body, having more than twice the caloric output upon metabolism than carbohydrates. Carbohydrates represent 4 calories per gram, and fats represent 9 calories per gram. Fats are necessary for the storage of fat-soluble vitamins like vitamin A, D, E, and K. Vegetable oils contain mixtures of fatty acid profiles that are each, in turn, attached to the glycerine base. The performance of the products, and the nature of the chemical differences relate to the following:

1. How many of the three glycerine 'arms' are attached to fatty acids (i.e., monoglycerides, diglycerides, triglycerides)?
2. The nature of the fatty acids attached to the glycerine in the three glycerine arms (i.e., Are they all different? Are two the same? Are they all the same?).
3. The level of saturation and molecular weight of the fatty acid 'arms' on the glycerine molecule (i.e., Are they saturated, mono-unsaturated, polyunsaturated?) All of these parameters relate to the melting point, stability, and viscosity and overall performance of the fats. See Fatty Acids, Unsaturated (Bond), Saturated (Satiated).

Fat Replacement – The replacement of fat is a compound problem:

1. Fats are non-polar; saliva is an aqueous system. When fat is used and then replaced, the order of volatilization of the individual flavorants can change, affecting the balance of the flavor as perceived.
2. Texturally fat contributes mouthfeel. This mouthfeel is called lubricity and has an overall effect on the perceived fullness of the flavor.
3. Fats contain trace aldehydes, lactones, fatty acids, and other volatile compounds. Therefore, the fat can contribute trace volatile flavor components. This is especially true with highly flavorful oils like olive oil.
4. Fats can solubilize volatiles. Volatiles can be partially separated into both the fat and oil phases. This effect is known as partitioning. Partitioning gives the final food product a more natural flavor partly due to the fact that that is the way the flavor exists in nature. This partitioning effect cannot occur in the same way in a fat reduced/mimetic replaced system so the resultant flavor would come out as being 'not right.' How have fats been replaced in the past? One approach is by using a combination of fatty mouth feeling agents or lubricants known as fat mimetics and flavors. In this example, starches and gums are helping to contribute the necessary lubricity. However, recent studies show that the body might have a mechanism that reacts to real fats, and it is this reaction that results in satiety. Therefore, fat substitutes might not be able to stop the constant craving, a foe to successful dieting plans. Sucrose fatty acid esters called Olestra™ as well as substances providing a similar effect can be used. Sucrose fatty acid esters are defined by the CFR, sections 172.859 and 172.867 (Olestra™).

Fatal Familial Insomnia – An extremely rare disease (28 families worldwide), transmitted by a dominant inherited gene based on the mutation of a prion that forms plaques similar to BSE (Bovine Spongiform Encephalopathy) and CJD (Cruetzfeldt–Jakob Disease). The patient experiences panic attacks, phobias, and hallucinations, loses weight, and then dies. It is considered a Transmittable Spongiform Encephalopathy (TSE). See Cruetzfeldt–Jacob Disease, Bovine Spongiform Encephalopathy.

Fats and Oils – The difference in definition between the two is basically which is solid (fat) and which is liquid (oil) at room temperature or 20°C. See Fatty Acids, Oil.

Fats – Dienals – Fats are often made from unsaturated fatty acids. These oxidize to produce dienals. See Aldehydes (Unsaturated Alkenals, Alkadienals, Alkynals, and Cyclic Non-Aromatic Aldehydes), Oxidation, Fat.

Fattouch – A mideastern dish that uses purslane as an ingredient. See Purslane.

Fatty Acids – Strictly speaking a fatty acid is an aliphatic acid that has an appreciable solubility in fats and oils. For this reason, some only consider aliphatic acids of C-5 and greater as the group known as fatty acids. However, for the purpose of practicality any organic acid that can link to a glycerine molecule could be considered a fatty acid because they are the acids that form the fat molecule. Free fatty acids describe those types of fatty acids that would be typically bound to a glyceride group, but currently are not. Recent research has indicated that the protein CD36 is responsible in the metabolism of fatty acids. See Fat (Olestra™).

Fatty/Green – Green compounds and fatty compounds are related. The difference is related to both molecular weight and the presence of unsaturated bonds.

Furthermore, the flavor is dependent on the degree of unsaturated sites (double or triple bond) and to the number of sites. There are intermediate compounds that are both fatty and green at the same time. This fat type is more typically found in fried foods like potato chips and French fries. Compounds having this character are trans 2 heptenal and trans 2 octenal.

Fava Beans – *Vicia faba.* A broad bean of the Fabaceae family that contains the alkaloids vicine and convicine which can induce hemolytic anemia in patients with the hereditary condition glucose-6-phosphate dehydrogenase deficiency. See Favism, Legumes, Beans.

Favism – An extreme food allergy to the broad bean, Vicia faba. The characteristics of this disease are a resultant lessening and destruction of red blood cells. This allergy is mostly found in people from the Mediterranean area but is widespread affecting an estimated 400 million people worldwide. See Food Allergy, Anaphylaxis.

FCC – See Food Chemicals Codex.

FDA (Food and Drug Administration) (FDA Approved Ingredients) – The FDA is the governmental agency that regulates the food supply. Legislation promulgated by the FDA is published in the Code of Federal Regulations Title 21. See Code of Regulations.

FDA GRAS – Before FEMA took on the challenge of GRAS determination, the FDA published a list of GRAS items in the CFR Title 21, in 1958 parts 182, 184, 186. The Life Sciences Research Office (LSRO) and the Federation of American Societies for Experimental Biology (FASEB) reviewed the chemicals within this list and published its findings. This listing is found in the website of the FDA as the SCOGS database. (Select Committee on GRAS Substances). See FEMA GRAS, GRAS, FDA.

Fecal – Reminiscent of the odor of feces. Some aroma ingredients that are fecal include Indole, Skatole, Isovaleric Acid, Valeric Acid.

Fechner's Law – Derived from the Weber Ratio, states that the perceived magnitude (Psi) is proportional to the log of the Physical Intensity (Iota). Psi = K log Iota, where Psi is the stimulus magnitude and Iota is the physical intensity.

Fecund – Prolific or fertile. Pertaining to a plant's ability to propagate.

Federal Register – The publication put out by the United States Government Printing Office, which cites official rules and regulations issued by federal agencies within the U.S. government. Annually, the summary of all approved laws for the year is appended to the previous legislation and is compiled by the printing office in the different titles corresponding to the different branches and agencies of the government. These publications are called the Code of Federal Regulations. See CFR Title 21, CFR Title 27, CFR Title 9, CFR Title 49.

Feeding Studies – The practice of evaluating the safety of components by selecting testing animals with a certain propensity to disease such as cancer, then feeding that specific ingredient at extremely high and consistent doses until the animal dies. Then the animal is dissected to determine what was the cause of death. The lethal dose is some number, which is predetermined, then 20 times that dose can be given to determine the LD20. The LD50 is 50 times that lethal dose. The data is often evaluated statistically among many animals to see if a clear pattern exists. See LD20, LD50, Saccharin, Artificial Sweeteners.

Feijoa (Feijoa sellowiana) – Also known as the pineapple guava, belongs to the same family as the guava, clove, and eucalyptus. The skin is inedible, the pulp is sweet and floral. It has a slight grainy texture that is similar to a cherimoya and a pear. The seeds are edible. See Guava.

Feingold Principle – The theory that artificial flavors cause hyperactivity in children. The NIS confirmed that the correlation could exist, but to such a small percentage of children, that the health risk is insignificant. See Hyperactivity. Other perspectives question the scientific method in its entirety.

FEMA (Flavor and Extracts Manufacturing Association) – The industry organization founded in 1909 that promotes the safety, evaluation, regulation, and industrial development of the flavor industry. The membership is made up of flavor ingredients suppliers, flavor users, flavor manufacturers, and those with an interest in the U.S. flavor industry. FEMA has established a long-term relationship built on trust and respect within the U.S. regulatory groups. In fact, FEMA's Flavor Expert Panel, who have collaborated on the GRAS list, has been well regarded by the FDA and other regulatory bodies. See NAFFS, Chemical Sources Association.

FEMA GRAS – A designation that means that an ingredient has been designated as generally recognized as safe by an independent Flavor Expert Panel for use in flavors. See Expert Panel, Toxicology, Decision Tree, Consumption Ratio, and Chart 486 – FEMA GRAS Lists Numbers Included, FDA GRAS, Bulk Flavor Labeling Statement.

Fenaroli's Handbook of Flavor Ingredients – A reference text used by the TTB to determine maximum usage levels and subsequent levels determining unfitness. If a flavor appears in Fenaroli's at x amount and the presence of that flavoring ingredient is 5 times the amount without any other mitigating ingredients like sugar, glycerine, etc., that flavor

is deemed non-potable by Fenaroli's and is elligible for Tax Drawback. See TTB, Non-Potable, Drawback.

Fenchyl Alcohol – Earthy and beety, similar to ethyl fenchyl alcohol, but weaker.

Fennel – Associated with Italian cuisine, fennel has been used by the Greeks, Chinese, Indians, and Egyptians. Fennel is reminiscent of anise or black licorice. Sprigs of the spice are used for both flavor and decoration. Used in natural black licorice flavors, as a modifier to root beer flavors, in liqueurs, sweet spice blends, sweet gherkin pickle spice, and many other seasonings. The leaves and stems are often used, as are the white large stems that are similar to the flat whitish base stems of celery. These fennel stems are quite sweet and contain a definite anise character. See Estragon, Estragole, Chart 156 – Fennel, and Appendix 2.

Fenugreek (Foenugreek) (Trigonella foenumgraecum) – Also called methi, fenugreek solid extract is a very commonly used flavor ingredient and is often used as the solid extract or absolute. As the solid extract, it is often used blended with St. John's bread, cherry bark, oak chip, or other solid extracts. It is also used in curry powders. The seeds can be soaked and can be prepared like legumes. Botanically, it is a legume. They also can be sprouted and added to salads. The roasted variety develops a definite brown, almost burnt sugar-like character that has been classically used in maple type syrups. The solid extract is one of the most common of flavor ingredients, and annual world production of seeds numbers in the thousands of tons per year. Some describe the crushed seed, when crushed (comminuted), as having a flavor that resembles a sweet spicy, proteinaceous character similar to protein or bouillon (like hydrolysates derived from wheat). This is probably due to an enzyme reaction of a glucoside present. Glucosidic enzyme reactions are present in many natural products. One example is the development of benzaldehyde by action of amygdalase on the glucoside amygdalin in prunus and amygdalus species. See Bitter Almond Oil, Chart 21 – Bitter Almond OIl, and Appendix 2.

Fermentation – One of the acceptable ways to produce natural flavorings according to the definition of natural flavors (CFR 21 Paragraph 101.22) is through the use of fermentation. Fermentation is the act of an organism on a product containing sugars, which, through its metabolic growth process, digests these sugars. By-products that are produced are mainly ethyl alcohol, other alcohols, aldehydes, esters, acids, and other aroma compounds. Examples of fermentation include wine, beer, and the baking process, which usually employs the use of saccharomyces cerevisiae strains of yeast as the major microorganism of fermentation. Citric acid is produced by the fermentation of Aspergillus niger or Candida spp. Lactic acid is another product of fermentation of carbohydrates. During World War II as supply lines were cut off from the United States, scientists developed a way to produce acetone, butanol, and acetic acid from fermentation. The step-wise fermentation of sugar is first through the anaerobic development of pyruvic acid, which is then reduced to lactic acid and acetic acid plus carbon dioxide. See Yeast; Sugar(s) and Polyhydroxyl Compounds; Alcohol, Aldehydes – Aliphitic and Keto Aldehydes; Alkyl Esters – Grouped by Alcohol Moiety; Acid; Cheese; Butter; Starter Culture Distillate; Starter Cultures; Chart 422 – Butter Derivatives, Wine, Beer.

Fermentation and Enzymatic Development of Natural Flavors and Chemical Flavors – Flavors deemed natural according to the definition of 'natural flavors by the Food and Drug Administration have been developed by fermentation and enzymatic conversion for years. Chart 414 – Enzyme Derived Chemicals lists some chemicals produced by fermentation. It is by no means all inclusive, and there are many other proprietary methods used by companies today to produce many more chemicals defined by the CFR 21 as 'naturally derived' Enzyme Derived Chemicals (By Fermentation). The future of fermentation techniques will include cells, cultures, and other plant material (rhizomes, etc.) in slurry to produce chemical blends similar to that found in nature developed by the whole plants themselves. In this way, the need for cultivation, maturation, fertilization, pollination, etc., is lessened. Some of the more costly products and those in greatest demand like vanilla, orris, and others are being developed in this manner.

Fermented –

1. In food possessing, a flavor reminiscent of a product that has gone through a process of fermentation.
2. Containing a flavor profile with acids, alcohols, aldehyde, and esters, characteristic of the above. See Fermentation.

Ferny (Fern-like) –

1. Reminiscent of the aroma of ferns.
2. In fragrances, a vegetable-like green with a touch of woodiness.

Feverfew or Tanacetum parthenium – See Appendix 2.

FFA – See Free Fatty Acids.

FFDCA – Federal Food Drug and Cosmetic Act.

FFPA – Free from prussic acid.

Fiber – See Dietary Fiber.

Ficin – A proteolytic enzyme derived from figs. See Fig, Enzymes.

Ficus – See Fig.

FID (Flame Ionization Detector) – There are two types of detectors used in a gas chromatograph: a flame ionization detector and a thermal conductivity detector. A flame ionization detector destroys the chemical by oxidizing it in a gas flame. A thermal conductivity unit is used when aromas are to be smelled out of the exit port. The Flame Ionization Detector is far more sensitive than a Thermal Conductivity Unit. See Detectors, Gas Chromatography – GC, SNIF NMR, Thermal Conductivity.

Fiddlehead Fern (Matteuccia struthiopteris) (Ostrich Fern, Osmunda cinnamomea – Cinnamon or Buckhorn Fern) – The unraveled circular fronds of generic ferns that resemble the tops of violins or fiddles. They are used in cuisine in Japan and in aboriginal New Zealand and Australian cooking. Also used by the American Indians. It is important to harvest the fiddleheads before they unravel and begin developing toxic and/or potentially carcinogenic substances. See Culinary Arts.

FIDS – Flavor Ingredients Data Sheet (Specification Sheets).

Fig – Ficus carica fruit from the species ficus carica L. whose dried powdered form is often used as a carrier for dried flavors. The tincture and extracts of this fig have been used in tobacco flavorings. The fig itself is not a fruit but a receptacle for the brittle seeds that are really the fruit. The fig has over 150 varieties. Some of the most common varieties are the black fig, which has a sweet but rather dry flavor; the green fig, which has a juicy character; the purple fig, which is the sweetest of the three, but the most perishable; and the Mission fig, brought to the United States by the Spanish. The fig is often dried because of perishability. The drying of the fruit enhances the sweetness and flavor, and a brown, slightly fermented character is developed. The fig is similar in flavor to the plum or prune with a subtle floral fruity character. The trunk of the tree contains latex, which has coagulating properties and from which the proteolytic enzyme ficin is produced. See Achene, Flavor Bases, Tincture, Extract.

Filbertone ™ – Trade name for 5 methyl 2 heptene 4 one FEMA # 3761 that Is reminiscent of filberts or hazelnuts. See Nutty, Ketones (Aliphatic).

Fillet – A slice or piece of a boneless meat or a fish.

Fill Temperature – The temperature at which the product is filled into its appropriate container. As flavor volatiles are greatly affected by temperature, the fill temperature can be critical to flavor quality. As a rule, the flavor should be added at the last stage in a heated food system if possible.

Fill Weight – The amount of product that is put into the final package. Some changes can occur in the package upon cooling and normal storage. Some of these can include moisture loss. The fill weight does not include any syrup, brine, or other liquid that is already in the container at the time of filling.

Film – An extremely thin layer of a substance. See Film Forming Agents.

Film Forming Agents – Additives that will assist in the formation a film of an immiscible or insoluble substance. See Film, Emulsifying Agent.

Filtering Aid – See Filtration.

Filth – Although the FDA does allow a certain amount of naturally occurring or unavoidable contaminants, filth is also defined on the site. Defect Action Level, FDA, HACCP.

Filtration – The process of transporting a liquid material through a substance capable of separating insoluble particles. This substance is referred to as a filter. This technique can be accomplished in many different ways: through vacuum, gravity, pressure; through paper, cloth, and a variety of other materials; with or without a filtration aid; and on a small or large scale. Filter aids used include diatomaceous earth, cellulose, activated carbon, or any other similar absorptive substance.

Fine Pick – The first pick of a tea crop in a given season yielding the finest tasting tea. See First Flush, Green Tea, Black Tea.

Fines – The by-product of smaller sized powder obtained from a process such as grinding, dehydrating or agglomerating. Due to increased surface area, fines can be extracted more efficiently.

Fines Herbs – Fragile or tender herbs that can be eaten raw including parsley, basil, dill, cilantro, tarragon, and chervil. Resinous herbs need to be extracted. See Resinous Herbs.

Finesse – The high quality differential character of a flavor profile that describes a varietal (variety of a grape).

Fine (Wine) – A superior flavor profile with a high degree of unique character balance and complexity.

Fining – The addition of clarifying agents in a wine such as tannins, gelatin, or other flocculating or clarifying agents.

Finish(ing) – The aftertaste of a product, how it lasts in the mouth, and the flavor impression it leaves. See Background, Flavor Profile.

Fir, Balsam (Abies balsamea (L.) Mill., A. balsamifera, or Pinus balsamea L.) – Balsamic and resinous, this ingredient may be used wherever a warm turpeny background is needed. It is most effective in citrus products, and tropical fruits like mango and passion fruit. It also can be used in pineapple, pear, etc., and in vegetables like carrot, turnip, and other root-type vegetables. See Aromatic, Balsamic, Resinous, and Chart 158 – Fir Balsam.

Fir, Pine – The Siberian fir needle oil contains a group of compounds related to larixinic acid (Maltol™). In general, the high degree of terpenes contained in this product lends itself to an oxidative instability. It is useful in citrus fruits and other flavor systems where a fresh turpeny note can be useful (tropical fruit flavors, root vegetables). As some terpenoid products have been identified at lower quantities in coffee and cocoa, it even could be used as a modifier in those as well as other brown or nut or leguminous flavors. See Piney, Terpenes, and Chart 159 – Fir Pine.

Firing – The drying process of tea. See Green Tea, Black Tea.

Firm Ball – See Hard Candy Manufacturing.

Firming – The process of changing a food product usually to enable it to resift the rigors of shipping and processing. One type of firming is a food's normal reaction to outside physical stresses to protect bruised tissues. Cherries undergo this type of change. Firming can also occur at lower temperatures, and can make the pits of a food easier to remove. Chemical firming such as the use of a calcium brine is one example. This is often used in the firming of soft fruit slices, cherries, and tomatoes. Here, calcium salts combine with pectin to produce calcium pectate.

Firming Agent – In cheese production, a gum or other thickening agent is added providing a resilient cheese structure. Cheese thus treated will not lose its shape when vegetables, fruits, or other moist substances are added.

First Flush – The first pick of a tea crop in a given season yielding the finest lasting tea. See Fine Pick, Green Tea, Black Tea.

Fish – Fish is consumed for food and varies throughout the world. However, out of the 20,000 different species of fish, only a dozen or two represent the major sources of food worldwide. These include fresh fish, frozen fish, salted fish, and smoked fish. Also the source of the fish is important whether it be freshwater or saltwater varieties. The main fish sources follow:

- Eel (Anguilla spp.) – Including American eel (A. rostrata), European eel (A. anguilla).
- Freshwater bass (Micropterus spp.) – Including largemouth (M. salmoides) and small mouth (M. dolmieni).
- Pike (Esox spp.) – Including northern pike (E. lucius), grass pickerel (E. americanus vermiculatus), chain pickerel (E. niger), muskellunge (E. masquinongy).
- Carp (Cyprinus carpio).
- Pike perch (Stizostedion spp.) – European pike perch (S. lucioperca), sauger (S. canadense), walleye (S. vitreum).
- Perch (Perca spp.).
- Trout (Salmo spp.) – Including brown trout (S. trutta), rainbow trout (S. gairdneri), lake trout (Salvenius namycush), brook trout (Salvenius fontinalis), common grayling (Thymallus thymallus).
- Bluefish (Pomatomus saltatrix) – Bluefish is characteristically oily and fishy tasting.
- Shad (Alosa spp.) – Including American shad (A. sapidissima), twaite shad (A. fallax), allis shad (A. alosa), alewife (A. pseudoharengus).
- Mullet (Mugil spp.) – Including gray mullet (M. cephalus). Monkfish (Lophius spp.)
- Sea bass (Disentrarchus labrax) – Including American white bass (Morone Americana).
- Sturgeon (Acipenser spp.) – Note: Caviar comes from salted sturgeon roe. Roe of other fish can be eaten and sold, but it cannot be called caviar. Different varieties of sturgeon yield different categories of roe including beluga, oestra, and svruga. If caviar is less than 5% salt and is of the best quality, it may qualify to be called malassol. This term means lightly salted in Russian. Payusnaya caviar is a pressed type.
- Sardine (Sardina pilchardus) – Sardines are typically packed in cans. They are packed in brine or oil and are so tightly packed that the phrase 'packed like sardines' meaning packed very tightly is in the common vernacular.
- Anchovy (Eangraulus encrasicolus) – Anchovy was used to make fermented fish sauces and waters; nuoc-mam and garum.
- Herring (Clupea harengus) – Herring is eaten in many forms including marinated, deboned, fried, pickled, salted, with or without tomato, oil, wine or vinegar, smoked. Other forms are Saur herring (cold smoked-turns reddish brown), bloaters (ungutted then moderately smoked), bucklings (pickled in brine, then smoked), kippers (beheaded, flattened, lightly cold-smoked, sold fresh, frozen, or canned). Mackerel (Scomber spp.) – Including common mackerel (Scomber scrombus), Australian mackerel (S. australascicus), and Spanish mackerel (S. japonicus).
- Sea bream (Chrysophrys aurata) – Conger (Conger spp.).
- Swordfish (Xiphias gladius) Gurnard (Trigla spp.) – Including gray gurnard (Eutrigla gurnardus), red gurnard (Aspitrigla cuculus), sea robin (Prionotus carolinus).
- Lamprey (Petromyzon spp.) – Including river lamprey (Lampetra fluviatilis) and Pacific lamprey (Entosphenus tridentalus).
- Redfish (Sebastes spp.) – These include the large redfish (S. marinus), large-scaled scorpion fish

(Scopraena scrofa), and small-scaled scorpion fish (Scopraena porcus). Both scorpionfish have venomous spines.
- Goatfish (Mullus spp.) – Including surmullet (Mullus surmuletus), red goatfish, striped goatfish (Mullus barbatus).
- Salmon (Onchorhynchus spp.) and (Salmo salar) – These include chinook or king salmon (O. tshawytscha); sockeye salmon or red salmon (O. nerka); coho salmon or silver salmon (O. kisutch); pink salmon (O. gorbuscha); chum salmon (O. keta); Atlantic salmon (Salmo salar), which is the only salmon found in the Atlantic ocean; ounaiche or landlocked salmon (Salmo solar ouananiche).
- John Dory (Zeus faber) Cod (Gadus spp.) – From which the salted smoked fish called bacala (Italian) or bacalhau (Portuguese) is made. Also including North Atlantic cod (G. morhua), North Pacific cod (G. macrocephalus), as well as haddock (Melanogrammus aeglefinus), hake (Merluccius spp.), common hake (Merluccius merluccius), silver hake (M. bilinearis), whiting (Merlangius merlangus), black pollock (Pollachius virens), tomcod (Microgadus tomcod) also known as frostfish. French salted or dried cod is called morue, and fresh or frozen cod is called cabillaud.
- Smelt (Osmerus spp.) – Including American smelt (O. mordax), European smelt (O. eperlanus), and capelin (Mallotus villosus).
- Tuna (Thunnus spp.) – Including bluefin tuna or tunny (Thunnus thynnus), albacore or white tuna (Thunnus alalunga), bonito (Sarda-sarda), yellowfin tuna (Thunnus albacares). Tuna is mostly canned, but can also be made into steaks.
- Skate (Raja spp.).
- Shark (selachian family) – Including hammerhead shark (Sphyrna zygaena), picked dogfish (Squalus acnthias), smooth hound (Mustelkus spp.), large spotted dogfish (Scyliorhinus stellaris), and school shark (Galeorhinus galeus).
- Plaice (Pleuronectidae. family) – Including American plaice (Hippoglossoides platessoidies), common plaice (Pleuronectes platessa), winter flounder (Pseudopleuronectes americanus), witch flounder (Glyptoccephalus cynoglussus), common dab (Limanda-limanda), yellowtail flounder (Limanda ferruginea), lemon sole (Microstomus kitt), flounder (Platichthus flesus), and summer flounder (Paralichthus dentalus).
- Turbot (Psetta maxima).
- Halibut (Hippoglossus spp.) – Including Greenland halibut (Reinharditus hippoglossoides).
- Sole (Solea spp.) – Including common sole (Solea solea).

See Caviar, Nuoc-mam, Garum, Crustaceans, Fugu.

Fish Mint (Houttuynia cordata) – Used in Vietnamese cuisine, the leaves of this heart-shaped herb have an unusual fishy flavor with a slightly sour character as well. It is a somewhat polarizing flavor as some people focus on the peculiar fishiness of the herb.

Fishy – Reminiscent of fish or protein deammonization by-products. High in aliphatic amines. Fishy characters have also been noted from the oxidation of linoleic acid-containing fats. See Aminoid, Oxidation, Fat.

Fit – Developed by the TTB, fit means acceptable or potable. A product needs to be unfit to be eligible for alcohol tax drawback. See TTB, Drawback, Unfit for Beverage Use, Flavor Unfitness Worksheet.

Five Spice (Mixture) – See Chinese Five Spice Mixture.

Fix (Load) – The percentage of oils in a spray dry. See Solids, Fixed Oil.

Fixation – The process of applying a fixative to a blend. See Fixative.

Fixative – A fixative is a product that by virtue of its physical or chemical characteristics actually lowers the overall boiling point of a mixture or components in the mixture or appears to lower the overall lightness or volatility of a mixture. This concept is used mainly in fragrances (perfumes); however, the concept of volatile fixation in a flavor is also one that enables a product to attain an increased degree of background flavor character, increased heat stability, microwave stability, or even extended shelf life. See Shelf-Life Stability, Microwave (Stability), Heat Stability, Background, Volatility.

Fixed Oil – The flavor 'oil' that has been effectively entrapped within the matrix of the spray dried media. The fixed oil as opposed to the unprotected surface oil percentage is used in the calculation of encapsulation effectiveness. Spray dry efficiency = (total oil – surface oil)/total oil. Total oil – Surface oil = Fixed Oil. See Spray Drying.

Flame Ionization Detector – See FID, Detectors, GC.

Flammability, Flammable Materials – The characteristic that describes a chemical's ability to catch on fire. Another spelling of the word is inflammable. See Flashpoint, Inflammable.

Flashpoint – The temperature at which a substance will burst into flames in the presence of a source of ignition, a spark, open flame, static, etc. There are two accepted methods of determining flashpoint: closed cup and open cup. The closed cup method

produces the more acceptable data, and is more widely used for adherence to regulations. See DOT, Hazardous Materials, Flammable Materials.

Flask – A glass apparatus with a larger butt and a thinner neck that usually holds a liquid. There are two main types of flasks: an Erlen-Meyer flask and a Florence flask. An Erlen-Meyer, which is the more widely used type for weighing materials on a scale, has a flat conical bottom. A Florence flask, which is more widely used for distillation, has a round bottom. It often sits in a heating mantle, which is an electronically heated jacket that covers the bottom of the flask. See Distillation.

Flat –

1. An area in a continuous flavor profile where there is a drop or leveling off of flavor within a given range.
2. In a time intensity profile curve, areas of the curve that indicates a steady, non-changing flavor profile.
3. A carbonated product that has lost its carbonation.
4. In tea terminology, lacking briskness or pungency. Flatness is a result of the incorrect processing of tea or incorrect growing conditions. This includes conditions and processes such as improper firing, over-fermentation, overwithering in the field. See Sensory Evaluation, Time Intensity Profile, Time Intensity Curve, Brisk, Pungent, Fermentation.

Flavedo – The flavor rich section of the peel. An example is a citrus peel where the essential oil is stored in the flavor buds. See Albedo.

FLAVIS Number – 'In 1996 the European Parliament and the Council laid down a procedure for the establishments of a list of flavoring substances in the E.U. Each flavoring substance was attributed a FLAVOS-number (FLnumber) and all substances are divided into 34 chemical groups. Substances within a group should have some metabolic and biological behavior in common.' See JECFA, E.U. Positive List.

Flavones – See Isoflavones.

Flavonoids – Those components found in the cell sap, flowers, and fruits of plants. Anthocyanins are flavanoids that can vary in color according to pH becoming purplish-blue at higher pHs and pinkish red in an acid environment. Flavonoids can be classified into three chemical categories: flavonoids (derived from 2-phenylchromen-4-one (2-phenyl-1,4-benzopyrone) structures), isoflavonoids (derived from 3-phenylchromen-4-one [3-phenyl-1,4-benzopyrone] structures), and neoflavonoids (derived from 4-phenylcoumarine [4-phenyl-1,2-benzopyrone] structures). Recent press indicates flavonoids are helpful as antioxidants, potentially slowing down the aging process; however, this has not been proven. Recent studies have shown that they seem to assist in the prevention of diseases such as cancer and heart disease. Flavonoids are also commonly referred to as bioflavonoids. See Anthocyanins, Isoflavones, Antioxidants, Nutraceuticals.

Flavor – The combination of odor and taste. Some describe total flavor as including textural (temperature, coolness, etc.) attributes, color, and sound; in other words, the total sensory experience. See Aroma(s), Taste, Organoleptics, Tongue, Sensory Analysis, Nose.

Flavor Adjuvant – An ingredient that affects the food product and/or aids in the perception of the flavor. These are the non-flavoring ingredients that are also non-foods. See Adjuvant.

Flavor Bases – A processed flavor system usually presented in a paste, made from cooked meat, fat, precursors, sugars, spices, etc. These bases are used often by chefs at higher than normal flavor usage levels.

Flavor Benefits – A train of thought and research that shows olfaction and taste are hard wired into the inner workings at the brain. One corollary to this would be that well-being and life enhancement effects could come directly from the ingestion of pleasing flavor sensations. Citing the positive effects of flavors is an important response to adverse publicity. This concept has a relationship to aromatherapy. See Aromatherapy.

Flavor Biogenesis – The chemical pathway or route of development of flavoring materials in nature. The flavor biogenesis can occur through the following pathways:

1. The biosynthetic pathway: (a) Includes the flavor buds of citrus fruits generating terpene-rich essential oils that can be either expressed or distilled. (b) Contact (seeds and pits) includes the leeching of volatile compounds (ionones, esters, terpenoids, etc.) from one organic structure to another. Like the seeds of a raspberry flavoring the pulp of the fruit and subsequently the juice as well. (c) Precursor breakdown. Example: the glucoside amygdalin, which forms benzaldehyde and HCN through the action of glucovanillinase. Glucovanillin becomes vanillin and glucose, and sulfur compounds in garlic developed from enzymatic (allicin) degradation of sulfur containing amino acids (alliin). (d) Enzymatic. Table browning is when a fruit is either left to ripen or bruised and it turns brown. This is a step in the ripening process that is enzymatically induced (polyphenyl oxidase).

2. Fermentation, and similar reactions where the application of an outside organism, enzyme, or other non-heat factors, can change the flavor system of a food. In the fermentation of wine, beer, etc., enzymes from an outside source (yeasts) enable the metabolism of sugars by yeasts. The by-products of fermentation (i.e., mainly ethyl alcohol, but also smaller amounts of other alcohol esters, acids, and tact compounds) comes from the metabolism of the yeast cells.
3. Oxidative pathway is where fats and oils and other oxygen sensitive chemicals can oxidize to form trace compounds like aldehydes, acids, and alcohols. Oil rancidity is an example of this. This takes place without the presence of heat.
4. Pyrolitic pathway is when heat is introduced, a host of chemical reactions take place. Caramelization burning, Maillard Reaction. The Maillard Reaction is called a non-enzymatic browning, which is represented by the reaction of amino acids and sugars forming pyrazines, thiazoles, thiazolines, etc., and not the action of enzymes.

Flavor Chemist – A professional that employs chemistry in the development of flavorings. A flavorist that has a chemistry degree or background. See Training.

Flavor Company – See Flavor House.

Flavor Description – The describing of flavor systems has been a source of confusion for many years. Many have devised procedures and standards to resolve this issue. See Flavor Nomenclature Workshop, Flavor Profile Analysis, Dynamic Flavor Profile Method.

Flavor Descriptive Analysis – The procedure by which a flavor is described using predetermined descriptors. See Sensory Evaluation, Dynamic Flavor Profile Method.

Flavor Descriptors – Words used to describe a flavor's volatile sensory attributes. See Lexicon, Descriptive Analysis, DFPM.

Flavor Enhancer – See Enhancers.

Flavor House – A term that signifies the company that produces flavorings.

Flavor Ingredients – With all of the adjuvants, and non-flavoring ingredients, modifiers and other items that can be used in a flavor we shall concentrate solely on the flavoring components of natural and synthetic varieties. For the most part synthetic Ingredients come from the petroleum industry via the selective distillation or cracking of petroleum and subsequent chemical reactions that provide thousands of chemical compounds, or terpene based chemistry based on the byproduct of the wood and paper industry called crude sulfate turpentine, again synthetically treated and modified to provide artificial Ingredients. For natural products the processes are quite varied including all of the ways natural products are defined by the FDA including toasting, roasting heating enzymolysis, distillation, extraction etc. See Natural Flavor Definition, FDA, CFR.

Flavorist – One who practices the creation of flavors. See Training, Flavor Chemist.

Flavor Legislation – See BATF (TTB), USDA, FDA, DOT, OSHA, FEMA, CFR, IATA.

Flavor Lexicon – A list of descriptors put out by both the American Society for Testing and Materials and the Society of Flavor Chemists. See Nomenclature, Henning, Zwaardemaker, Crocker Henderson Odor Classification System.

Flavorist Training Program – A set of procedures and policies designed to train people in the art and science of flavor chemistry. Training programs are set out mainly to teach general food science and the organoleptics of natural and synthetic chemicals, essential oil, oleoresins, distillates, juice concentrates, essences, florals, thermally processed flavors, spices, adjuvants, and extracts and how they can be combined to simulate those found in nature. A good flavorist must be more than that in today's industry. Regulatory issues, nutritional issues, shelf-life and production issues, as well as flavor characteristics of GRAS ingredients, are necessary fundamentals. A general training program could be outlined as follows:

1. Organoleptic experience – Tasting and smelling of chemically related homologues in water, acidified water, and sweetened systems. These will include chemicals, extracts, and essential oils.
2. Application experience – Tasting different flavors and flavor ingredients in base systems to see how they differ in different media, through different processing conditions, etc.
3. Regulatory and commercial experience – A flavorist must know the applicable regulations for FDA, BATF, USDA, DOT, and other governing bodies. The flavorist should begin to learn concepts like sensory testing, market analysis, and other commercial and marketing aspects to better communicate with internal sales people or the customers themselves.
4. Artistic or practical experience – The applicant should also spend much of the training period (this is by far the longest) in the appreciation of how flavors are made, how ingredients blend, how products can be enhanced, substituted, masked, and synergized. Care must be taken to develop a good mental library of natural products and how they can be simulated. A good

training program will include a great deal of solid reference material. The flavorist should spend much time working with the mentor (a requirement to join the Society of Flavor Chemists) and practice the art. The culmination of the training experience is the opportunity to join the Society of Flavor Chemists after 5 years of training ending in passing a test by the Membership Committee to be an apprentice member and then again at the end of 7 years to pass the test once more and be a certified member.

See Society of Flavor Chemists, Syllabus.

Flavor Labeling – The policies and procedures that apply to the labeling of foods and the labeling of flavors follow:

1. Flavor labeling – CFR Title 21 Food and Drugs, Sections 101.1 to 101.29
2. Protein hydrolysate labeling – CFR Title 21 Food and Drugs, Sections 102.22
3. Food labeling – CFR Title 21, Food and Drugs, Sections 101.1 to 101.l08 and Appendix A, Part 101 and Appendix B, Part 101.

See FDA, USDA, BATF, FTC, USDA.

Flavor Modification – The alteration of the profile of a flavor submission so it better resolves the customer's issues at hand, be it a different profile, better stability in the process, or another adjustment.

Flavor Nomenclature Workshop – The demonstration and seminar developed by this author to establish a common language for the description of flavors.

Flavor Profile – The overall attributes of taste and aroma of food products. See Rounded, Disjointed, Time Intensity Curve.

Flavor Profile Analysis – First developed by A.D. Little, a system that assigns from a list of descriptors, attributes to a given product. See Texture, Profile, Descriptive Analysis.

Flavor Reactions and Interactions – Reactions within the flavor can happen upon storage. These reactions can be favorable or unfavorable, but most are unavoidable. Some can be controlled through the use of antioxidants and/or sequestrants, and most are at issue in Shelf-Life Testing. See Storage Stability, Shelf-Life Testing, and Chart 418 – Flavor Reactions.

Flavor Quality – An entirely subjective assessment of the performance and character of a flavor. Some have claimed that a good flavor is one that sells. This may be true at first glance; however, many systems are developed to be just good enough for the marketplace but could have been optimized and might soon fail. Also other flavor parameters might not come to light until longer ambient shelf-life conditions are maintained. Also, one person's great flavor may be another's failure. The complexity of people's likes and dislikes and organoleptic sensitivities all have an effect on a product's success rate and usually are never taken into account. See Food (Flavor) Quality.

Flavor Regulation(s) – See BATF (TTB), USDA, FDA, DOT, OSHA, FEMA, CFR, IATA.

Flavor Safety – Flavor safety concerns involve different levels of exposure, flavor manufacturing exposure, flavor laboratory exposure, flavor applications exposure, flavor plant exposure, end product flavor using plant exposure, and finally consumer exposure. We will discuss this from the last or least exposed forward. Consumers are exposed to flavors that are used at levels that are minute. The levels of ingestion appear at parts per million and oftentimes as little as parts per billion and less. The consumption ratio has been discussed elsewhere, and the argument can be made whether or not the chemicals that we are exposed to by using flavors exceed or are exceeded by those chemicals already found in food. The overuse of flavoring materials to toxic levels has been deemed by the Food and Drug Administration as being 'self-limiting,' that is, the levels of disgust where flavoring are 'way too high' and unpleasant are well below toxicity levels. There has been one case cited that prolonged exposure to the specific chemical, diacetyl in buttered popcorn, smelled as a hot aroma right out of the microwave, caused a lung disease. A study is currently being conducted that might indicate after this exposure is discontinued and the disease has not progressed, the symptoms might reverse. This needs further exploration. Chemicals that were discovered to have been developed as contaminants in processed flavors were thought to be suspect, but again, levels found already in cooked foods were higher than levels obtained from flavors, and the body appears to handle those effectively. The Flavor Expert Panel has reviewed and continues to review the safety of GRAS materials. As far as production facilities that use flavors, the exposures are higher than with consumers. Here the chemical diacetyl has been cited as causing bronchiolitus obliterans, a serious lung disease. Some claim that the chemical would not have caused this effect if sufficient OSHA guidelines were followed; however, this is currently under investigation. Flavors should be treated like any other mixture of chemicals in the levels of industrial size. Flavors should be used by those using eye protection and skin protection and even breathing masks when necessary. Although flavors are GRAS and food grade, they are chemicals. People would not want to put vinegar in their eyes, and that is a food. This respect for flavors should also translate to the laboratory that produces and creates flavors. Eye,

skin, and perhaps mouth protection should be used when logic dictates. In the flavor plant, the exposure levels are much higher. Here, chemicals that are heated should be produced where adequate ventilation is present. The use of face masks, air movement, and respirators are all good manufacturing practices that should also be followed. See GRAS, Self-Limiting, Expert Panel, GMO, Good Manufacturing Practices, Feeding Studies, Flavor Safety Assessment.

Flavor Safety Assessment – Due to the nature of the solvents used in flavors, namely ethanol, triacetin and propylene glycol, the flavors themselves and the production areas associated with mixing the flavors can be considered low care/low risk areas. Challenge studies have concluded that 20–30% Propylene Glycol, 12.5% Ethanol or 75% Triacetin (Glyceryl Triacetate) have bactericidal properties and minimize the risk in flavor plants. This is not meant to say that flavors can be used as antimicrobials as flavoring systems have been GRAS approved for the purpose of introducing flavors and not to be used as such. It is further known that phenols, terpenes, and similar substances have similar antimicrobial characteristics and that these compounds are often used in flavorings. See Solvents, Challenge Studies, Propylene Glycol, Ethyl Alcohol, Triacetin.

Flavors with Modifying Properties – Those GRAS ingredients that enhance, subdue or otherwise effect other flavors without themselves being sweeteners or flavorings. FEMA has developed a protocol published in the November 2013 Edition of Food Technology. See Enhancers, Modifying Properties, Sensory Evaluation.

Flavor Trends – See Trends.

Flavor Unfitness Worksheet – The form developed by the TTB that assesses the flavor's potability based on the presence of select chemicals. Some of the decisions based on these chemicals for potability considerations was based on 5× the maximum levels of flavor ingredients published by Fenaroli's Handbook of Flavor Ingredients. See Unfit, Fit, TTB, Potability.

Flavor Wheels – See Wheels.

Flavour – The spelling used by Great Britain and countries in the European Community (EC) or in countries that accept the EU-based approach over that of the United States.

Flavory – A tea terminology that indicates a certain seasonal, district related, or 'Green-fly' tea.

Flaxseed Oil – A cold pressed, non-solvent extracted linseed oil, useful as a nutraceutical for its high omega 3 fatty acids, especially alpha-linolenic acid. Omega 3 fatty acids have shown to be beneficial for heart health. Flaxseed is also used in the prevention of inflammatory bowel disease, arthritis, and other health conditions. Flaxseed oil contains lignans that might be cancer preventatives. See Solin Oil, Fats and Oils, Linseed Oil, Nutraceuticals, and Appendix 2.

Fleabane – See Erigeron.

Flesh –

1. The meaty portion of an animal product under the protective skin or hide.
2. The soft edible tissue in the inside of a fruit or a vegetable.

FLEXPAN – An acronym meaning the Flavor Expert Panel, comprising of Medical Experts, Toxicologists, Biochemists, etc. See GRAS, Expert Panel, FEMA, Toxicology.

Flinty – In wine, the flavor similar to the sulfury metallic smell of struck flint. This is typically due to metallic ions present within the wine and is usually due to soils with a high mineral soil.

Flocculation – The process of forming larger-sized particles from smaller particles, which then can be filtered out. Flocculation, therefore, is often used to clarify a liquid.

Floral – Reminiscent of a flower. Floralcy is usually associated with an aldehyde or alcohol of a terpene or aliphatic aldehyde such as decanal at lower levels. Some chemicals that are nonbased exhibit floralcy. The best example is phenyl ethyl alcohol, reminiscent of and found in rose absolute. See Aldehydes – Aliphatic and Ketone Aldehydes and Cyclic Aldehydes, Alcohol, Level, Absolute, Terpene, and Chart 415 – Floral Terpene Esters and Ethers.

Floralcy – The quality of having a floral character.

Floral Terpene Esters and Ethers – In general, these products are based on terpene alcohols, although some phenyl ethyl esters could be considered here as well. Some of the common floral terpene esters are based on citronellol, geraniol, linalool, and terpineol. See Chart 415 – Floral Terpene Esters and Ethers.

Florentine – A style of food consisting of spinach, butter, cheese, and Mornay sauce.

Floret – Also called an inflorescence. A floret is a structure that contains many flowers, like broccoli.

Flour –

1. Flour is the generic description of a finely ground food, usually a grain or a vegetable. Flour can be made from wheat, barley, buckwheat, oats, millet, rice, wild rice quinoa, corn, amaranth, rye, triticale, chestnuts, manioc, chickpeas, lentils, potatoes, peanuts, and manioc. The types of flour include whole wheat (made from the entire grain), Graham flour (whole wheat flour with bran), and often without the germ (for shelf-life extension), all-purpose flours (a mixture of soft and hard wheat flours), cake and pastry flour

(fine grind, low protein, high starch flour), self-rising flour (one which has had a leavening agent added usually baking soda or sodium acid pyrophosphate), unbleached flour (one using natural bleaching, with a stronger end flavor), gluten flour (a starch-free flour), and bread flour (high gluten bard wheat flour).
2. Flour can also be the designation of extremely fine grind as in flour salt.
3. In culinary arts, flour is used as a thickener in a jus lié and as both a thickener and a source of proteins for the Maillard Reaction that transpires during the development of a roux.
4. Flours used to avoid gluten containing wheat flour include; Almond, Coconut, Garbanzo, Millet, Quinoa and others.

See Wheat, Grains, Allergens, Roux, Mother Sauces, Béchamel, Chart 490 – Gluten Free Grains Status.

Flow Rate –
1. Flow rate is the volume of gas in a piece of equipment that passes through a certain point in a given time. 2. Flow rate is the rheology of a semi-liquid. Flow rate can be measured by a Bostwick Consistometer. See Rheology, Thickness, Gums, Bostwick Consistometer, Centipoise, Viscosity, Analytical Chemistry.

Flowability – The characteristic of a liquid or a powder to move with relative ease. This is a measurement that is relative to ease of gravity migration or pouring, pumping, dumping, vibration feathering, corkscrew migration, sifting, etc. See Rheology, Physical Characteristics.

Flower Pollen – See Appendix 2.

Flowers (Edible) – The following flowers are edible and non-toxic. Although flowers do not appear often in U.S. cooking, they are used in exotic foods. In India, the festive rice dish called kheer is a seasoned rice flavored with rose water. Also, a Turkish sugar, cornstarch, and mastic blend called loukoum is flavored with rose water as well. Loukoum is used to soak baklava pastries. Rose is also used to flavor brandies. Blancmange is a creamy dessert flavored with orange flowers. Blancmange stems from medieval times and is popular in the Middle East. Ratafia is a spiced (cinnamon) cordial made from carnation petals. See Chart 415 – Edible Flowers.

Flue Curing – The process of drying tobacco and the casing by exposing to high temperatures or to direct flames in a tall chimney-like structure. See Hunter List, Casing, Tobacco.

Fluid Extract – A liquid extract prepared directly or more likely a dilution of a solid extract of the same source material.

Fluidity – The degree of flow of a liquid. The opposite of viscosity.

Fluidity Starch – A starch that cooks at a very high temperature and sets quickly. These types of starches are used in conjunction with molding starches to produce starch gel candies. Fluidity starches are acid-converted starches and are gelatinized by equipment such as jet cookers.

FMP – See Flavors with Modifying Properties.

Fo – The number of equivalent minutes at a temperature of 250°F to activate a microbial population with z value at 1°F. For clostridium botulinum Fo = 12D.

Fo-Ti or Polygonum multiflorum – See Appendix 2.

Foam – A colloidal dispersion of gas in liquid. Foam stability is important in some food products like marshmallows, whipped toppings, beer, etc., and products where foam stabilizers or foaming agents are used. Foam stability can also be a problem as well in other food systems. If an unwanted foam is present, a silicone-based defoaming agent may be used. An antifoaming agent is used before the foam forms and helps prevent it from forming. See Foaming Agents, Emulsion, Gel.

Foaming Agents – Products that are used to stabilize a foam already present and/or create a foam themselves. For the most part, proteinaceous products do the best job in this regard but Chart 419 – Foaming Agents lists other foaming agents of note. See Antifoaming Agents, Leavening and Aerating Agents.

Focused Mitigation Strategy – The part in a Food Defense Plan that Identifies how Actionable Process Steps can be controlled to eliminate the possibility of Intentional Food Adulteration. This is similar to the part of a HACCP plan that identifies Preventative Controls and Control Measures. See Food Defense Plan, Significant Vulnerability, Purposeful Adulteration, HACCP, HACCP Plan, Critical Control Point, Preventative Controls, Control Measure, Hazard Analysis.

Foenugreek – See Fenugreek.

FOIA – Freedom of Information Act – See Freedom of Information Act, Trade Secret (Protection).

Foie Gras – A delicacy produced by force-feeding a duck or goose through a gavage method and then using the liver in the food preparation. Force Feeding has been used for centuries for fattening and records of this technique goes back as far as ancient Egyptian culture. Force Feeding, Gavage.

Fold – The numerical designation that represents the ratio of final material of a folded oil that is left. One hundred pounds minus 90 pounds would leave 10 pounds and therefore a tenfold oil. A formula to use follows: fold = weight of starting material/weight of final material. See Folding of Extracts and Essences, Concentrated or Folded Oils.

Folded Extracts and Essences – Folding of extracts or essences is usually done under vacuum as with essential oils. The difference is that the sugars present will increase and might have a tendency to scald, burn, or caramelize if care is not taken. The very tops of the distillation are scalped and added back later as essence juice recovery products. See Vacuum Distillation; Terpenes, Oxygenated Components, Essence.

Folding of Extracts and Essences – The process of evaporation of the top notes or terpenes in a citrus oil or other essential oil to achieve a positive goal. Terpenes are unstable (oxidize and form rancid off notes), are insoluble in water (form rings around the neck of soda bottles), and are relatively weak (much less in strength when compared to the oxygenated components). Folding, which is a process of concentration, removes these terpenes so that the more stable, stronger and more water-soluble oxygenated aldehydes, alcohols, and other flavor compounds are enhanced. Folding is usually done in a vacuum still but can also be done in a blow over still. One hundred pounds of oil that has had 80 pounds of terpenes removed is therefore 20 pounds out of l00 or one-fifth the level it was originally. This is defined as a five-fold oil (although different techniques affect the accuracy of the fold number). See Vacuum Distillation, Terpenes, Oxygenated Components.

Foliate Papillae – A series of folded tissue or grooves in the rear surface of the tongue. They contain a number of taste buds, which are connected to the glossopharyngeal nerve. See Fungiform or Circumvallate Papillae.

Folic Acid – A vitamin essential to the production of red blood cells by the bone marrow. Found in liver and some vegetables, adequate amounts are usually available in a well-balanced diet. Deficiency of this vitamin results in megaloblastic anemia. See Vitamin Deficiency Diseases, RDA, Deficiency Diseases, Vitamins.

Fond –

1. A stock or base. These are called collectively fond de cuisine. There are three primary fonds de cuisine in classic French cooking. The first is a fond blanc or white stock. It is made from non-browned veal, poultry meat, possibly with vegetables, or fish. The second is fond brun or brown stock. This is made with browned beef, veal, poultry meat, or perhaps browned or caramelized vegetables. Often a caramelized tomato or tomato pinçage is used to give both flavor and color. The stock can also be colored with an onion brulée. The last is a fond de vegetal or pure vegetable stock, made with sautéed vegetables.
2. The flavorful bits at the bottom of a pan made from the caramelization and Maillard Reaction products of low moisture cooking techniques like a sauté. The fond is usually deglazed using liquid while still hot and then employed in the development of a sauce.

See Fumet, Stock, Caramelization, Maillard Reaction, Culinary Arts.

Fondant – A mixture of corn syrup or oil and sugar used in confectionery products.

Fond Blanc – See Fond.

Fond Brun – See Fond.

Fond de Vegetal – See Fond.

Fondue – A hot fluid dip made by mixing cheese with seasonings and/or flavors. Fondues usually contain alcohol, which lowers the boiling temperatures below those where cheese will burn.

Food – Nourishment. That which an organism ingests to provide nutrients in order to sustain its life's functions.

Food Additives Amendment of 1958 – An amendment to the act of l938 that provides for the protection and safety of the food supply by requiring proof of safety of food additives. This initiated actions by the Flavor and Extract Manufacturer's Association to appoint the select Flavor Expert Panel to review and devise the GRAS list. The committee was organized by Ben Moser. This act is also the one incorporating the wording of the Delaney Clause. See Delaney Clause.

Food Allergen Labeling and Consumer Protection Act of 2004 (Title II of Public Law 108–282) – The Act starts off as follows:

A. Approximately 2 percent of adults and about 5 percent of infants and young children in the United States suffer from food allergies; and
B. Each year, roughly 30,000 individuals require emergency room treatment and 150 individuals die because of allergic reactions to food
C. Eight major foods or food groups – milk, eggs, fish, crustacean shellfish, tree nuts, peanuts, wheat, and soybeans – account for 90 percent of food allergies
D. At present, there is no cure for food allergies; and
E. A food allergic consumer must avoid the food to which the consumer is allergic. The final result is that all flavors must be labeled according to allergies contained within despite those levels. (A de minimus approach is now being taken, but no indications are if it is to be written into the regulations.) The flavor label should read: Allergen – (The Common and Usual Name – listed in C); Next to the categories 'fish,' 'crustacean shellfish,' and 'tree nuts,' shall also be listed the specific name. Example: Allergens – Tree Nuts – Brazil Nuts. See Allergens, Food Allergy, Anaphylaxis.

Food Allergy – The inappropriate reaction of the immune system to a food. Small children are often allergic to cow's milk, wheat, shellfish, eggs, nuts, and particular peanuts, which produce some of the strongest reactions. These reactions are usually uncommon, but can be fatal. This extreme sensitivity to an allergen can result in the complete shutdown of the body, called anaphylaxis. Food allergy is more common with people who suffer other allergies as well like allergic rhinitis hay fever, asthma, and dermatitis. The best way to protect against potentially lethal reactions is to avoid the allergen. Immediate reactions can occur or reactions can delay for a few hours. Some symptoms are lip swelling, tingling in the mouth and throat, itching, the development of hives, throat soreness, throat swelling, abdominal distention, borborygmi (audible bowel sounds), and diarrhea. In the worst case where a total shutdown of the immune system occurs as in anaphylaxis, immediate medical attention must be administered or the result can be death. In this case, people with this potential should carry a self-administrable epinephrine injection called an epi-pen (epi is short for epinephrine) at all times. Food allergies are becoming an area of great concern, and companies are now requesting statements of their suppliers as to the presence of nut products. Wheat products, fish proteins, peanut products, and other potential allergens provide sources in order to furnish information so that the customer can assure the safety of their foods. Studies show that the allergen might not only be a specific protein, but in order to be a food allergen, the protein must fit in a range of molecular weight. The allergens that elicit the most severe responses are those that mitigate a protein called IgE. Most reactions to chemicals are therefore sensitization reactions and not allergic reactions. However, sensitization reactions can also be acute and can elicit other adverse bodily reactions as well. See Food Safety, Chinese Restaurant Syndrome, Food Allergen Labeling and Consumer Protection Act of 2004, Food Intolerance.

Food Allergy and Anaphylaxis Network (The) – (FAAN) – An organization which states that they are the providers of education, advocacy, research, and awareness. www.foodallergy.org

Food and Drug Administration (FDA) – The governing body that regulates foods, drugs, and cosmetics. The laws that the FDA passes are compiled in CFR Title 21.

Foodborne Infection – Any infectious illness whose cause is the ingestion of food tainted by bacteria, virus, worms, or other organisms. There are two ways that food may become infected with harmful organisms. One way is that the food itself comes from an animal that harbors the organism as a host. A second way is through handling, processing, or environment, and the food becomes exposed to an organism. In less affluent, third world countries, foodborne infection is much more common than in developed countries, where sanitation and removal of waste has become routine. Inoculation against diseases like typhoid and cholera provide only a partial solution, and hygiene and good sanitation are the only real choices for the assurance of good food safety. One quandary facing microbiologists was; 'If bacteria like salmonella are destroyed at low pH and the stomach levels are typically around 2.0, how do these bacteria survive to infect the body?' One possible answer as published in Nature Magazine is that a full stomach can raise the pH to about 6, that the food surface itself somehow protects the bacteria, and that the presence of free amino acids seems also to aid in their acid resistance. See Microbiology, Food Safety.

Food Chemicals Codex (FCC) – A collection of monographs that prescribes minimum standards for purity, source, and physical constants consistent with good manufacturing practices and food grade status. Quoted from the Food Chemicals Codex; 'FCC Does Not Provide Information on the Regulatory Status or Safety of Food Chemicals' and 'FCC Serves as a Resource for Companies That Manufacture, Process, or Use Food Ingredients and Seek to Determine Minimum Standards for Components of Their Food Products'. Furthermore FCC does not distinguish between natural and artificial chemicals. The FCC is recognized as a standard by the FDA's Code of Federal Regulations and the Joint Expert Committee on Food Additives Is recognized by the FAO/WHO of the United Nations as having approval and oversight over flavoring substances within the Codex. Some of the tests used such as IR have been described as obsolete in light of other more definitive tests such as GC/Mass Spec. Discussions have taken place within the Science Committee of FEMA illustrating some areas where the FCC standards can also be modernized and/or better defined. See USP, NF.

Food Contact Surfaces – Areas that come into direct contact with food products in the plant are considered food contact surfaces. This can include but is not limited to food conduit piping in continuous operations, mixers, paddles, sieves, packaging, scoops, thermometers, or cookers. It is important that these surfaces remain free from potential contamination from personnel, extraneous matter, microorganisms, non-food grade substances, and

non-food grade equipment. Stainless steel is the recommended surface for food contact surfaces because it is very cleanable and certain alloys blends resist corrosion. See HACCP, Food Safety, Stainless Steel.

Food Code 2013 – The latest ruling by the Food and Drug Administration as of the writing of this book. Annex 4 has a table that lists the main pathogenic organisms found in retail and restaurants and the recommendations by the FDA for their remediation. See Food Safety, Microorganisms, Microbiological Assay, HACCP, Environmental Sampling Plan, Food Code 2013 Annex 4.

Food Code 2013 – Annex 4 – Table 1a–1c Selected Biological Hazards found at retail, related foods and control measures. A useful chart published by the FDA found in the Food Code 2013 in the internet. See Food Safety, Microorganisms, Microbiological Assay, HACCP, Environmental Sampling Plan.

Food Danger Zone – The temperature range wherein most harmful organisms can flourish. It is between 41°F and 140°F. When making a stock, it is imperative to cool it down immediately so the danger zone is not maintained. Furthermore, due to heat penetration and conduction, metal containers are better than plastic for cooling. See Food Safety, Pathogenic Microorganisms.

Food Defense Plan – The Document developed independently of the HACCP Plan which describes the steps taken to avoid Intentional Adulteration. The sections of the Food Defense Plan are similar in scope to the seven steps of the HACCP Plan. See Significant Vulnerability, Actionable Process Steps, Focused Mitigation Strategies.

Food Drug and Cosmetic Act of 1938 – Its law is still enforced today. It defines a food, prohibits adulteration of foods, defined labeling of foods, and set some standards of identity. See Food Additive Amendment of 1958.

Food Energy – Calories from foods are published by the USDA in the Agricultural Research Service under the National Nutrient Database for Standard Reference. Energy is cycled through the ATP/ADP cycle absorbing energy from food to become ATP and releasing energy into the body to form ADP. This aerobic respiration represents the addition of oxygen with molecules within the food. Calories (Cal) or Kcal is 1000 calories. Most Food Energy calculations are determined by direct oxidation in a bomb calorimeter. This gives a somewhat erroneous as the actual calories used in metabolism (The Metabolizable Energy Intake) is different from the molecular energy of oxidation due to the sequence of chemical and enzyme reactions that take place. Furthermore, different types of ingredients are metabolized differently. Also, when on a diet there is an adjustment made by the body to prevent starvation so metabolism is not linear to intake. One study show an approximate 13% overall reduction on top of the typical metabolic decrease over a long period of time. Some studies show that protein reduces appetite, fiber reduces calorie absorption, and time of day (Thermal Effect of Food) affects metabolism and calorie expenditure just on the basis of normal digestion requirements and organ needs. The resting energy expenditure or REE, is the normal expenditure of calories at rest mostly by the liver brain and heart and counts more from body mass, gender age and hormones than exercise. See Calories, Ribose, Energy.

Food Grade Acceptability – Edible and safe. In some instances, monographs in the Food Chemicals Codex prescribe tests and purity specifications that enable the flavorist to be assured that the product is food grade. However, with all of the flavor materials, this is not the case for everything. Care must be taken that the flavoring material is made by a reputable source, that the compound is GRAS, that the purity is sufficient, and that there are no other harmful materials as contaminants derived from the source or the process. Legally the addition of non-food grade material to a food flavoring constitutes criminal adulteration. See Grades.

Food Guide Pyramid – The history of food guides includes a sequence of recommendations; Basic 7 (1943–1956), the Basic Four (1956–1992), the Food Guide Pyramid (1992–2005), and MyPyramid (2005–2013). The previous pyramid recommended food consumption pyramid developed first by the USDA in 1992 and then updated in 2005. The pyramid illustrates that certain foods can be consumed in larger quantities (grains, vegetables) while others must be consumed in moderation (fat, salt). Recently, the USDA developed a new guide called MyPlate, because it was said the pyramid was too confusing and found on the internet at 'choosemyplate.gov'. See MyPlate, MyPyramid, Nutrition, NLEA.

Food Industry – The segment of the marketplace that deals with all aspects of the food we consume, produce, market, export, and import.

Food Intolerance – The inability to handle or digest certain foods by certain individuals. This is not ascribed to physical disorders or to food poisoning. The root of food intolerance can be physical due to organ malfunction, or inappropriate enzyme production, or other organic causes. Lactose intolerance is one of the most common types of food intolerance due to a deficiency in the production of lactase and enzyme that breaks lactose down into simpler

mono-sugar. Food intolerances range from least severe to very annoying to major. MSG has been deemed to be a minor intolerance while lactose intolerance can be quite problematic. Celiac Sprue disease can be severe while intolerance to sulfites can be life threatening. See Food Allergy, Gluten, Sensitivity, Food Sensitivity.

Food Labeling Laws – The Code of Federal Regulations Title 21 of the Food and Drug Administration defines clearly the appearance and requirements of food labels including nutritional information, pictures, representations, claims and inferences. Type size color and description are discussed as well as other label details. As of the writing of this edition the FDA and to a greater extent the USDA is exploring a clearer definition for the term natural as it involves other than flavors but is used to describe ingredients in general. Natural Flavor Definition, FTC, FDA, USDA, Organic, Claims.

Food Masking Agents – Flavor blends that can cover up certain adverse flavor characteristics found or developed in foods during processing. Certain brown, spicy, or minty blends can do an adequate job on certain off notes.

Food Poisoning – The illness derived from the ingestion of food with varying degrees of stomach pain and nausea, vomiting, and diarrhea. The onslaught of symptoms can occur up to 48 hours after ingesting the food in question. Food poisoning is classified into two main categories: infectious and non-infectious. Infectious types include bacterially contaminated shellfish. Some livestock like chickens are susceptible to bacterial contamination. If frozen chicken is not completely thawed, before cooking, food poisoning can occur. Some bacteria, such as salmonella, can be transmitted to food by flies and by people who do not wash thoroughly after using the lavatory, and by animals that are infected. If contaminated food is left at room temperature to warmer temperature (incubation temperature), a surge of growth of the microorganism can then occur. Some microorganisms are very difficult to destroy by cooking. Staphylococcus is one of them. Two types of viral infection, the Norwalk virus (from shellfish) and rotavirus can cause food poisoning. Poisonous plants, like mushrooms can also cause food poison. Also chemical poisoning by use of pesticides and fertilizers can be another source. See Food Preservatives, Preservatives.

Food Producers Association – Formerly the NFPA (National Food Producers Association) conducts FPA-safe audits and maintains quality standards. Members meet to help solve issues of the food industry.

Food Product Cycle – A sequence of events in the lifetime of a food product and therefore the flavor it uses. A product goes through a lengthy development time, sometimes years. In the initial introduction there could be a spike in sales due to the filling of the pipeline. Then, after the initial introduction a food goes through an initial stage of sale and repeat purchase. If the product is a good one, it can 'Take off' and sales increase. Sometimes this can take a while as well depending on the nature of the product, advertising, distribution, etc. At the peak of sales a few things can happen; either the product loses its 'luster' or people don't buy it as often, another more competitive (cheaper, better) comes into play, or there is negative publicity about the product. Sales begin to dip and might come back a little equilibrating to a sustainable level or the product could be discontinued due to lack of revenue. See Marketing.

Food (Flavor) Quality – As opposed to food safety, food quality is the assurance of a consistently reproducible flavor profile. Shelf life packaging and storage considerations come into play. Best used by or good until are frequently used terms for shelf life. See Shelf Life, accelerated Storage Conditions, Accelerated Storage Testing.

Food Safety – Food Safety is the subject of how the foods that we consume can be maintained as healthful sources of nutrition and enjoyment. It is the application of safe biological principles, the engineering of systems and food plants that use cGMP or current good manufacturing practices, and the employment of sound Hazard Analysis by Critical Control Points (HACCP) systems. HACCP involves an analysis of a food production system from a risk-based perspective through a seven step process. The process is as follows: (a) Conduct a hazard analysis; (b) Identify Critical Control Points; (c) Establish Critical Limits for Each Control Point; (d) Establish Critical Control Point Monitoring Requirements; (e) Establish a Corrective Action Program; (f) Establish Record Keeping Procedures; (g) Establish Procedures that assure the HACCP program is working appropriately. The HACCP plan is developed and identifies prerequisite programs including environmental monitoring, equipment cleaning, personnel issues and many more as well as the identification, monitoring and documentation of Critical Control Points. All together this is considered the extended HACCP Plan. See Prerequisite Programs, Pre-operation Procedures, GMP, Post Operation Procedures, CCPs, Allergen Protocol, Extraneous Matter Protocol, Environmental Monitoring, Safety Assessment, Corrective Action Procedures, Continuing Improvement Practices, Shipping and Receiving Protocols, Microbial

Monitoring, Cleaning Procedures, Verification Practices, Validation Studies, Verification versus Validation, HACCP, Current Good Manufacturing Practices (cGMP), Pathogenic (Pathological) Organism, Pasteurization, Flavor Safety.

Food Safety Auditor(s) – Food Safety Auditing Plans, Systems, Requirements – In response to the Food Safety Modernization Act of the United States and the Global Harmonization System of the United Nations, many Food Safety Systems have arisen. Some of these include BRC, SQF, Iso 9001, AIB, IFS, FSSC 2200. See BRC, SQF, ISO 9001, BMI, IFS, FSSC 22000, ISO 22000, IFS, GHS, GFSI, FSMA.

Food Safety Modernization Act – FSMA – The Food Safety Modernization Act was signed into law on January 4, 2011. It was developed to shift the responsibility for food safety from a response protocol to one of prevention. Initially, references were made to the Food Safety Standards developed by the World Health Organization and the Global Food Safety (Initiative of the United Nations. The major points include; Preventative Controls, Product Tracing, Sanitary Transport, Foreign Supply Verification, and Records Access. Recently published Guidelines (May 2 2014) – of the FDA Food Safety Modernization Act (FSMA) outlines the strategic implementation of the law. See Food Safety, HACCP.

Food Sensitivity – A food sensitivity is a non-allergic response to a food. It can include an intolerance like Celiac Sprue, Lactose Intolerance and Sulfite Intolerance and can be very serious despite the lack of a non-IgE anaphylactic pathway. See Food Intolerance, Allergy.

Food Starch – See Starch, Carbohydrates.

Food Starch, Modified – See Modified Food Starch.

Food Supply – The generic term meaning the all-encompassing available industrial/agricultural system that provides for the food production of a given population.

Food Technologist – A person who uses food technology in their day-to-day activity.

Food Technology – The science and study of food, food preparation, food safety, food product development, as well as food production, distribution, and marketing.

Food Trends – See Trends, Marketing.

Force Feeding – The act of feeding an animal against their will. This often is done through the gavage method as in the force feeding of corn to fatten up ducks or geese rendering the livers to a fatty state thus enabling them to be used in culinary preparations. See Gavage, Foie Gras.

Forcing – A procedure by which certain plants, like wild chicory, are placed in a moist, dark area just after the plant buds form and the root system begins to minimize development of green leaves and bitter principles. See Chicory.

Formula – In chemistry, a formula is a description of the makeup of a molecule. This is further split into the following categories:

1. Molecular Formula – Example: CH_4 is the molecular formula for methane, indicating that for every carbon there are four atoms of hydrogen. Some molecular formulas can show a structural group like benzene and alkyl groups, etc. For example, C_6H_6COOH would be a benzene ring with (C_6H_6) attached to an acid group (COOH). This would show benzoic acid.
2. Empirical Formula – Same as molecular formula, except no structural designations are shown. C_6H_6COOH would only be $C_7H_7O_2$.
3. Structural Formula – A structural formula would show all of the linkages for all of the atoms. For example, butane would be as follows in Figure 20.
4. Condensed Structural Formula – This is the same as a structural formula without the linkage indications as follows. For example, butane above would be $CH_3CHCHCH_3$. When there are repetitive groups, these can be placed in parentheses. For example, – $CH_3(CH2)_2CH_3$.
5. Another usage of the word formula is for the proprietary listing of specific flavor chemicals and their corresponding amounts that make up a flavor. Alternate designations of this term are flavor formulation and flavor recipe. See Proprietary, Organic Chemistry, Single Bonds, Double Bond, Triple Bond, Benzene Ring.

Formulas Online – The TTB development that greatly simplifies registration of formulas at the Non-Beverage Laboratory for potential approval for drawback and non-fitness confirmation. Some of the ingredients that make a flavor unfit are based on a five times Fenaroli's Flavor Ingredients publication maximum. The project is under ongoing improvement and makes registration far simpler than past procedures. See Potable, Potability, Non-Potable, Flavor Unfitness Worksheet.

Formulation – See Formula, Recipe.

Butane Structure

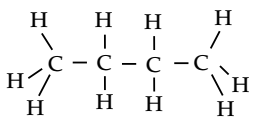

Figure 20

Foxy – A flavor description of some of the wines native to the U.S. It is a common characteristic of concord grapes and the wines from which they are developed. Foxiness is usually attributed to the presence of anthranilates, specifically to methyl and dimethyl anthranilate.

FPA (Food Producers Association); FPA-Safe Audit, Formerly NFPA, National Food Processors Association (NFPA); and NFPA Safe – As appears in the FPA-food.org website of the Food Producers Association, they state they are the largest trade association serving the food and beverage industry worldwide. Their areas of expertise and concentration are scientific and public policy issues, involving food safety, security, nutrition, consumer affairs, and international trade. They manage the FPA-Safe Audit program.

FPA-Safe Audit – An intense quality audit program for food and food ingredient producers, similar to the AIB Audit. See American Institute of Baking (Audit), Food Producers Association.

Fragrance –

1. A perfume. Fragrances are the non-food grade mixtures that impart aroma to items not to be consumed.
2. A fragrance is the positive aroma of an item.
3. A fragrance of a product is the general description of the odor profile.

Fragrance Description – For the purpose of this book, fragrance descriptions have been added because there is much potential cross fertilization of ideas to explore similar concepts across industrial boundaries.

Fragrant –

1. A positive description of a natural-smelling aroma.
2. A warm floral or spicy floral odor.

Frankincense (Frankincense or Boswellia thurifera) – See Olibanum and Appendix 2.

Free – As science progresses and the ability to identify smaller and smaller presence of Items within a mixture evolves, the concept of 'Free' becomes more and more confusing. It is the general consensus in the Scientific community that the word free just should not be used when dealing with science and Instrumental analysis. However, in marketing of the word 'free' has developed into a legal definition and changes according to the item about which the term is being used. Gluten Free is different from Fat Free which is different from Allergen Free, all causing great confusion in the marketplace. See Chart 249 – Nutrient Claims Nutritional Claims.

Freedom of Information Act – The Freedom of Information Act is a law that gives citizens the right to access information form the U.S. Federal Government. Exemption 4 of the FOIA protects 'trade secrets and commercial or financial information obtained from a person [that is] privileged or confidential. See Regulations, Trade Secrets, Trade Secret Protection.

Free Fatty Acids (FFA) – The measurement of fatty acids that have been produced from a fat source through oxidation. See Analytical Chemistry.

Free Radicals – Molecular fragments that retain electrons. Free radicals possess a charge and can react with other molecules. It is thought that the existence of free radicals are a result of and contributor to oxidation of fatty acids and rancidification of fats and can have an effect on the aging process and health. Antioxidants such as Vitamin E, ascorbic acid, and others are thought to be possible substances that can be used to minimize this effect. See Oxidation, Rancidification, Stability, ORAC (Oxygen Radical Absorption Capacity).

Freeze Drying – A process by which water is sublimated from a frozen state. A water-containing product is first frozen then evacuated. Ice will sublimate directly to steam under vacuum. Therefore, a product that is concentrated in this manner will retain more of its original flavor, due to the lack of extreme heat normally needed to distill or evaporate the extractant in other processes. The operation is typically a batch process and can be somewhat costly unless large volumes are treated in this manner.

Freezer Burn – The drying out of a food due to inadequate wrapping.

Freeze Thaw Stability – The character of a starch or other product to retain its integrity after a number of freezing and then thawing cycles. In starches, the integrity of the molecules is affected after a number of freeze thaw cycles. The starch will release water (synurese) and this might even affect the product's microbiological stability, all of which could affect the flavor profile. Example: Hydroxypropylation of starches increases shelf life, as well as protects the molecule from freeze thaw retrogradation.

Freezing – Freezing Point – The temperature at which a liquid turns into a solid. It is important for some flavors to be protected against freezing lest the solids fall out. See Shipping, Refrigeration.

Freezing Point Depression – The observation that the freezing point of a liquid can be lowered by the addition of solids. See Boiling Point Elevation.

French Fries – Potato strips that have been immersed in hot oil. Fries take on a fried oil flavor that combines with components produced by the Maillard Reaction, which occurs in potatoes at elevated temperatures. See Grilled, Fried (Oil) Flavor.

French Press – An instrument that compresses ground coffee and allows the extracted liquor to be pounded through a fine sieve. This allows for micro fine particulates, which greatly enhance the fullness of the flavor. See Suspended Matter, Full, Mouthfeel.

Freshness – A descriptor that has been somewhat elusive to identify in general. Freshness seems generally to be contributed by lighter volatiles, which subsequently evaporate on age, but often compounds that are produced by fresh products are also from those produced later due to enzyme action. Recent studies indicate the possibility of defects in the COX gene (cytochrome c oxidase) responsible for mitochondrial energy production and production of free radicals.

Friable – Friability – Hard particles or clumps that are easily broken up into powder are considered friable. See Caking, Anticaking, Powder, Hydroscopicity.

Fried (Oil) Flavor – The chemistry of frying is very interesting and much research has been done on it of late. The degradation of fats into their fatty acid and unsaturated aldehydic constituents with trace amounts of compounds derived from the food materials that are fried provide the flavor with trace sulfur compounds and brown-type Mallard products that form in the food. Also, due to the breakdown of the oil into fatty acids, there is an optimum time when the fatty acid profile tastes best, and later when the accumulation of fatty acids is incorrect. At this point the oil is deemed spent and should be replaced. See Fatty/Green.

Frog – A web-footed amphibian, which is occasionally eaten. More typical of French dishes. Frogs are bred on farms. The leopard frog is Rana pipiens.

From the Named Food – A label designation meaning that a natural flavor contains flavor ingredients that only came from the source as named. This does not include non-flavor ingredients. Example: A butter flavor (FNF) can be made from enzyme-modified butter, spray dried butter, butter starter culture, lipolized butter oil. It cannot use milk products, cheese products, or other similar ingredients because, although they come from dairy systems, they are not from butter that has a standard of identity. Purists might also question the use of butter starter distillate, although here the areas are gray.

From the Named Fruit (FNF) – A label designation meaning that all of the ingredients are derived from the fruit named on the label. Example: Natural orange (FNF) means you could use orange oil, orange peel oil, distilled orange essence, and natural ethyl butyrate distilled from orange essence recovery oil, just to name a few. See From the Named Food.

Fructose – Also known as levulose. A monosaccharide found in fruits from about 2–7% and in honey from 35–45%. It is the sweetest of all natural sugars. A sucrose solution that is acid catalyzed, heated, or that has bad enzymes added will convert to dextrose and fructose. This resultant product is called invert sugar. At higher temperatures, the sweetness of fructose seems reduced. See Invert Sugar, Humectant.

Fruit – The part of the plant that produces the fertilized ovary of the flower, where the ovules become seeds for the propagation of new plants. Fruits are usually sweet foods and are usually consumed as snacks, desserts, or at breakfast. Fruits have a limited use as additions to meats and other foods. Lemon is the most popular fruit for use in these areas. Foods that are considered vegetables but are really hulls are eggplant, tomato, squash, olive, avocado, and nuts. (Note – Peanuts are legumes, not nuts.) Until the 1900s, vegetables were all thought to be fruits (fruits of the earth). Fruits can be prepared in many varieties other than fresh – candied, dehydrated, pureed, juice concentrates, fruit juice essences, and as syrups. Categories of fruits are the berries, stone fleshy fruits, pomme fleshy fruits, citrus, tropical, and melons. Fruits are good sources of vitamins (A, B6, C) and minerals. Rhubarb, considered to be a fruit, is really a vegetable related to the sorrel or buckwheat. See Concentrated Fruit Juice; Fruit Juice Concentrates; Fold; Vegetable, Vegetative.

Fruit Classification – A fruit can have three layers; an exocarp (outer), mesocarp (middle) or endocarp (variable inside). The category of simple fruits include: 1. fleshy fruits – hesperidium (specialized berry with a leathery rind – example citrus); berries (example tomato, grape, raspberry), pepo (berry with a hard rind, example pumpkin), drupe (examples, cherry, peach), pome (with a core – examples, apple, pear), hip (fruit of a rose plant); 2. Dry fruits – dehiscent (ones that split when ripened), including follicles, legumes, capsules, and siliques (Milkweed, Soy, Eucalyptus and Horse Chestnut, Winter Cress), Indehiscent Fruits – Achene (Strawberry) Caryopsis or Grain (Grasses and Grains – example, Wheat), Samara (Maple Seed), Schizocarp (Oak Acorn), Loment (Tick Vetch), and Nuts (Brazil Nuts). See Fruits versus Vegetables, Taxonomy.

Fruit Distillates – See Essence and Distillate.

Fruit Extract – See Extracts – Fruits.

Fruit Juice – The product derived from the expression of fruit matter. Fruit juices are usually high in flavor, acidity, sugar, and color. Unfortunately, fruit juices are not very shelf stable and begin fermenting

almost immediately. For this reason, they must be kept frozen. Preservatives like sodium benzoate and potassium sorbate can help, but concentrating the fruit juice is usually the best option. See Fruit Juice Concentrates.

Fruit Juice Concentrates – The product derived when the fruit juice is evaporated and water is removed, yielding a thicker liquid product, which is a concentrate of the original fruit juice. The product having less water is easier to handle, easier to store, and because of its higher solids content, becomes easier to stabilize. These products do much better under frozen and even refrigerated storage conditions. As the water is removed, some of the subtle top notes or essence of the juice volatilizes. If the first water removed is further concentrated, this essence can be added back to the juice. This product is referred to by a number of different names, essence, juice essence, essence add back, etc. The essence is usually obtained when the juice is purchased, and just enough essence that came from the specific juice bought is supplied. However, with certain juices that are processed in huge volumes like apple juice, the apple essence is readily available without having to buy the juice. This essence is also folded and a strength value placed upon it. Having seen 200-fold essences, 150-fold essences, and 1,500-fold essence, none of which bear any strength or character resemblance to each other, it is anyone's guess as to how the fold is determined or the true derivation of the essence. See Essence, Folding of Extracts and Essences, Brix, Preservatives, and Chart 416 – Fruit Juice Concentrates.

Fruit versus Vegetable – In taxonomy, the science of categorization of living things, determining whether a food is a fruit or a vegetable can be a bit confusing. Legally, it is further problematic in that the courts rules that a tomato should be considered a vegetable according to the Tariff Act of 1883 claiming the usual names should prevail and not the biological ones. A few rules are as follows: 1. If the plant has seeds or a pit, it is a fruit. 2. If the plant part is from an herbaceous plant, meaning one that has leaves and stems that either die or go into hibernation at the end of a growing season, it is a vegetable. Science however does not define vegetable. It is instead a culinary term. See Fruit, Taxonomy.

Fruity –

1. The descriptive terminology that describes flavors typical of fruits, usually sweet estery aromas with corresponding sweet, somewhat sour tastes.
2. In tea, fruitiness describes an off flavor. One possible cause is over fermentation.
3. In wines, it means a fruity type of taste typical of any fruit other than grape. See Descriptive Terminology, Alkyl Esters – Grouped by Alcohol Moiety, Sweet, Sour, and Chart 146 – Alkyl Esters Grouped by Alcohol Moiety.

Frutte di Mare, Frutta de Mar, Frutte de Mar – A dish comprised mostly of varied seafood types, often mixed with vegetables and other items.

Fry – To cook a food in a hot oil. See French Fry Flavor.

Frying Methods – The different procedures for frying relate to the types of foods to be fried as follows:

- Basket Method – For food that can be fried and does not have a tendency to stick together but would otherwise be hard to collect if not in an enclosed wire container. Useful for many small items.
- Double Basket Method – For food that is light and would come to the surface so much that an uneven frying would occur unless it was fully submerged.
- Swimming Method – For food that is best floating around in the oil. This method is best used for foods that would otherwise have a tendency to stick together (for battered or large items).

FSMA – See Food Safety Modernization Act – FSMA.

FSSC 22000 – Food Safety System Certification 22000 – One of the approved audit systems within the GHS (Global Harmonized System) or GFSI (Global Food Safety Initiative supported by the World Health Organization of the United Nations. It claims to answer the desire of the GFSI protocol to include prerequisite programs into the scheme of ISO22000. See SQF, ISO 9001, AIB, GFSI.

FTC (Federal Trade Commission) – Regulates trade, advertisement, brands, etc. See Claims, Food Labeling Laws

Fudge – A soft confectionery made from milk, sugar, butter, and flavorings.

Fugu – A fish of the genus Takifugu or blowfish. The fish is extremely poisonous, but is eaten in certain Asian countries. It is said to give a peculiar tingling sensation to the lips when eaten. Care must be taken so as not to rupture organs and tissues that contain too high a level of tetrodotoxin, the poison responsible for the fish's lethality. Licensed chefs perform this task. Perhaps the excitement of engaging in such a dangerous cuisine is in part a reason for this fish's allure. See Fish, Toxins.

Full – In tea terminology, suggestive of a strong-flavored product with no perceived bitterness. See Full Bodied.

Full Bodied – A terminology that indicates that a product has a good degree of aroma and taste impact accompanied with an overall roundness of flavor profile; thick and tactile to the sensations. See Roundness, Descriptive Terminology, Mouthfeel.

Fumé – A fish stock made by first sweating the Mirepoix and usually includes wine. See Culinary Arts, Mirepoix, Sweating.

Fungal –

1. Reminiscent of the aroma of growing fungi. In some instances, fungal can also mean similar in flavor to mushrooms, but it is more specifically illustrative of rotting wood with a fungal growth.
2. In fragrances, a fungal odor is added by the use of hydrotropic aldehyde dimethyl acetal. See Mushroom-like, Mushroomy; Earthy.

Fungus – Organisms of the plant kingdom, which include molds, mildews, yeasts, mushrooms, and toadstools. Because spores of airborne yeasts and molds can be present anywhere, they can subsequently inoculate most food products. Hence, yeasts and molds are commonly tested for in a typical microbiological assay. In a multiple product interface, as in filled doughnuts, where moisture activity is significantly different in two parts of a food, moisture can migrate from one part of the food to the other. Here again microorganisms can grow at or near the interface. At worst, this can lead to significant mold growth, but the effect is minor. The result can still affect the flavor profile. During their normal metabolism, yeasts and molds can produce acids, alcohols, and other aroma components that can affect the overall flavor of a product. Beneficial fungi, like the yeast used in baking, brewing, and development of wine (Saccharomyces cerevisiae) can also be grown on molasses as a flavorant or source of amino acids and proteins used in a processed flavor. However, fungi can also cause illness and disease or poisoning. Grains and cereals can be infected with a fungus that produces a toxin called ergot. Aflatoxin is produced by aspergillus spp. and has been attributed to liver cancer in Asia and Africa. See Microbiological Assay, Yeast, Processed Flavor, Water Activity, Moisture Migration.

Furyl Compounds – (Furfurals, Furanones, Furans) – The furyl compounds are found in nature as by-products of fermentation of grains, sugar, etc. The base compound, furan, is a four-carbon structure with two double bonds containing oxygen within the ring. Furyl compounds usually have a characteristic brown and pungent flavor. Furanones make up some of the most powerful flavor components. Maple furanone seems to have the most pervasive aroma. The odor is often absorbed into the skin and clothing and is difficult to wash away. Many times after working with maple furanone, or accidentally spilling it on your shoes or clothes, people nearby will comment how you smell like maple syrup for days later. Furfural, found in vanilla extract is a brown sugar-like or molasses-like aroma that can be used in a host of flavors where that type of nuance is beneficial, for example, chocolate, rum, butterscotch, whiskey, vanilla, etc. When sulfur compounds are added to the molecule, a number of exciting new characteristics evolve. Furfural mercaptan, for instance, is a good key for coffee as most people are aware, but it is also an important compound for tuna flavor, chocolate flavor, peanut butter flavor, butterscotch, hazelnuts and most other nut flavors. A furan is a 5 membered lactone. See Chart 412 – Furyl and other Oxygenated Compounds, Lactones.

Furyl Esters and Related Compounds – Furyl esters are generally brown and fruity and lend themselves to usage whenever more ripened and sophisticated fruit flavors are desired. See Chart 411 – Furyl Esters.

Fusel Oil – The heavier alcohols derived from fermentation, mostly amyl alcohol. Fusel oil mostly contains C-5 and C-6 alcohols. Fusel oil is distilled from fermented beverages like wine, whiskey, etc. Any alcohols of this type are pungent, fatty, and oily at higher levels, and nutty at lower levels; therefore, fusel oil can be used in nut and brown flavors like cocoa. It is partially the presence of fusel alcohols in distilled spirits that contribute to the 'hangover' effects the day after someone consumes alcoholic beverages in excess. At lower levels, fusel oil can be perceived as being nutty and can lend an interesting note to coffee, nut, and chocolate/cocoa flavors. See Alcohols, Aliphatic, Fermentation, Amyl Alcohol, and Chart 160 – Fusel Oil.

F-Value –

1. In microbiology, the number of minutes it takes to destroy a variable amount of a given microorganism at 250°F.
2. The number of minutes for the survivor curve (cells remaining) to conclude one cycle. See Microbiology; Sterilize, Sterilization.

G

Gai-Lohn – See Chinese Cabbage, Chinese Kale.

GAIN Report – Global Agricultural Information Network of the Foreign Agricultural Service of the Unites States Department of Agriculture. This report states 'USDA's Global Agricultural Information Network (GAIN) provides timely information on the agricultural economy, products and issues in foreign countries since 1995 that are likely to have an impact on United States agricultural production and trade. See FEMA, USDA.

Galactose – A six-membered sugar that is formed in the body by hydrolyzing lactose. See Lactose Intolerance.

Galanga Root (Alpinia spp. including A. officinarum Hance) (galangal, Chinese ginger) – The flavor is somewhat aromatic and camphoraceous and blends well with ginger and other types of spicy/sweet compounds. For this reason, it works well in ginger ale flavors, root beer flavors, and other spicy blends. Also called greater galangal, Thai ginger, laos, khaa, lengkuas, lesser galangal, kencur, krachai. See Ginger and Chart 165 – Galanga Root.

Galangal Oil – See Galanga Root.

Galbanum – Galbanum oil contains myrcene, cadinene, and alpha pinene. Quantities of methoxy-substituted pyrazines give the oil its characteristic green vegetable background profile. Soft (levant) or crude galbanum is used in flavors versus hard galbanum in order to distill the essential oil. Flavor profile descriptors include green pepper or tossed green salad. Therefore, it is important for use in natural vegetable flavors. However, recent shortages have sent the price of oil upward, making it a difficult product to use from a cost standpoint. See Pyrazines, Chart 264 – Pyrazines.

Galatine – A widely varied culinary preparation of meat or fish either stuffed in its own skin, or covered in a gelatin aspic, pressed and served cold. See Culinary, Charcuterie.

Gallates – Trihydroxy Benzoic Acid Derivatives. See Phenol.

Gambia (Gambia Catechu, Pale Catechu) – Acacia Species Above, Colors. This is properly called Gambia catechu or pale catechu. See Real Catechu and Chart 90 – Catechu.

Gambir – See Catechu Gambir.

Gambir Catechu – See Catechu Gambir.

Gamification – The introduction of gaming techniques to encourage job performance and learning. Gamification has a place in a modern Flavorist Training Program. See Flavorist, Training.

Gamma, g (Greek, Γ, γ) –

1. A Greek letter representing the letter G, the lowercase type is designated by a curved small 'v' pointing downward or a stylized downward facing stylized fish.
2. In a lactone structure, it means a five-membered ring structure. See Delta, Epsilon, Omega.

Gamey, Gamy –

1. Possessing a flavor that is characteristic of animals or meat products caught in the wild and not domesticated.
2. A peculiar aroma profile that somewhat is reminiscent of 1.
3. Containing branch chained fatty acids of the C-7 to C-9 type.

See Meaty.

Ganache – An icing or filling made by pouring hot, heavy cream over chocolate and whipping so an emulsion is formed. The ratio between the cream

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and chocolate is 1 to 1.5 (for soft ganache), 1 to 2 (for medium ganache for piping), 1 to 2.5 (for hard ganache). See Culinary Arts.

Ganoderma lucidum or Lingzhi or Reishi – See Appendix 2.

GAO – Government Accountability Office – From the Internet Government website; 'The U.S. Government Accountability Office (GAO) is an independent, nonpartisan agency that works for Congress. Often called the 'congressional watchdog,' GAO investigates how the federal government spends taxpayer dollars.' On the FEMA website under 'Flavor Safety Myth Versus Fact' it cites the GAO finding that 'the US Government Accountability Office has said FEMA GRAS™ processes [help FDA better ensure the independence of scientific assessment.]' See FDA, GRAS, Expert Panel.

Garam Masala – A variable mixture of spices and seasonings used in Indian cooking.

Garcinia cambogia or Malabar Tamarind – Garcinia is a plant whose fruit rind is used to make extract HCA, an ingredient that claims efficacy as a dieting aid. This should not be confused with Garcinia hanburyi which is gamboge resin. The claims come from the presence of HCA or hydroxy citric acid that inhibits the enzyme citrate lyase and interferes with metabolisms of fatty acids. Another name for garcinia is Malabar Tamarind but is a totally different genus and species from the tamarind used in flavors; Tamarindus indica. See Appendix 2.

Garde Manger – Translation keeper of the food. This is the culinary term for those who do salads, creative preparations and small plates in a restaurant. See Culinary.

Garden Cress – See Cress.

Gardenia gummifera (Nadihingu) – An ancient herb mentioned in the Ayurvedic medicines of India. Mostly used for gastrointestinal ailments. See Appendix 2 and Chart 485 – Gardenia gummifera.

Garlic (Allium sativum L.) – Garlic oil contains many sulfur containing compounds including polysulfides (di-, tri-, and tetra-sulfides). The undisturbed food has little odor until the cells are crushed, cut, or otherwise disturbed, emitting alliinase, an enzyme that catalyzes the amino acid alliin, and begins the production of allicin. Allicin has been linked to reduction in serum cholesterol. Other enzymes like alliacin are present as well. Allicin breaks down further into diallyl disulphide, thioacrolein, 2 vinyl 4H 1,3 dithiin, and ajoene (4,5,9 trithiadodeca 1,6,11 triene 9 oxide). Allyl sulfide has also been studied as a possible antibiotic. Pink and white garlic are the most prevalent varieties. The use of garlic powder in flavors and seasonings is quite prevalent. It is used as a vegetable top note and in meat seasoning blends. Because it is grown directly in the soil, bacterial contamination is a problem, and some garlic powders can have an extraordinarily high standard plate count (in excess of 1,000,000 per gram). Pasteurized or gas-treated powders are therefore often necessary. Both garlic and onion powder are cited as examples in the Code of Federal Regulations (Title 21) describing dehydrated foods that are not true spices, that cannot be considered flavors, and must therefore be listed as its common and usual name on the ingredient statement, that is, dehydrated (powder). See Sulfur, Onion, Chart 168 – Garlic, and Appendix 2.

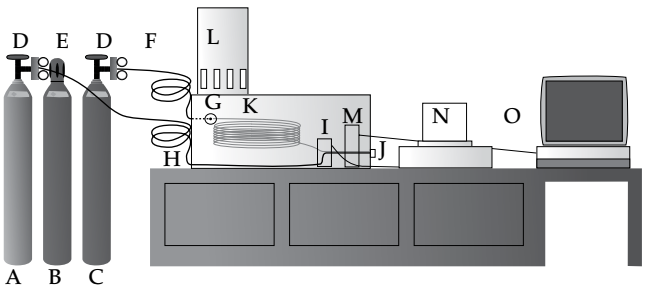
Garum – See Fish (Anchovy).

Gas Chromatography (GC) – The process and technique of applying an unknown mixture onto a supportive substrate, while blowing heated gas over and throughout the internal surface of a thin to finely stretched metal or glass column. Due to the nature of the affinity of the unknown compounds to the substrate and their relative boiling points, the chemicals will move (elute) through the column at differing rates according to their specific characteristics. The detector port at the other end is usually of two general types: a flame ionization port or a thermal conductivity unit. A flame ionization device burns off the product, and cannot be used to smell the exiting compounds to aid in their identification. For this purpose, a splitter could be used to divert some of the effluent for organoleptic analysis. Alternatively, the use of a thermal conductivity unit would allow someone to identify aromas as they exited the machine at the port site and not be destroyed in the flame of a flame ionization device. Since the advent of mass spectroscopy and computers, recent systems hook up computerized databases that contain mass spectrographic fragmentation patterns to systematically identify the unknowns. For the purpose of quality control and identification of purity, and perhaps authenticity of essential oils, GC can certainly be of great use. However, due to time constraints, conflicting identification, inaccuracy of sensitivity versus the human olfactory system, and a whole host of artifacts that might be present, to date much of the duplication work that is done in the flavor industry is still done by flavor experts trained in organoleptic type duplication. The two generally used columns substrates fall into the categories of a polar and non-polar column packing. Lengths of column vary for increased separation and therefore sensitivity. The polar-type columns (an example is Carbowax™) respond poorly to organic acids and water. The non-polar silicon-based packing reacts better for separation and identification

of acids. Very thin columns known as capillary columns increase the degree of separation significantly. A proprietry-developed methodology that couples aroma description with NMR spectra is called SNIFF NMR. This is a more recently developed protocol for the identification of unknown blends. See Mass Spectroscopy, High Pressure or High Performance Liquid Chromatography (HPLC), Duplication, Chiral Columns, SNIFF NMR, Gas Chromatography – Olfactometry (GCO).

Gas Chromatography – Olfactometry (GCO) – A technique that combines the extreme sensitivity of the human olfactory system, coupled with instrumentation. Some techniques of GCO are Aroma Extract Dilution Analysis (AEDA), Charm analysis, and OSME. Both AEDA and Charm analysis are a simple sensory technique that the minimal perceptibility of a chemical by an analyst is measured. The unknown is diluted to the point at which the subject can no longer perceive an odor. This is either the Flavor Dilution (FD) value in AEDA or the Charm in Charm analysis. OSME, however, attempts to quantify the intensity of an odor using magnitude estimation techniques. See Gas Chromatography (GC), Sensory Analysis, Magnitude Estimation. See Figure 21.

Set up of a Gas Chromatograph
Mass Spectrometry Unit



A - Hydrogen Tank for Flame Ionization Unit
B - Spare Tank
C - Carrier Gas
D - Gas Control Valve
E - Capped Gas Tank
F - Gas Pipe
G - Injector Port
H - Gas Line for Hydrogen (FI)
I - Detector Port - Flame Ionization or Electronic Absorption
J - Exit port
K - Column - Regular/Capillary - Polar/Non Polar etc.
L - Auto-injector Unit
M - Ion Source Mass Filter and Detector for Mass Spec Unit
N - Printer for GC output
O -Information Analyzer (Computer, etc.)

Figure 21

Gastrique – A sugar and vinegar reduction used a base to add other Ingredients such as fruits, stock, alcohol, etc. used in culinary preparations. See Culinary.

Gaufrette – See Knife Cuts.

Gavage – The force feeding through the nose (nasogastric) or the mouth (orogastric) used in toxicological research or in the production of foie gras. See Toxicology, Foie Gras.

GC – See Gas Chromatography.

GCO – See Gas Chromatography – Olfactometry.

GC × GC – Comprehensive Two Dimensional Gas Chromatography – The typical set up is a conventional GC hooked up with a fast GC such as a Time of Flight GC. It is used for complex mixtures of substances like flavors. The most common combinations of the two GC's are; a poly(dimethylsiloxane) or silicone column in the first GC and a poly(ethyleneglycol) or Carbowax column in the second instrument. See Time of Flight GC, Gas Chromatography.

GE Foods – The alternative recommended way to describe GMO products as recommended by the FDA. See GMO.

Gel – A short textured, usually clear structure typified by those formed by gelatin.

Gelatin – Made from by-products of animals (hooves, etc.), gelatin is a proteinaceous-based material, which when acidified and boiled, and then subsequently refrigerated, forms a gel. See Gums and Thickeners.

Gelation, Gelatinization – The state of performing like or becoming a gel. See Gums and Thickeners.

Gene – The unit of heredity in a living organism. See Genetics, Genetic Engineering, DNA.

Genet (Spartium junceum L.) – Genet is commonly known as broom because it grows as long weeds and is often used in Europe as whisks in brooms. The botanical has a pronounced honey-like green odor. It also possesses a warm brown character and is useful in many products of that type: cocoa, chocolate, maple, vanilla, tobacco flavors, honey, butterscotch to name but a few examples. See Green, Brown (Compounds), and Chart 169 – Genet.

Genetically Engineered Foods and Flavors – Foods that are altered and flavors that are derived by administering procedures that can adapt or change the basic structure of the genetic code. First, it is necessary to determine the site of an undesirable or desirable characteristic. This can be done after much trial and error, and often by observing the parent organism. Secondly, by using techniques including enzyme cleaving of the molecule, host cell utilization, and a number of other techniques, the desired attribute is transferred and the parent organism is

left to mature so that the trait manifests itself. Some products can easily be mass-produced by classical techniques of selection, breeding, and subsequent harvesting. Monosodium glutamate and other amino acids are produced by fermentation, as are some gums such as xanthan and others. The hope of genetic engineering is to increase yields, diversify resultant product types, and control quality. Genetically modified organisms used to produce commercially sized quantities of specific aromatic chemicals such as the production of natural propionic acid as produced by the propionibacterium bacteria are kept as proprietary by the individual companies. Organic substances derived by Genetically Modified catalysts are being scrutinized by the NOS (Natural Organic Substances) division of the USDA. Genetically modified substances in crops have been around for decades, but recently there has been adverse press overseas (in Europe) and some reports (monarch butterfly) that hold a negative air around their use. The U.S. government claims that the science illustrates that they are safe to use. See Fermentation, Natural Flavor, Monarch Butterfly, SPI (Science in the Public Interest, GMO, and Chart 443 – GM Products, GE Plants.

Genetically Modified Organisms (Genetically Modified Substances) – See GMO, Genetically Engineered Foods and Flavors, GE Plants.

Genetic Engineering – The practice of changing the genetic structure of organisms through techniques such as recombinant DNA. See Genetics, Recombinant DNA, GMO, Asilomar Conference.

Genetics – The study of DNA, genes, hybridization, genetic traits, recessive and dominant gene theory, evolution, biological type, and how genetic structure both explains and predicts these attributes.

Genotoxin – A chemical that affects the chemical structure of the DNA molecule and therefore by its disruption can cause mutations in subsequent offspring or develop tumors within the organism. Even though it is not a chemical, radiation is considered genotoxic because of its effect on DNA. See DNA, Gene, Genetics.

Gentian (Purple Gentian) (Gentiana lutea L. Gentiana acaulis L.) – Used for bitterness in alcoholic beverages. Was used as a source for purple #1, but was delisted. Used also as a throat swab against streptococcus and other infections in the past. Gentian extract powder is green in its anhydrous form and purple when hydrated. See Color (Colorants) and Chart 170 – Gentian.

Gentian (Yellow Gentian) – Cross-Leaved Gentian, Five-Flowered Gentian – See Appendix 2, Nutraceuticals Overview.

GE Plants – The preferred way the FDA would like products that have been described as GMO to be referred. See the full description under FDA Publication – Foods from Genetically Engineered Plants. See GMO. Genetically Modified Organisms.

Geranium (Pelargonium graveolens Linn. and Other Pelargonium spp.) – Geranium exhibits a powerful rosy odor owing to presence of geraniol, linalool, and phenyl ethyl alcohol. Bourbon oil has the most dimethyl sulfide character and can therefore lend itself to a wide variety of uses as a top note enhancer, especially in fruit flavors like raspberry, strawberry, and tropical flavors. Reunion or Bourbon oil is distilled upon initial blooming. The Algerian type is obtained by distillation prior to the leaves turning yellow. The Moroccan variety of P. roseum has more of a green herbaceous character. Care must be taken that the product is authentic because adulterated versions have appeared in the marketplace. See Terpenes – Oxygenated and Other Related Compounds, Floral, Chart 171 – Geranium.

Geranium (Pelargonium odorantissimum) – Apple Geranium – See Appendix 2.

Geranyl Esters – See Floral Terpene Esters.

Germ –

1. Slang for a microbe or microorganism.
2. The embryo of a seed that contains the highest concentration of fat, nutrients, vitamins, minerals, and proteins.

German Chamomile – See Camomile.

Germander (Teucrium chamaedrys L.) – Alcoholic beverages only. Bitter for use in alcoholic beverages. See Bitter.

Germander, Golden (Teucrium polium L.) – Alcoholic beverages only. Bitter for use in alcoholic beverages. See Bitter and Chart 172 – Germander and Golden Germander.

Gerstmann Sträussler Scheinker Syndrome – A very rare prion-based disease like Creutzfeldt–Jakob Disease, but inherited, not consumed. It is transmitted through a dominant gene and is found within families. It is considered to be one of the Transmittable Spongiform Encephalopathies. See Creutzfeldt–Jakob Disease, BSE.

GFSI – Global Food Safety Initiative – During the early 21st century, food safety was on everyone's mind due to some major food product recalls. At the same time there was the need to tighten up the number of auditors, their scheme and need for accreditation. At the Consumer Goods Forum, the CEOs of global food organizations created GFSI to harmonize food safety standards. The benchmark document called the GFSI Guidance Document was the basis of third party audit systems that were

approved by the GFSI. Some audit systems approved within this framework are; Primus GFS™, IFS PACsecure, FSSC 22000, SQF and BRC. See Food Safety Audit (s), GHS, FSMA.

Ghatti Gum – See Gums and Thickeners.

Ghee – A form of clarified butter where the milk solids are left in the bottom of the pot, thereby developing a unique nutty flavor. See Clarified Butter, Culinary Arts.

Ghrelin – The hunger hormone. See Hunger.

GHS – Global Harmonized System – Developed by the United Nations, this system is intended to replace all the different systems used throughout the world for the classification of hazards. It is not yet used by all nations of the world as of the publication of this book. The United States (OSHA) has implemented a law that is GHS compliant called HAZCOM 2012. This system uses an SDS based Specification system versus the MSDS systems and utilizes graphic depictions for hazards, and expanded descriptions. Danger versus Warning are used as trigger words for hazard acknowledgement. See OSHA, HAZMAT, DOT, UN.

Gianduja – Swiss word meaning ultra-decadent blend of hazelnut-flavored chocolate.

Gin – An alcoholic beverage made from the distillation of dextrose containing fermented juniper fruit. See Juniper Berry.

Ginger (Zingiber officinale Roscoe) – The active ingredient in ginger is zingerone, which is responsible for its biting character. The most common usage is a combination of one or more of the following with citrus and other characters to make ginger ale-type products. Gingerbread is made from ginger, clove, nutmeg, vanilla, and other spices with caramel, molasses, sugar, and dough. Ginger is commonly found in oriental recipes. See Ginger Ale, Pungent, Trigeminal Nerves, Beverage, Chart 173 – Ginger, and Appendix 2.

Ginkgo Nut (Ginkgo biloba) – The ginkgo tree is a very old species dating back to pre-ice age. The tree has sustained a viable reproductive cycle for over 1,000 years. An orange membrane surrounds the nut. It contains a fair amount of unstable oil that rancidifies and therefore must be quickly removed once the nut is harvested. The yellow-green kernel has a mild resinous flavor. Recent health claims for gingko biloba cite a promotion of circulatory function and a link that ingredients that could accelerate the aging process (such as free radicals) might be controlled by the use of this product as well as stabilizing prostate gland health in men. See Fruit, Nutraceuticals, and Appendix 2.

Ginseng – There are three different types of ginseng. The first, Korean ginseng, is the term used for any 11 of the Panax species. It is also called Chinese ginseng, Oriental ginseng, and Panax ginseng. The active ingredients are ginsenosides. The second type of ginseng is Siberian ginseng. Siberian ginseng, as opposed to Panax ginseng, is grown in eastern Siberia. Siberian ginseng (Eleutherococcus senticosus) is not really a ginseng but another extract that acts like ginseng. It too is an adoptogen, but of a woody root rather than a fleshy root as in true ginseng. It contains eleutherosides rather than ginsenosides. American ginseng or Panax quinquefolius is produced in the United States and Canada and is prized in Chinese societies. Ginseng is considered to be an adaptogen, adapting its effect to whatever is needed by the body. The name comes from the Chinese language meaning man-root because the root resembles a body with two legs. See Nutraceuticals and Appendix 2.

Gland – A group of specialized cells that produce a substance, usually a hormone or enzyme used for the body. The two types of glands are the endocrine glands, which have no ducts and produce substances that are directly absorbed into the bloodstream. Examples are the pituitary gland, thyroid and adrenal glands, and the exocrine glands that have ducts that release glandular secretions into a specific site such as the salivary glands and glands in the stomach which product pepsin. See Endocrine Gland, Exocrine Gland.

Glass Policy – A requirement for a Food Safety Plan, identifying the presence of glass, discussion of the procedures upon glass breakage and the limitation of glass whenever possible. See Brittle Glass and Plastic, HACCP, Food Safety.

Glass Transition – The state of matter that is neither solid nor liquid corresponding to characteristics including transparency and amorphosity. The efficiency of spray drying is enhanced by the percentage of material going through a glass transition state and not a solid state, enabling the particle to contract and not become brittle. If the particle were too brittle cracks would appear and would enable the internal flavor oils to leach and migrate to the outside. The range at which the material exists in a glass transition state is called the transition temperature range. See Spray Drying, Sugar(s) and Polyhydroxyl Compounds, Hard Candy, Crystallization, Vitrification.

Glaze – An external coating often made using gums, sugars, starches or other carbohydrates, or proteins. A glaze usually contributes a shiny coating. Honey glazed ham is one example.

Global Reference List – (IOFI) – As stated on the IOFI website, 'The IOFI Global Reference List (GRL) is an

open ended, global, positive list of flavoring materials that are considered to be safe for their intended use by one or more internationally recognized assessment bodies'. This is the international (U.N.) version of the U.S. GRAS list. See GRAS, Legislation, Food Safety.

Globulins – Those protein substances that are fully soluble in 10% NaCl. Most globulins are found in plant tissue. However, there are minor amounts of globulins found in animal tissue as well. Globulins are proteins that include gamma globulins (antibodies) and a variety of enzymes and carrier/transport proteins. Most of the globulins in our body are present in the form of gamma globulins. The globulin/albumin ratio in the bloodstream is optimally 2:1. See Protein, Albumin.

Globulus – See Eucalyptus.

Gloppy – Short textured. See Rheology, Texture.

Glossopharyngeal Nerve – The ninth cranial nerve arising from the medulla oblongata with branches to the tongue, parotid gland, and pharynx. This nerve transmits sensations from the rear two-thirds of the tongue, while the facial nerve transmits impulses from the front two-thirds of the tongue. The glossopharyngeal nerve transmits both the stimuli of bitter from the rear of the tongue and the gag reflex. As they are both interrelated, the correlation makes sense. See Facial Nerve, Bitter, Toxins, Cranial Nerves.

Glucans – See Oat – Oat Beta Glucans and Appendix 2.

Glucosamine – See Appendix 2.

Glucose Oxidase Catylase – See Enzymes, Oxidation, Reduction.

Glucose Pentaacetate – See Chart 372 – Non-Nutrative Sweeteners.

Glucoside – A glycoside derived from glucose. A compound made up of a glucose sugar and another chemical. See Glycoside.

Glucosidic Cleavage – The breaking of the bonds between sugars in a carbohydrate. This occurs during the hydrolysis of carbohydrates, whereby using acids or enzymes, the bonds break and are replaced by hydroxyl moieties.

Glutamate Receptor – MGluR4 and T1R1 and T1R3 r3eceptors have been shown to be responsible for the perception of Mono sodium glutamate. See Taste, Umami.

Glutathione (GSH) – Aka 2-amino-5-{[2-[(carboxymethyl)amino]-1-(mercaptomethyl)-2-oxoethyl] amino}-5-oxopentanoic acid. A tripeptide that has antioxidant properties and protects cells against damage from free radicals. See Free Radicals, Oxidation, Aging, Nutraceuticals, and Appendix 2.

Gluten – One of the proteins found in wheat (spelt, kamut, farro and durum, bulgar and semolina) and other grains such as; Barley, Rye and Contaminated Oats). Gluten is made by combining glutamine, a highly elastic protein and gliadin (less elastic) and develops upon mixing flour in the presence of water with mechanical manipulation. Gluten is responsible for the tough, elastic nature of dough. Celiac sprue disease that affects from 0.1–0.2% of the population but some claim it might be 10 times that amount. Celiac is a sensitivity and intolerance to gluten. Some people have a direct allergy to gluten as well. It has been seen that continued ingestion of gluten, a hard protein to digest seems to have complications and brings on other sensitivities/allergies to other protein types. The most common offshoot seems to be soy. It was thought that only flours from wheat, rye, or triticale have enough gluten to make quality bread. However, in response to a rising awareness of gluten sensitivity/intolerance breads and other foods use Quinoa, Rice Flour, Amaranth, Buckwheat, Corn, Job's Tears (Hato Mugi), Montina (Indian Rice Grass), Brown Rice (wild Rice), Rice Flour, Potato Flour, Teff, Garbanzo Flour, Arrowroot, Mesquite, Millet, Ragi, Sorghum, Soy and Tapoioca. See Food Intolerance, Food Allergy, Certified Gluten Free, Cereals and Grains, Baking.

Gluten Free – See Certified Gluten Free.

Glycemic Index (GI) – A rating for carbohydrates based on their effect on blood sugar levels. High glycemic index foods will result in quick increases in serum sugars and are desireable for recovery after a strenuous workout. Low GI foods are more appropriate for most people especially diabetics who need a slow and steady release of energy into the system. The glycemic index is the basis of the 'South Beach Diet'® and was the logical diet answer to the low carbohydrate 'Atkins Diet'® craze. See Diet, Carbohydrates, Blood Sugar.

Glycerides – Formed by the combination of glycerine (a trialcohol) with one or more fatty acids.

Glycerine – The trialcohol of propane that is a water-soluble solvent. Although its solvation properties are nowhere near as efficient as propylene glycol, it is used in flavors in some instances. Glycerine can form links with acid moieties at the hydroxyl groups, losing a hydrogen and esterifying with these fatty acids to form fats. If each of the three arms of glycerine is attached to a fatty acid, the resultant product is a triglyceride. If only two are linked, it is a diglyceride. If only one is so linked, it is a monoglyceride. See Fat.

Glycerol – See Glycerine.

Glycerol Esters of Wood Rosin – See Ester Gum and Chart 470 – Ester Gum.

Glycidates – A special category of ether esters, the most used or popular of which is the so-called strawberry aldehyde, aldehyde C-16, or ethyl methyl phenyl glycidate. See Strawberry; Aldehydes, So-called; and Chart 162 – Glycidates.

Glycolipid – A carbohydrate combined with a lipid.

Glycols – Dialcohols. Propylene glycol is propane diol. See Alcohols, Aliphatic.

Glycolysis – The anaerobic stage of carbohydrate metabolism wherein pyruvic acid is formed by oxidation.

Glycoprotein – A carbohydrate combined with a protein.

Glycoside – A compound made up of a sugar molecule tied up with another chemical at the anomeric carbon (carbon next to the ring oxygen). Glycosides and especially glucosides are often bitter. They also can be biologically potent and even toxic. It can be viewed as nature's way of tying up a molecule for future use, often to be expressed later, cleaved by a glycosidase. See Amygdalin, Bitter Almond Oil, Pome Fruits, Prunus Fruits, Enzymes, Anomer.

Glycyrrhizin (Glycyrrhiza or Licorice Root) (Glycyrrhiza glabra) – Glycyrrhiza or licorice root is combined with anethole to yield the characteristic black licorice product. Licorice alone however, has a very brown-type character. It also has shown to synergize with the sugary sweeteners used in products and is therefore considered an effective sweetener enhancer. Even though it is a glucoside, glycyrrhizin is effective as a non-nutritive sweetener because its DE is 10,000 (100 times the sweetness of dextrose). The solubilized form of glycyrrhiza, ammoniated glycyrrhiza, produced by extracting the botanical in an ammonia-based alkaline system is then further refined to produce the cleanest tasting, most powerful version, which is MAG (mono ammoniated glycyrrhizinate). licorice does not taste like anethole, nor does anethole taste like licorice, but they are considered inseparable due to a long-standing combination. Because black licorice is so often flavored with anise or anethole, licorice is commonly associated with the odor of anethole. Licorice is used as a potent flavorant against bitter principles. For this reason, it is used as a modifier in beer like Porter™ and Bass™. It produces very stable foam in carbonated beverages. It also is greatly used in tobacco flavorings. Two varieties are G. glabra var. typica = Spanish licorice and G. glabra var. glandulifera = Russian licorice. See Licorice (Root).

GMA – See Grocery Manufacturer's Association.

GMO (Genetically Modified Organisms) – More accurately described as genetically modified substances. Classical manipulation of genetics has been done in the past through breeding and cross-fertilization. This technique is called the Mendelian approach discovered and developed by Gregor Mendel (1822–1884). Recent discoveries in genetics have enabled scientists to develop organisms whose genetic structure is actually combined with other genetic structures through a procedure called recombinant DNA. It is the DNA that codes for the expression of proteins that enables many things to be developed through this method. However, as the public and even some scientists are wary and skeptical about this technique, many countries have adopted anti-GMO policies, or at best full disclosure of all GMO-related practices to the public. Some recent press coverage as with reports of the death of monarch butterflies, has reinforced the public's concern in the United States. The U.S. government has adopted a position to date that GMO products are safe according to their findings. Public opinion has affected the industry's response to all of this. GMO has become a controversial issue in many segments of the country and within certain food producing companies. At the time of the writing of this book legislation brought up as Initiative and Referendum in California under Proposition 37 in 2012 was defeated. However, many other states have taken up the issue. In March of 2014 it was claimed by The Center for Food Safety that nearly half of all the states have introduced a bill requiring GMO labeling. Currently there is a bill in congress to define GM labeling in response to state activities. Recently there have been states that have adopted GM regulations (Vermont being the first). The Non-GMO Project is an independent organization that has addressed this as well. There is a bill in congress as of the writing of this publication and the future is unclear how federal legislation will proceed. See Recombinant DNA, Protein Expression, Gene, Natural (Flavors), and Chart 445 – GM Products, GE Plants.

GMO Project (non-GMO Project) – See GMO.

GMP – See Good Manufacturing Practices.

God Particle (Gazintas) – See Particle Physics

Goesintas – A coined flavor industry terminology that means 'goes into.' One method of flavor creation and production is the development of keys and concentrates that are subsequently diluted and/or mixed. This process can yield a convenient method, however, if there are too many goesintas, time, money, production efficiency and inventory costs will be greatly affected.

Goji or Lycium barbarum – See Appendix 2.

Gold Standard – The best iteration of a food product. Usually designed by a chef or culinary trained food scientist, the gold standard is the reference by which

all future modifications of the food product should be judged. See A La Minute versus Industrial Scale Production, Culinary Arts.

Goldenrod or Solidago virgaurea – See Appendix 2.

Goldenseal or Hydrastis canadensis – See Appendix 2.

Gone-Off – In tea terminology, a moldy or tainted tea, a flat or old tea. This type of off character usually develops by microbial growth due to too high a moisture content. See Yeast and Mold, Microbiological Assay.

Good Manufacturing Practices (GMP) – The accepted industrial procedures by which product integrity, safety, quality, and consistency are maintained. The Food and Drug Administration provides that flavor houses conduct their business in adherence to all pertinent regulations. Current Good Manufacturing Practices (cGMP) include as examples; a working sanitation program, glass and brittle plastic control, allergen control, metal object and other extraneous matter control, raw material control, finished product control, equipment maintenance, personnel issues, food safety control and assessment, a visitor policy, and other systems that are part of the overall HACCP system outside the HACCP plan. See HACCP, Prerequisite programs, Food Safety, Food Contact Surfaces, Microbiological Sampling Program.

Gooseberry (Ribes grossularioides) – Very popular in European cooking, gooseberries can be variable in color, but usually with streaks on the outside of the skin. The fruit is tart with a slightly bitter aftertaste. It is a relative of the currants. See Fruits.

Gotu Cola – Centella or Centella asiatica Urban – See Appendix 2.

Goulash – A stew that is made with beef, onions, paprika, caraway, and other seasonings.

Gourd, Edible – The term gourd can mean the hollowed, dried shell of the fruit of the Curcubitae family in which pumpkin is found. It could also refer to the entire fruit. Some gourds can be eaten, others are used for decoration, and still others are used for utilitarian reasons. Some are made into instruments. Gourds are also used to make dippers as an aid to drink yerba mate in South American countries. See Pumpkin.

Governmental Regulations (Restrictions) – See Corresponding Agencies, FDA, USDA, FTC, FCC, BATF, OSHA, EPA, DOT, DEPE.

Grades – The grade of a chemical is the rating of its purity, contaminants, and usability, for example:

- Food grade is able to be used in food products.
- Pharmaceutical grade is usually higher than food grade and is able to be used in pharmaceuticals.
- Spectrophotometric grade is usually of significantly high purity for instrumental work, but not necessarily food grade.
- Reagent grade is of a definite lesser quality, and no implication that the material is of food-grade quality.
- Industrial grade is the lowest grade and certainly not of food-grade quality.

Graduated Cylinder – A long, thin cylindrical glass or plastic vessel with measuring marks placed outside on the sides. Graduated cylinders are used to measure liquids usually, but can also be used to measure the bulk density of powders. See Bulk Density.

Grain – As in grain vinegar. Ten units of grain is equivalent to 1% acetic acid by volume. See Acetic Acid, Vinegar.

Grains – See Cereals and Grains and Individual Listings Under Botanicals.

Grains of Paradise (Melegueta Pepper) (Aframomum meleguata Rosc.) – Otherwise known as Melegueta pepper, the spice is related to cardamom, and has a very similar flavor profile. See Cardamom and Chart 175 – Grains of Paradise.

Grainy –

1. A textural attribute associated with small resilient particles or the reminiscence of particles in a food.
2. A flavor attribute reminiscent of the flavor attributes of cereals, meals, and grains in general.

Gram – A unit of measurement in the metric scale. As originally developed, a gram was equal to the weight of 1 cubic centimeter of water at 25.116°C. Note: 453.6 grams = 1 pound. See Kilogram, Weight, Mass.

Gram Negative Bacteria – A microorganism that does not retain a Gram stain coloration in the test of the same name. The resultant coloration differential shows shades of purplish-blue and red. See Gram Positive Bacteria, Gram (Stain) Test.

Gram Positive Bacteria – A microorganism that retains a purplish-blue coloration from the Gram stain. See Gram Negative Bacteria, Gram (Stain) Test.

Gram (Stain) Test – A procedure developed by the Danish physician Christian Gram, which uses a purplish-blue stain to differentiate bacteria types. The stain is made of a combination of crystal violet and iodine and a subsequent treatment of the cell by alcohol. The Gram test is useful in the identification of microorganisms. See Gram Negative Bacteria, Gram Positive Bacteria, Wright's Stain.

Granule – A small but firm structure that with others can contribute a grainy texture. Examples of granules are cellulosic materials, stone cells of pears, starch molecules arranged in certain patterns, and other types of materials. See Grainy.

Grape (Vitis spp.) – One of the oldest and most widely distributed fruits in the world, the grape is used in wine and other alcoholic beverages like

champagne, port, and cognac. Grapes come in three major species. The first, Vitis vinifera, includes the best grapes for wine making. Vitis labrusca and Vitis rotundifolia are two varieties of the second species that are native to North America. The labrusca variety includes the Concord grape (black with blue seeds), the Niagara grape (green seedless), and the Catawba grape (red). The third species is really a group of hybrids made from Vinifera species and Labrusca species. These are called the 'French hybrids.' In 1863 the French wine industry was almost totally decimated by the accidental importation of a louse from the United States that fed on the roots of French grape vines. The crop was saved from total ruin by grafting louse-resistant American rootstock to the European plants. European grapes include the Cardinal variety (purple), the Muscat of Hamburg (light purple), the Lival grape, and the Ribier (blue and black grape). The white European grapes include Chassleas (yellow-green), the White Muscat, the Gros-Vert, and the Servant. North American varieties also include the Flame grape, the Delaware grape, and the Ruby, a red seedless. Unlike the European varieties, the skins of the American grapes do not cling to the pulp of the fruit. Black Corinth grapes are also called Zante currants or champagne grapes. A natural coloring is made from extracting the skins of red- and purple-colored grapes. This colorful extract is called enocianina. Another food-approved colorant is made from extracted Concord grape juice. This is called grape color extract or enocianina. See Wine, Enology, Fermentation, Anthranilates, Color (Colorants), Anthocyanins, Enocianinna, and Appendix 2.

Grapefruit – See Citrus, Naringen, Nootkatone, and Chart 176 – Grapefruit.

Grapefruit Oil (Citrus paradisi Macfad. and C. decumana L.) – Grapefruit oil is distinguished from the other main citrus oils – orange, lemon, lime, and tangerine – by a sulfuraceous character and the presence of nootkatone. Often sulfur esters or terpene mercaptans like pinanyl mercaptan and geranyl mercaptan can be used to achieve this characteristic. Enhanced levels of naturally-occurring nootkatone, a sesquiterpene that is found in this oil, is at least partially responsible for higher quality oils. Grapefruits are either pink or yellow in the inside. See Nootkatone, Naringin, Citrus, and Chart 176 – Grapefruit.

Grapefruit Seed Extract – See Appendix 2.

Grape Seed Extract – See Appendix 2 and Chart 466 – Grape Seed Extract.

Grape Skin Color – Enocianina – Chart 432 – Enociannina and Appendix 2.

GRAS (generally recognized as safe) – The definitions of GRAS or generally recognized as safe are as follows:

- GRAS Self-affirmation – The manufacturer of this chemical or substance has conducted all of the appropriate testing and research and has formed an internal expert panel to review the findings and conclusions and have concluded that it is generally recognized as safe and can defend its safety to the FDA. The GRAS self-affirmation petition is filed with the FDA for review and approval. The FDA then can issue its ruling in the Federal Register. Some ingredients in this book are labeled GRAS. This is an example of this process. Some of the polyols are typically approved in this manner (maltitol, erythritol, lactitol). The 'GRAS exemption claim' is cited in proposed 21 CFR 170.36(c)(1).
- GRAS FDA-pending – The manufacturer has provided all of the testing and research and has submitted this to the FDA and is awaiting their finding for GRAS approval.
- GRAS – No Comment – The FDA has responded to a submitted claim with 'no comment,' meaning that there are no further challenges on the product's GRAS status. The history of the GRAS concept follows: With the advent of the Food Additives Amendment of 1958, the FDA listed a number of chemicals, essential oils, and other ingredients that were felt to be Generally Recognized as Safe within the intended use and published it in the Code of Federal Regulations, Title 21. However, as more requests for inclusions to the list were sought, the FDA began to see that testing was to be very cumbersome. Dr. Richard Hall, a member of FEMA, worked out a system with the FDA to develop a Flavor Expert Panel (also known as FLEXPAN), made up of toxicologists, biochemists, physicians, and other experts to assess the safety of flavor ingredients. Ben Oser of IFF presided over the FEXPAN for many years. Over the years this panel has periodically reviewed existing literature to assure that any adverse toxicological findings would be considered in the GRAS status of an ingredients as well as providing for a mechanism of delisting. This became the FEMA GRAS lists as published by the Flavor and Extract Manufacturer's Association in the journal *Food Technology* published by the Institute of Food Technologists. The previous designation of 'All of the ingredients contained in this product are approved for use by the FDA' then became 'All of the ingredients contained in this product are approved for use by the FDA or

appear on an FDA approved Industry List.' See GRAS List, FEMA, Regulations.

GRAS Exemption Claim – See GRAS.

GRAS List (FEMA GRAS List) – Developed by the Flavor and Extracts Manufacturer's Association (FEMA), Washington, DC through the work of Bernard Oser, Richard Hall, and others, who instituted an independent Flavor Expert Panel (i.e., toxicologists, physicians, etc.) to review the flavoring additives as introduced into the food supply for safety. Originally, the FDA published a list of approved substances in its Code of Federal Regulations Title 21, but could not keep up with the multitude of new items desired by the industry to be approved for use in flavors. The first GRAS list was called #III, and was published in *Food Technology* in February 1965. It began with item #2001 (acacia gum) and ended with item #3124 (zingerone). These lists have since been added to, updated, and reviewed by the panel. To date, the FDA explicitly accepts these lists. As of the writing of this book there are 27 published GRAS lists. See FEMA, Expert Panel, Toxicology, Safety and Chart 486 – FEMA GRAS Lists Numbers Included.

Grassy – The term grassy means reminiscent of green grass. If a leafy green component like cis 3 hexenol and a warm brown chemical like coumarin (not GRAS) or a coumarin replacer are mixed, a grassy character would result. See Green, Hay-Like (Flavor).

Graviola (Annona muricata) Soursop – See Appendix 2.

Gravlax – A Nordic dish made from slightly fermented salmon, salt and seasoned with dill. Lax (similar to lox) indicated the salmon part and grav literally means grave indicating the method of curing. The salmon or another fatty fish is buried in the sand above the high tide mark. The fermentation begins in a few days and develops brine that can be used in other dishes. Non-traditional recipes can use beetroot, pepper, alcoholic beverages like Aquavit, Vodka or smoking and other additional treatments. See Culinary Arts, Fermentation.

Great Nettle – See Nettle.

Greater Galangal – See Galanga Root.

Greek Lettering – In some chemical terminology, Greek lettering is used. Typically, it is α – alpha; β – beta; γ – gamma; δ – delta; or ω – omega. See Lactone, Nutrition, Fatty Acids.

Greek Sage – See Sage, Greek.

Green – Reminiscent of green leaves, unripened fruits or vegetables. This profile is characteristic of aroma chemicals with one or more double or triple bonds or certain sulfur compounds at lower levels. Examples are green apple (trans 2 hexenal), green leaves (cis 3 hexenol), green watermelon rind (trans 2 cis 6 non-adienal), green vegetables (dimethyl sulfide), cooked cabbage (methyl mercaptan). See Hexenyl Esters, Leaf Alcohol, Leaf Aldehyde, Unsaturated Esters, Sulfur Compounds, Fatty/Green.

Green Algae – See Chlorella and Spirulina and Appendix 2.

Green Bean – An unroasted dried coffee bean. See Coffee.

Green Bell Pepper – See Pepper, Sweet.

Green Bell Pepper Pyrazine – 2 methoxy 3 isobutyl pyrazine. This has been described as one of the strongest GRAS-approved aromatic compounds known. See Pyrazines.

Green/Fatty – See Fatty/Green.

Green Gram Bean – See Mung Bean.

Greens –

1. Often referring to salad greens, those leafy vegetables that can be eaten raw examples are; lettuce, spinach, members of the chicory family (like endive), members of the brassica family (like curly kale);
2. Braising Greens – a number of harder to digest greens that must be braised first in order to be edible these include; mustard greens, kale, chard, collards, mustard, bok choy, radicchio, and turnip greens. See Culinary, Salad, Composed Salad.

Green Tea – A product derived when leaves of the tea plant; Camellia sinensis are cut and then dried without a subsequent fermentation stage. See Black Tea and Appendix 2.

Gremolada – A mixture of sautéed orange and lemon peel, finely chopped garlic, and parsley developed first in Milan, Italy. To achieve the best effectiveness, it should always be added at the last minute to a dish.

Grilled – A food that has been cooked on a grill or under a broiler.

Grinding – The action of converting larger particles into smaller particles. This can be done in a hammer mill, blade grinder, or other suitable piece of equipment. Care must be taken so the heat generated from friction does not adversely affect the quality of the product. A cooling system or the inclusion of dry ice in the mix could help alleviate this problem. See Production, Particle Size, Sieve Analysis.

Grits – A grain dish popular in the southern U.S. states often eaten for breakfast. Grits is made from broken cereal grains, the most common of which is corn that have gone through the process of Nixtamalization. The word comes from the English word groats meaning a porridge typically from Wheat. See Nixtamalization, Cornmeal, Corn.

Gritty – A textural property that simulates tiny non-compressible granules in a given product. Similar in texture to grainy, but with harder particles. See Texture.

GRL – Global Reference List – Published by IOFI, it consists of items that are generally recognized as safe (International Counterpart to GRAS List). It is divided into two parts: Part 1 – CDS – Chemically Defined Substances and Part 2 – NCS – Natural Complex Substances. See IOFI, GRAS.

Groats – See Oats (unripe oat straw) and Appendix 2.

Grocery Manufacturer's Association (GMA) – The organization made up of suppliers to grocery stores and related establishments. The GMA reports sales and distribution information on the industry. See SAMI.

Guacamole – A dip of Mexican origin made of mashed avocados, onion, tomato and spices. See Avocado.

Guacatonga (Casearia sylvestris) – See Appendix 2.

Guaiac (Guaiacum officinale L., G. sanctum L., and Bulnesia sarmienti Lor.) – Guaiac wood oil and extract have a characteristic woody-rosy odor. The active constituent is guaiol, a sesquiterpene alcohol. Trace quantities of phenols like guaiacol are also present and give the product its characteristic clean pungent background. Its peculiar green fatty taste can be used sparingly in most fruit flavors, and perhaps in some natural vegetable and dairy characters as well. See Woody and Chart 177 – Guaiac Wood.

Guaiacyl Esters – Esters of guaiacol are typically phenolic or smoky owing to the strength predominance of the alcohol. Some phenolic esters can be described as having a leathery aroma. See Chart 163 – Guaiacyl Esters.

Guanabana – a.k.a. Soursop. *Annona muricata* The fruit is found or is cultivated in all parts of the world. It is related to the cherimoya. There are claims that it has an anti-carcinogenic but this is not substantiated. It has a flavor profile which is a mixture between strawberry and pineapple. See Tropical, Strawberry, Pineapple.

Guarana (Paullinia cupana H.B.K.) (P. sorbilis Mart.) – A roasted seed that exhibits taste and aroma characteristics similar to cocoa and chocolate. Guarana also contains caffeine. When roasted, guarana seeds exhibit a chocolate-like profile similar to cocoa or chocolate. The extract contains theobromine and caffeine as does cocoa extract. The paste made from these roasted seeds produces a chocolate-like product known as guarana paste. This guarana paste is also called Brazilian chocolate when sweetened with sugar. Because the extract enhances the brown nuance of a fruit, it can be used to add a ripened note to most fruit flavors. See Brown (Compounds), Chart 178 – Guarana, and Appendix 2.

Guar Gum – A thickener made from the grown splits of the Cyamopsis tetragonolobus plant. Guar gum is perhaps the least cost-in-use gum because it is relatively inexpensive and is a powerful thickening agent. Guar gum is also used in the treatment of diabetes due to its coating effect on the stomach lining. This coating then retards nutrients to the intestine. See Gums and Thickeners.

Guatemalan – A coffee variety with a diverse range in coffee flavor profile. In Central America, Guatemalans include Antigua™, Atitlan, and Coban varieties. Antigua™ is noted for its distinctive chocolate/cocoa nuance. See Coffee.

Guava (Psidium spp.) – The guava somewhat resembles a mango in size and shape; however, the inside pulp is usually pinkish-to-pinkish orange. The flavor is fruity and sweet and only slightly acid. See Tropical Fruits and Chart 179 – Guava.

Guggul or Mukul Myrrh Tree (Commi-phora mukul) – See Appendix 2.

Gum Acacia, Gum Arabic – See Gums and Thickeners.

Gumbo – A rich, heavily seasoned soup typical of Cajun cooking thickened with okra. Gumbo is commonly seen in Cajun recipes typical of the U.S. Louisiana/Mississippi River delta region.

Gum Ghatti, Elemi, Tragacanth Gum, Arabic, Acacia, etc. – See Gums and Thickeners.

Gummy – A textural attribute usually carrying with it a negative connotation. Gumminess could also be associated with attributes such as bitterness, graininess, grittyness, and metallic, depending on the source of gums or gummy ingredient.

Gums and Thickeners – There are many gums and thickeners used by the food industry. We will not discuss the FEMA GRAS-approved gums and thickeners here. Note: Not all of these gums are thickeners; they also include gum oleoresin and other exudates. See Culinary Thickening Techniques and Chart 164 – Gums and Thickeners.

Gurjun Balsam Oil (Dipterocarpus spp.) NOT FOOD GRADE – Gurjun is used as an adulterant in fabricated essential oils. A product originally from the far east, which is further refined for perfumery in Europe and the United States. Used to correct essential oils in order to meet USP (United States Parmacopoeia) demands. Luckily, the use of the product in perfumery has declined considerably.

Gustation – The process of tasting. The gustatory organs are the organs of chewing and swallowing, the salivary glands, the tongue, the teeth, mouth tissue, lips, and gums. Gustation is the sense of taste sensed through the taste buds of the tongue and throughout the oral cavity carried to the brain through the gustatory nerve. Allied sensations are the sensations of heat, chemical irritation, coolness, etc., which are associated with the sense of touch transmitted through the trigeminal nerves. See Olfaction; Agustia; Tongue; Taste; Mint (herb);

Capsaicin; Heat; Temperature; Texture; Cool(ness), Cooling, or Mintyness; Trigeminal Nerves.

Gustatory Cortex – The area in the brain responsible for the perception of taste. Recent studies show hot spots in the gustatory cortex for the perception of sweet, salty and Umami. On the tongue the receptors are intermingled, while in the brain they are clearly separated is surprising according to Nicholas Ryba of the National Institute of Dental and Craniofacial Research, Bethesda, MD. Bitterness has to do with aversion for the most part as bitter substances are often toxic, while Sweetness has to do with enhanced nutrition and ripeness. There does not seem to be a sour hotspot in the Gustatory Cortex, so there certainly is more to discover. Furthermore, it has been established that memory is best 'downloaded' when during REM while a person is ingesting their favorite food. See Taste Buds, Taste, Odor, Brain.

Gustducin – A G-protein having to do with the perception of sweet, bitter and Umami sensations. Gustducin and transducin (vision) are structurally related hinting that they are from the same biological chemo-evolutionary starting point. See Nerve Receptor.

Guyanese Arrowroot – The starch made from yams. See Yam, Chart 164 – Gums and Thickeners.

Gymnema sylvestre – See Appendix 2.

H

HACCP – (Hazard Analysis by Critical Control Points) – A procedure first recommended by FSIS, the Food Safety and Inspection Service of the USDA, prompted by lethal poisoning by the potent E. coli strain O157 – H7 or other microorganisms that could be pathogenic. It begins by the assessment of the production facilities by a 7 step approach: (1) Hazard Analysis; (2) Critical Control Point Identification; (3) Establishment of Critical Limits; (4) Monitoring Procedures; (5) Corrective Actions; (6) Record Keeping; and (7) Verification Procedures.

1. Hazard Analysis – Hazards such as microbiological, allergen and foreign matter are identified as to be potential hazards within the operation. Example; A microbiologically sensitive product is first identified. Monitoring for pathogenic species such as Listeria monocytogenes, Campylobacter jejuni and coli, Salmonella, E. coli, especially E. coli O157:H7, Clostridium perfringens, Staphylococcus aureus.
2. Critical Control Point Identification: Areas in the operation are identified as places where hazards can be avoided or controlled. Example; An analysis of the production sequence, areas, procedures, etc., are identified for potential microbial and other contamination. In this case, heat treatment might be an effective control of pathogenic organisms.
3. Establishment of Critical Limits: Development of SSOPs (Sanitary Standard Operating Procedures). Example: Through investigation of the Food and Drug Administration database, acceptable times and temperatures for the reduction of pathogens are documented. The times and temperatures are then set as the Critical Limits of the CCP. A standardized calibrated thermometer is used and the times and temperatures are documented. The system includes a check and signature by a supervisor and review that the system, documents, and thermometer are up to date in place and validated.
4. Monitoring Procedures – Checkpoints, procedures, and systems are the put in place to not only identify whether there has been a breach, but also to avoid the possibility of one occurring. Example: Establish anti-microbial treatment procedures and have a written plan and documentation that this is being conducted properly. Example 2: Environmental monitoring and product testing verifies that the system is in place, is working properly.
5. Corrective Actions: Finally, there must be in place a system to identify if something goes wrong, what measures, root causes, cures, responses and procedures must be considered to alleviate the problem at hand and mitigate potential problems in the future. This might include the product being put on quarantine, a report to the reportable food registry, a recall, a withdrawal, destruction of material or any other response to the problem. A corrective action report is typically documented and closed out once the solution to the problem is verified as being achieved.
6. Record Keeping – This is one of the key principles in the HACCP program. The FDA takes the stance that if it is not documented it was never done.
7. Verification Procedures – This is the collection of data through the monitoring procedures that verifies that the program is running properly. Example: If the allergen cleaning program is working effectively a quantitative analysis of the wash water during an allergen clean will verify

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the reduction if not elimination of allergens below a certain threshold.

See Regulations, Quality Assurance, FSMA, Food Safety, GMP.

HACCP System versus HACCP Plan – The HACCP plan is very specific and is analyzed and developed using the seven step protocol. The HACCP system, however encompasses all of the issues of Food Safety Including such items as GMP, Personnel Issues, Food Security, Equipment Maintenance, and other considerations. See GMP, Food Safety.

Halal Supervision – In Arabic meaning permissible or edible. The Regulations of Halal are similar to kosher regulations, with added restrictions such as the elimination of any ethyl alcohol in the product. See Kosher Supervision.

Half-Life – The time it takes for at least half of an isotope to lose neutrons and convert to a lesser atomic weight form. It is the half-life effect of carbon isotopes that enable the confirmation of natural sourcing. Ratios of degradation to non-degraded material assure the proper 'natural state.' See Carbon 12, Carbon 13, Carbon 14, Isotopic Analysis (Isotopic Ratio), Natural (Flavors).

Halo Effect – When more than one sample is being tested, samples tend to influence each other. Example: If three products are being evaluated, and they score high on a hedonic scale, a lower quality fourth one will tend to score higher than if it were either tested alone or tested with samples of a lesser quality. See Logical Errors, Stimulus Error, Expectation Error, Order of Presentation Error, Mutual Suggestion Error, Motivational Error, Personality Errors (Capriciousness versus Timidity), Error of Habituation.

Halogen – A group of elements that represents the most reactive group of non-metallic atoms. These have a tendency to receive one electron (oxidizers), thus forming ions which when dissociated have a negative – (–1) charge. In this form they are known as halides. The group includes; Fluorine (F), Chlorine (Cl), Bromine (Br), Iodine (I), Astatine (At), and the yet undiscovered Ununseptium (Uus). They exist in nature as diatomic molecules: F2, Cl2, I2, Br2, At2. Fluorine and Chlorine are gases, Bromine is a liquid, and the rest are solids at room temperature. Fluorine is the most reactive and can actually form compounds with the otherwise inert elements, the noble gases (Argon, Krypton, Xenon, and Radon). Hydrofluoric acid can etch glass.

Halophilic – Halophilic organisms are those that can thrive in high concentrations of salt (salt loving).

Ham – The hind leg of pork that has been cured through salting, smoking and/or rubbing, bringing out a distinctive flavor. See Culinary, Meat.

Hard – 1. In tea terminology, hard means pungent. This is particularly a trait that is desirable and seen often in teas of the Assam variety. 2. Hardness is a function of the non-friability of a product. Hardness can be achieved by coating a product on the outside, agglomeration, moisture addition, bridging or crystallization. See Agglomeration, Moisture, Crystallization, Glass Transition Phase.

Hard Candy Manufacturing – In the manufacture of hard candy, sugar typically goes through a sequence of steps as it is heated. It goes through the following stages and temperatures: 1. From 230–235 degrees F (Thread Stage) Sugar concentration about 80%, sugar dropped into cold water will yield a long thread like effect. This is the Syrup stage. 2. As it is heated from 235–240 degrees F (Soft-Ball Stage), sugar concentration about 85%, sugar dropped into cold ware will form a flexible ball. It will flatten like a pancake if placed on a flat surface. 3. Further heating from 245–250 degrees F (Firm Ball Stage), the sugar will form a firm ball that retains its shape but will be able to be squeezed and flattened in the hand. 4. From 250–265 degrees F, the sugar will form a harder ball than in the Firm Ball Stage. 5. From 270–290 degrees F, (Soft Crack) sugar put in cold water solidifies into threads. When removed they are flexible and not brittle. 6. From 300–310 degrees F, (Hard Crack) the threads will be brittle when removed from the water. This is the stage suitable for hard candy. From 320 degrees (Clear Amber Liquid) 340 degrees (Brown-Liquid Caramel) and 350 degrees (Burnt Sugar Stage) caramelization truly occurs. See Caramel, Maillard Reaction.

Hard Crack – See Hard Candy Manufacturing.

Hardness – The amount of certain dissolved minerals in water. These minerals include calcium, magnesium, etc., and have a tendency to form a sludgy insoluble mass with soap. Hard water is a concern in flavors as these metals often introduce an off taste to the food in which it is used. This taste is neither a true taste, nor an odor, but a trigeminal sensitivity to the chemical presence of these ions. See Trigeminal Nerves.

Hard Water – See Hardness.

Harmonization – The ongoing policy of mutual collaboration between the EU and FDA positive lists. Although in principle this was to be a smooth transition, it has taken many years without final results. Hopefully it will be finalized soon.

Harsh –

1. In tea terminology, an extract or tea beverage that is harsh is overly biting. This is often the result of under withering, under fermentation, and more likely under-rolling.

2. A negative flavor description usually referring to a pungent or otherwise irritating character. See Toners, Blenders, Mellow, masking Agent.

Haw Bark (Viburnum prunifolium) – The main constituent of haw bark is salicin (Saligenin glucoside) and viburnin. See Bitter and Chart 199 – Haw Bark Extract.

Hawthorn or Crataegus oxyacantha (LINN.) – See Appendix 2.

Hay (NOT FOOD GRADE) – Hay oil, also called flouve oil, was used in flavors in the past, but its use was discontinued due to the content of coumarin in the oil.

Hay-Like (Flavor) –

1. In tea terminology, a characteristic that then develops further into an autumnal flavor.
2. Reminiscent of hay.
3. In fragrances, hay-like profiles are achieved by the use of coumarin (not GRAS). See Brown (Compounds), Coumarin Derivatives.

Hazard – (1) The definition of a Hazard by OSHA is: 'Hazard: Any facility, location, equipment, tool, job, task, or action that presents a potential of serious injury or death to any employee. This is the OSHA view. Serious injuries are those that result in time loss (beyond the three-day grace period) and/or hospitalization beyond an emergency room visit.' (2) The Definition of Hazard (Hazardous Material) by the DOT is a dangerous material that falls under one or more of the following classes: 1: Explosive, 2.1: Flammable gas, 2.2: Non-flammable gas, 2.3: Poisonous gas, 3: Flammable liquid, 4.1: Combustible solid, 4.2: Spontaneously combustible, 4.3: Dangerous when wet, 5.1: Oxidizer, 5.2: Organic peroxide, 6.1: Poison (Keep Away From Food), 6.2: Infectious material, 7: Radioactive, 8: Corrosive, 9: Miscellaneous. (3) The definition of a hazard by the FDA is one that can cause bodily harm or death to an individual. See OSHA, HAZCOM 2012, DOT, HACCP.

Hazard Analysis – The procedure used in HACCP systems and HAZCOM 2012 assessments as examples. Hazard analysis explores systems, procedures and ingredients and assesses the likelihood and degree of exposure as in HACCP and/or hazard associated with exposure to chemicals and chemical mixtures as in HAZCOM 2012. See HAZCOM 2012, HACCP.

Hazard Category – Hazard Class – DOT Classes:

1. Explosives
2. Gases
3. Flammable Materials
4. Flammable solids, etc.
5. Oxidizers and Organic Peroxides
6. Toxic Materials and Infectious Substances
7. Radioactive Materials
8. Corrosives
9. Miscellaneous

The classes are further designated into packing groups. Packing Group I is High Danger; Packing Group II is Moderate Danger; and Packing Group III is Low Danger. Under the new HAZCOM 2012 ruling that is in general concert with the GHS system issued by the United Nations, the classes of hazards are: OSHA Explosion Pictogram (Explosives, Self-Reactives and Organic Peroxides) – 1.1 to 1.6 with 1.1 being the most hazardous; Flame Pictogram (Flammable Liquids (1–4.1 is most dangerous); Flammable Solids (1–2) Self-Reactives (Types A–G), Pyrophorics (1 Category Only); Self-heating (1–2); Emits Flammable Gas (1–3) with 1 being the most dangerous; Circle and Flame Pictogram (Oxidizers (1–3); Oxidizing Gases (1 category only); Organic Peroxides (Types A–G); Gas Cylinder Pictogram (Gases under pressure, (4 Groups); Skull and Crossbones Pictogram (Acute Toxicity) 1 to 4 with 1 being the most dangerous; Exclamation Point Pictogram (Acute Toxicity, Skin Irritation, Eye Irritation, Skin Sensitizers) 1, 2A and 2B with 1 being the most hazardous; Man with Asterisk Pictogram (Carcinogen 1A, 1B and 2); Respiratory Sensitizers (1A and 1B); Reproductive Toxicity (1a, 1B and 2); Target Organ Toxicity (1–3); Germ Cell Mutagens (1A, 1B and 2); Corrosive Pictogram (Eye Corrosion (1, 2A 2B); Skin Corrosion (1A, 1B, 1C, 2 with 1 being the most dangerous); Aspiration Hazard (Category 1 only); Corrosive to Metal Category 1 only); Tree and Fish Pictogram (Aquatic Toxicity).

Hazard Materials Communications Act – The Occupational Safety and Hazard Administration (OSHA) regulation that mandates the reporting of the use, disposition, and storage of certain hazardous materials identified by OSHA. The legislation promulgated is cross-referenced across a number of regulatory institutions like the EPA, the DOT, as well as affecting rules authorized by the FCC, FTC, FDA, etc.

Hazardous Materials – Hazardous Substances – Chemicals and other ingredients that have been deemed by the appropriate regulatory agencies to pose a hazard. Flavor materials can still be food approved for intended use while being hazardous in a concentrated form. A few of the flavoring materials can be considered corrosive such as the ionizing acids (acetic, propionic). Others are toxic in the pure form but are not so at the levels used in flavors (phenol, formaldehyde) and others are flammable. See OSHA, DOT.

HAZCOM 2012 – The United States Department of Labor – Occupational Safety and Health Administration has developed a standard in compliance with the Globally Harmonized System of Classification and Labeling of Chemicals. They claim

the 'Standard that gave workers the right to know now gives them the right to understand. It includes the change from an MSDS system to an SDS format similar to the one adopted by the U.N. (GHS). It identifies 16 sections including: 1. Identification (Product Identifier, Manufacturer or Distributor Name, Address, Phone, Emergency Phone Number, Recommended Use, and Restriction on Use); 2. Hazard(s) Identification (Chemical information and label elements); 3. Composition/Information on Ingredients (Chemical Ingredients and Trade Secret Claims); 4. First-aid Measures (Important Symptoms/Effects; Acute, Delayed, Required Treatment); 5. Fire Fighting Measures (Suitable Extinguishing Techniques, Equipment, Chemical Hazards from Fire); 6. Accidental Release Measures (Emergency Procedures, Protective Equipment, Proper Methods of Containment and Cleanup); 7. Handling and Storage (Precautions of safe handling and storage including incompatibilities); 8. Exposure Controls/Personal Protection (Permissible Exposure Limits (PELs), Threshold Limit Values (TLV), Appropriate Engineering Controls, and Personal Protective Equipment); 9. Physical and Chemical Properties (Chemical Characteristics); 10. Stability and Reactivity (Chemical Stability and Possible Hazardous Reactions); 11. Toxicological Information (Routes of Exposure, Related Symptoms, Acute and Chronic Effects, Numerical Measures of Toxicity); 12. Ecological Information; 13. Disposal Considerations; 14. Transportation Information; 15. Regulatory Information; 16. Other (Date of Preparation or Last Revision). This is found in the CFR 29 Sections 12 through 15 Paragraph 1910.1200(g)(2). See OSHA, Hazardous Substances, Quick Cards.

Hazelnut (Corylus spp.) – This variety of hazelnut is also known as a filbert. Hazelnuts have a flavor that is somewhat like a butternut and somewhat like a Brazil nut. Suppliers of pyrazines point out that the non-nature identical methyl thio methyl pyrazine is characteristic of hazelnut. It is not found in the natural product. It is so characteristic of the nut, however, that it is therefore logical that the presence of non-GRAS sulfur containing pyrazine or thiazoles or similar components are responsible for the characteristic flavor profile. See Pyrazines, Nutty, Filbertone™.

HAZMAT 2012 – See HAZCOM 2012.

HDL – High density lipoprotein. See Cholesterol.

Headspace – The enclosed air over a mass of odiferous material. Example: The headspace in a jar is the entrapped gases in between the material in the jar and the lid. See Headspace Analysis.

Headspace Analysis – A procedure by which an instrument, usually a gas chromatograph, analyzes the volatiles in the headspace of a given food system. One way is to use Solid Phase Micro Extraction (SPME). See SPME.

Health Care Products – Health care product category includes all products including medical preparations and pharmaceutical preparations available by doctor's prescription or not. These products include the major category of shampoos, mouthwashes, toothpastes, etc. Also called personal care products. Usage of flavors in this category relies heavily on the use of menthol type products and other mints (spearmint, wintergreen). Covering up medicinal systems is more difficult and care must be maintained not to adversely affect the flavorist tasting these often potent and potentially harmful medicinal preparations. Historically, anise, high benzaldehyde cherry flavors, root beer flavor, other potent brown-type flavors (anise, vanilla, chocolate), and grape flavors have also been the most popular in this case. See Toothpaste Flavors, Mouthwash Flavors, Health Foods, Nutraceuticals.

Health Food Industry – The many companies that make up processors and producers, marketers, distributors, and advertisers of purportedly healthful products. This is a fast growing segment of the food industry.

Health Foods – Those products that promote their positive effect on health and nutrition. Most health foods promote simple or single approaches to specific types of concerns (i.e., low fat, low sugar, low calorie, high fiber, low sodium, etc.). There are many types of products that claim to be health foods. From high nutrition supplements used by body builders, to the promotion of exotic herbs and plant derivatives, these products purport varying degrees of healthfulness. Effectiveness verification is an issue. Many splinter groups have developed promoting that their products are healthy. In the past, some cases citing overingestion of certain amino acids were found to be harmful, some ultra-low fat diets were thought to be responsible for gall bladder problems, and some diet drinks were found to be devoid of essential nutrients. According to the American Medical Association, a fully nutritious diet is best for overall good health.

Heart –

1. The large, fleshy edible part of the artichoke located at the base of the vegetable. See Artichoke.
2. The center of an edible plant.
3. The organ that pumps blood and sustains life in animals.
4. An edible type of offal.

See Offal, Palm.

Heat –
1. The temperature of a food or flavor.
2. The trigeminal burn of capsaicin or capsicum pepper extract.
3. The latent energy of a food product that when oxidized provides an amount of heat energy measured in calories.
4. Heat can be the worst enemy of a flavor as most flavorings contain volatile highly evaporative chemicals. Care must be taken to store flavors in a reasonable temperature range such as 50°F–70°F. However some heat might work to a flavor's benefit. In these cases flavors can be generated by heat as precursors. Example and excess of unreacted sugars or amino acids can exist in a flavor so whatever volatile loss occurs over time, might be replaced by volatile contribution although slowly at ambient temperature Maillard reactants. See Cool(ness), Cooling, or Mintyness; Trigeminal Nerves; Calorie (c); Calorie (C).

Heat of Reaction – The temperature change a system undergoes when one product reacts with another. A positive heat of reaction, the process that gives off heat is called exothermic. A negative heat of reaction, the process that absorbs heat from its surroundings is called endothermic. An example of an endothermic reaction is the snap mix plastic cooling preparations used in bruises and bone traumas. The roasting of coffee is mostly endothermic, that is, it absorbs heat from the roaster. But at the last stages, it becomes endothermic, and it is at that point that flue fires can occur. See Endothermic, Exothermic.

Heat of Solution – The temperature change a system undergoes when one product is solubilized in another. A positive heat of solution means that the act of solubilization gives off heat and is therefore exothermic. A negative heat of solution means the act of solubilization absorbs heat from its surroundings and is called endothermic. See Endothermic, Exothermic.

Heat Stability – The ability to withstand high temperatures without degrading. See Accelerated Storage Stability Testing.

Heat Transfer – The movement of thermodynamic energy from one substance to another by one or more of a combination of conduction, convection, or radiation. Conduction occurs as a result of direct contact between a hotter substance upon a colder substance. Convection occurs when currents are formed by virtue of a differentiation of heat and subsequent change in densities. Heating and mixing therefore is not convection but conduction as the substance is transferred to contact another by physical means. Finally, radiation is the transmittance of heat energy through space in the form of infrared waves, microwaves, etc. Surface color can affect the rate of heat exchange through radiation of infrared waves. Metallic substances can affect the absorption of microwaves. Select varieties and configurations of metal designs control the degree of heat rise in microwave systems. Swept surface heat exchangers use a conductive system of heat transfer and can exhibit severe oxidation or charring at the interface unless product is mixed well. A stirring system (Teflon™ stirring bar or Teflon™ blade) is usually used in a small distillation setup. See Microwave Oven, Processing Conditions, Production Issues.

Heavy – A descriptive term that means the flavor is predominant in higher molecular weight substances and has more of a background than a middle or foreground flavor profile.

Heavy Metals – Metallic elements that are trace contaminants in foods include:
- Lead – Previously used in paint, ingested by children possibly through pica (eating of non-food materials by children), or as a contaminant in foodstuffs from containers, the environment, and other sources. Affects the kidneys and the nervous system, and can lead to hypertension.
- Mercury – Mercury is transformed by bacteria into methyl mercury. Methyl mercury is then able to store itself in fish tissues and bioaccumulates as it moves up higher on the food chain. Long-term exposure results in nervous system damage, hearing loss, permanent brain damage, and reproductive issues including birth defects, to lung damage, coma, and death.
- Other Heavy Metals of Concern (Cadmium, Arsenic, and Chromium) – These metals affect the balance of zinc and copper in the body, cause cardiac abnormalities and severe respiratory problems, respectively. See Heavy Metals, Quality Assurance, Analytical Testing.

Hedonic (Rating) Scale – A sliding scale that measures like and dislike of a given product. For adults, a numerical rating is used, and for children, face diagrams can be used, depicting faces from frowns to smiles. The scale used is any odd number, where –X is the lowest (least liked) and +X is the highest (most liked), and where 0 is exactly in the middle (neither preferred or not preferred). The word hedonics refers to Hedon, the figure in Greek mythology that enjoyed pleasurable experiences. See T-test. See Magnitude Estimation, Sensory Evaluation

Hedonic Test – An analysis that measures the pleasure factor of a product. See Discrimination Testing, Overall Difference Test.

Heirloom Foods – The general term of heirloom means interesting and sometimes odd varieties of foods grown in small farms or residences. See Seed Savers Exchange, Heirloom Seeds.

Heirloom Seeds – A trend or movement in the agricultural industry whose goal it is to preserve unique and valuable seed stocks of heirloom foods. The Seed Savers Exchange is one organization that enables the exchange of unique and interesting natural hybrids and varieties of seeds. See Seed Savers Exchange.

Helichrysum – See Immortelle, also called Everlasting.

Heliopsis longipes Extract – Heliopsis shows to have fungistatic and bacteriostatic pro-perties. It is also used to prevent dry mouth and in other medicinal preparations. The active ingredient is a bornyl ester of deca-2E,6Z,8E-trienoic acid. See Nutraceuticals and Appendix 2.

Heliopsis – See Chart 473 – Heliopsis.

Heliotropine – See Piperonal (Heliotropine).

Hemiacetals – See Acetals.

Hemicellulase – See Enzyme Hydrolysis.

Hemlock (Spruce) – Has a piney/balsamic character with a sweet almost fruity undertone. Could be used in any citrus flavor to give a fresh piney top note, or in mango, passion fruit, or papaya to contribute that elusive tropical exotic pineyness. See Balsamic and Chart 200 – Hemlock.

Hemoglobin – The iron-containing compound that is responsible for the oxygen/carbon dioxide transfer in the blood as absorbed through oxygen-rich alveoli compartments in the lung. The hemoglobin molecule is red in an oxygen environment and blue in a carbon dioxide environment. The molecules exchange either gas with the other when the other is mostly present. This exchange is called respiration. Some other gases form a permanent non-exchangeable bond with hemoglobin resulting in suffocation. Two of these are cyanide gas and carbon monoxide. See Nutrition, Minerals.

Hemp (Cannabis sativa L. subsp. sativa var. sativa) – The industrial variety (non-drug) version of cannabis. The active ingredient(s) of hemp or marijuana must be removed in order for it to be used as a nutraceutical. Cannabanols and cannabandiols are some of the chemicals that are responsible for the psychotrophic action of 'marijuana' and must be removed. See Appendix 2.

Henning – (Hans Henning) – Developed a system of odor identification in 1916 he called the 'smell prism'. This included; Flowery, Foul, Fruity, Spicy, Burnt, Resinous. See Crocker Henderson Odor Classification System, Zwaardenaker.

Heptyl Esters – See Chart 146 – Alkyl Esters Grouped by Alcohol Moiety.

Herb – The aromatic leaves or flowers of flavorful botanical materials. Some herbs have a history of use and are not specifically defined or approved by the FDA. Due to their long-standing historical use, the FDA states they need to be declared if used, but not regulated. See Section, Herbaceous.

Herbaceous – A flavor profile typical of the herbs, somewhat green and vegetable like, with a spicy background and a slight phenolic or medicinal nuance.

Herbal Tea – Herbal teas are non-traditional (non-camellia sinensis) tea varieties and blends of those types produced to achieve a desired result. Sometimes herbs are used to produce a tea without caffeine, other times it might be to achieve a non-traditional tea flavor profile, or blends might be made to achieve a certain nutraceutical characteristic or advantage. See Coffee, Tea, Nutraceuticals.

Herbicide – A substance that kills herbs or plants.

Hermetic – Airtight.

Hermetically Sealed – Sealed in an airtight container.

Hesperidin – The glucoside made up of glucose and hesperitin. See Hesperitin.

Hesperitin – (±)-Hesperetin or 5,7-Dihydroxy-2-(3-hydroxy-4-methoxy-phenyl)-chroman-4-one-. The aglycone (chemical without the sugar in a gycoside) form of the glycoside hesperidin found in citrus products. Hesperitin has been found to exhibit anti-inflammatory effects. The glucoside hesperidin has been seen to reduce cholesterol and blood pressure. See Phenol, Nutraceuticals, and Appendix 2.

Heterocyclic Amines – See Polycyclic Heterocyclic Amines.

Heterocyclic (Compound) (Ring) – A ring structured chemical compound that contains more than carbon in its inner ring structure (usually oxygen, nitrogen or sulfur, or combinations thereof). See Pyrazines, Pyridine, Pyrazoles, and Pyrrole (quinolines, oxazolines and oxazoles), (thiophenes, thiophenones, dithianes, trithiolanes, thieno pyrimidines, dithiazines, and trithianes), Theaspiranes.

Heterogeneous – Heterogenous means having more than one type represented. Usually used for particle size and type in a dry seasoning or flavor. Heterogeneous particles can tend to separate on shipping or standing. Agglomeration of particles helps this. Spray-dried flavors added directly to tea results in a problem of this type, because the spray-dried matrix has a different bulk density and size to tea. See Homogeneous.

Hetero Molecule – A molecule having an element other than oxygen, hydrogen, or carbon. An atom containing elements such as nitrogen or sulfur typically.

Hexanoic Acid – Hexanoic acid is also known as caproic acid. This is a flavor ingredient that is very characteristic of human sweat. It is an important ingredient in Italian cheese flavors and is also important in the profile of fermentation products. See Butyric Acid, Valeric Acid, Acetic Acid, and Chart 4 – Acids All Types.

Hexenyl Esters – The hexenyl esters, or esters of leaf alcohol, are by virtue of their root alcohol green in nature. As is typical of homologues, the higher the molecular weight of green compounds, the less harsh, leafy, and pungent green and the more vegetable like and fatty green the products become. See Green, Leaf Alcohol, Leaf Aldehyde, Homologue, Harsh, Leafy, Pungent, Fatty, and Chart 333 – Unsaturated Esters Aliphatic.

Hexyl Esters – See Chart 146 – Alkyl Esters Grouped by Alcohol Moiety.

Hibiscus sp. – See Appendix 2.

Hickory Bark (Carya species) – Used to impart woodiness or seediness to any flavor. See Woody, Smoke Flavor, and Chart 201 – Hickory Bark.

Higgs Boson – See Particle Physics.

High Amylose Starch – One that contains over 50% amylase as opposed to amylopectin. See Amylose, Amylopectin, Modified Food Starch, Starch, Thickeners.

High Fired – In tea terminology, an oxidized tea, however one that is not yet at the point of being burnt or overly phenolic. Results from high temperatures in the firing or drying stage being applied and maintained longer than is necessary. See Phenolic, Burnt or Burned.

High Pressure or High Performance Liquid Chromatography (HPLC) – See HPLC.

High Risk/High Care – One audit system defines high risk/high care areas as those areas that have the ability to support the growth of listeria so. Listeria was used as an indicator organism because of its high percentage of mortality, ease to grow in lower temperatures environments and the low dose needed to cause infection. Foods that fall into the HR/HC protocols are those that do not undergo a subsequent cooking/kill step, those that are distributed chilled or frozen and those that have inappropriate water activity (>.8500) pH (above 4.6), and do not have preservatives, and are therefore vulnerable to the growth of pathogens. See Low Risk/Low Care, Food Safety, HACCP, Pathogenic Organisms.

High Temperature Short Time Processing – HTST – 72 degrees C (161°F) for 15 seconds. See Pasteurization, Thermal Kill Step, Food Safety, Vat Pasteurization, Ultra pasteurization, Aseptic Processing, Canning.

Higher Temperature Shorter Time Processing – HTST – 89 degrees C (191°F) for 1.0 seconds, 90 degrees C (194°F) for 0.5 seconds, 94 degrees C (201°F) for 0.1 seconds, 96 degrees C (204°F) for 0.05 seconds or 100 degrees C (212°F) for 0.01 seconds. See Pasteurization, Thermal Kill Step, Food Safety, Vat Pasteurization, Ultra pasteurization, Aseptic Processing, Canning.

Hilum – A scar or eye developed in a bean, where it was attached to the pod.

Histamine – A protein responsible for allergic reactions. It is developed in the body by the decarboxylation of the amino acid histidine through L-histidine decarboxidase. It is one of the chemicals in the complex series of events called anaphylactic shock. It is also released as part of sexual orgasm and is responsible for the sex flush among women. Antihistamines are used to counteract the ill effects of histamine in the body. See Food Allergy, Anaphylaxis, Food Intolerance.

Histogram – A chart bar chart that displays statistical Information that occurs within certain equal ranges or intervals. See Statistics – Statistical Analysis, Sensory Evaluation.

History – The modern history of the flavor industry begins around the mid-nineteenth century, when the chemicals benzyl alcohol and phenyl acetic acid were first synthesized commercially by S. Cannizzaro. In the next year, coumarin was synthesized by W.H. Perkin. Since then many other flavor ingredients were commercialized: benzaldehyde (F.W. Wilhelmi, 1870), salicylaldehyde (K. Reimer, 1876), vanillin (K. Reimer and F. Tiemann, 1876), cinnamic acid (W.H. Perkin, 1878), phenyl acetaldehyde (E. Erlenmeyer and A. Lipp, 1883), cinnamic aldehyde (G. Peine, 1884), alpha terpineol (O. Wallach, 1885), methyl salicylate (Schimmel & Co., 1886), piperonal (G. Ciamician and P. Silber, 1890), nitro musk (A. Baur, 1891), and ionone (F. Tiemann and P. Krueger, 1893). Since then, thousands of chemicals have been synthesized for use in perfumery and flavors throughout the world. See GRAS List, FEMA, Code of Federal Regulations.

HLB – Huonglongbing – See Citrus Greening Disease.

HLB (Hydrophilic Lipophilic Balance) – A value based on a sliding scale indicating whether a substance is water soluble (high HLB) or oil soluble (low HLB). Although most flavoring materials (volatiles) are oil soluble, some like the lower molecular weight fatty acids are more water soluble (ionize) than oil soluble. The HLB system prescribes the use of emulsifying agents. Flavor ingredients and systems can use an emulsifier that affects the HLB of the system that will affect the relative vapor pressures of the flavor volatiles and therefore, the resultant flavor profile. See Emulsion, Emulsifying Agent, Vapor Pressure, Lipid, Aqueous, Miscibility.

Ho Leaf or Ho Wood Oil – A good source of linalool and camphor, however this oil is not food approved due to its safrole content. See Chart 433 – Ho Oils.

Hollandaise – One of the Mother Sauces used in culinary applications. A sauce made from the yolks of eggs, butter, and lemon juice, which can be added to lukewarm eggs (Eggs Benedict), vegetables, or fish. There are a few successful 'instant' Hollandaise mixes. However, purists state they cannot come up to the quality standards of a freshly prepared sauce.

Holy Basil (Tulsi or Ocimum sanctum) – See Appendix 2.

Holy Thistle – See Thistle, Blessed.

Homeopathic Medicine – Developed originally by Christian Hahnemann, a German physician around 1807. The theory claims that treating the sick with extremely diluted agents that, in undiluted doses, produce similar symptoms in the healthy will produce an eventual cure. Today many believe this to be quackery and inconsistent with today's scientific and medical knowledge.

Hominy – Cornmeal that has undergone Nixtamalization. The Niacin (Vit. B3) becomes more available and prevents the vitamin deficiency disease pellagra. This is also called Grits. See Mixtamalization, Corn.

Homogeneous – Homogeneous means similar in particle types or particle size. A homogeneous blend of particles will assure that there is no separation of those particles upon standing, vibrating, or shipping. See Heterogeneous.

Homogenization–

1. The stabilization of an emulsion.
2. The process of making fat globules in a system small enough that it is more likely for them to stay suspended in an emulsion. It is the electrostatic charge that enables the micelles to repel each other that helps in the emulsion stabilization. See Micele, Emulsion, HLB, Emulsifying Agent.

Homologous Series – A group of chemicals that share the same structural characteristic, but differ by one carbon number. The homologous series of ethyl esters, commonly known as an ethyl ester series, ranges usually from ethyl formate (ethyl + 1 carbon) to ethyl palmitate (ethyl + 16 carbons). Another homologous series would be the gamma lactone series; gamma butyrolactone to gamma dodecalactone, and so on. See Isomer, GC.

Homologue – A chemical that has a similar structure to another yet differs by carbon number or by other simple differences. An isomer is a specific homologue that usually differs only structurally but shares the same molecular weight and empirical formula. See Isomer.

Honey – The food product produced by bees for the nourishment of their young. Produced by enzymatic conversion by bees of nectar obtained from flowers, honey has a powerfully sweet, yet subtle flavor profile. Honeys also can take on some of the volatile characteristics of the flowers from which it is derived. It seems that some of the most honey-like compounds are the phenyl acetates. However, some phenyl acetates and phenyl acetic acid remind some of the odor of horse urine, and not of honey at all. It takes 30,000 to 60,000 bees to produce only 2 pounds of honey each day. Milder honey is alfalfa honey and clover honey. A dark variety is the reddish brown heather honey. Acacia honey is another mild variety. Honey can have Clostridium botulinum contamination and can be responsible for floppy child syndrome. Honey is used to make the cordial Drambuie™. See Honey-like, Phenyl Ethyl Esters and Phenylacetates, and Appendix 2.

Honey Bush – See Rooibos.

Honey-like –

1. Very sweet, yet heavy flavor character. Usually typical of the phenyl acetates, phenyl propyl, or phenyl ethyl esters. Beeswax absolute, genet, and styrax have also been used to replace the aroma of honey.
2. In fragrances, honey character is very sweet and heavy with a waxy background.

Honeysuckle – A widespread species of *Lonicera.* used as a tea to ward off sickness. Known for its taste like a floral like honey. See Honeysuckle Chart 498 – Honeysuckle.

Hoodia (Hoodia gorgonii) – A cactus-like plant that grows in South Africa. Authentic hoodia is extremely rare. Hoodia purportedly contains several nutraceutical components that help suppress the appetite. One of them has been designated as P57. The chemical has a DE rating of approximately 10,000. Studies show that it affects the mid-brain where sensations of appetite and fullness reside. Currently, there has been no negative reports or side effects to the usage of hoodia. See Non-Nutritive Sweeteners, DE Rating, Nutraceuticals.

Hoodia gordoni – Hoodia has been recently thought to help in weight loss programs although some believe that the amount of hoodia available on the marketplace cannot represent the rare and limited amount of this cactus that is the worldwide source. See Appendix 2.

Hops (Humulus lupulus L.) – The main characterizing chemicals in hops are humulone, lupulones, and humulenes found in this unique botanical. The most prevalent usage for hops as an ingredient is in the flavoring of beer. Hops are either previously extracted or directly to the beer as well. Lupulin is

the glandular trichomes from the strobiles of the hops that contain the most powerful concentrations of flavor compounds. For this reason, lupulin oleoresin provides the most potent form of hops for use in beer. Hops are a useful flavorant that can be used to impart its special character in flavors for cocoa, coffee, and tea because of its resinous background note. To produce the best extract, the sweet wort is boiled first to denature proteins, deactivate the enzymes, and turn bitter alpha acids (humulone) to beta acids or lupulones. See Beer and Chart 202 – Hops and Appendix 2.

Horehound (Hoarhound) (Marrubium vulgare [Tourn] L.) – Bitter for use in alcoholic beverages and other bitter purposes. See Bitter, Chart 203 – Horehound, and Appendix 2.

Hormone – Any of a family of glandular secretions. Endocrine hormones are secreted directly into the bloodstream. These include the sex hormones such as testosterone and estrogen. Exocrine hormones are secreted directly into a duct then into the body. These ducts are similar to the tear ducts and salivary glands. See Enzymes.

Horned Melon (Cucumis metuliferus) – A member of the Curcurbitaceae family to which the cucumber, zucchini, and melon belong. The outside skin is orange and has horn-like protrusions, and houses a dark greenish pulpy mass with soft edible seeds inside. The flavor is a cross between the greenness of a melon and cucumber to which the horned melon is related, with a fruity/estery and citrus nuance. See Tropical Fruits.

Horny Goat Weed or (Epimedium) – See Appendix 2.

Hors D'Oeuvres – Flavorful and attractive bits of food served at the beginning of a meal as appetizers or taste stimulators for the main meal.

Horse – Horsemeat has been used for animal and human food for many years. In France as an example, horsemeat is used instead of cattle meat in hamburgers. Many claim it is a sweeter-tasting meat. In the United States as well as in other cultures, eating horsemeat is not common. In some cultures, eating horsemeat is taboo. There are bills in the U.S. government prohibiting this practice. See Meat, Cultural Differences.

Horse Chestnut or Aesculus hippocastanum – See Appendix 2.

Horsemint (Monarda punctata L.) – The botanical has a burning medicinal odor similar to thymol. It is also called wild bergamot, horsemint, or Oswego tea, as it can be brewed to make a tea-like beverage. For this reason, American colonists used it instead of tea around the time of the Boston Tea Party. It can be used sparingly in salads and stuffing mixes. Erroneously called Monarda Punctuata. See Peppermint, Chart 204 – Horsemint, and Appendix 2.

Horseradish (Armoracia rusticana) – Horseradish is mentioned in the Bible (one of the bitter herbs of Passover). In France it is called German mustard. The oil is similar to mustard oil and contains isothiocyanates. See Pungent, Lachrymator, Sulfur, Chart 205 – Horseradish, and Appendix 2.

Horseradish Oil – See Chart 205 – Horseradish.

Horsetail or Equisetum hyemale – See Appendix 2.

Horticulture – The science of the cultivation and propagation of fruits and vegetables. Horticultural applications will appropriately address optimization of crop output, flavor quality and disease resistance. See Plant Disease.

Hot –

1. High in temperature.
2. The sensory impression of being high in temperature usually due to piperine from black pepper, or capsaicin from jalapeno or other hot peppers. This stimulus is detected as the chemical sense through the trigeminal nerves. Capsaicin is the chemical occurring naturally that is responsible for this impression.

Household Extract – A flavoring for use at home, usually diluted in alcohol or propylene glycol. A typical usage for a household extract is in teaspoons per pound of cake or cookie mix. See Extract.

How a Bill Becomes a Law – In this modern age when flavors are regulated by so many governmental agencies, it becomes crucial to understand the timing and procedure for how a bill becomes a law and then is implemented. First, the idea for a new law originates as an idea from a government representative of the public. If the bill is to gain traction a sponsor of the bill will gather support for the bill and introduce the idea to the House of Representatives. A House of Representatives bill clerk will assign an HR number to it whereby it is read into the minutes and the Speaker of the House will assign it to a standing committee. If further information is needed it can go into subcommittee of experts to discuss the bill's particulars. Once the bill is agreed upon it is read or reported to the House where the debate begins. The bill is then voted on. If there is a majority, then the bill is sent over to the Senate. If there is a majority in the senate, it goes to the president. The president can either accept of veto the bill. If the president vetoes the bill It can go back to the House of Representatives who can override the veto by a 2/3 majority. If the bill is approved, it becomes law and is enforced by the government. Here the governmental organization such as the Food and Drug Administration works on the implementation of the

law by developing the rules of law. They put together a proposed regulations based on the original Federal Food Drug and Cosmetic Act, or other amendments of that act such as the Orphan Drug Act of 1983, Food Quality Protection Act of 1996 and the Food Safety Modernization Act of 2011. The proposed regulations can also be developed as guidance documents. There is typically a comment period so the industry and other input can be heard on the proposed regulations. After all of this, there often is a period of time set aside so that there can be compliance to the new regulation. This can often take some time. So as you can see the development of a new law and the implementation of that law goes through a lengthy time period. See Regulations, Food Safety Modernization Act, Food Drug and Cosmetic Act.

Ho Wood Oil – See Camphor.

HPLC (High Pressure or High Performance Liquid Chromatography) – Useful for separating (eluting) non-volatile substances. See Gas Chromatography (GC), Liquid Chromatography.

HTST (high temperature, short time) – A sterilization procedure that exposes a food product to very high temperatures for at least a sufficient enough time to kill all of the microorganisms. Typically, conditions are 180°F for 30 seconds. See Processing Conditions; Sterilize, Sterilization.

Hue – The type of color that is attributed to a certain visual experience. Colors are combinations of reflected or transmitted light. Reflected light is made up of the three primary colors: red, yellow, and blue. Transmitted light is made up of cyan, magenta, and yellow. The hue is the single primary or compound secondary color. Example: Orange is made of reflected yellow and red; yellow-orange is made up of an overage of yellow plus reflected red; and white is made up of the three transmitted primary colors cyan, yellow, and magenta. See Chroma, Intensity, Color (Colorants).

Huila – A variety of coffee from Colombia.

Huitlacoche (Ustilago maydis) – A purplish edible mushroom-like fungus that grows on corn. The flavor is smoky and earthy and is used in quesadillas, tamales, and other Mexican dishes. Also called corn smut. See Culinary Arts.

Hull –

1. The outer coating of a seed, nut, or fruit.
2. To remove the hull.

Humectancy – Humectancy is the state or ability to act as a humectant.

Humectant – An ingredient that enables a food system to absorb and/or to retain moisture. Glycerine, propylene glycol, gums, phosphates, corn syrup, invert sugar, starches, and some monoglycerides can be used to achieve this goal. Gums and starches for the most part do not tie up enough water because they are potent and are used at low levels to achieve a good viscosity. See Water Activity.

Hummus – A food made from ground chickpeas. See Chickpea.

Hungarian Chamomile – See Chamomile, Hungarian.

Hunger – The complex reasons for the feeling of hunger are currently being researched. One aspect is a nervous hunger that is linked to anxiety, habit, or other factors. Another cause of hunger is as follows: (1) stomach nerve endings sense a need to fill up contents; (2) this, coupled with a lowering of blood sugar; (3) triggers a set of chemical responses related to a complicated liver/blood/vitamin equilibrium; and finally, (4) the stomach muscles involuntarily contract, and hunger 'pangs' begin. The hormone ghrelin is a peptide hormone produced by ghrelinic cells in the gastrointestinal tract. When the stomach is stretched the opposite hormone is produced; leptin and the feeling of satiety is felt. It has been determined that it can take up to 20 minutes for a person to be aware that they are 'Full' after eating. See Metabolism, Satiety.

Hunter List – The Hunter List is a list of ingre-dients used in cigarettes. It was an industry developed list that seems to have been put together around the 1980s, but is probably a lot earlier than that. The list of approved flavor chemicals for use in tobacco products as submitted to the government occurred in 1994. This list of 599 additives in cigarettes submitted to the United States Department of Health and Human Services in April 1994. The list applies, as documented, only to American manufactured cigarettes intended for distribution within the United States by the listed companies. The five major tobacco companies that reported the information were: American Tobacco Company, Brown and Williamson, Liggett Group, Inc., Philip Morris Inc., R.J. Reynolds Tobacco Company. See Tobacco, Cigarettes, Safety, E-Cigarettes.

HVP – See Hydrolyzed Vegetable Protein.

Hyacinth (Hyacinthus orientalis L.) – Hyacinth is a green floral character similar to galbanum oil. See Galbanum Oil and Chart 206 – Hyacinth.

Hydrate – A product that is loosely combined with or has absorbed water. Often salts, amino acids, and other similar materials can be hydrates. Cysteine hydrochloride monohydrate is cysteine combined with hydrochloric acid and one molecule of water. See Water Activity, Moisture.

Hydration – The process of taking up water. Gums and starches hydrate when they absorb water loosely bound between their polysaccharide molecules, until

either enzymes, great fluctuations in temperature, or excessive shear breaks the bonds and the water weeps. This is called syneresis. See Weeping, Syneresis.

Hydrocarbons – Chemicals that are made up of hydrogen and carbon. Hydrocarbons are a special class of organic compounds (compounds that contain carbon). An atom that has neither hydrogen nor carbon is called a heteroatom. Common heteroatoms found in flavors compounds are oxygen, nitrogen, and sulfur. Hydrocarbons contain no heteroatoms. Hydrocarbons are classified as being either straight chained (aliphatic) or those that contain a benzene ring (aromatic). Straight-chained compounds that are connected to another compound are called an alkyl group. Benzene ring-containing groups are called aryl groups. The most common of flavor chemical groups that can be classified as hydrocarbons are the terpenes. See Carbohydrates, Terpenes.

Hydrocolloid – Polymers of high molecular weight that are derived from animal or plant origin and that combine with water to form thickening and gelling matrices. The groups called hydrocolloids are polysaccharides, made up of many sugar molecules. Linear polysaccharides, like carrageenans and alginates are derived both from seaweeds. Examples of substituted linear polysaccharides are xanthan gum and galactomannan. Branched polysaccharides include gum arabic. Examples of galactomannans are guar gum and locust bean gum. Xanthan gum is the first microbially biosynthesized gum, being a fermentation product of xanthomonas campestris. The polymeric protein, gelatin, is a wonderful macromolecule, which contains every single amino acid essential to human life with the exception of tryptophan. Gelatin is derived from the partial hydrolysis of collagen. Collagen is responsible for the support of connective tissues and firmness of cutaneous tissues. Both collagen and its subsequent hydrolysate, gelatin, are derived from hide and bones. See Gums and Thickeners; Polymer, Polymerization; Pectins.

Hydrogen – The simplest of elements, with one electron encircling one proton. Therefore, an ionized hydrogen atom or ion has a +1 charge and is just a proton with no electron circling around it. Hydrogen is one of the essential elements in a hydrocarbon (CH) and is found in almost all organic compounds. See Organic Chemistry.

Hydrogenated Oils – The addition of hydrogen or saturation to unsaturated fatty acids within a vegetable oil's structure (double bonds). This Increases the oil's stability and physical characteristics often increasing the fat's hardness. Partially hydrogenated oils have been the focus of introduction of trans fats into the food supply and the FDA has delisted those products as having GRAS status. See Partially Hydrogenated Vegetable Oils.

Hydrogenated Vegetable Oils – See Hydrogenated Oils.

Hydrogenation – The act of adding hydrogen to a product. Hydrogenated oils are oils that have unsaturated bond sites exposed to hydrogen with the aid of a catalyst. This results in the addition of two atoms of hydrogen added across the double bond thus making the bond fully saturated. The resultant oil has a higher, sharper melting point (one that begins and ends quickly as the temperature rises steadily) and is often solid at room temperature. Hydrogenation, therefore, also increases a fat's shelf life and ability to hold volatiles of the oil soluble nature (acts as a volatile sink). The characteristic of partially hydrogenated oils falls somewhere between unsaturation and full saturation by hydrogen. These oils have the best of both worlds in that they have increased shelf life and still remain liquid at room temperature. The idea of good cholesterol and bad cholesterol is really a function of how cholesterol is carried in the blood. LDLs (or low density lipoproteins) carry cholesterol from the liver to the cells. When there is a surplus of cholesterol as used for fuel, the remainder gets deposited on the linings of the arteries. HDLs (or high density lipoproteins) on the other hand are thought of to be cholesterol scavengers. It is believed that when the level of HDL is of sufficient concentration in the bloodstream, they redissolve cholesterol from the arterial linings and can act as solvents for the blood-clogging substance. Therefore, hydrogenated oils or hard oils are thought to increase the LDL in the system. See Hydrogen, Unsaturated (Bond), Double Bond, Saturated (Satiated), Single Bond.

Hydrogen Cyanide (HCN, Prussic Acid) – The compound H–C=N is a poisonous gas. HCN is produced as a by-product of the breakdown of amygdalin to benzaldehyde by amygdalase, an endogenous enzyme. See Cyanosis, Enzymes, Bitter Almond Oil, Natural Flavor.

Hydrolysis – The action of making a product more soluble in water by the action of reducing macromolecules into smaller more soluble one through the use of heat, enzymes, acid, or other means. This can occur artificially, naturally (definition of the FDA), or as a normal process of aging, ripening, and senescence. See Senescence, Enzymes, Hydrolyzed Meat Protein, Hydrolyzed Plant Protein, Hydrolyzed Vegetable (Plant) Protein, Acid Hydrolysis, Autolysis, Protein, Amino Acid, and Figure 22.

Hydrolyzed Meat Protein – See Meat Digest.

Hydrolyzed Plant Protein – See Hydrolyzed Vegetable (Plant) Protein.

Hydrolized Vegetable (Plant) Proteins

First, the protein fraction of a plant is isolated. Wheat, corn, and soy are the typical proteins used, however, any protein can be used or any combination of proteins can be used as a starting material.

+ HCl

Second, Hydrochloric acid is added. This is typically added under pressure. The proteins are chewed up and simpler amino acid fractions and other components result.

+ HCl + NaOH

Then, Sodium Hydroxide is added to neutralize the Hydrochloric Acid, thus yielding an HVP (HPP) and salt.

$$\text{HVP (HPP)} + \text{NaCl} + \text{H}_2\text{O}$$

The product is dehydrated removing the water to produce the final dry powder with a significant amount of salt.

Figure 22

Hydrolyzed Vegetable (Plant) Protein – Also called hydrolyzed plant protein. A protein that has been derived from a botanical source and has been exposed to physical, chemical, or enzymatic means to reduce the proteins to their simpler amino acids, making the overall product more soluble in water. For an HVP to be regarded as FCC, it must have no more than 20% glutamic acid, and this glutamic acid can be no more than 35% of the total amino acid profile. It also can have no more than 25% sodium. See Hydrolysis, AYE, Acid Hydrolysis, Enzyme Hydrolysis.

Hydrometer – See Hygrometer.

Hydrophilic – Hydro (water) philic (from phyle, to like). Hydrophilic describes a product that mixes with water and is water soluble and polar. A hydrophilic product is likely to be lipophobic.

Hydrophobic – Hydro (water) phobic (from phobia, to hate). Hydrophobic describes a product that does not mix with water and is oil soluble and nonpolar. A hydrophobic product is likely to be lipophilic.

Hydroscopic – Hydroscopicity – Hydroscopicity is the physical characteristic or tendency of absorbing moisture. See Caking, Friable, Hard, Hygroscopicity.

Hydroxy – The chemical group made of hydrogen and oxygen (OH), characteristic of organic compounds called alcohols.

Hydroxy Acid – A chemical that has both a hydroxyl (OH) unit and a carboxyl unit (COOH). When the molecules lose water (HOH or H_2O), it enables the formation of a ring connected at the hydroxyl carbon to the carbonyl of the carboxyl carbon. This interesterification or ring formation can produce lactones. See Lactone, Esterification.

Hydroxycitric Acid – One isomer of HCA, known as (2S,3R). HCA has been seen in one study to inhibit pancreatic alpha-amylase and intestinal alpha-glucosidase. This could possible lead to a reduction in carbohydrate metabolism and thereby show some effect in weight loss. See Appendix 2.

Hydroxy Esters – See Keto and Hydroxy Esters, Lactate Esters.

Hydroxyl – The hydrogen and oxygen group (OH) that is present in organic alcohols.

Hygrometer – A moisture-measuring device useful in the measurement of atmospheric moisture conditions, especially when working with hydroscopic materials.

Hygroscopic or Hygroscopicity – Having the property or tendency to absorb water. See Caking, Water Activity, Anticaking Agent, Hydroscopicity.

Hyperactivity Study – See Feingold Principle.

Hyperosmia – Unusually sharp sense of flavor perception. See Anosmia.

Hypertension – High blood pressure. See Blood Pressure.

Hypoglossal Nerve – The nerve that controls tongue movement and the rear third of the tongue's taste sensations including the gag reflex and bitter sensation. Because most poisons are bitter, it does seem logical to have these two sensation/response mechanisms tied together.

Hypoguesia – Reduced sense of taste.

Hyposmia – Hyposmia is defined as a reduced sense of odor perception.

Hypotension – Low blood pressure. See Blood Pressure.

Hypothymus (Gland) – See Brain.

Hyssop (Hyssopus officinalis L.) – Hyssop has a burning odor similar to horsemint, but more camphoraceous. Used in spice and seasoning blends and in soups and stews. The flavor of hyssop has the particular character of the cordial Chartreuse™. Ancient Greeks boiled hyssop with rue and honey and used it as a cough medicine. It is also used in herbal teas. Hyssop oil contains pino-camphene and has been questioned as to safety, especially for people with seizures. See Nutraceuticals, Horsemint, Chart 207 – Hyssop, and Appendix 2.

IAFIS (International Association of Food Industry Suppliers) – Formerly DFISA.

IATA – International Air Transport Association. Along with DOT regulations regarding the safe transport of air freight, IATA regulates International shipping via air. They publish a book similar to the DOT Shipping of Hazardous Substances book that outlines the international regulations for air shipping. They publish a handbook updated annually called the Dangerous Goods Regulations. Example; 2104 is the 55th Edition. See DOT.

Iceland Moss (Cetrartia islandica (L.) Ach.) – Bitter for use in alcoholic beverages. See Bitter, Chart 208 – Iceland Moss, and Appendix 2.

Identity Preserved/Identity Preservation – The concept that all of the source information from seed to flavor is known. As an example, if a flavor house buys natural ethyl alcohol, an identity preserved support basis would have to state where the corn was grown, as well as the manufacturing site of the fermentation and distillation.

IFEAT – International Federation of Essential Oil and Aroma Trades.

IFRA – International Fragrance Association.

IFS – International Featured Standards – One of the approved audit systems within the GHS (Global Harmonized System) or GFSI (Global Food Safety Initiative supported by the World Health Organization of the United Nations. See SQF, ISO 9001, AIB, GFSI, GHS, FSMA.

IFT – See Institute of Food Technologists.

I + G™ (disodium 5′ guanylate and disodium 5′ inosinate) – A 50:50 blend of the two nucleotides. The mixture produces a synergistically enhanced effect versus each of the single substances alone. See Synergism, Masking, Enhancers.

IgA – Immunoglobulin Type A – The substance in the bodily immune arsenal that in cooperation with plasma blood cells is responsible for immunity in the mucosa from nasal to intestinal. One thought on developed pseudo-allergic responses like that of Gluten sensitivity, sulfite intolerance and other similar onset hypersensitivities is that a lack of IgA and T-Cell mechanism could be the cause. See IgE, IgI, Allergy, Immunity, Intolerance.

IgE – Immunoglobulin Type E – It seems to be only found in mammals, this substance is responsible for many allergic responses from simple hay fever to asthma to anaphylaxis.

Ig Family (IgD, IgG, IgM) – Other Immunoglobulins responsible for the fight against infections. See IgE, IgA.

Illusory Elution – The perception that a mixture appears or is noticed in steps or a sequence akin to that sequence that would elute on a GC. The reason for this phenomenon is that lighter volatiles will stimulate the olfactory senses first, and then will die down, due to anesthetization, while the next lightest volatile arrives, stimulates, and in turn, dies down, and so forth. Therefore, this phenomenon is a combination of vapor pressure and nerve impulse effects. See Vapor Pressure.

Imflammable – See Inflammable.

Imitation – Artificial. See Artificial.

Immiscibility (Immiscible Liquids) – The characteristic or inability to mix. Like the old adage, oil and water don't mix, can be replaced by oil and water are highly immiscible. See Solubility, Vapor Pressure, Emulsion.

Dictionary of Flavors, Third Edition. Dolf De Rovira, Sr.

Immobilization – See Immobilized Enzymes

Immobilized Enzymes – The use of Immobilized enzymes has been around for many years. In 1967 they are first mentioned by Chibata and co-workers. The immobilization process can be used for many reasons; for labeling, stability and control of the process steps, multiple use of the enzyme, ability to stop the reaction easier, and control contamination by the enzyme. The inert substrate is an important choice to make. Initially early substrates included charcoal and alumina. More recently the list has broadened significantly to include; cellulose, glass, polymers, zeolites, silica gels and others. Stability of enzymes is increased through immobilization. Lipase and proteases might have a 4 day shelf life in use while the immobilized variety can show up to 8 month shelf life by comparison. The types of binding include; covalent binding, entrapment, adsorption, ionic binding, affinity binding, and metal linking, although not all of these techniques result in food grade applications. See Enzymes.

Immortelle (Everlasting or Helichrysum) – Immortelle or Helichrysum leaf oil or absolute has a warm, herbaceous, almost brown character. It is useful in many WONFs. See Brown (Compounds), Chart 209 – Immortelle, and Appendix 2.

Immunity – The ability to fight off an offending invader such as a microbe or chemical substance. See Allergy, Food Intolerance, Food sensitivity.

Impact – The time-oriented degree of perception. The flavor impact of a product is a measure of the speed of perception of a volatile aroma. High impact would be the immediacy of recognition of a particular nuance or character. Low impact would be a longer-term, lesser-defined character of less recognizable nuance or character. See Character, Nuance, Level, Recognition, Perception, Volatility, Vapor Pressure, Characterizing Ingredients.

Imperatoria (Peucedanum ostruthium (L.) Koch) – A bitter principle used in alcoholic beverages. See Bitter and Chart 210 – Imperatoria.

Imprinting – A psychological term meaning to save a memory (cognitive sensation) that will be a very strong recollection and will have a significant effect on the responses of the individual. Ducklings have the odor of their mother imprinted on their psyche so they follow her by sense of smell. Animals that eat certain flavored feed as they grow up will associate that aroma and taste with their childhood and prefer that flavor throughout their life. See Animal Feed Flavors, Pet Palatability Flavors, Aroma(s).

Incidental Additives – Incidental additives need not be declared on the package of the food (CFR Title 21 101.22h3 and 101.100 a3 i to iii4) as long as they are at 'insignificant levels' and have no '… technical or functional effect but are present in a food for reason of having been incorporated into the food as an ingredient of another food, in which the substance did have a functional or technical effect.' See Processing Aids, Code of Federal Regulations, Anticaking Agent, Buffers, Antifoaming Agents, Adjuvant, Preservatives, Antioxidants, Emulsion Stability, Weighting Agents.

Indian Cress – See Nasturtium.

Indian Gum – Ghatti Gum. See Gums and Thickeners; Gum Ghatti, Elemi, Tragacanth Gum, Arabic, Acacia, etc.

Indian Tobacco – See Lobelia.

Individually Quick Frozen – See IQF.

Indole, Skatole – Both of these compounds exhibit fecal types of odors. Actually, they are found in nature in jasmine, neroli, bitter orange, and others. Skatole that is derived from decomposition of proteinaceous materials is perhaps the reason for the odor recognition. Useful in flavors at extremely low levels. Both can be used in fruit flavors at very low levels, almost threshold, to give a warmth and ripeness (again similar to decomposition in nature). Also used in meats and nut flavors for the same reasons. Indole is an important character in the simulation of a true to nature jasmine profile. See Flavor Biogenesis, Threshold Value, and Chart 198 – Indoles and Skatole.

Industrial Approach (to Marketing of Flavors) – A policy or approach to the manufacture and selling of flavors that does not consider product type as much as end use. Here, the concept is one where the same flavor cannot necessarily be used in different applications, and each flavor must be modified to meet the need of the industry into which it will be promoted. Specialists might be assigned the task of learning the inside information in a given industry, its policies, trade organizations, industry shows, important personnel, etc. These specialists are called industry managers or industrial marketing managers. The industrial units in the flavor industry are included in Chart 437 – Listing of Industries within the Food Industry.

Industrial Size (Issues) – See A La Minute versus Industrial Scale Production.

Industry Vernacular – In most industrial food segments, a language is developed that is known by the people within the industry but not necessarily shared by others outside their circle. For instance, my participation in the development of the Flavor Dynamics Coffee Cupper's Kit and the corresponding Coffee Profiler Computer Program illustrated this fact. Nomenclature used by coffee roasters such as herb, ferment, floral, and salt were very specific to a type of herb, a blend of fatty acids, a combination

of fruity floral, and potassium chloride rather than sodium chloride. See Coffee.

Infectious Diseases – Diseases of man or animal that are transferred by the ingestion of food substances, insect bites, or other causes. Usually the introduction of the organism into the body is by way of direct introduction into the bloodstream or into the bloodstream via intestinal absorption. See Diseases, Pathogenic (Pathological) Organisms.

Inflammable – Meaning able to ignite. There is confusion about the meaning and spelling of inflammable because the in as in innocuous, inconsequential, etc. usually means not. In this case the 'in-' is an old Latin derivation of the prefix en- or to enflame. The negative prefix rules state that il- is used for words that begin with 'L' like illegal, im- for words that start with 'B, P or M' as in immobile, and ir- with words that start with the letter 'R' like irregular. Imflammable is an incorrect word, and the negative to flammability should be non-flammable. 'In-' as a prefix is used typically in all other cases. See Flash Point.

Infrared Spectroscopy – An instrumental analysis performed by scanning through the low energy infrared spectrum (wavelengths of 2,500 to 16,000 nm) to produce an absorption pattern that is characteristic of a specific molecule. IR, therefore, can be used as a qualitative tool for the identification of unknown compounds. Absorptions refer to frequencies of molecular vibrations such as bending, twisting, and stretching. See Mass Spectroscopy, UV Spectroscopy, Visible Spectroscopy.

Infusion –

1. A somewhat defunct term meaning a subtle alcoholic extract used in perfumery. As far as flavors are concerned, to infuse is to extract in modern terminology.
2. In cooking, however, the term means to pour boiling water over herbs to extract the fragrant essences contained therein. See Extract.

Ingotine – See Colorings, Blue No. 2.

Ingredient – An item for use in a food or flavor product. See Flavor Ingredients.

Ingredients of Concern – Published by the Environmental Working Group and taken on by others, this is a trend towards over-reactive suspicion of everything in our food supply. It is often quoted from self-proclaimed experts that 'if an ingredient has more than a certain number of syllables or an ingredient is difficult to pronounce then it has to be unsafe'. Many reasonable websites offering counter explanations get little press by comparison. FlavorFacts.org has been developed by FEMA and shows a reasonable approach to the question of food additives and safety. See FEMA.

Injection – Injection Marinades – Injection Tenderization – The process of introducing fine needles typically with a liquid marinade that both tenderizes and introduces the marinade into a meat system. See Marinades, Meat and Savory Industry.

Inorganic Compounds – Compounds without the presence of carbon. Some of the more important inorganic compounds as food additives are as follows in Chart 181 – Inorganic Ingredients. Note: It is generally accepted that carbon dioxide and carbonates are oxides of carbon and can be regarded as inorganic compounds for this list.

Insects – Edible Insects – Although I am one of those people who have a real aversion to this practice, recent demonstrations at the 2015 Fancy Food Show® in New York City shows an Increasing amount of Interest In at least cricket flour. It is a peculiar concept with the tighter scrutiny of HACCP and FSMA labeling because insect parts are considered defects and the 'Defect Action Level' of the FDA defines limits to the presence of insect parts in foods. Some insects have proteins which show cross allergenic responses similar to shellfish and those who are sensitive to these should avoid the consumption of Insects. Some EU countries are tolerating the addition of insects in food and many are considering the EFSA (European Food Safety Authority) ruling where they state 'The specific production methods, the substrate used, the stage of harvest, the insect species, as well as the methods used for further processing will all have an impact on the possible presence of biological and chemical contaminants in insect food and feed products.' One internet site listed the following insects (although admittedly incomplete) currently used In food; agave worms, ants (honeypot, leafcutter, lemon), bamboo worms, bees, centipedes, cicadas, cockroaches (farm raised only), crickets (often seen as cricket flour), dragonflies, dung beetles, earthworms, fly pupae, flying ants, grasshoppers, hornworms, jumiles, June bugs, locusts, lice, mopane worms, meal worms, midge flies, nsenes, pill bugs, sago grubs, silk worms, scorpions, tarantulas, wasps, walking sticks, water bugs, wax worms, wichetty grubs and zaza-mushi. I cannot attest to the accuracy of all of these and certainly do not ask me to provide a descriptive flavor profile. See EFSA, EU, FDA, Filth, Regulations

Insight – Insight literally means looking inward. Insight is a stage in the creative process in which lateral thinking can produce novel ideas, approaches, relationships of data, etc.

Insipid – Insipid means tasteless, having no flavor whatsoever. See Vapid.

Inspections – Inspections of the facility can come in many different ways including; OSHA, FDA, local Departments, state Departments, TTB, IATA/DOT, Customs/Border Inspections, Fire Inspections, DEA, third party audits, customer audits, and other inspections involving safety, quality and legality. See OSHA, FDA, TTB, DOT, DEA, Third Party Audit.

Institute of Food Technologists – A trade organization that is headquartered in Chicago, IL. The organization publishes a magazine called *Food Technology* and holds an annual meeting in a different city each year. One of the important functions of the IFT and the magazine *Food Technology* is the publication of the FEMA GRAS lists with reports of findings by the Select Panel of Experts (FLEXPAN).

Instrumental Analysis – A procedure to determine the physical and chemical nature of a product by the use of electronic instruments. The advent of computer (micro) chips has significantly improved the quality and speed of this method of testing. See Physical Analysis, Wet Analysis.

Integrated Pest Management – A procedure or system in which a program of routine inspections, pesticide applications, and maintenance assures the absence of pests in the plant including rodents, insects, or other macrobiological contamination. This, coupled with a sound HACCP program, and microbiological scrutiny helps assure the biological integrity of the product.

Integration – In mathematics, the integration is the fitting of ever-increasing points of data to a curve. The integration of a GC curve is the computerized addition of the area under the curve of an elution peak. The calculation was originally done by hand assuming that each peak is a triangle. Using the mathematical equation that the area under the curve, which is equivalent to the calculation of the area of a triangle, it is computed by multiplying one-half the base of the triangle by the triangle's height. This is called the triangulation method for obvious reasons. Because many peaks are off the scale on the GC printout, the easiest way to get a true hand calculation is to multiply the height by the width of the peak one-half way up the scale. Today, a computer connected to the GC handles integration.

Intellectual Property – According to dictionary definitions, it is something (such as an idea, invention or process) that comes from a person's mind). See Secrecy Agreements.

Intensity –

1. The degree of impact.
2. Typically the vertical left bar on a time intensity scale.
3. A magnitude estimation of the relative sensory signal versus another or a standard.

Interactions – See Flavor Reactions and Interactions.

Interesterification – Internal esterification. The process whereby a compound, such as a hydroxy acid, can produce an internal ester forming a ring called a lactone. See Lactone, Creamy, Stability.

Internal Standards – Due to possible inaccuracies of chromatographic results, it becomes necessary to standardize the sample to be injected. Choice of what ingredient to mix with the test relates to elution time, ease of identification, reactivity, stability, etc. See Gas Chromatography (GC), Ester Series, Kovats Indices.

International Association of Food Industry Suppliers (IAFIS) – Formerly Dairy and Food Industries Supplier Association (DFISA).

International Federation of Essential Oils and Aroma Trades (IFEAT) – See U.N., FEMA, and Regulatory.

International Fragrance Association (IFRA) – See U.N., FEMA, and Regulatory.

International Organization of the Flavour Industry (IOFI) – See U.N., FEMA, and Regulatory.

International Union of Pure and Applied Chemistry – See IUPAC (International Union of Pure and Applied Chemistry).

International Units – See IU (International Units).

Internet Sites of Note – The Internet is a relatively recent advance in worldwide communications. Most people predict that greater amounts of business will be transacted through the Internet in future years. One of its important advantages is the communication of ideas and information. The Reference Internet Sites lists web sites that are available for regulatory information at the time of the writing of this book and are used as reference material.

Interpretation – Gas Chromatograph/Mass Spectroscopy – The analysis and subsequent identification of unknowns in a mixture as identified and quantified by either GC alone using internal standards or with the aid of mass spectral instrumentation. See GC, Mass Spectroscopy.

Intolerance – See Food Intolerance.

Intrinsic – See Extrinsic versus Intrinsic

Intuition – Intuition is the subjective thought process that has to do with non-logical, artistic, and lateral thinking.

Inula – See Elecampane (Scabwort).

Invert Sugar – An acid catalyzed, heated sucrose syrup treated in such a manner as to form a syrup containing glucose and fructose. This technique can also employ the use of enzymes.

Invoice – The bill of lading. The document that identifies the Shipper's Name, Customer, Quantity and Price along with other important information

(lot number, emergency contact number, etc.) See Shipping Document (Papers).

Iodine Value – A wet analysis test to determine the amount of iodine a fatty acid or fat will absorb. This directly correlates with the number of double bonds present. As any site of unsaturation could likely be an area of potential oxidation, forming rancid type off notes, the iodine value also correlates to the stability of an oil. See Rancid (Rancidity), Oxidation, Shelf-life Testing, Analytical Chemistry, Wet Analysis.

Iodized Salt – Salt (NaCl) that has had 0.01% potassium iodide added to help prevent goiter. See Nutrient, Minerals.

IOFI (International Organization of the Flavour Industry) – The European Counterpart to FEMA. The IOFI among other responsibilities organizes and updates the General Reference List (GRL) that is the International Counterpart of the U.S. GRAS Lists. From the IOFI website; The 'GRL (has) been reviewed and determined to be safe for flavor use by at least one of the following bodies: the European Food Safety Authority (EFSA), the Council of Europe (COE), the Scientific Committee on Food (SCF), the U.S. Food and Drug Administration (FDA), the Expert Panel of the Flavor and Extract Manufacturers Association of the United States (FEMA), the Joint FAO/WHO Expert Committee on Food Additives (JECFA) or the Japanese Food Safety Commission (FSC)'. See FEMA.

Ionization – The process of giving up or gaining electrons and forming electronically charged particles called ions. Example: Salt dissolved in water forms a +1 charged sodium ion and a –1 charged chloride ion.

Ionizing Radiation – Ionizing radiation is either a particle type radiation or an electromagnetic type radiation. In either case, ionizing radiation means that the radiation is powerful enough to cause ionization to occur, in that an electron typically in the outer shell of an atom can be removed. Irradiated foods do not use ionizing radiation, which is the harmful type of radiation. See Irradiated Foods.

Ionones, Methyl Ionones, Irones, Pseudo Ionones and Ionols – This class of compounds holds a unique relationship as they all provide various degrees of woodiness. Ionones and its relatives are some of the more powerful ingredients being detected at low levels (1 ppm to 0.01 ppm). See Woody, Threshold Determination, Threshold Level, and Chart 182 – Ionones.

Ions – Ions are charged particles that have split up (ionized). See Ionization.

IQF (Individually Quick Frozen) – A method to maintain a food product's quality by capturing all of its flavor, freshness, and textural attributes through quickly freezing the product.

Iris – See Orris.

Irish Moss (Chondrus crispus) – Carrageen or Pearl Moss. See Gums and Thickeners; Carrageenan (Extract).

Irradiated Foods – Irradiation – In 1980, the Food and Agricultural Organization of the World Health Organization (FAO of WHO) of the United Nations, issued a blanket approval for foods that have been irradiated up to 10 kGy. Although public opinion against food irradiation is somewhat based on a lack of knowledge, irradiation remains one of the least expensive and most effective means of assuring a safe food supply. The effectiveness of the irradiation upon a food is measured in D-values. The definition of D-value is the amount of irradiation needed to kill 90% of an organism. The amount of radiation taken in is called a Gray (Gy). This term used to be called a mega Rad. It takes 0.3 kGy to kill 90% of E. coli O157, so the D-value of E. coli is 0.3 kGy.

Irritants – Ingredients that cause a discomfort, itching, reddening, or an otherwise bothersome reaction. Example: Allyl isothio cyanate is an example of an extreme irritant that causes tears in the eyes to form and is therefore also considered a lachrymator. See Hazardous Materials.

Iso –

1. Indication of an isomeric status, rather than the normal or straight-chained molecular configuration.
2. In some compounds, the generic use of iso means a methyl group in the terminal placement. Isopropyl alcohol means 2-methyl ethanol.
3. Iso can also mean a mixture of isomeric products, the preponderance of which is the terminal substituted variety like some iso esters. Isoamyl alcohol is a mixture derived naturally from the fusel oils of fermented products like grapes (wine fusel oil) and grain fermentation (whiskey fusel oil).
4. ISO is a family of standards for Quality Management Systems.
   ISO stands for International Organization for Standardization. ISO 9000 is the standard that is used most in the flavor manufacturing industry, although it is not nearly used to the same extent as it is in Europe. It is a costly system to set up and to maintain and does not guarantee the quality of end products and services but assures consistency. In one opinion, if something is done wrong, ISO 9000 assures it will be done the same way every time. See ISO 9000, Isomer.

Isoamyl Alcohols – Isoamyl alcohols are a mixture of alcohols, the predominance of which is 3-methyl butanol or iso pentanol.

ISO 9000 – A system of procedures, rules, certifications, regulations, and standards first developed in Europe and now being used in other parts of the world. ISO 9000 registration seems to be a costly procedure by which an ISO 9000 consultant develops a program with a company, and then helps register a company for certification. Other systems like HACCP, GMP, and TQM are available and seem to be in wider use in this country today. See ISO.

ISO 9001 – a.k.a. ISO 9001:2008 – This standard developed a criteria or quality management systems and is the only standard that the ISO organization allows to be certified to. This standard claims to have over a million company followers both large and small and within over 170 countries. It is another of the accepted GHS third party audit systems. See SQF, BRC.

Isoelectric Point – The isoelectric point is the pH at which solutions of proteins produce the least electrical conductivity, the least osmotic pressure, and the least viscosity. This is the point at which the protein shows the least swelling and does not undergo cataphoresis (no migration of particles to either electric pole + or –). As other ions are at their maximum, proteins best coagulate and contain the least amount of inorganic matter at their isoelectric point. See Gels, Gums and Thickeners.

Isoflavones – A subclass of flavanoids, isoflavones are indicated in the reduction of hormonal-dependent diseases and has shown to reduce the incidence of cancer, cardiovascular disease, and osteoporosis.

Isolate – A product that is derived from another product. Example an isolate of lime oil is natural alpha terpineol. See Isolation.

Isolation – The process of separating by either distillation, extraction, chromatographic means, or other physical or chemical methodologies to produce a purified chemical or desired essence or nuance. See Isolate, Distillation, Extraction, Purification, Recrystallization.

Isomer – A related structure different only by a simple change in configuration. A branched isomer is related to the straight-chained chemical by the substitution of the branch, but its molecular weight and empirical formula are the same. A transisomer of an alcohol differs from its cis counterpart because it contains a less sterically hindered configuration where the R1 and R2 groups are across from the double bond. See Cis (Isomerism), Double Bond, Trans (Isomerism), Ortho, Meta, Para, Optical Isomers, D (Isomer), L (Isomer).

Isopentene – Not a GRAS substance as such but is important to flavors because it is the building block of terpenes. Two isopentene molecules make a terpene (empirical formula C10H20), three isopentene molecules make one sesquiterpene (one-and-one-half terpenes; empirical formula C15H30), and four isopentene molecules make a diterpene (two terpenes; empirical formula C20H40). See Terpenes.

Isoquercitrin Enzymatically Modified – Reported found in many foods including buckwheat. The extract comes mainly from the Japanese Pagoda tree, Sophora japonica. Related to rutin, isoquercitrin has been seen to increase blood flow and perhaps be a cure for such maladies as varicose veins, hemorrhoids, and possible use for arterial flow as well. Also has been shown to have anti-irritation properties as well. Recent studies have shown possibilities in increased brain functions due to increased blood flow and might be useful in the treatment of progressive Alzheimer's disease. See Nutraceuticals, Botanicals, Appendix 2, and Chart 475 – Isoquercitrin Enzymatically Modified.

Isothiocyanate – The active ingredient to mustards, also found in bulb vegetables. See Sulfur Compounds.

Isotope – An atom that differs in atomic mass (weight) and has, therefore, a different number of neutrons in its nucleus. See Isotopic Analysis (Isotopic Ratio), Nucleus, Atom, Protons, Electrons, Chemistry.

Isotope Analysis – See Isotopic Analysis (Isotopic Ratio).

Isotopic Testing – See Isotopic Analysis (Isotopic Ratio).

Isotopic Analysis (Isotopic Ratio) – The procedure that uses a mass spectroscope and applies statistical analysis to the fragmentation pattern to determine if the material has been obtained through natural or synthetic means. For most flavor materials, the carbon-13 method is used. For vanilla, carbon 13 and even carbon 14 methods have been recently employed. See Natural (Flavors), Adulteration.

Italian Broccoli (Brassica rapa var. ruvo or italica) – Italian broccoli is also called broccoli rabe, broccoli raab, or broccoli di rape. Italian broccoli is different than regular broccoli in that the flowerlets are in loose clusters of floral buds. The flavor is green with a slightly bitter pungency. See Broccoli; Green; Vegetable, Vegetative.

IU (International Units) – Refers to vitamins A, D, and E effectiveness measurement units.

IUPAC (International Union of Pure and Applied Chemistry) – The organization that has worked to standardize chemical nomenclature and the convention for description of chemical structures. Some simplified IUPAC designations versus older terminologies are listed in Chart 441. If the acid is of the C-16 type, the old way would be to call it palmitic

acid; the IUPAC way would be to call it hexadecanoic acid. Similarly, if the ester was called amyl myristate, it is now called pentyl tetradecanoate. Also amyl alcohol (fusel alcohol) is now called pentanol or pentyl alcohol. See Chemical Structure, Chemical Nomenclature. The flavor industry uses many of the older non-IUPAC terms as a matter of tradition such as valeric, amyl, caproic, and similar designations. See Flavor Nomenclature Workshop.

Iva (Achillea moschata Jacq.) – Iva is used in alcoholic beverages like Chartreuse™ and Benedictine™, but currently is not used too often in flavors. Iva is a relative of milfoil or yarrow (Achillea millefolium). See Nutraceuticals and Chart 211.

Ivy (Poison) or Rhus Toxicodendron (LINN.) or Poison Ivy – See Appendix 2.

Ivy or Hedera helix – See Appendix 2.

J

Jaboticaba (Myrciaria cauliflora) – The fruit looks like small plums or giant grapes. The fruit is popular in Brazil, but is elsewhere unknown. The white or pinkish flesh is juicy and sweet. See Tropical Fruits.

Jack – Fruit juices that have been fermented to produce alcoholic beverages.

Jack, Apple – Apple Jack is made through the fermentation of apple juice. Apple jack comes from hard cider that has been derived from fermenting apple juice. A special type of jack is made from fermented apple juice or cider whose alcoholic content is raised by freezing. Freezing the fermented cider removes water. This is then skimmed off and the resultant liquid is raised in proof. Commercially distillation is used, but this is an illegal process for home use, and the freezing method is still fairly effective. Apple jack can be used to make apple cider vinegar. See Apple Cider Vinegar, Fermentation.

Jackfruit (Artocarpus heterophyllus) – The fruit is rounded and covered with tiny spines. Its flavor does not seem to change much upon ripening, having a sweet juicy, fruity flavor. See Tropical Fruits.

Jacquarding – As opposed to needle injection tenderization, the process of tenderizing meat by mechanically tearing muscle fiber using needles or lances. See Marinades.

Jamaican Pepper – See Pimento.

Jambu – See Chart 212 – Jambu.

Jammy – Jammy character is a complex taste and aroma associated with fruit jams. From a taste standpoint, a blend of sweet and sour is important. From an aroma standpoint, appropriate esters and acids should be present to develop a true brown nuance. Usually maltol, ethyl maltol, or other brown characters can be used. See Maltol, Ethyl Maltol, Brown (Compounds), Acid, and Chart 146 – Alkyl Esters Grouped by Alcohol Moiety.

Japanese Artichoke – See Crosne.

Jasmine (Jasminum officinale L. and Other Jasminum species) – The jasmine flower is best cut during the daylight when the production of oils continues. Because of the continued production of oils in the flower, the petals used to be mixed with tallow, and the tallow subsequently extracted. This process is called the enfleurage process. Kosher considerations have made this method somewhat obsolete. Jasmine cultivated too late at night is said to be of off character, having too high an indole content. This is an important flower and is used in flavors for its unique character. Linalyl and benzyl acetate as well as jasmonates are the important esters in this floral, as well as are some ketones such as jasmone. A spicy background contributed by eugenol and eugenyl compounds as well as phenolic undertones make this product a complex one indeed. Indole, as noted before, contributes a warmth in the profile that makes jasmine unique. Jasmine is a flower that produces a warm fragrance. The absolute of jasmine contains compounds endogenous to jasmine known as jasmonates and jasmones. The predominant ester in jasmine is benzyl acetate as well as the jasmonates. Indole is extremely important in contributing the warm background character of jasmine. Jasmine contains a spicy character associated with eugenol-related substances (methyl eugenol, eugenol, eugenyl acetate, etc.). Jasmine is one of the few flowers that produce oil well after the flower is cut. For this reason, a special fat extraction procedure called enfleurage was developed. In the enfleurage method, beds of fat-coated flats are layered with cut flowers. The

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fat is extracted and more fat is added to the flowers until no further oil is produced. Some sources have claimed that jasmine that blooms during the night has greater indole content, but this author has not seen any authentic material that illustrates this fact. Characteristic warm jasmine odors, the jasmones and jasmonates are used in re-creating a natural jasmine character. See Absolute, Floral, Indole, Beeswax, Concrete, Chart 213, and Appendix 2.

JECFA (Joint Expert Panel for Food Additives) – An international organization similar to the Flavor Expert Panel of FEMA that reports to the international organization of the United Nations, the World Health Organization. See EU, FLAVIS.

Jerusalem Artichoke (Helianthus tuberosus) – The Jerusalem artichoke is a tuber that has a flavor similar to water chestnuts or potatoes. Jerusalem artichokes contain inulin, a polysaccharide that is converted to fructose. See Water Chestnuts, Potato.

Jicama (Pachyrhizus erosus and P. tuberosus) – P. erosus is from the Amazon; P. tuberosus is from Mexico and Central America. The jicama possesses a flavor similar to the water chestnut and look like a flattened turnip. Also called a Mexican potato. See Tropical Fruit.

Jiaogulan or Gynostemma pentaphyllum – See Appendix 2.

Jojoba or Simmondsia chinensis – See Appendix 2.

Joshua Tree – See Yucca.

Juice – The liquid portion of a food product, usually made up of mostly water. Fruit juices tend to be variably colored, with an appreciable amount of acid. They also contain flavoring volatiles, minerals, and other ingredients like pectins, tannins, and other non-volatiles. The minimum acceptable Brix level for the following single-fold juices are listed in Chart 184 – Juice and Juice Concentrates. Excerpt from CFR Title 21, 101.30 (h), values are Brix per 100% juice. See Juice Concentrates.

Juicy – The characteristic aroma and taste of juices, the term is usually associated with the fruit juices. Different juicy notes characterize different fruits. In the citrus products, juiciness is derived from lower molecular weight aldehydes like acetaldehyde and trace esters. In the pulp fruits like peach, mango, apricot, and others, juiciness is usually derived from a predominance of lower molecular weight esters like ethyl acetate, ethyl butyrate, etc. In other instances, juiciness can be accentuated by presence of trace sulfur components like dimethyl sulfide. In tropical fruit flavors, this is especially important, and the usage of thiomenthone, buchu oil, and other sulfur components can contribute to a tropical flavor's juiciness. See Lift, Impact, Freshness, Ethyl Esters, Dimethyl Sulfide, Ethyl Acetate, Ethyl Butyrate, Acetaldehyde, Trace Compounds, and Chart 13 – Aldehydes Aliphatic & Keto Aldehydes & Cyclic Ald.

Jujube (Ziziphus jujuba) – The fruit resembles a reddish olive in appearance. It has been reported that the candy Jujubes™ is made from jujube paste. The pulp is not very flavorful and is a bit slimy in texture. When the fruit is dried, the crunchy, only slightly sweet pulp becomes spongier and sweeter. See Tropical Fruit.

Julienne – See Knife Cuts.

Juniper Berry (Juniperus communis L.) – The fruit of the juniper tree contains dextrose. The fruit is mashed, fermented, then distilled to produce the alcoholic liquor called gin. See Alcoholic Beverages, Gin, Chart 214 – Juniper Berry, and Appendix 2.

Jus Lié – To thicken in a food's own cooking juices. See Culinary Arts.

Just Noticeable Difference – See Least Noticeable Difference.

Just Right Scale – A measuring device that determines the range of acceptableness of a product or unknown. See Sensory Evaluation.

K

Kaffir Lime (Citrus hystrix DC) – Used in Indochinese cooking. The flavor of the fruit is lemony and the leaf oil has mostly citronellal (approximately 80% with nerol, limonene, and citronellol making up the rest). It is characterized by a double petiole, which looks like two leaves connected together in a series. See Lime, Lemon, Citrus.

Kaiseki – Originally a meal that was part of the traditional Japanese Tea Ceremony, but has now evolved into a light style of meal, usually akin to a tasting menu often of a minimum of 15 courses.

Kale (Brassica oleracea Var. acephala F. Sabellica = Common Kale) (B. oleracea Var. acephala = Ornamental Kale) – Ornamental kale has a flavor reminiscent of broccoli and cauliflower and has dark green to bluish green finely curled leaves. See Broccoli, Cauliflower, Chinese Kale (Gai Lohn).

Kamaboko – Japanese fish substitute made from surimi. The usage of this product goes back over 900 years.

Kano Model – Kano Analysis – A system of analysis for product development and customer satisfaction developed by Noriaki Kano in the 1908s which defines customer satisfaction into five categories:

Must-be – Attributes that are expected to be in a product but whose presence does not accentuate satisfaction. Examples: safety seals on a jarred product, a camera that doesn't take pictures.

One Dimensional – Attributes which are positive if present and negative if not. Example: A product improvement and price increase can be considered warranted but a straight price increase might not be.

Attractive – Attributes that are positives if present but not negative if absent. Example: Low Salt.

Indifferent – Attributes that are neither good nor bad. Example: Tuna packed in either oil or water.

Reverse – Attributes which when overextended will turn some people off. Example: Added so much technology to a product that some find it hard to work. QFD or Quality Functional Deployment turns qualitative user demands in to quantitative parameters. See Marketing.

Karaya Gum – See Gums and Thickeners.

Kava or piper methysticum – See Appendix 2.

Kelp – See Gums and Thickeners.

Kelp or Laminaria digitata Lmx. or Fucus vesiculosis – See Gums and Thickeners and Appendix 2.

Kernel –

1. The fleshy inside of a nut.
2. The whole grain or seed of a cereal.

Ketals – Although no ketals are approved for use, they form normally when ketones are dissolved in alcoholic-based solvents. An example of this is the unavoidable formation of propylene glycol ketal when ionone (a ketone) is dissolved in propylene glycol, a common solvent. Example: Ionone PG acetal. See Acetals.

Ketone – A chemical structure defined as a carbonyl linked with two different atoms in the form of R1C = OR2, where C = O represents a carbon linked to an oxygen by a double bond and R represents an alkyl or aryl group. See Chemistry, Organic Chemistry, Ketones Chart 185 – Keto and Hydroxy Esters, Chart 186 – Ketones – Aliphatic and Chart 187 – Ketones – Aromatic.

Keto and Hydroxy Esters – Compounds with both carbonyl groups and ester groups that have a unique combination of sweet fruity and pungent notes. See Ketones – Aliphatic, Chart 146 – Alkyl Esters Grouped by Alcohol Moiety, and Chart 185 – Keto and Hydroxy Esters.

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Ketones (Aliphatic) – Aliphatic ketones of both the straight chain (alkyl) and cyclic types have variable flavor profiles. Special classes of these compounds are the ionones and related compounds, the damascones, which are woody and berry like and characteristic of raspberry, currant, sloeberry, loganberry, cranberry, etc. Diketones are another special class of ketones include the buttery types (diacetyl to acetyl butyryl, etc.). The cyclodiones are products that are developed through sugar fermentation and the process of caramelization and are quite sweet and brown. Methyl aliphatic ketones are reminiscent of bleu cheese characters formed by Penicillium roquefortii. Therefore, the methyl C-6 to C-12 ketones are called the bleu cheeses ketones. See Chart 186 – Ketones Aliphatic.

Ketones (Aromatic) – Aromatic ketones are somewhat variable in flavor characteristics. Some feel acetophenone and related products remind them of the odor of shoe polish. At low levels some aromatic ketones enhance sweet compounds like vanillin, maltol™, etc., and can be used to accentuate the same. See Chart 187 – Ketones Aromatic.

Kewra or pandanus tectorius – Found in Micronesia, the kewra fruit is eaten raw or cooked. The leaves are also used in a jam called kaya and in some regional curries. It is claimed to have antiviral, anti-allergen, anti-inflammatory and antioxidant properties. See Antioxidants.

Kiddie Panel Testing – It is an accepted fact that our senses of taste and odor change as we grow older. When we are younger, flavors that are disjointed, simple, harsh, and unbalanced are usually preferred over the well-balanced intricate flavors desired more in mature adults. Because of this, flavors designed for the children's market are very difficult to evaluate, unless you have an expert panel of children. For this reason, companies that sell candies, chewing gums, and other products geared almost exclusively for children employ a kiddie panel. See Marketing, Sensory Tests, Hedonic (Rating) Scale, Hedonic Test.

Kilogram – 1000 grams, or roughly 2.2 pounds. See Weight, Mass.

Kinase – See Protein Kinase.

Kinestetic – See Tactile

Kiwi (Actinidia chinensis) – Originally called the Chinese gooseberry, as it was originally native to China. Around the turn of the century, the fruit was introduced into New Zealand. It was renamed a kiwi due to its resemblance to a native bird. The fruit is now grown worldwide and has increased in popularity in the last 10 years. The pulp is bright green with a number of black edible seeds. The flavor is slightly sweet, but mostly harsh and sour in character with a heavy green aldehyde profile almost resembling a very unripe strawberry. Recently, the fruit has been used in salads, dressing, and a variety of other food applications, including its use as an attractive garnish. See Culinary Arts, Strawberry.

Kluveromyces fragilis – The yeast that ferments whey. This process has enabled some high volume whey sources to be converted into beneficial alcohol for use in beverage and other applications. See Yeasts, Whey.

Knife – The tool of the cook. The parts of the knife are the tip or point, the spine or thick top side of the metal blade opposite the cutting edge, the cutting edge, the heel or the squared off part just below the handle, and the handle. There are many techniques to using a chef's knife. The first is the slicing movement. If you press the blade of a knife against food, it takes a lot of pressure to cut. However, if the blade is drawn over the food in a slicing motion, the sharp blade cuts easily. The curved cutting edge also facilitates the rocking movement for dicing. The heel is used by placing it on a hard item like chicken bones, and with the palm of the hand at the opposite side, just at the end of the handle called the bolster. The leverage then enables the harder cuts to be made. The rivets and handle are self-explanatory. See Culinary Arts.

Knife Cuts – There are various standard knife cuts. Each can be used to achieve a different result. Sometimes with certain sulfuraceous vegetables, the way the food is cut affects the flavor. This occurs when enzymes are released during the cutting process. See Culinary Arts, Knife Skills.Knife cut descriptions follow:

- Allumette – A Julienne cut made with potatoes.
- Brunoise – Tiny cubic cuts used often for decoration. The brunoise cuts are formed by dicing allumette/julienne strips. These little cubes measure 1/8 inch on all sides.
- Bâtonnet – Long thin strips 1/4 inch square and 2–2-1/2 inches long.
- Bias Cut – A slanted cut. Carrots cut on the bias will result in oval shapes.
- Chiffonade – Rolled leaves that are then cut into strips. This is a good way to allow flavors trapped in the leaves to diffuse to a dish. Basil is often chiffonaded and added as tasty little curls to the presentation dish.
- Fine Julienne – Long sticks measuring 1/16 by 1/16 by 1–2 inches long.
- Gaufrette – A waffle or lattice cut. Usually this is accomplished on a Mandarin slicer. A ridged cut is made first, then the food is rotated 90 degrees

and cut again. The result is the attractive lattice patterns called gaufrette.
- Julienne – Also known as a matchstick cut. Matchstick sized cuts. Usually 1/8 by 1/8 inch by 1–2 inches about 2-1/2 inches long.
- Large Dice – Large cubes measuring 3/4 inch on all sides. See Allumette.
- Lozenge – A diamond-shaped cut measuring 1/2 by 1/2 by 1/8 inch thick.
- Medium Dice – Medium cubes measuring 1/2 inch on all sides.
- Oblique Cut – A cut done on an angle to the countertop so that the food has an edge to it.
- Paysanne – Flat wafer-shaped cut measuring 1/2 by 1/2 by 1/8 inch thick.
- Small Dice – Tiny cubes measuring 1/4 inch on all sides.
- Tourner – A football-shaped cut. It is a difficult cut to master and for that reason is seldom seen in the fast-paced restaurant environment. If right-handed, the proper holding technique is to hold a presized piece between the middle finger of the left hand and the thumb of the right hand. The thumb of the left hand rotates the piece while the right hand makes the cut. See Culinary Arts.

Knife Skills – The ability that a culinarian has with the knife.

Kohlrabi (Brassica oleracea var. gongylodes) – An odd-looking vegetable with a bulbous stem and thin stalks. Younger specimens taste like turnips, more ripened types have a flavor similar to radish. The stems taste like cabbage. See Turnips, Radish.

Kokumi – Possibly considered the 6th taste (although fat and calcium taste receptors have been also researched), kokumi enhances flavor as does monosodium glutamate. Umami seems to be a heterodimer of T1R1 and T1R3 proteins, two proteins responsible for taste reception coupled by a G-protein (Guanosine Nucleotide binding protein) and acts as a broad l-amino acid receptor. The sensation of kokumi has been shown to be linked to gamma peptides specifically of the makeup of Glu-Cys-Gly and Glu-Val-Gly. See Taste Buds, Taste Receptors, Umami, Taste.

Kola Nut (Cola Nut) (Cola spp.) (Ex. Cola nitida or Cola acuminata) – It is a relative of the cacao tree that produces cocoa nibs. Botanically they are seeds, but are considered by most to be nuts, partly due to their bitter principle and usage. Historically, they were first used in cola-type beverages. Two species, C. nitida and C. acuminata, are commonly used. Like cocoa, tea, and coffee, kola nuts contain caffeine. Also, like cocoa, kola nuts contain theobromine. See Cola Beverages, Chart 215 - Kola Nut, and Appendix 2.

Korintje Cinnamon – Named from Mount Korintje in Sumatra, this type of cinnamon has a higher natural coumarin level than other variety and manifests itself into a warmer-flavored oleoresin.

Kosher – See Kosher Supervision.

Kosher Dairy – See Kosher Supervision.

Kosher Meat – See Kosher Supervision.

Kosher Pareve (Parve) – See Kosher Supervision.

Kosher Passover – See Kosher Supervision.

Kosher Supervision – The Hebraic laws written in the Talmud governing what may be eaten, and how it is to be prepared is the basis of the kosher system of rules. One of the fundamental premises is that no dairy and meat may be mixed. Certain kosher restrictions also apply as to how animals are slaughtered, and how other foods are prepared. The products must be prepared in a clean manner, and vessels must be boiled, steamed, or flamed, especially if it had been previously used for a non-kosher process. Cold preparations are not as stringent as heated processes. Also, some food products are totally prohibited like shellfish and animals with cleaved hooves, such as pork. An overseer or a mashgiach watches over the process from start to finish to assure that the ingredients and the process adhere to the rules and regulations as are prescribed by religious dictum. Due to the restriction of mixing meat and dairy, a product that is kosher and is dairy derived is called kosher dairy, and a product that is kosher and meat derived is called kosher meat. If neither meat nor dairy is used in the process and none of the utensils, vessels, or processing apparatus has come in contact with meat or dairy without sufficient koshering (see above, steaming, etc.), the product can be called kosher pareve, or kosher parve. A set of special rules and regulations govern foods that have something to do with religious ceremonies. This is why it is difficult to kosher certify wine or even grape juice. Another set of rules applies to the Passover season, and kosher for Passover is regarded as a very stringent certification. One of the rules applied to kosher for Passover is the use of unleavened bread, and for this reason, products made from grains cannot be consumed during Passover. Instead of cornstarch, corn syrup or another such grain-derived ingredient, such as potato starch and sugar can be used. The potato is a tuber and the sugar is a cane or stalk. There are a number of kosher supervision agencies throughout the country although only a limited number seem to be the preferred organizations. There is a specific prohibition against the eating of crustaceans, so no crustaceans are kosher. Traif is the word for non-kosher. Recent findings have indicated that microscopic organisms called copepods exist in

New York City's water system, rendering the water traif. This has made many Jewish New York City citizens very concerned. See Halal Supervision, Labeling.

Kovats Index – A mixture of hydrocarbons used as internal standards in a GC. The standardization starts with unit 6 (hexane) and ascribes the unit number for the number of carbons in each molecule.

Kramer Ford Hall Decision Tree – See Decision Tree.

Krebs Cycle – Also known as the citric acid cycle, or the TCA cycle. This mechanism is a series of chemical reactions wherein chemical conversion of carbohydrates, fats, and proteins are changed into carbon dioxide and water. This is typical to all aerobic organisms and is called respiration. The result of this reaction is the generation of energy to keep the cells going. Sir Hans Krebs (1900–1981) was awarded the Nobel Prize in Medicine for its discovery in 1953. Plants respire during the night and use the alternative reaction, photosynthesis, which produces sugars in the presence of sunlight during the day. This is why a plant can theoretically live in a closed system.

Kudzu variety Pueraria thomsonii – See Appendix 2.

Kukui Nut or aleurites moluccans – See Appendix 2.

Kumquat (Fortunella spp.) – The rind, which is edible, is fragrant and sweet. The rind houses multiple pulpy fruit sections. These sections are acidic, albeit pleasingly so. The kumquat is also hybridized with other fruits to produce different fruits. It is mixed with the lime (limequat), orange (orangequat), lemon (lemonquat), and mandarin (calamondin). See Tropical Fruits.

Kuru Disease – A form of Prion Disease known also as 'Shaking Death or Laughing Disease.' It is found in New Guinea spread probably by the ritual acts of mortuary cannibalism in the act of eating the brain of the enemy. Since the termination of cannibalism in New Guinea, the disease has disappeared for the most part. See Creutzfeldt–Jacob Disease, Mad Cow Disease.

L

L (Isomer) – A designation indicating a substance's ability to rotate polarized light in the counter-clockwise direction. An alternative designation would be 'S' for sinister (Latin meaning left). See Optical Rotation, Stereoisomerism, D (Isomer), DL (Isomer).

Labdanum (Cistus spp.) – It is said that this product has a flavor reminiscent of ambergris with a resinous, animal-like note. Cistus oil made from labdanum is not really an essential oil steam distilled from plant material, but a steam distillation of the labdanum resinoid. Labdanum oil is produced by the steam distillation of the plant material. See Myrrh, Olibanum (Frankincense), and Chart 252 – Oleoresins.

Label Claims/Label Concept Claims – See Concept Claims and Nutrient Claims.

Label Control – Within the scope of HACCP sometimes considered a CCP, the control of labels and allergens is considered. In the pre-op and post-op programs, a count of the labels controls quality, the identification of allergens used in the batch controls safety and legality. See HACCP, Food Safety, Allergens, FSMA.

Labeling – The food and flavor labeling law is quite complex and could not be done justice here; therefore, we will excerpt some of the fine points and note citations elsewhere in this work. The labeling of flavors will be the only issues discussed here:

- Natural and Artificial Flavor – See Natural Flavor, Artificial Flavor, Reference CFR Title 21 Subpart B, 101.22 (a)(1) to 101.22 (5)(k)(3).
- Characterizing Flavor – See Characterizing Flavor, Reference CFR Title 21, Subpart B, 101.22 (a)(5)(i).
- Spice – See Spice, Reference CFR Title 21, Subpart B, 101.22. Food – Food shall be designated as common and usual name. Reference CFR Title 21, Subpart B, 101.22.

See Bulk Labeling Law, GRAS, FDA, CFR, USDA.

- Protein Hydrolysate – See HVP, Reference CFR Title 21, Subpart Pyroligneous Acid – Reference CFR Title 21, Subpart B, 101.22.
- Chemical Preservative – See Preservatives.
- Exemptions – See Exemptions, Processing Aids, Incidental.
- Comparative Claims – Reference CFR Title 21, 101.54, 56, 60, 61, 62, 65, 95.
- Fruit Juices – Reference CFR Title 21, 101.30, 102.33, 146.113, 146–187. Note: A common practice of the flavor industry to regard the tacit approval by the FDA of the FEMA GRAS list is to add words such as – 'All flavor ingredients contained…Administration, or a Food and Drug Administration recognized industry list.'

The labeling of foods and flavors are regulated also by the FTC (federal Trade Administration) for things like truth in advertising issues as well.

See Artificial Flavor, Natural Flavor, Preservative, Processing Aids, Incidental Additive.

Labeling Manual – The Labeling Manual is a FEMA/RIFM project that documents the GRAS ingredients used in flavors and their Hazard Classes as designated by OSHA. This manual is useful in referencing Hazard Information for the Hazcom 2012 OSHA ruling. See HAZCOM 2012, Hazard Analysis, Hazards.

Locavore – A coined word meaning a local eater. See Carnivore, Herbivore, Vegetarian, Lacto-Ovo Vegetarian, Vegan.

Lachrymator (Lachrymation) – A lachrymator is a chemical that brings tears to the eyes, for example allyl isothiocyanate (mustard oil). See Irritant, Sulfur Compounds, Mustard.

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Lack of Motivation Error – Different individual's degree of motivation to find the answer to a difficult evaluation will result in a potentially skewed result. See Logical Errors, Stimulus Error, Halo Effect, Expectation Error, Order of Presentation Error, Mutual Suggestion Error, Personality Errors (Capriciousness versus Timidity), Error of Habituation.

Lactase – See Enzyme Hydrolysis.

Lactate Esters – Esters of lactic acid (hydroxy propionic acid) are generally fatty and creamy. Butyl butyryl lactate is used in cream flavors and also in fruits where a creamy background would be appreciated such as peach and apricot, banana, and even apple and strawberry. Although the esters have a characteristic flavor, it is subtle, and can be overcome by more powerful groups like hexenyl groups, etc. See Creamy, Cream Flavor, Structural Character Predominance, and Chart 188 – Lactate Esters.

Lactic Acid – Also known as hydroxy propionic acid (C-3) produced through fermentation. Lactic acid is also produced in the cells by the breaking down of glucose during anaerobic metabolism. Lactic acid overproduction in muscular tissue produces cramps. Although the lactic acid dissipates relatively quickly (within an hour to up to a day later) DOMS or delayed onset muscle soreness is attributed to not only lactic acid abut other presently unknown factors. If lactic acid accumulates in the body, the result is acidosis. Lactic acid is also found in sour milk. The inoculation of lactic acid-producing cultures is one way of preserving meats. Salami and pepperoni are two such meat products. Lactate esters range from very little odor to milky, creamy odors. See Lactate Esters, Fermentation.

Lactobacillus – See Starter Cultures.

Lactone – The chemical structure of a lactone can be considered an interesterified hydroxy acid. Lactones are responsible for the creamy aromas. Five-membered lactone rings (gamma lactones) and six-membered lactone rings (delta lactones) are the most commonly used for flavors. Chemically, six- and five-membered rings are the most stable. Gamma lactones in the range of C-6 to C-12 have coconut-like character. Delta lactones in the range of C-6 to C-12 are peachy, apricot like, and milky/creamy. Using lactones along with sulfur components like thio menthone (buchu menthone) or buchu oil are responsible for most of the exotic or tropical fruits like mango, passion fruit, guava, and papaya. Lactones have a fine window of effectiveness. Too high and they taste on the bitter side, too low and they are indistinguishable. Lactones can degrade how-ever in the presence of acid-containing flavors. The original discovery of lactones was reportedly an accidental discovery by heating castor oil and finding a very creamy characteristic that had developed. It allowed one company to be known for the best peach flavor in the early days of the flavor industry. See Creamy, Delta, Gamma, Coconut, Peach, Apricot, Buchu Oil, Mango, Tropical Fruits, Passion Fruit, Guava, Papaya, Bitter, Omega, Epsilon, Chart 189 – Lactones, and Figure 23.

The Chemical Structure of Lactones

Chemically, a lactone is an interesterification of a hydroxy acid thus forming a ring typically of 5 or 6 carbon length.

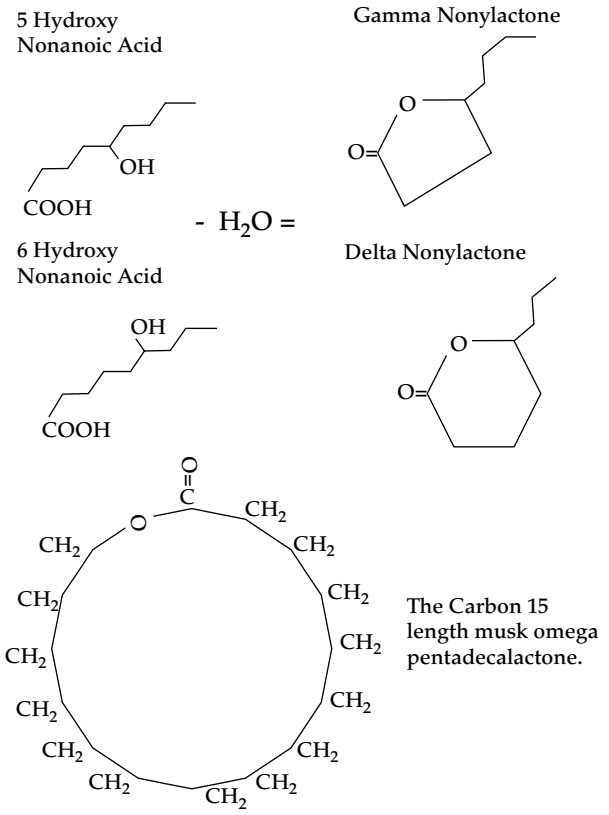

Figure 23

Lacto-Ovo Vegetarian – A person who chooses to eat no animal products but eggs and milk. See Vegetarian, Vegan.

Lactose – Milk sugar. A disugar made up of glucose and galactose, which can be split into those monosugars by an enzyme called lactase. A deficiency of lactase in a person can result in a condition called lactose intolerance. Intestinal flora converts lactose into lactic acid that helps inhibit the growth of pathogenic organisms. See Lactose Intolerance.

Lactose Intolerance – The inability to produce sufficient amounts of lactase resulting in the inability to successfully metabolize lactose. Lactase is produced

by the small intestines. The resultant symptoms are stomach cramps, flatulence, bloating, and diarrhea due to fermentation of lactose in the intestine. Ingested enzyme is helpful.

Lady's Mantle or Alchemilla vulgaris (A. xanthochlora) – See Appendix 2.

Laevorotatory – Designated by the small letter 'l' with a dash (l–) meaning a chemical's ability to rotate polarized light counterclockwise. This ability is due to the presence of an asymmetric carbon atom. See Racemic, Enantiomer, Dextrorotatory, Optical Rotation.

Lagniappe – A small culinary treat given as an extra at a restaurant as a token of appreciation. See Amuse Bouch.

Lamb's Lettuce (Valerianella locusta and V. olitoria) – A vegetable that is classified as a member of the valerian family (which includes catnip). Thus, as a typical member of this family, the flavor can vary from acid (valeric acid) to nutty. See Valerian.

Language – The difficulty in describing flavors has been with us for quite a while. Some have attempted to resolve this dilemma by developing a system of flavor nomenclature, including this author known as the Dynamics Flavor Profile Method. See Descriptive Analysis, Descriptive Terminology, Flavor Nomenclature Workshop, Flavor Profile Analysis™.

Larch Gum – Arabinogalactan. See Gums and Thickeners.

Lard – Pork fat. See Beef Fat (Tallow), Chicken Fat, Rendering.

Large Dice – See Knife Cuts.

Larixinic Acid – Palatone™. See Maltol.

Lateral Thinking – The ability to link previously unrelated thoughts in order to come up with a new association, procedure, idea, or concept. Lateral thinking is one way to develop creative ideas. One of the authors on this topic is Edward de Bono who introduced the concept of Po, which stands for provocative operation. This concept poses a question or issue and makes no judgment whether it is valid or invalid, a good idea or a bad one. See Creativity, MBTI.

Laurel Berries, Leaves – See Bay, Sweet.

Lavandin (Lavandula hybrida Rev.) – Lavandin is a hybrid between L. latifolius Vill. (spike lavender) and L. officinalis Chaix (true lavender) that contains a new mown hay-like character. See Lavender, Spike Lavender, and Chart 217 – Lavendin.

Lavender (Lavandula officinalis Chaix) – Lavender contains linalool and linalyl acetate. Lavender has a floral character that is quite dominant. It can be used effectively in most fruits like plums, raspberries, blueberries, cherries, apple flavors, grape flavors, citrus, peaches, apricots, and tropicals. The two different lavenders, spike lavender, which is camphoraceous, and true lavender, which is floral and linalool based, impart very different flavor profiles. Although the true lavender is used more often in fragrances than in flavors, the oil is sometimes used to contribute a natural source of linalool and linalyl acetate. Bergamot or Bois de Rose could also be used for this purpose. Spike lavender has been replaced by lesser expensive lavandin – a hybrid between the true lavender and the spike lavender variety. See Lavender, Bergamot, Camphoraceous, Chart 218 – Lavender, and Appendix 2.

Lavender, Spike (Lavandula latifolia Vill) (L. spica D.C.) – Spike lavender is known by many names: Aspic (in France), spike oil, lavender spike, or Spanish spike oil. The oil is one of the parents (with Lavandula officinalis) of the hybrid lavandin. The spike oil has a warm, woody background. See Herbaceous and Chart 219 – Lavender Spike.

Layering – The culinary technique of using many flavors and cooking techniques that complement the whole, producing a balanced rich flavor profile.

LCFA – Long Chained Fatty Acid – Short chain fatty acids (SCFA) are fatty acids with aliphatic tails of fewer than six carbons (i.e. butyric acid). Medium-chain fatty acids (MCFA) are fatty acids with aliphatic tails of 6–12 carbons, which can form medium chain triglycerides. Long-chain fatty acids (LCFA) are fatty acids with aliphatic tails 13 to 21 carbons. Very long chain fatty acids (VLCFA) are fatty acids with aliphatic tails longer than 22 carbons. See Fats.

LD20 – An LD20 value is the amount of a substance it would take to kill 20% of test animals in one dosage. Otherwise known as a 20% Lethal Dose. See Toxicology.

LD50 – An LD50 value is the amount of a substance it would take to kill 50% of test animals in one dosage. Otherwise known as a 50% Lethal Dose. See Toxicology.

LDL – Low density lipoprotein. See Cholesterol.

Leaf Alcohol – Cis 3 hexenol. The name given because the chemical is found in leaves and is quite reminiscent of the aroma of green leaves. Found in many unripened fruits and vegetables. See Green.

Leaf Aldehyde – Leaf aldehyde is chemically trans 2 hexenal. It is very reminiscent of green apples. See Green, Apple.

Leaf Lard – The highest quality of pork fat coming from the kidneys or loin of the pig. See Lard.

Leafy – A flavor that is described as being leafy is said to be reminiscent of green leaves. The best example is cis 3 hexenol or leaf alcohol. See Hexenyl Esters, Green, Unsaturated Esters.

Lear Oil (Low Erucic Acid Rape) – In the U.S. the amount of Erucic Acid must be less than or equal to 2% and in the E.U. less than or equal to 2%. Erucic acid is a C-20 omega unsaturated fatty acid often described as LCFA or long chained fatty acod. See Canola Oil.

Leek (Allium porrum) – A celery-shaped vegetable with a green onion-type profile. See Onion and Chart 220 – Leek.

Least Noticeable Difference – Also known as the Weber ratio or Weber fraction. The concept here is that in order to make a difference in the flavor character, a change of some ratio must be made over the existing amount. This number seems to be constant across aromas and is roughly 15–20% and is between 10–15% for tastes. However, this oversimplification seems to be true for simpler mixtures. One study showed that in fairly complex systems, changes of reasonable magnitudes 10–20% were not seen. The supposition was that when the complexity of the aroma/taste/trigeminal stimuli increased, synergies and masking effects confound apparent sensory cues. See Weber Fraction (Weber Ratio), Fechner's Law, Steven's Power Law, Beidler Model, Masking, Synergism.

Leathery –

1. Pungent and smoky, often phenolic characteristic of the cresyl esters.
2. In fragrances, leathery notes are achieved by using compounds like birch tar, cod oil, and most cresyl esters. See Cresyl Esters.

Leavening and Aerating Agents – These substances both provide for the generation of gas for the development of foam, for the expulsion of material under pressure, and for the generation of gas so that upon cooking, dough or similar substances will have entrapped air pockets that will yield a more pleasing fluffy textured effect (leavening). See Chart 190 – Leavening Agents.

Leaves and Other Wrappings – Many leaves are used to wrap foods. This process has roots in ancient history before the advent of modern utensils. The leaves are first steamed to remove bitter components and to make them pliable for wrapping. Although the leaf is sometimes not eaten as such, the flavor of the leaf melds with the food inside. Examples of leaves and wrappings that have had a long use in the food supply are listed in Chart 440 – Leaves and Wrappings.

Lecithin – A phospholipid, which, by virtue of the fact that it has both polar and non-polar structures on the molecule, may act as an emulsifying agent. Lecithin can be derived from soybeans and is also present in egg yolks. Lecithin is needed by cells and is a key component of membranes. In the membrane, it functions as an antihardening substance. Furthermore, lecithin protects cells from oxidation as well as protecting the brain by forming sheaths that surround it. Chemically, the molecule of lecithin contains phosphoric acid esterified with a molecule of choline. In foods, lecithin is found in both soybeans and egg yolks. As it is used typically in a food product, one problem that might arise is a soapy, sometimes bitter flavor. Refined versions tend to overcome this off note. Recent claims for the use and consumption of lecithin as a dietary supplement claims its emulsification ability and the theory that blood content of lecithin could dissolve cholesterol deposits. This has so far not been conclusively supported. See Emulsifying Agent, Emulsion, Micelle, Polar, Non-polar.

Legislation – Laws, considered collectively as those promulgated by a certain governing body or bodies, such as Food Legislation. See Regulations.

Legumes – Legumes are a group of plants whose roots contain bundles of nitrogen fixing bacteria drawing nitrogen from the air and turning it into needed nitrates. Without this, life would be very difficult as inert Nitrogen is the most abundant part of the earth's atmosphere but biologically unusable as is. A group of legumes called pulses or pod containing plants includes; beans, lentils and peas. See Soybean, Clover, Sweet, Peanut, Lentils, Pulses, Peas, Beans.

Lemon (Citrus limoneum [L.] Burm. f.) – Of all citrus fruits, the lemon is typically the most tart, the skin is usually the thickest, and the flavor is the strongest, owing to the characterizing aldehyde citral. Lemon is one of the most popular of the essential oils, and certainly the most popularly added fruit used in American cooking. The active constituent citral has a typical lemon furniture polish-like odor and is made up of two related terpene aldehyde isomers: neral and geranial. Most lemon is produced as distillates of the peel, or flavedo, where most of the lemon flavor is concentrated. Argentinean lemon oil has a greenish tinge to it, and a usually higher aldehyde content. Lemon oil from California was grown in orchards, some of which have been converted over the years to more valuable real estate. Therefore, pure coastal lemon oil is becoming harder and harder to find. Groves that have been planted inland produce oil usually with a lower aldehyde content. This oil is called desert lemon oil. U.S. lemon oil available today is typically a mixture of coastal and desert types. California remains the largest single producer of lemon oil followed by Argentina. Italian oils are produced in large quantities as well, but some question authenticity of commercially

available sources. The technique sometimes used in production of Italian oils employs the old 'hand squeezing into a sponge' method as classically produced Italian oils. This is a cost ineffective method, but one that claims to produce the least evaporation residue. Citric acid, which occurs at high levels in the juice, plays an important part in the overall profile of the fruit. It is the acid and the aldehyde content that affords lemon's unique masking and blending properties. Use of the fruit is well known on fish products, in tonic drinks, and other beverages. Citral, in its natural state from lemongrass or other naturally approved sources, can easily be added to these above oils to create fortified flavors called WONFs, Lime, Citrus, Lemon. Lemon pettitgrain as with other pettitgrain oils is the oil derived from the leaves and twigs of the plant. See Citrus, Orange, Grapefruit Oil, Lime, Tangerine, Chart 221 – Lemon, and Appendix 2.

Lemon Balm – A perennial herb that is also known as bee balm because of its attraction to bees. The herb is used as a condiment. It is typically used in foods in which mint has also been employed. Lemon balm is also known as melissa, bee herb, balm mint, or balm gentle. Extracts of lemon balm are used in various liquors especially eau des Carmes. Lemon balm as a fresh herb has a synergistic property with lemon and works very well in combination with lemon in many dishes. See Lemon and Appendix 2.

Lemongrass (Cymbopogon citratus Dc or Andropogon nardus var. ceriferus = West Indian Type) – The essential oil of lemongrass contains from approximately 65–75% citral. For this reason, it is often used in lemon WONF formulations. Chinese Litsea cubeba has come into the United States as a strong contender for natural sourcing of citral and has replaced lemongrass cost-wise as a starting material for the chemical production of materials like methyl ionones. Also known as fever grass because it is used to treat malaria in western Africa and Southeast Asia. Although it is grown throughout the world, the use of the herb in foods is popular in eastern cuisines namely in Thai and Vietnamese cooking. See Lemon, Chart 222 – Lemongrass, and Appendix 2.

Lemon Thyme or Thymus × citriodorus – See Appendix 2.

Lemon Verbena (Lippia citriodora H.B.K.) – Lemon verbena is used as a substitute for lemongrass in Asian recipes. Verbena is a relative of vervain, although it is of a dissimilar genus. It has a high citral content and is used to impart a lemony character to foods. It is considered a resinous herb. Green and fatty notes can add to the zestiness of lemon such as 3-octanol, perilla aldehyde, trans 2 hexenal, etc. See Lemon, Lemongrass, Litsea Cubeba, Resinous Herbs, and Chart 223 – Lemon Verbena.

Lemony – Having a flavor profile reminiscent of lemon. See Lemon.

Lentil (Lens esculenta or Lens culinaris) – Eaten since prehistoric times, this pulse has been a staple throughout history. Spicy lentil dishes called dal are eaten in India. Lentils are circular, flat seeds, and come in different varieties including small types (microspermae) and large types (macrospermae). Colors are variable coming in black, orange, red, yellow, and green. The flavor of the cooked lentil is somewhat creamy and vegetable like with a slightly nutty nuance. See Beans, Legumes.

Leptin – The satiety or feeling full hormone. See Hunger.

Lethal Dose – See LD20 or LD50.

Lettuce (Lactuca sativa) – Lettuce comes in many varieties including those listed in Chart 443 – Lettuce. See Green, Garnish, Salad, Salad Dressing.

Leukotriene – The name leukotriene was first introduced by Swedish biochemist Bengt Samuelsson in 1979. It is a triunsaturated fat produced by leukocytes (white blood cells). They assist in the inflammatory response and have been cited as important components in the pathway of asthmatic reactions. Leukotriene inhibitors, therefore can be seen as mitigators against asthmatic reactions. Examples of food that inhibit production of leukotrienes are ginger and Boswellia (Frankinsense). See Nutraceuticals.

Level (Usage Level) – The level is the amount at which a flavor ingredient is used in a product to be smelled or tasted. The level of some ingredients can be very critical. Some ingredients, like lactones, exhibit a small window of effectiveness below which they cannot be smelled and above which they are too strong and become almost bitter. Another example of the importance of level is dimethyl sulfide. At higher levels, it is sulfury, vegetable-like, and similar to asparagus. At continuingly lower levels, it becomes reminiscent of corn, then molasses, raspberry, then milky and creamy. Some say at very low levels; it appears serumy or similar to warm beef broth or rare steak. See Lactone, Dimethyl Sulfide, Bitter, Serumy.

Levulinates – Esters of levulinic acid (keto valeric acid) have generally non-descript but estery flavors. See Non-Descript and Chart 191 – Levulinates.

Levulose (Fructose) – See Sugar(s) and Polyhydroxyl Compounds.

Lexicon – A list of terms used in a vernacular. The Society of Flavor Chemists developed a flavor lexicon in the 1990s.

Liaison – A culinary term meaning a mixture of egg yolks and cream added without heat at the end just before service to prevent curdling to thicken a soup or sauce or stew. See Culinary Arts, Thickeners.

Licorice (Root) – Aka glycyrrhiza, the active constituent of glycyrrhizin. See Glycyrrhizin, and Appendix 2.

Lift – The quality of lightness and initial or front impact. A product whose lift has been increased will appear to be stronger and will be apparent sooner. See Impact.

Light –

1. In aroma profiling, the characteristic of volatility. Lightness is associated with lower boiling, higher volatile aromas that hit the olfactory organs first.
2. Lightness can also be a description of overall character versus another. A product is light versus a standard when it is significantly less in overall flavor profile. In this case, lightness can be construed as a negative, that is, having little or no impact.
3. In tea terminology, a light tea is one where the beverage obtained from the tea lacks body or thickness.
4. In wines, a wine that is light is often a positive characteristic meaning slender of body or less overall fullness, flavor level dryness, etc. A light wine is appropriate in some instances.
5. For the governmental definition of Light or Lite see Chart 249 – Nutrient Claims.

Lignan – Lignans are one of the two major classes of phytoestrogens. Phytoestrogens are antioxidants and have been viewed as reducing ill effects in the body as cellular destruction, aging, etc. Lignans have been found in many plants including the seeds of flax, pumpkin, and sesame, and also in rye, soy, beans, berries, and broccoli. See Antioxidants, Nutraceuticals, and Appendix 2.

Lily of the Valley or White Calla Lily Convallaria magalis (LINN.) – See Appendix 2, Nutraceuticals Overview.

Li Hang Mui – An oriental plum that has received great popularity in Hawaii.

Lima Beans (Phaseolus lunatus) – Lima bean is also known as butter bean. It comes in oblong pods of varied colors. Caribbean varieties have a toxic substance called cyanogenetic glycoside. However, soaking and cooking remove this compound. North American varieties do not have this substance. See Beans.

Limburger Cheese – One of the washed rind cheeses famous for its characteristic aroma. See Cheese

Lime (Citrus aurantifolia Swingle) – Lime is a very interesting fruit indeed. A yellow-greenish fruit which when eaten directly off the tree is quite similar to lemon fruit in flavor profile. The expressed peel oil is very similar to the chromatographic profile and flavor profile of expressed lemon oil, and the pulp of the fruit is a little different from lemon, but still quite similar. In fact, the characteristic lime lollipop flavor of distilled lime oil is an artifact of processing. Expressed lime juice contains peel oil from the rind. But most lime oil is made by distillation of fruit that is not fit for direct consumption. This fruit is steam distilled in Haiti and Mexico and the oil from the peel, as well as the citric acid from the pulp interacts. With the heat of distillation, catalyzed by the citric acid, the citral present in the lime fruit is turned into alpha terpineol. The alpha terpineol is the ingredient that gives the distilled lime oil that green lollipop-like profile. Key lime or Persian lime has a unique flavor profile because it contains furan-based terpene structures. The sweet lime is not commercialized in North America. The major use of oil of lime is in carbonated beverages, specifically cola-type beverages, where it is often blended with other citrus oils like orange, tangerine, grapefruit, but mostly with lemon. Cola beverages are quite varied in flavor profile, but fundamentally, they are a spiced citrus character with spicy notes like cinnamon, clove, nutmeg, or other such spicy nuances. Methyl salicylate is often used in cola beverages as are brown characters like vanilla, etc. Persian or key lime has a unique 'brown' character correlating to the presence of furanone-related compounds. Limette oil from citrus limetta is a lime oil variant grown in Italy. Lime oil like most citrus oils are important in flavor compounds because they can achieve a lightness or pleasing lift in the top note of the blend. See Colas, Citrus, Distillation, Lily of the Valley or White Calla Lily Convallaria magalis (LINN.), Chart 224 – Lime, and Appendix 2.

Limited Ingredients – TTB – From TTB website;' There are four artificial flavor materials that TTB allows to be present at certain levels in alcoholic beverages without affecting the label declaration. If the levels of each of these, or a combination of them, exceed TTB's limitation the alcoholic beverage must be labeled as 'imitation.' The ingredients and their limits are: vanillin (40 ppm), ethyl vanillin (16 ppm), maltol (250 ppm), and ethyl maltol (100 ppm). Please note that these are individual limitations. When vanillin and ethyl vanillin (or maltol/ethyl maltol) are used in combination, the combined use calculated as vanillin may not exceed 40 ppm. In calculating the combined use, multiply the level of ethyl vanillin by 2.5 and add to the level of vanillin. This is the 'total vanillin.' The same scenario applies to

maltol and ethyl maltol.'. See TTB, Chart 42 – TTB Restrictions Chart.

Limonene – The most common terpene, making up to 95% or greater in some citrus oils, appears in mints, spices, tree oils, etc. See Terpenes.

Linaloe (Wood or Seed) (Bursera delpechiana Poiss. and Other Bursera Species) – Linaloe seed oil contains a high content of linalyl acetate while the wood oil has a more rounded odor profile, which is sweet, woody, and floral. See Chart 225 – Linaloe Wood.

Linden Flowers (Tilia Species) – A botanical with a very soft floral profile. The tree is erroneously called a Lime Tree. It is used in nutraceuticals preparations for stomach maladies and cold related medications. In the past it was used more for anxiety-related ailments like hysteria, anxiety-related indigestion, irregular heartbeat, and vomiting. See Floral, Chart 226 – Linden Flowers, and Appendix 2.

Linearize – To calculate each of the final amounts of all of the ingredients in a formula. The process takes each of the known subcomponents or subformulae (goesintas) in the final formulation and adds like components together. Other terms used for the result of this technique are extrapolation or explosion. The process can eliminate premixes and/or goesintas (subformulae) so accurate calculation can be made for costing, production, simplification, etc. See Goesintas.

Linear Regression – The technique of fitting a line to points resulting in a possible relationship. See Sensory Evaluation.

Line Scale – A linear measuring device, usually 10 or 15 centimeters long, marked off in centimeters, where points are plotted to compare the intensity of attributes. A line scale is a tool in the process also known as magnitude estimation. See Magnitude Estimation.

Linseed Oil (Linum usitatissimum, Linaceae) – Cold pressed non-solvent extracted is also called flaxseed oil. A low linolenic acid oil is called solin oil. See Fats and Oils, Solin Oil, Flaxseed Oil, Nutraceuticals, Chart 442 – Linseed Oil, and Appendix 2.

Lintner – The scientist who developed the scale for use in determining amylase activity in malt syrups. Specified in degrees Lintner. When there are higher degrees of activity, the results are reported in Sandstedt–Kneen–Blish (SKB) units. See Enzymes, Sandstedt–Kneen–Blish Units.

Lipase – See Enzyme Hydrolysis.

Lipholyzation – In simplest terms, it is equivalent to freeze drying, however, the substance might not exactly be frozen, and needs to be dehydrated as well.

Lipid – A lipid is a fat. Examples of types of lipids are triglycerides, phospholipids (important constituents in cell membranes), and sterols (like cholesterol). See Fatty Acids, Glycerine.

Lipolysis – Reduction or enzymatic conversion of a lipase on a fat to produce simpler fatty acids. See Proteolysis, Hydrolysis, Lipase, Protease, Cellulase.

Lipolyzed Butter Oil – Butter oil that has been treated with lipase enzymes to produce fatty acids. See Chart 444 – Lypolizd Butter Oil and Cream.

Lipolyzed Cream – Cream that has been treated with lipase enzymes to produce fatty acids.

Lipophilic – Lipo (from lipid, a fat) and philic (to like). A lipophilic substance is one that mixes with fats or oils and is oil soluble and non-polar. By elimination, a lipophilic product is likely to be hydrophobic. See Hydrophilic, Solubility, Miscible.

Lipophobic – Lipo (from lipid, a fat) phobic (from phobia, to hate). A lipophobic product is one that does not mix with fats or oils and is water soluble and polar. Therefore, a lipophobic product is likely to be hydrophilic.

Lipoprotein – Lipid and protein combinations. These ingredients help carry fatty substances throughout the body. High-density lipoproteins (HDL) are considered to be good chemicals because they can eliminate deposited cholesterol from the blood vessel walls. Low-density lipoproteins are non-beneficial because they carry cholesterol to the cells. See Nutrition.

Lipoxygenase – See Enzymes, Oxidation, Reduction.

Liqueur – An alcoholic beverage made with approximately 15–30% of alcohol and a lot of sugar, flavored with a wide variety of substances like mint (example: schnapps), anise (anisette), etc. As opposed to liquor that is usually a grain distilled alcoholic beverage (example: rum, scotch, whiskey). See Alcoholic Beverage, BATF.

Liquid – As opposed to solid, most classical flavoring systems are produced In a liquid state using approved solvents such as ethyl alcohol, propylene glycol, glyceryl triacetate or benzyl alcohol. Some systems might employ terpenes, vegetable oils, glyceride fractions or have no solvent at all. These would be considered flavor concentrates. Solvents could form unwanted by-products with aldehyde called acetals, but some concentrates could be unstable and costly for inventory purposes. See Acetals, Terpenes, Propylene Glycol, Ethyl Alcohol, Vegetable Oil.

Liquid Chromatography – Commonly described as high pressure or high performance liquid chromatography (HPLC). An analytical method used to separate a mixture of compounds by selective elution due to their affinity to flowing liquids. This type of chromatography yields more non-volatile type of compounds than its gaseous counterpart, gas chromatography. This instrument is therefore

useful in the analysis of sugars, amino acids, alkaloids, and other non-volatile components. See Gas Chromatography (GC), Chromatography, Instrumentation, Solid Extracts.

Liquid Extract (Fluid Extracts) – See Extracts.

Liquor –

1. The liquid material made up of cocoa powder and cocoa butter that has gone through the conching process.
2. A strong alcoholic beverage made up of 30–90% alcohol (60–180 proof), usually distilled from molasses (rum), rye (whiskey), potatoes (vodka), rice (saki), or other sources. See Chocolate, Conching, Liqueur, Bitter Orange, ATF.

Liquid Smoke – See Smoke.

Litchi – See Lychee.

Lite, Light – For the governmental definition of Light or Lite see Chart 249 – Nutrient Claims.

Litsea cubeba – Chinese May Chang Oil of the Laurel Family is a good source of natural citral. See Citral, Chart 465 – Litsea Cubeba.

Load (Fix) – The percentage of flavor oil in a spray-dried material. Typically, the load is 20%. See Spray Drying, Dehydration.

Lobelia or Lobelia inflata or Indian Tobacco – See Appendix 2.

Lobster – A crustacean considered a delicacy by most. Lobster, like most seafood flavors, is characterized by an aminoid overtone with iodine-like camphoraceous and seaweed notes. For this, extracts of oak moss and seaweeds add a needed character in lobster flavorings. Adding top notes to natural seafood extracts creates most flavors of this sort. See Seafood, Crustaceans, and Chart 445 – Lobster.

Locust Bean – See Carob Bean.

Loganberry – A hybrid between blackberry and raspberry. See Blackberry.

Logical Errors – Logical errors are errors that occur when outside stimuli bias a testant logically to an 'if…then' conclusion. Example: If the best-tasting orange juice has pulp in it, then if this sample of orange-flavored juice has pulp, it must be better than one that has no pulp. See Stimulus Error, Halo Effect, Expectation Error, Order of Presentation Error, Mutual Suggestion Error, Motivational Error, Personality Errors (Capriciousness versus Timidity), Error of Habituation.

Longan (Dimocarpus longan) – Similar to the lychee and rambutan, the longan resembles a kiwi without the fuzzy exterior. The seeds contain saponin and are used for shampoos in China. The flavor is similar to the lychee although subtler. In China the fruit is called the eye of the dragon because of a white marking on the seed inside. See Lychee, Kiwi.

Long Textured – A viscous material having a stringy or Newtonian flow. See Texture.

Longonza – A plant found in Madagascar that has shown to have anti-aging properties when used as a skin cream additive. See Chart 446 – Longoza.

Loofah or Luffa aegyptiaca – See Appendix 2.

Loquat (Eriobotrya japonica) – Also known as a Japanese medlar, the loquat is a relative of the pear, peach, and apple. The real medlar (Mespilus germanica) is a rare fruit and is only edible when extremely ripened. The loquat tastes like a cherry or plum, but needs to be sufficiently ripened or it is very sour. See Pear, Peach, Apple, Cherry, Plum.

Lovage (Levisticum officinale Koch.) – Lovage oil possesses a warm, brown maple-like odor useful in all types of brown compounds. The oil is quite expensive in comparison to the solid extract, but strength versus cost is often acceptable. The oil has a warm, brown undertone reminiscent of celery. The oil synergizes effectively when added to other sweet components. The extract, oil, and herb can be used in sweet sauces, gravies, pickles, and seasonings. It can be used in maple flavors, chocolate flavors, vanillas, and any other brown-type compounds. It is one of the most powerful of all natural materials. However, the oil and absolute are often adulterated with cyclotene, and propylidene or butylidene phthalide. The herb is reminiscent of celery, but unlike celery contributes a flavor profile that remains after the cooking process. The lovage leaf or herb can be used in dishes to enhance the flavor of celery. See Brown (Compounds), Celery, and Chart 228 – Lovage.

Low – For the governmental definition of Low or No see Chart 249 – Nutrient Claims.

Low Acid Foods – Usually Low Acid Canned Foods – Guidance by the FDA for the safe production of low acid canned foods has been established to eliminate the possibility of clostridium toxin development and other pathogen reduction. Most of the pathogenic organisms do not grow in low pH (high acid) systems so the need for heat treatment in low acid (higher pH) systems is required for food safety. See HACCP, Food Safety.

Low Moisture Cooking – See Dry Heat Cooking.

Low Risk/Low Care – In sections 418 and 421 of the Food Drug and Cosmetic act and section 103c of FSMA there is a discussion of what constitutes low risk food production. However, the designation of a low risk system does not release the company's obligation to produce safe products. The broad definition of a low care product area/production includes low pH, added preservatives, low water activity, heat treatment, safe ingredients, sanitary

conditions, and other systems, ingredients and conditions. The HACCP plan will assess risks and determine critical control points based on the risk type. See HACCP, CCP, Food Safety, pH, Water Activity, Preservatives.

Low Taster – A person who is considered a low taster is one with a lower than average amount of taste buds and a correspondingly lowered ability to perceive non-volatile components. See Medium Taster, Supertasters.

Lozenge – See Knife Cuts.

Lubricity – The degree of slipperiness or sense of lubrication in the mouth. Lubricity is an important factor in determining fattiness or creaminess. See Texture, Mouthfeel.

Lucuma – *Pouteria lucuma* – A fruit indigenous to the tropics, lucuma is found in Peru, Bolivia, and Costa Rica, it is also known as eggfruit. It is also found in Indochina and has been cultivated in California as well. It has a very unique flavor of maple and sweet potato and when cooked develops a butterscotch like characteristic. See Tropical Fruits.

Lungmoss (Lungwort) – Bitter for use in alcoholic beverages. See Bitter and Chart 229 – Lungmoss.

Lungwort – See Lungmoss.

Luo Han Guo or Momordica grosvenori (also spelled Lo han guo, Luo han kuo, or lo han kuo) A fruit native to Southern China and Northern Thailand whose fruit Is hundreds of times sweeter than sugar. It is GRAS approved and can be used as flavor modifyer not a sweetener in this country. See Appendix 2, FMP, Luo Han Guo Chart 497 – Luo Han Guo.

Lupines (Lupinus spp.) – Lupines as a group contain approximately 100 species; some contain alkaloids that impart a bitter taste. Two more common varieties are yellow and white lupine (L. albus). Common to Mediterranean dishes. See Beans.

Luscious –

1. In wine, a balance of all qualities of fruitiness, sweetness, ripeness with a low degree of harshness, acidity, tannic character, and alcoholic bite.
2. An overall highly positive descriptor of no specific determination.

Lutein – A carotenoid found in marigold seeds, spinach, and kale. Found to be a healthful compound for eye benefits.

Lutein and Letein Esters – See Nutraceuticals and Appendix 2.

Lychee (Litchi chinensis) – Also called the lychee nut. The ripened fruit has a flavor that is reminiscent of a combination of strawberry, rose, and a Muscat grape. Some lychee flavors simulate the faintly nutty flavor of the unripened fruit. The fruit is susceptible to a loss of flavor due to over-ripening and a lack of flavor development when unripened. Both the pulp and the outside of the fruit are pink in color with small spiny protuberances. Geranyl compounds are often used in producing the floral note seen in the mid to background of the fresh fruit. See Tropical Fruits.

Lypophobic (Lipophobic) – Insoluble in oil or hydrophilic. See Lipophilic, Hydrophobic.

M

Maca or Peruvian Ginseng Lepidium meyenii – See Appendix 2.

Macadamia Nut (Macadamia integrifolia) – The macadamia nut has a fatty smooth and creamy smooth character. They are generally dry roasted or boiled in oil. As a nut they are quite high in fat. Hawaii has adopted the nut although it seems to have originated in Australia. Macadamias are sold whole or in pieces, plain or covered with chocolate or other coatings. See Nut(s).

Mace (Myristica fragrans Hourt.) – Mace is a unique spice. It is made by the dehydration of the arillodes of the nutmeg. The mace sits atop the nutmeg 'nut' and has a brilliant red color. The spice in its natural state is an inverted cup-like shape with flattened fat tendrils radiating from the top of the meg. It almost resembles a rooster's comb. Mace has a profile similar to that of the nutmeg and is often used to mask sulfury odors. It can be used wherever nutmeg is used – in pumpkin spice, egg nog, etc. The color of the blades of the mace aril or arillode is a clue to the origin. Orange red blades are indicative of Indonesian spice and orange-yellow blades are a clue to a Grenada origin. See Nutmeg and Chart 230 – Mace.

Maceration – The soaking of a solvent (extractant or menstruum) with the comminuted material (extrait). Frequent mixing is employed for rapid extraction. If the material is suspended toward the upper surface of the menstruum, the process is called circulatory maceration. The process can take days or weeks depending on the ingredients, process, and desired result. Percolation is another form of maceration where the menstruum is continually circulated through the comminuted material, either using heat or mechanical means to affect the resultant extraction. See Menstruum, Comminuted Material, Extraction, Percolation.

Macqui – Aristotelia Chilensis – The berry found in Argentina of interest due to its high anthocyanin content. It was used by local inhabitants for its treatment of diarrhea, inflammation and fever. See Nutraceuticals.

Macroemulsion – A bottler's emulsion. A macroemulsion is typically a cloudy emulsion. It is usually made by the dispersion of oil in water. For beverages, gum arabic or modified food starches are used. In pharmaceuticals and in mouthwashes, surfactants like Pluronic™ and polysorbates do a better job. The particles are smaller in this case, and these emulsions are more accurately called microemulsions. The particle size of a macroemulsion is usually 2 to 100 microns in thickness. The resultant emulsion is typically milky white and thermodynamically unstable. See Emulsion, Microemulsion, Emulsion Stability.

Macrosmatic – Macrosmatic means having a sharp sense of smell. See Anosmic, Hyperosmia.

Mad Cow Disease – See BSE.

Magnitude Estimation – A technique by which the intensities of different sensory attributes of a product are assigned a point on an arbitrary scale, usually a 10 cm line scale. See Sensory Evaluation, Duo Trio Test, Triangle Test, Hedonic Rating, Tetrad Test.

Magnolia officinalis – See Appendix 2.

Maidenhair Fern (Adiantum capillus spp. Veneris L.) – Bitter for use in alcoholic beverages. See Bitter and Chart 231 – Maidenhair Fern.

Maillard Reaction – A non-enzymatic browning reaction first discovered by Louis Maillard in 1912. Amino acids and reducing sugars form characteristic

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brown-colored and brown-flavored aroma compounds in the presence of heat. These products are typical of those ingredients present in roasted, toasted, and cooked foods. The Maillard Reaction is really a complex sequence of sub-reactions. The first stage in the Maillard Reaction is the formation of a Schiff base plus water. A Schiff base reaction is one that takes place between an aldehyde and an amine such as methyl anthranilate or an amine group in an amino acid. This Schiff base structure (n-substituted glycosylamine) is unstable and undergoes an Amadori rearrangement to form a ketosamine (example: 1-amino 1deoxy 2 ketose). This can further react in one of three ways: 1. Lose more (2 molecules) forming reductones and dehydro reductones. These are caramel like aroma products and are also responsible for the antioxidant properties of Maillard products. 2. Development of short chain ketone, aldehyde, and alcohols which then can react with amino acids to form Strecker aldehydes. Here, the loss of carbon dioxide reduces the carbon number by one and forms the corresponding aldehyde. Methionine (2 amino methyl thio butyraldehyde) becomes methyl thio propionaldehyde in this process losing a carbon to carbon dioxide. 3. The third step is perhaps the most complex. Here the Schiff base reacts with furfural a by-product of the initial phases and forms nitrogen based chemicals and copolymers. The copolymers, called melanoidins, can contribute bitterness, but for the most part are the brown colorants of the browning reaction. This step involves the loss of three water molecules and in that forms sulfur/nitrogen heteromolecules responsible for meaty vegetable aromas, and single or double nitrogen compounds (pyrazines) that are responsible for roasted toasted notes. Studies show that that oxidation reaction, warmed over flavor in refrigerated/frozen meats, is retarded by meats that have had their outsides seared (Maillard browned). The Maillard Reaction does occur slowly at room temperatures but accelerates quickly at the higher temperatures above 220°F. Room temperature Maillard is exemplified by the browning of nonfat dry milk over time. Chart 192 – Maillard Reaction shows some typical Maillard combinations. For ease of demonstration, the reducing sugar is dextrose. Examples of Maillard products are provided in Chart 192 – Maillard Reaction. A perplexing question has troubled this author for many years, as there are relatively no carbohydrates in meat, is the browning of meat a true Maillard Reaction. Over the years, I have been told it is the ribose from the RNA (ribonucleic acid) that contributes the reducing sugar for the Millard Reaction in beef. Alternatively, others claimed the aldehydes from oxidized fatty acids within the lipids, and a host of other explanations, all of which would yield to a way-low a percentage of reactants and just did not make sense. Most of the glycogen in meat is metabolized post slaughter. So where does the reducing sugar come from? A recent article I came across made a little more sense; that the browning of beef is not a true Maillard Reaction, but a chemical degradation of some other compounds namely the oxidation of mitochondrial cytochromes and other mitochondrial chemicals. The jury is still out and I still like my steak medium rare. See Enzymatic Browning.

Maintenance – Part of the overall GMP program, sanitation and maintenance is a crucial factor in keeping the flavor plant running well. The maintenance aspects involve keeping up with equipment, and monitoring for spare parts, running properly, strange noises, wear and tear, and other aspects of the machinery. See Sanitation and Maintenance Program, Food Safety, GMP.

Maitake or Grifola frondosa – See Appendix 2, Mushrooms (food), Fungus.

Malanga (Xanthosoma sagittifolium) – A starchy vegetable grown in South America and the West Indies with a hazelnut-like flavor with earthy undertones. In Puerto Rico, the vegetable is called yautia. See Starch.

Malates, Malonates – Esters of malonic acid (methyl dicarboxylate) are generally fruity and apple like. Esters of malic acid (ethanol dicarboxylate) are similar. See Chart 193 – Malonates.

Malodor – An off or disagreeably bad odor, a taint. The term always has a negative connotation. See Taint.

Malt (Hordeum vulgare L. and Other Grains) – Malt is the general terminology for a product that has been malted or has gone through the malting process. Malt is usually attributed to malted barley used in beers and malt liquors. Malt is also used as a flavoring because of its unique flavor characteristics. Malted milk uses a malted barley flavoring system. The flavor of malt is quite complex because it is derived from a fermentation process on the endogenous precursors in grains that yields many aromatics. Some of the important chemicals derived in this manner are the sugar-related poly hydroxyl and poly ketonic products like aliphatic and cyclic diketones, cyclotene, maltol™, etc., along with sulfur compounds derived from the breakdown of proteins like dimethyl sulfide or methyl thio propanal, etc. See Malting Process, Endogenous, Precursors, Diketones, Aliphatic, Cyclic Compounds, Cyclotene, Maltol™, Dimethyl Sulfide, Methyl Thio Propionaldehyde, Barley, Grains, and Chart 232 – Malt.

Maltaise Sauce – A dressing made from egg yolks, lemon juice, black pepper, unsalted butter, and blood orange juice.

Malted Milk – A mixture of dried malt sugar and milk solids. See Malting Process.

Malting Process – The process where a grain, like barley, is added to water and allowed to germinate. Upon germination, the mass is boiled to kill the seedlings. Complex sugars, proteins, and amino acids are broken down into simpler chemicals during the ripening process. These are produced through the action of internal (endogenous) enzymes. The process takes place to develop a feedstock for the germinating embryo and the growth of the seed. Flavor volatiles are also produced during this change and yield components that are the characteristic malted flavor. Malted products can be dried and added to milk giving rise to malted milk. See Malted Milk, Malt.

Maltodextrin – Maltodextrins are carbohydrates in the dextrose equivalent (DE) range higher than a dextrin, but lower than a sugar (less than 20 DE). Maltodextrins of 10 DE are the most widely used for stability, cost, and other attributes. Maltodextrins can be used to improve hygroscopic instability as with simple sugars like dextrose. It possesses a mild flavor and has great water solubility. For those characteristics, maltodextrins are used as diluents for dry materials, for spray-drying matrix, for polar systems, and a base for dry flavors. See Dextrins; Starch; DE Rating; Sugar(s) and Polyhydroxyl Compounds; Carbohydrates; and Chart 448 – Maltodextrin.

Maltol and Related Products – Maltol and ethyl maltol are widely used ingredients in the flavor industry. Chemically, they are both pyrans, in other words, a six-membered oxygen heterocyclic ring with a carbonyl structure para to the cyclic oxygen. They are classified as GRAS ingredients as well as flavor enhancers by the BATF and FDA. See Enhancers and Chart 194 – Maltol and Related Products.

Maltose – Malt sugar. A disaccharide made up of two glucose molecules. Maltose is not a naturally occurring sugar and is created by splitting starch molecules with the use of an enzyme found in malt called a diastic enzyme. Maltose is commonly used in many food products including bread, baby food preparations, coffee substitutes, and beer. See Sugar(s) and Polyhydroxyl Compounds.

Malty –

1. Reminiscent of the flavor of malted products.
2. In tea terminology, a desirable quality characteristic of a controlled firing of the leaves. See Malt, Malting Process.

Mandarin (Citrus reticulata Blanco) – Mandarin is a very interesting citrus fruit. Mandarin resembles what we in the United States know as a tangerine. However, the tangerine is a cross between the mandarin and the bitter orange. The fruit, citrus reticulata that is native to China, was brought over to Europe. The mandarin of today is quite different than the one that was brought over to Europe from China. But the tangerine that is prevalent in the United States is more similar to that original fruit. The mandarin is rounder, while the tangerine is flattened. The flavor of the mandarin is somewhat sweeter and less turpenoid than the orange owing to a greater amount of trace esters. The mandarin has some popular varieties including the true mandarin, citrus reticulata which resembles a small flattened orange with easy to peel skin and a high sweetness level. The clementine is another hybrid that is a cross between the mandarin and the bitter orange. With its juicy flesh, it is not as aromatic. The Satsuma mandarin, small and seedless, is often found canned. The tangor (Citrus nobilis) is a cross between tangerine and the sweet orange, with a tangy sweet taste. The tangelo is a cross between the grapefruit and mandarin. It is a tart, fragrant, and acid fruit. The ugli fruit is a cross between the grapefruit, pomelo (bitter orange), and the mandarin. The ugli fruit has a delicious and juicy flavor. Petitgrain mandarin has been used as a source of natural dimethyl anthranilate (approximately 50%), and is therefore useful in grape WONF flavors. It has a unique plum/grape-like character with other fruity undertones, and works well in grape flavors, gooseberry flavors (relative to currant flavors), and tutti fruity flavors as well as many others. The dimethyl (really methyl, n methyl) anthranilate does not form Schiff base reactions. It is cultivated in Italy, Spain, Algeria, and Cyprus. The natural essential oil occasionally contains a fishy/aminoid top note. See Mandarin, Orange, Citrus, Lemon, Lime, Grapefruit Oil, Tangerine, and Chart 233 – Mandarin.

Mango (Mangifera indica) – The fruit has an orange smooth skin when ripened, with an elongated hard seed. When ripened, the fruit is sweet, with a good tart character and a flavor profile that is both fruity and tangy with a smooth lactonic character and a sulfury pineyness. Previously known only in the tropics, since its original introduction into the U.S. many years ago, its flavor has been introduced into the mainstream of cooking and food products, and is now a popular profile for hard candies, salad dressings, beverages, etc. See Tropical Fruit and Chart 447 – Mango.

Mangosteen (Garcinia mangostana) – The fruit has had a long history of use dating back thousands of years. The mangosteen is also known as the mangostan. The fruit is sweet and juicy and has an excellent flavor profile. The covering of the fruit

contains tannins and is inedible. The fruit of the tree is very difficult to grow and takes 10 to 15 years for the tree to bear fruit. A thick, reddish membrane covers the fruit, and this membrane and also the outside peel are both inedible. The light-colored fruit covers a pinkish, inedible stone. See Tropical Fruit and Appendix 2, Mangosteen Distillate Chart 502 – Mangosteen.

Manioc – See Casava.

Mannitol – See Sugar(s) and Polyhydroxyl Compounds.

Manufacture, Manufacturing – The commercial scale process of producing pro-ducts for commerce. See GMP, HACCP, ISO 9000, Production Methodologies, Industrial Size (Issues). See A La Minute versus Industrial Scale Production.

Manufacturing Size (Issues) – See A La Minute versus Industrial Scale Production.

Manuka – See Tea Tree or Ti Tree.

Maple, Maple Syrup (Acer saccharum, A. nigrum) – Maple syrup is usually collected after the winter, in the early spring thaw when the sap is running. The syrup is collected by scoring the bark of the tree and collecting the effluent sap. The syrup is then boiled down to produce the proper consistency and flavor profile. The 'brown' flavor of maple syrup is developed through a number of reactions. First, coniferol is developed. It is produced by enzymatic action on the glucoside abietin, a parent substance to the substance lignin (used to produce one source of synthetic vanillin). Coniferol (gamma hydroxy isoeugenol) then undergoes an oxidation via the high heat reduction of the boiling of the syrup. Para conifer-aldehyde is then produced. Para conifer-aldehyde is also known as 4 hydroxy 3-methoxy cinnamic aldehyde. It is also known as maple aldehyde. This is not to be confused with either maple lactone (cyclotene) or maple furanone. Coniferaldehyde is the active flavor ingredient of the natural maple syrup. As you can see, this can be a tedious process, and with the popularity of maple syrup in the country, there is not enough of the raw material to meet the demand. Therefore, to meet this demand, a synthesized maple syrup substitute using a small bit of real maple syrup was developed. Although the maple syrup sold in the mass supermarket is somewhat different than the flavor to the real maple syrup, the general population has learned to identify it with the term 'maple syrup' rather than the profile of real syrup. In fact some studies showed that the mass market prefers the synthesized maple syrup to the real substance. This is a true example of the power of mass marketing and learned associations. Synthesized maple syrup is made from sugar syrups flavored with fenugreek, St. John's bread, glycerrhiza, malt, celery, lovage, molasses and other brown extracts and chemicals (cyclotene, maltol™, etc.). Maple syrups commonly used today are not true maple syrups as such, but are blends of corn syrup, sugar syrups, and added flavors, with varying degrees of real maple syrup added. These are known as table syrups or table maple syrups in the industry. These use other brown flavor notes to simulate the same character-like extracts of fenugreek, carob, glycyrrhiza, lovage, celery, coffee, cocoa, and vanilla. See Brown (Compounds), Furanones – Maple Furanone, Mountain Maple Bark.

Marfona Potato – See Potato.

Margarine – First developed in France in 1869 during a contest sponsored by Napoleon Bonaparte. The production and R&D of margarine illustrate the concept of selective flavor partitioning. Fatty acids used in butter flavors for margarine have both a water solubility and oil solubility. This affinity measured as a solubility into each of the phases at once is called the chemical's partition solubility. The rate at which the chemical will dissolve into one phase versus the other is called the partition coefficient. Therefore, flavors added to margarine should be evaluated after at least 3 to 5 days. Margarines are based off of vegetable oils. Low cholesterol concerns therefore, can be met as a replacement of butter. However, as researchers learned more about hydrogenated or partially hydrogenated fats, they became aware of trans unsaturated fats developing as a result of this hydrogenation treatment. Trans unsaturated fats actually act very much like fully saturated fats in the bloodstream. Both raise unsaturated fats, and saturated fats raise the level of cholesterol in the blood. So, those who really want to lower the amount of cholesterol production can do so through ingestion of both trans unsaturated fats and saturated fats. Therefore, they should choose the soft margarines low in both of those ingredients. See Fat, Butter, Partitioning.

Marigold, Pot (Calendula officinalis L.) – Pot marigold is also called marybud or hollygold and is different from tagettes also known as marigold (tagettes spp.) See Tagettes and Chart 235 – Marigold.

Marinade – A liquid made of variable materials designed to add flavor and moisture to a fruit, meat, vegetable, or fish. Use of a marinade either accentuates the existing flavor or improves upon the eating quality of the food. Some types of marinades contain enzymes or acids that degrade some of the harder to digest proteins and hydrolyzes them into simpler components. Upon cooking these simpler amino

acids can react with reducing sugars in the nonenzymatic Maillard browning reaction to produce flavorful ingredients. Marinades can also introduce a flavor character directly into the food. Marinades can also be mixtures of wine, beer, or other alcoholic-based preparation, mustard, acids, vinegar, oil, salt, spices, or flavorings. Most marinades are based on water in some form or another. Phosphates can be used, salt is essential, and sugar of one form or another is usually helpful for flavor or precursor development. Acids are also fairly critical to the performance of a marinade. Thickeners help the pumping of the marinade into meats. Injection marinades introduce the marinade into meat fibers by needles. Marinades can also be static, rubbed on, and massaged into the meat. The greatest pick up, however is in the vacuum tumbling of marinades. It is both the evacuation of air and the tumbling effect that introduces the marinade deep into the muscle tissue. See Vacuum, Vacuum Tumbling, Enzymes, Phosphates, Moisture, Water Activity, Seasonings.

Marinate – To soak in a marinade.

Marjoram, Pot (Marjorana onites [L.] Benth. [Origanum vulgare]) – Pot marjoram is seldom used in the U.S. It is warm and thyme-like with an aromatic and bitter character versus M. hortensis. It is also known as wild Spanish marjoram. However, this is a misnomer because Spanish marjoram is actually a different species (Thymus masticina). See Thyme and Chart 236 – Marjoram.

Marjoram, Sweet (Origanum majorana L. [Majorana hortensis Moench.]) – Origanum majorana or Majorana hortensis is called sweet marjoram and has a warm, woody odor reminiscent of nutmeg and camphor, as opposed to the marjorams as a group, which include the thymes and origanum. The oil of sweet marjoram contains no phenols. The leaf or herb of the marjoram goes very well in tomato-based foods. See Woody, Nutmeg, Camphor, and Appendix 2.

Marker – An internal standard used in a gas chromatograph that has a specific elution time, and is compatible with the substance being tested. For a marker to be effective it must elute with a good degree of resolution, it must come out at a point that will not interfere with the rest of the peaks.

Marketing and Marketing Trends – Those changes and inflections in the overall buying trends of food products. Flavors often are used to aid in replacing, enhancing, and reformulating foods in response to marketing trends. Examples are flavors that are used to enhance salt replacer systems, fat replacer systems, HVP replacer systems, stabilizer flavors for microwave, etc. The easiest way to detect wherein the next new product explosion might be, is to see what industry segment has been wallowing in dogma. The most popular of food product success stories seem to be where products elicit sensory stimulation from the most senses. The true test of the quality of a flavor is not how complex or esoteric it is by nature, but does it answer the purpose which it was meant to achieve, does it work and will it sell? See Replacements.

Marshmallow –

1. Althaea officinalis – An herb called marshmallow root from which marshmallow was originally made, used as a nutraceutical supplement. Marshmallows were originally made from the mucilagenous extract of the roots. See Appendix 2.
2. The gelatin-based confectionery that has a characteristic spongy texture. It also uses sugar, egg whites, and gums for foam stabilization. See Nutraceuticals.

Marzipan – From the European candy marzipan or almond paste, where sugar and almond paste are mixed and occasionally flavored with orange, rose, etc. See Bitter Almond Oil – FFPA.

Masa – See Corn.

Masking – The reduction of an apparent target flavor or attribute by the addition of another flavor or attribute that has an overall reducing effect. See Masking Agent, Synergism, Mellow, Toners, Blenders, and Flavor Profile.

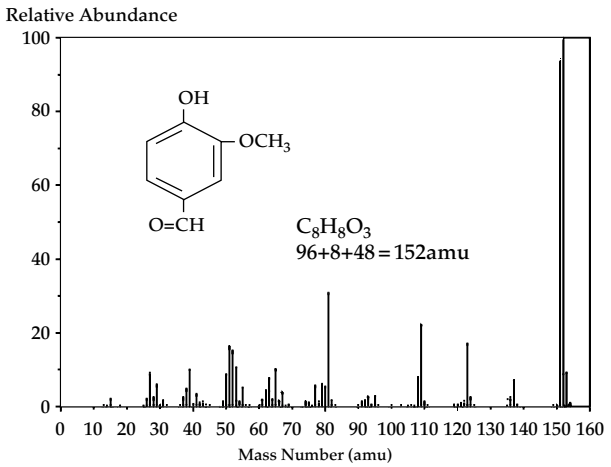
Masking Agent – An ingredient, which when used in a specific system tends to subdue or lessen the impact of some targeted aspect of a product. Sweet components, like anethole, brown compounds, and citrus products can cover up many off characters like vegetable oil rancidity. See Synergism, Masking, Toners, Blenders and Chart 449 – Masking Flavors.

Mass – The quantity of matter within a substance. Weight is the mass times the acceleration of gravity. Grams is a mass unit. Pounds is a weight unit. See Units of Measure.

Massoia Bark Oil (Cryptocaria massoia) – Massoia bark contains approximately 60% delta decen 2 olid and 35% delta dodecen 2 olid. The bark is mostly grown in Indonesia. It is a useful source of natural lactones, finding its way into many natural WONFs needing a creamy character. Useful in WONFs and natural-type flavors of the coconut, dairy, creamy fruit (apricot, peach, tropicals), vanilla, and related types. Massoia bark oil is also good for natural masking flavors, fat replacers, butter, cheese, and milk enhancers. See Lactone, Creamy, Masking, Enhancement, and Chart 195 – Massoia Bark.

Mass Spectroscopy – Also known as a mass spec. An instrument that breaks down a molecule into characteristic fragments. Each fragment has a specific molecular weight that is measured and charted. The amplitude of the signal and the mass numbers identified yield a special fingerprint called a fragmentation pattern. An infrared spectroscopic pattern is also a useful tool that gives a unique fingerprint according to the chemical's structure. A mass spec fragmentation pattern can also give clues to an unknown structure as well, because certain types of bonds and substructures split up in unique ways. The most useful application for a mass spectroscope is when it is hooked up to a gas chromatograph. However, the quality of the MS library, the GC data itself, and human interpretation are areas where data can be skewed. Internal standards can assure a second check of GC retention times correlates to accurate identification. Besides the data, library, and interpretation, if the identity of the unknowns is determined by computer, the possibility of misassignment is dependent on the sophistication of the programming and the accuracy of the reference data and the interpretation programming protocol or algorithm. See Gas Chromatography (GC) and Figure 24.

An example: The Mass Spectrograph of Vanillin



Typically in a mass spectrum, some of the mass fragment identities are difficult to determine with certainty. Previous experience can allow for good predictions, however. The mass weight of vanillin is 152 amu. There is a peak at 151 and another at 152. This is due to molecular vanillin and the easily split off Hydrogen from the alcohol (OH) group = -1). The next three mass fragments showing the greatest abundance are at 81, 109, and 123. The mass at 123 seems likely to be the molecule minus the CHO group. However the other mass fragments are not as clear. This illustrates that the mass spec profile is useful as a fingerprint, but not necessarily easily used the structure of the fragments generated.

Figure 24

Maté (Paraguay Tea) (Ilex paraguariensis St. Hil.) – Maté forests are called yerbales. The leaves of the plant are called Yerba Maté leaves and are dried under smoldering fires that can lend a phenolic character to the tea. The product contains a green, leafy profile. Green chemicals that have been identified are cis 3 hexenol, non-adienal, amyl heptine carbonate, and styrallyl acetate. See Tea, Chart 237 – Mate, and Appendix 2.

Material Safety Data Sheet (MSDS) – A document that itemizes the crucial data of a material. This document is used in the Hazard Chemicals Communication Act, assuring the accurate relay of safety data on the potentially hazardous materials used in foods and flavors. This is to be replaced by Safety Data Sheets under the GHS protocol and the HAZCOM 2012 legislation passed by OSHA. See Specifications, New Jersey Right to Know Law, DOT, OSHA, SDS, HAZCOM 2012, GHS.

Matignon –

1. An edible bed of Mirepoix often placed on the bottom of a braise or roast to prevent burning on the bottom of the pan and promote an even cook.
2. Vegetables that have been cooked down to a pulp or (melted to a fondue, which means melted in French).
3. An artichoke dish made from wine, matignoned vegetables, and bread crumbs and browned.

Mature –

1. In tea terminology, a mature tea is one that has the positive flavor profile and has many characteristics that are desirable. A mature tea is neither flat nor young.
2. Mature wine also is aged wine. This is accepted as a positive characteristic, as opposed to the negative characteristic of old wines that develop an oxidized character.

Mayonnaise – A dressing made from oil, eggs, spices, and seasonings (mustard, wine, salt, vinegar, and garlic) that is made into an emulsion. It is the protein in the eggs that stabilizes the emulsion system (at least 65% oil in water). Tarragon and other spices are used to season the product. Saffron can be added to both color and flavor the product. Mayonnaise done in the kitchen is a bit tricky and care must be used so as not to break the emulsion. Here egg yolks are used. However, as it is a cold system, pasteurized egg yolks are needed.

MBTI® (Meyers–Briggs Type Indicator®) – A personality test developed originally in 1943 that tests the individual's tendency toward one type or another within four traits. These traits include attitudes, functions, and lifestyles. Within attitudes, a person can be either an introvert (I) or an extrovert (E) or

somewhere in between. Within the functions class, a person can be either polarized toward sensation (S) or intuition (I), or somewhere in between. Also within the function class, the test judges a person's inclination toward thinking (T) or feeling (F). The lifestyle category assesses the personality propensity toward judging (J) or perception (P). One citation indicates the testing procedures developed do not rate the degree of polarities well enough. Within the four traits, there can be 16 variations of type. One report of population types found in the U.S. shows the predominant types as being ISTJ, ISFJ, ISFP, ESFP, ENFP, ESTJ, and ESFJ. Again, there is no rating as to the degree or predominance of each of these specific polarities within the types. Another personality assessment called the Kiersey Temperament Sorter correlates with the MBTI assessment but claims not to be directly associated with it. Here potential career choices seem to be one of the goals. See Creativity, Lateral Thinking.

MCFA – Medium Chain Fatty Acids – C6 to c12 fatty acids. See LFCA (Long Chain Fatty Acids.

Meadowsweet (Filipendula ulmaria) – See Appendix 2.

Mealy – An off taste associated with grains, cereals, or gums.

Mean – Where the distribution of counts is centered, in a statistical grouping. In an array of 1, 2, 3, 4, 5, 6, and 7, the value 4 is the mean. See Average, Standard Deviation.

Measurement – The estimation of the magnitude of an attribute. This oftentimes involves the use of a measuring device. In the translation of the gold standard to a working food product able to be sold in mass quantities, inaccurate measurements employed by culinary techniques must be accurately translated to pounds or kilos, as an example. The *margin of error* and the *confidence level* are two factors that are important to consider.

Measures (Pinch, Dash, Dollop, and other not very accurate amounts) – Due to the inaccuracy of these measurements, it makes it difficult to translate the gold standard into a working recipe or formula that can be costed precisely and reproduced. When working with these kinds of measurements, they should be weighed before addition.

Meat –

1. The edible flesh of animals. Meat comes in many varieties including:
   - Beef (bos) – An ox is a castrated male cow. The fat is called tallow.
   - Veal (bos) – A calf less than a year old, fed milk, grain or grass, sheltered from the light. The resultant meat is light colored, sometimes tougher, however, and tasty.
   - Pork (sus) – An omnivorous animal whose meat has a sweet, characteristic taste. Cured pork is called ham. Ham can be seasoned with clove, molasses, and other spices. Bacon is derived from the under belly or loins of the pork. The fat is called lard. Jewish and Muslim law forbids the use of pork because in the past, these meats were seen to be the cause of disease and expressly forbidden in texts such as the Bible. In fact, trichinosis, a parasitic worm infection (Trichinella spiralis) that used to contaminate much pork, can easily be killed by cooking at temperatures exceeding 140°F. Today little trichinosis infects our pork. Pork is often added to fruits like apples, pineapples, etc. It is thought that these kinds of combinations reflect either enzymatically enhanced digestibility (papain from pine-apple) or aromatic compatibility (substituted aromatic acids found in both apples, pineapples, and pork).
   - Lamb (ovis) – The fat from lamb or mutton (an older animal with tougher meat) is called a hard fat because it has a tendency to solidify once the meat is served.
   - Deer (venison) – The roe deer (Caprolus capreolus) and the red deer (Cervus spp.) are two typical varieties of deer that are commonly eaten.
   - Rabbit (oryctolagus) – A prolifically reproducing mammal that soared in population in Australia (where there are no natural predators). Rabbits have a mild-tasting flesh. The hare, a wild relative to the domestic rabbit, has a darker, more flavorful meat.
   - Offal – The edible non-muscular parts of slaughtered animals. Red offal includes the heart, tongue, lungs, spleen, and kidneys. White offals include the brains, teats, marrow, and testicles (also known as mountain oysters). Other parts are eaten like sweetbreads (pancreas), brains, kidneys, and tripe (stomach lining). After the animal is slaughtered, lactic acid can be produced either by inoculation with lactic acid-producing bacteria or by degradation of muscle tissue. This is accomplished in the second example by virtue of enzymes in the muscle cells. Here certain organic phosphorous compounds such as glycogen, the starch in animal tissue, are converted into lactic acid and the pH drops. Nucleotide breakdown was suggested as a reason for the taste of ripened meat, and inosine mono phosphate and the related guanyline salts are now used as a meat flavor enhancer.

2. The softer part of the nut. See Silverskin, Myosin, Carry Over Cooking, Delicatessen Meats, Offals, Protein.

Meat and Savory Industry – Includes all of the cheese, meat, and prepared foods used, produced, and prepared in the United States. An easy way of differentiating between the sweet goods industries and the meat and savory industry is 'If you add salt, it is meat and savory, and if you add sugar it is sweet goods.' The meat and savory industry includes prepared vegetables; mixed and dry soups, gravies, sauces; instant meals; refrigerated frozen foods; salad dressings; stuffing mixes; dips; tenderizers; pickles and other condiments; and meats. Other industrial segments are the snack food industry, pet and animal feed industry, health care industry, and beverage industry. See Marketing, Industrial Approach to Flavors, Blood – Aroma of, Marinades.

Meat Digest – Meat that has been hydrolyzed by the use of proteolytic enzymes. This product is usually used as pet or animal palatability enhancers in pet and animal feeds.

Meat Paste – a.k.a. Mechanically Deboned Meat.

Meaty – Having a flavor profile similar to a meat. See Proteinaceous, Fatty/Green, Gamey, Tastant, Amino Acid, MSG, HVP, AYE, Nucleotide.

Medicinal – Having a flavor reminiscent of medicine. This is an inaccurate term that can mean the bitterness of medicinal preparations, camphoraceous, or reminiscent of the cherry, orange, licorice, grape, or other similar flavors used historically in medicinal preparations, vitamins, aspirins, etc. See Bitter, Blood Orange, Licorice (Root), Masking.

Medium Dice – See Knife Cuts.

Medium Taster – One who has an average taste acuity and therefore an average amount of taste buds on the tongue and therefore has a correspondingly average amount of trigeminal nerves around the fungiform papillae. See Supertasters, Low Taster.

Melaleuca melilotus – See Cajeput (Melilotus).

Melaleuca sp. – See Tea Tree or Ti Tree and Appendix 2.

Melamine – 1,3,5-Triazine-2,4,6-triamine or Cyanurotriamide $C_3H_6N_6$ is combined with formaldehyde to produce a useful formable plastic resin. Originally patented as a non-protein source of nitrogen for feedstock, its use was later discontinued due to poor absorption. Recently, however, its use has produced many pet deaths. Reports indicate a supplier was using the ingredient to build up the protein assay in gluten by using this additive and not declaring its use. The pets are thought to have died due to excessive ammonia production by the chemical's metabolism with resulting renal failure. This is further illustration of the need for diligent sourcing, testing, and documentation. HACCP plans should incorporate continuing letters of guarantee, occasional testing, and other supplier certifications to help avoid these types of occurrences. See HACCP, Continuing Guarantee Letter, Food Safety.

Melilotus officinalis or Sweet clover – See Clover, Sweet and Appendix 2.

Melissa – See Lemon Balm and Appendix 2.

Mellorine – A non-dairy animal or vegetable fat dessert produced similarly to ice cream.

Mellow –

1. A flavor profile that is rounded, smooth, balanced, and with real or simulated aged character.
2. In wine, this can come from a well-matured, well-aged lot. See Toners, Blenders, Masking Agents.

Melon (Cucumis melo) – The fruit is divided into two categories, summer melons and winter melons, and is quite varied. Among the summer melons is the true cantaloupe (C. melo var. cantalupensis). However, the true cantaloupe, grown around Cantalupo near Rome, Italy, is not really cultivated. It is also not really found elsewhere, so the original fruit from which the name cantaloupe comes is almost never seen. The fruit that is typically seen is the United States labeled 'cantaloupe' is really a muskmelon. The muskmelon is a summer melon like the true cantaloupe from which it derives its common albeit inaccurate pseudonym. It is also called a netted melon due to the nature of the outside skin that looks like it has a net laid over it. Botanically, the muskmelon is C. melo var. reticulatus. The flavor of this most popular fruit varies from a sweet vegetable sulfury character (almost with a potato undertone) to a rosy floralcy. However, the characterizing ingredients are a group of unsaturated aldehydes and alcohols found in the fruit. Historically, the flavor compound called melonal was used to simulate this profile. However, with the advent of so many natural-smelling aroma chemicals, there is now many more to choose from to simulate this note. Muskmelons were originally grown in Cavaillon, Charente, and Touraine, France. The varieties bear the names of those areas (for instance, the Charenteis melon from Charente). Today, California, other U.S. states, South America, and many other regions in the world grow melons to meet the American demand for the popular fruit. Winter melons are relatively smooth-skinned types. They include the honeydew melon. This fruit, with a sweet green pulpy inside, has a flavor reminiscent of green grapes and kiwi due to the presence of an (E)2 (Z)6 nonadienal undertone. Other types of winter melons include the prince melon (resembling a honeydew melon in flavor profile with an orange

inside flesh); the casaba melon (with wrinkled yellow skin and a creamy pulp that is less flavorful than other types); the Persian melon (with skin that has fine, brownish netting and looks like a large muskmelon); the canary melon (with bright yellow and pinkish-white pulp); the oblong yellow, black, and green striped Santa Claus melon (with its pale green flesh resembling the honeydew); the Ogden melon (with its hard, smooth, ribbed skin and juicy pulp); and the Galia melon (with ribbed and netted skin and a flavorful pale green flesh). The last two melons mentioned were recently developed in an Israeli kibbutz. Melons are known to absorb odors and also give off ethylene gas that hastens the ripening process and also the contamination of the flavors of other foods. Therefore, melons should therefore not be stored in the refrigerator for an extended period of time for this reason. See Aldehydes and Chart 450 – Melon.

Melting – Melting Point – The temperature at which solids turn into a liquid. See Evaporation, Volatile, Volatility, Solid, Liquid, Temperature, Sublimation, Glass.

Melting Point Curve – Also known as Solidification or Freezing Point Curve, or Phase Diagrams. These chart typically show temperature and pressure in the x and y axes respectively. The point at which a substance can be either in a gaseous, liquid or solid phase by veering off in a direction is called the triple point. Different products have different curves and different designations within the curve such as; dew point, sublimation point, supercritical point, steam point, equilibrium points, critical points, etc. The nature of the phase of the product in which a flavor is found can greatly affect flavor perception especially when dealing with fatty acid profiles. See Chocolate, Conching, Supercritical Carbon Dioxide Extraction.

Membrane – A skin of variable thickness and flexibility. Example: The rigid separation between the halves of the kernel of a walnut. Also the semipermeable part of a membrane filter. See Filtration, Membrane Separation.

Membrane Separation – The process of separating substances dissolved in a liquid system by using a semipermeable membrane.

Meniscus – The concave or convex dish-like structure that forms on the top of a liquid in a closed cylinder due to capillary action. In a graduated cylinder, the middle of the meniscus is used to measure the amount of liquid in the cylinder. See Capillary Action.

Menstruum – The liquid portion of an extract, the extrait. See Extraction.

Mentha arvensis L. – Mentha arvensis is also known as cornmint oil or mint oil. The oil is grown mostly in Brazil but also in Japan as well and other countries to a lesser extent. Cornmint is used to produce most of the l-menthol used in this country. It is obtained through cold temperature recrystallization from the crude oil. One of the best tests for the presence of Mentha arvensis in a blend or for its undeclared use as a cutting agent for other mints is the absence of menthofuran. Menthofuran is a coumarinoid found in true peppermint oils (Mentha piperita) to varying degrees. In a typical chromatograph, menthofuran is found between the monoterpenes and the menthol. Mentha arvensis has a lingering vegetable like off note that must be removed for suitable use in flavors. One way is through the recrystallization process mentioned previously in the production of pure menthol. Another is by topping the oil. Topping is the removal of, for example, 20–30% of the volatile terpenes and other lighter volatiles. This is done typically under vacuum. Another treatment is to top the oil by only a few percent and then topped rectifying the oil. Rectification is the process of blowing over the entire oil under heavy vacuum, with or without a residue collector to retard severe oxidation of high boilers. See Distillation, Rectification, Oxidation, Blow Over Still, and Chart 468 – Mentha Arvensis.

Menthol and Menthone Derivatives – The presence of a menthol or menthone structure almost without exception yields the typical characteristic of a cool/minty sensation typical of the mint-type flavors. This is a trigeminal sensation as detected by the trigeminal nerves found in bundles mostly on the fungiform pappilae taste buds. Menthol is produced by the recrystallization of mentha arvensis oils (cornmint). See Chart 196 – Menthol and Menthone Derivatives and Appendix 2.

Menthyl Esters – See Chart 196 – Menthol and Menthone Derivatives.

Meringue – A light mass usually used as a topping (although some preparations, like soufflés call for its use internally to add fluffiness). Meringues are made from sugar and egg whites beaten until the mass is a rigid emulsion. Here the emulsion is an air in liquid emulsion stabilized by the protein of the egg. There are three types of meringue; French, Italian and Swiss. The French Meringue Is made by beating fine white sugar into egg whites, the Italian Meringue uses hot sugar syrup beaten into softly whipped egg whites. This type is best for its soft stability and is used in baked items where collapsing is a problem. The third, a Swiss Meringue is whisked over a water bath to warm the egg whites. This is whisked steadily until the mass cools forming a denser consistency than the other two styles. See Culinary, Baking, Meringue Peaks.

Meringue Peaks – Dependent upon the degree of whipping, Meringues can form peaks of differing consistency. Until the whipping has formed a stable

mass, after something like a spoon is dipped into the meringue, it will not for a pinched point when the spoon is withdrawn. 1. A soft peak is attained when the peaks gradually fall. 2. A firm peak is achieved when the ridges are more distinct but they fall back while the peak itself stays. A stiff peak is the result of a thick heavy consistency without any collapsing. This is a prime example of a colloidal dispersion where the continuous phase is the egg whites, the dispersed phase is air and the colloidal agent is the protein in the egg white. See Culinary, Emulsions.

Merosmia – A condition otherwise known as specific anosmia. Merosmia is an inability to distinguish only certain odors. See Anosmia.

Mesh Size – Mesh size is the number of wires per inch. A 40-mesh sieve indicates the sieve has 40 wires per inch. The higher the number of the mesh size, the smaller the sieve 'holes' and subsequently, only the tinier particles may pass through. There are also size numbers associated with standard sieve sizes. See Sieve Analysis, Physical Analysis, Bulk Density.

Meso – See Diastereomers.

Mesocarp – Mesocarp is the inside shell of a seed or bean. An example of a mesocarp is the silver skin of a coffee bean. See Endocarp.

Mesquite (Prosopis spicigera) – Mesquite is extremely hardy and draws water deep from the depths of the ground through its long taproot. It has a very sweet aroma when used as a smoke wood and mesquite smoke extract has found its way into many food products including snacks, barbecue sauces, salad dressing, and the condiments. The pods are also ground into flour and used to make bread, jams or jellies. The variety Chilean Mesquite or Prosopsis chilensis is also used. See Chart 474 – Mesquite Wood Extract.

Meta – A chemical containing a benzene ring is called an aromatic compound. An aromatic structure where two moieties (groups) are separated by one carbon in between. See Ortho, Para, Benzene Ring, Aromatic, Chemical Structure.

Metabolism and Growth – The study of the workings of an organism. This varies greatly depending on the class and structure of the organism. See Nutrition, Yeast and Mold, Vegetables, Fruit, Animals, Enzymes, Digestion.

Metabolite – Any final chemical component changed within an organism by action of the metabolism of an ingredient by that organism. Alcohols, acids, and esters are all volatile ingredients produced by yeasts during the fermentation of sugars in grape juice to produce wine and would be considered metabolites of yeast. See Organism.

Metal Detectors – The first industrial metal detector was developed by Kerr and Hiscock in 1947. The structure commonly used has a central amplitude modulated (AM – a signal like radio) transmitter coil and two receiving coils on either side. When a piece of metal passes through the detector, a disturbance is generated creating a signal which is then amplified. There are three basic types; Pipeline and conveyed types and free fall detectors. The first have either mechanisms or belts that divert the product to a different area, the latter lets the reject product drop. See HACCP, Sieve Analysis, Food Safety, Extraneous Matter.

Metal Fragments – See Extraneous Matter, Sieve Analysis.

Methanol – The simplest of alcohols. An alcohol group (OH) attached to a methyl group (CH_3–) or CH_3OH. This alcohol is by far more toxic than ethanol, its two carbon relative, and can produce multiple symptoms even at low exposure over a long period of time including blindness. When methanol loses a single hydrogen, it becomes the methyl group, as found in a methyl ester (CH_3O). See Ethanol Chart 7 – Alcohols Aliphatic Alcohols.

Methional (Beta methyl mercapto propionaldehyde) – This compound is quite characteristic of boiled potatoes and is useful in developing vegetable characters. It is also useful in introducing sulfuraceous notes important in milk, bread, cheeses, as well as fruits such as pine-apple, and other tropical fruits. See Sulfur Compounds.

Methyl Esters – See Chart 146 – Alkyl Esters Grouped by Alcohol Moiety – Alkyl Esters Grouped by Alcohol Moiety.

Methyl Thio Propionaldehyde – See Methional.

Meyers–Briggs Type Indicator – See MBTI, Creativity, Personality.

Meze – Mezze – Small food sizes typically accompanied with alcoholic beverages served as entrées in restaurants offering Near Eastern cuisine. See Culinary.

Micella – The mixture of solvent(s) and extractives from which the solvent is subsequently removed. This process leaves the solid extract or an oleoresin, depending on the nature of the solvent system. See Solid Extract, Extraction, Absolute, Oleoresin, Concrete.

Micelle – The globule of dispersed phase in an emulsion that is stabilized as a result of a film-forming agent. A micelle is either polar or non-polar. The micelle is attracted to a similar-type structure in the continuous phase, be it polar or non-polar. The charges built up on the surface through electrostatic molecular attractions are like charges and therefore repel, separating the particles. The particles actually move in a random manner, which causes them to look like they are vibrating. This is called the Tyndall effect and is seen under a microscope. Also, the particle, having charges evenly dispersed throughout its structure, takes on the shape of a sphere. This forms a stable micellular particle. See Emulsion, Emulsifying Agent, Surfactant.

Microbial Contamination – The potentially unsafe effect of environmental microorganisms coming into contact with food or food plants and equipment. It is a concern that with the organic movement that many consumers do not realize that using non-chemical fertilization procedures necessitates careful cleaning of produce before ingestion, and consider any organic product safe and healthy. See Food Safety.

Microbial Monitoring – The program set forth by a sound HACCP Plan that includes environmental sampling and monitoring, drain cleaning and sampling, finished product sampling, and raw material monitoring. When trends indicate a well-run system, random monitoring might replace constant testing. See HACCP, GMP.

Microbial Protease – A mixture of protease and other enzymes made by a bacterial culture, for example, using the species aspergillus oryzea as well and others. See Enzymes, Natural Flavor, Cheese.

Microbial Specifications – The section within the specification sheet that sets the limit for the microbiological assay on a food or flavor. Limits range from product to product and typically include APC, Yeast and Mold, E. coli, and Salmonella. Coliforms, Listeria, Staphylococcus and other microbes are also included in certain instances. See Microbiological Assay, Food Safety, HACCP, Microbiological Sampling Plan, Environmental Monitoring.

Microbiological Assay – A determinative test for both the qualitative identification and the quantitative analysis of microorganisms. A typical microbiological assay will include:

1. Standard plate count – The total amount per gram sample of all microorganisms.
2. Yeast and mold – The total number of yeasts and mold reported separately per 10-gram sample.
3. Escherichia coli – The microorganism found in the intestines, indicating fecal contamination. In a 1-gram sample of product, the presence of E. coli should be negative.
4. Coliforms – Related to E. coli, however found in the soil. Therefore, an unavoidable coliform count can sometimes contaminate some food products. Also in dairy systems, coliforms can occur from unsanitary milking processes. Minimization of contamination should be the goal with products such as these.
5. Staphylococcus (for example, Staphylococcus aureus) – This also should be absent. The toxins of certain microorganisms can be very difficult if not virtually impossible to destroy by heat. Staphylococcus contamination can be one such case. Contamination usually comes from infected handling personnel where proper sanitation practices are not followed.
6. Streptococcus (for example, Streptococcus pyogenese) – This contamination usually also comes from unsanitary handling personnel.
7. Salmonella sp. – This is a problematic pathogen that must be absent. It is a spore former so low moisture powders can still contaminate systems when rehydrated. See Food Code 2013, Food Code 2013 – Annex 4, HACCP, Food Safety, Pathogens.

Microbiological Sample Plan/Program – Part of the overall HACCP Plan and GMP, a microbiological sampling program includes environmental monitoring and drain sampling, periodic sampling for raw materials and finished products and routine microbiological testing. The results of this sampling verify the prerequisite program and GMP procedures are working properly. See Environmental Monitoring, HACCP, Prerequisite Program, Pre-Op, Post-Op, Cleaning Procedures, CCP, Validation versus Verification, Non-Conformance.

Microbiological Specification – See Microbial Specifications.

Microbiological Stability – See Pasteurization; Preservatives; Sterilize, Sterilization; Aseptic Processing, Challenge Studies.

Microbiology – Microbiology is the study of microorganisms.

Microbrewing – Specifically describing beer, cider or other fermented beverages and not wine, the development of the niche artisan food producer has been a recent explosion. Flavors for beers using different grains, different treatments, addition of flavorings, toasting techniques, hops, etc. have made the flavors offered beer as well as cheese, wine and many other foods and beverages explode. See Beer, Fermentation, TTB.

Microemulsion – A microemulsion is an emulsion whose particles are less than 1 micron in size (usually 0.75–2 microns). Incidental light waves are smaller than these particles so the waves do not refract off of the particles. In that case, the resultant dispersion of two immiscible liquids in a microemulsion is clear. The emulsion is thermodynamically stable. An oil and water mixture with a surfactant-based emulsion stabilizer like polysorbate is an example of a microemulsion. See Emulsion, Emulsifying Agent, Macroemulsion.

Microorganisms – Any living thing that cannot be seen by the naked eye. Microorganisms come in many varieties: yeasts, mold, bacteria, and viruses. These can either be beneficial, inconsequential, problematic, or deadly. A recent protein structure,

which is infectious but is not really considered a viable organism, is a prion, the causative agent to spongiform encephalopathy. Where applicable, specification sheets for food products and flavors should include a microbiological assay. This document would indicate the absence of harmful (pathogenic) organisms, yeast, and mold counts and standard plate counts. The four types of microbial reactions are:

1. Obligate Aerobes – Those microorganisms that require molecular oxygen for growth.
2. Obligate Anaerobes – Those organisms that are unable to develop in the presence of molecular oxygen.
3. Facultative Anaerobes – Microorganisms that can grow in either condition.
4. Microaerophiles – Microorganisms that grow under oxygen conditions less than that of atmospheric oxygen. See E. coli, Salmonella, Microbiological Assay, Streptococcus, Pathogenic (Pathological) Organism, Staphylococcus, Coccus, Yeast and Mold, Clostridium botulinum, Food Safety, HACCP, Environmental Monitoring, Food Code 2013 – Annex 4, CCP, APC, Yeast and Mold.

Microsmatic – Microsmatic means having an underdeveloped sense of smell.

Microwave Oven – The discovery of the cooking potential of microwaves was done quite accidentally when Percy Spency was working at a Raytheon building with magnetrons and noticed a strange sensation. He saw that a candy bar he had in his pocket started melting. Microwave energy excites water molecules and they begin to vibrate. The heat caused by vibrational friction builds up and water boils. The cooking is done from the inside out. Temperatures reached in a microwave are boiling water temperatures, and not high enough to initiate caramelization or an effective Maillard Reaction. Food cooked in a microwave therefore was previously bland and texturally inadequate. With the advent of combination convection cooking units, and metal pieces within the food container called susceptors, higher temperatures can be attained. It is a curiosity that metal is affected by microwaves only at sharp points. Theoretically, a metal ball bearing in a microwave will not get hot. Packaging technology has advanced greatly along these lines in the last few years. See Microwave (Stability), Maillard Reaction, Caramelization.

Microwave (Stability) – The characteristic of a food to be protected either wholly or partially against the rigors of microwave cooking. In essence, it means a food that is able to maintain acceptable flavor quality during microwave heating. One approach to this is to address differential characteristics of volatiles in a microwave system. Another approach is to use a volatile sink such as selective fats and other fixative-type base components. See Heat Stability, Volatiles.

Microvilli – Submicroscopic protuberant structures of the cell's membrane that greatly increase exposed surface area. These structures appear on taste buds to aid in tastant absorption.

Middle Ground – The center of the flavor profile in a time-intensity descriptive profile. The sequence of volatiles and taste impacts are top note, middle ground, then background. See Organoleptic Profile, Time Intensity Curve, Flavor Profile.

Mignonette – A sauce made from peppercorns, vinegar and shallots classically used with oysters. See Culinary.

Milfoil – See Yarrow Herb.

Milk – The nutrient-rich secretion from the mammary glands of mammals. Cow's milk is the most commonly produced variety. Other versions of milk are used in food systems, especially where standards of identity are specified for the production of certain cheese types. Lactose is the sugar found in milk, as is casein, whey proteins, and milk fat. The inability to digest lactose is a condition called lactose intolerance. This is due to a deficiency in the enzyme lactase that hydrolyzes the sugar into its component parts, glucose, and galactose. Yeasts can ferment glucose, but it seems galactose is a fermentation inhibitor to saccharomyces c. because lactase-treated lactose is still not fermentable by the organism. Heating pasteurizes milk. Milk that has less than 3.25% milk fat is heated to 145°F for 30 minutes or 163°F for 16 seconds. This time temperature ratio is further accelerated as in ultra-rapid high temperature pasteurization (192.2°F for 1 second) then cooling rapidly to 39.2°F. Ultra-rapid high-temperature pasteurization retains flavor and vitamins better. Milk normally contains about 3.4% fat. This fat can separate over time, and it creams or rises to the top. To stabilize the milk from this happening, it undergoes a homogenization process. Today, most milk is both homogenized and pasteurized. Ultra-filtered milk tends to eliminate more of the microorganisms that affect the milk's shelf life. Low-fat milk is defined as 2% fat, and partially skimmed milk is defined as having 1% fat. Non-fat or skimmed milk has less than or equal to 0.3% fat. Buttermilk is non-fat or low-fat milk that has had starter microorganisms added. Acidophilus milk is whole or low-fat milk that has had the bacteria lactobacillus acidophilus added. It is said that acidophilus aids the digestion. UHT or ultra-pasteurized milk is subjected to an ultra-heat treatment that exposes the milk to

269.6–302°F for 2 to 6 seconds, then chilled to room temperature. Evaporated milk is milk that has had about 60% of the water removed. Condensed milk is similar to evaporated milk, except that it has had sugar added. Condensed milk undergoes caramelization and Maillard browning during the heating stage. This provides a unique flavor. Flavored milk is milk that has had cocoa, strawberry flavor, or malted barley added to it. Powdered or dehydrated milk contains the fat of the original milk. When skim milk is dehydrated, it is called non-fat dry milk solids. Sour cream is milk that has had Streptococcus lactis culture added. Butter is formed when a starter culture separates the fat from the whey. When the milk is thus treated then churned, the cream becomes butter. Adding one or more lactic bacteria to milk, such as Streptococcus thermophilus or Thermobacterium bulgaricus, or Acidophillus sp., yogurt is made. Curd is milk that is fermented naturally at room temperature without the aid of a culture. Kefir is partially skimmed and then fermented milk. Alcohol and gas are present in kefir due to the fermentation process. The fermenting agents used in kefir are saccharomyces kefir, candida kefir (yeasts), Lactobacillus caucasucus, L. casei, Streptococcus lactis, or S. diacetilactis (bacteria). Kumis or koumiss is similar to kefir, but it is left to ferment for a longer time and thus develops a greater amount of alcohol and is quite fermented in taste. The final kumis has a similar amount of acid and alcohol to white wine. Ice cream is made by taking cream and adding sugar, flavoring, and sometimes gums or other stabilizers and then going through a whipping/freezing cycle to develop the proper aeration. In ice cream parlance, this aeration is called overrun. See Lactose Intolerance, Sherbet, Sorbets, Ice Cream.

Milk Thistle or Silybum marianum – Also known as Silymarin. See Appendix 2.

Millet (Panicum miliaceum and Setaria italica) – There are many varieties of this grain. The Chinese make an alcoholic drink out of millet flour called mao-tai. In Ethiopia, infera is the national bread made from millet flour. Faffa is a mixture of flour, milk, salt, sugar, and teff flour. Faffa is used as a dietary supplement. See Grains and Chart 451 – Millet.

Mimosa (Acacia decurrens Willd. var. dealbata) – Known in Australia as a Sidney black wattle tree, mimosa is mostly available for use in flavors as the absolute, with its refined woody, green character. It is useful for a mellowing effect in many natural WONFs. See Woody, Green, and Chart 239 – Mimosa.

Mimosa Drink – A mixture of champagne and orange juice.

Mince – To finely chop into little fine bits. See Knife Cuts.

Minerals – Nutrients that are necessary for proper bodily function. The Food and Drug Administration has set recommended daily allowances for minerals. This is called the RDA or Recommended Daily Allowances. Although the minimum intake for vitamins and minerals varies by age and occasionally by sex, set numbers have been developed. Some of the more important minerals are calcium for strong bones and teeth; iodine for proper thyroid function; iron for healthy red blood cells (which contain hemoglobin, an iron-containing molecule); magnesium for the activation of enzymes and for bones, teeth, and muscles; phosphorus for the devel-opment of phospholipids, for the production of peptides and other protein-oriented functions; zinc for maintenance of organs, the development of nucleic acids and proteins, and for use in the promotion of healing; chromium for the ability to use glucose; and copper, which controls release of iron, which in turn helps in the formation of hemoglobin, the active constituent of red blood cells. See Hemoglobin, Nutrition, RDA, Vitamins.

Minestrone – An Italian dish made up of pasta and legumes.

Minimum Order Requirements – Minimums – When developing a flavor, it is crucial to figure on minimum order requirements for raw materials to calculate accurate costing of the product. See Availability, Delay, Shipping Protocols.

Minimum Perceptible Concentration – The smallest amount of an ingredient needed to be barely detectable. This, of course, varies not only from individual to individual, but also varies in one individual depending on the time of day, day-to-day health, recent intake of food, etc. This concept, also called the flavor ingredient's threshold value, varies considerably due also to the nature of the media, be it oil or water. Similarly, factors like pH, temperature, viscosity, masking, synergism, texture, and other attributes can have a considerable effect on the value. For this reason, when developing a chart of minimum perceptible differences (MPD), the matrix, pH, and other factors should be defined and kept to a standard. Some chemicals have very low MPDs. One of the lowest is less than 2 ppb for 2 isobutyl 3 methoxy pyrazine. Others have very high MPDs, approximately 3% for lactose. In general, tastants usually have higher MPDs than aromas. Aldehydes are higher than their corresponding alcohols, and most sulfur containing compounds have very low MPDs no matter what the chemical structure is. See Flavorist Training Program, Comparative Flavor Chemistry.

Minimum Perceptible Difference (MPD) – The smallest amount of change of the percentage of an ingredient needed to be able to notice a difference in the flavor properties of that ingredient. It is an accepted industry standard that this is roughly about 15–20% for aroma. See Weber Fraction.

Mint (herb) – Besides the popular peppermint and spearmint, the red-stemmed raripila has a strong flavor and is easily cultivated. Apple mint and its variegated cousin, pineapple mint, are useful herbs. Basil mint looks like basil and has a lemony flavor that can be used in baked goods. Lemon mint is very powerful and is used sometimes in drinks but rarely in cooking. Other mint types are water mint, catmint, apple mint, round-leaved mint, and pineapple mint as well as many others. As of the publication of this edition, many mints have been added to the GRAS list including: Horsemint (*Mentha longifolia)*, Erospicata Mint (variety of Spearmint), Curly Mint (var. crispa), Ginger Mint (var. gracilis), and Scotch Spearmint (var. cardiaca). See Spearmint, Peppermint, Horsemint, and Chart 480 – Mint Varieties.

Minty – A botanical with a characteristic cooling effect on the lining of the mouth. Some examples are spearmint, peppermint, cornmint, and wintergreen. See Menthol and Menthone Derivatives; Terpenes; Trigeminal Nerves; Cool(ness), Cooling, or Mintyness; Sweet; Spearmint; Mentha arvensis L.; Peppermint; Birch.

Miscible (Miscibility) – The ability of two or more liquids to mix together. See Solubility, Immiscibility.

Mirepoix – A mixture of diced vegetables and herbs that are used in the flavoring of foods. The standard mirepoix is one-part celery, one part carrot, and one part onion. This is especially used to produce a brown stock. To produce a white stock, parsnip, mushrooms, or leeks can be substituted for the carrots. See Culinary Arts.

Mise en Place – Literally meaning 'everything in its place.' The technique of mise en place is used in culinary arts meaning to prepare all of the components of a dish in front of the chef so a simple combination of the proper ingredients in the proper order is ready for service. This is necessary for a good 'a la minute' or made-to-order program. Mise en place is also a mental state meaning a state of mental preparedness considering all parameters like cook time and hold conditions, appearance, temperature, and quality of the food to be served. See Culinary Arts.

Mixers – The flavor industry uses a wide variety of mixers. Liquid mixers are typically propeller types. However, mixing can be achieved in transit, in a piston homogenizer, in an emersion homogenizer, circulating systems, in-tank mixers, vertical stand type (Hobart® style), Grinder/Mixers, Pulse Mixers, Kitchen Blenders, or elsewhere in the processing. Dry flavors are mixed using a variety of blenders; such as V-Blenders, Double Cone Blenders, Ribbon Blenders, Pulse Mixers, Kitchen Blenders, or other types of mixing systems. Care must be taken if a product is heterogeneous, that gentle vibration does not segregate unlike particles due to their difference in size, shape or bulk density. See Bulk Density, Shape, Size.

Mixing – The act of blending or co-mingling two ingredients either liquid or dry. See Blenders, Cavitation, Mixers, Bulk Density, Miscible.

Mock Recall – A periodic exercise of the recall procedure is to be conducted on a regular basis. The recall should include hypothetical raw material contamination or finished product non-conformance and should identify a mass calculation of product in, product used, product shipped, who got the product, where there any tests performed, what is the disposition of the material and in some cases would the CDC have been contacted under the reportable food registry. These recalls confirm that system is in working order. See Recall, Withdrawal, HACCP, Food Safety.

Mode – The value of greatest predominance. In an array of 1, 1, 3, 3, 3, 4, 5, the mode is 3 because it appears most often. See Statistics, Statistical Analysis; Mean; Average.

Moderate Tasters – People who have an average number of taste buds per square inch and therefore possess average taste acuity. See Low Taster, Supertasters.

Modified Atmosphere (Packaging) – The introduction of an inert gaseous substance to protect the ingredients contained within a package from deterioration (usually oxidation). Such inert substances include nitrogen and carbon dioxide. See Controlled Atmosphere Packaging/Modified Atmosphere Packaging.

Modified Food Starch – An ingredient produced by the alteration of the starch molecule in order to change its attributes in a given manner. Food starches may be chemically modified or physically modified. According to Yook, epichlorohydrin is used to form hydroxypropylated freeze thaw stable starches and propylene oxide is used to increase cross-linking to improve functional properties and viscosity. See Dextrinize, Enzymatic Conversion, Corn Syrup, and Chart 454 – Modified Food Starch.

Modifier, Modifying Ingredients – A terminology first developed by Frank Fischetti Jr. explaining the nature of flavors. This description defines three types of flavor properties the characterizing, modifying and differential portions of the flavor profile.

A flavorant that somewhat alters the overall profile. Items that characterize define the identity of the product, while the modifier sets the tone. For example, the use of ethyl maltol™ in a strawberry flavor makes the flavor jammier and modifies the strawberry flavor to a jammy strawberry. Modifying Properties, flavors with Modifying Properties (FMP).

Modifying Properties – The terminology describing the use of non-flavoring Ingredients that modify or enhance flavors but do not in themselves add non-flavoring attributes like sweetness for example. Care must be taken with GRAS items such as Rebauside that it exists in the flavoring as a modifying property and not as a sweetener because the GRAS concept does not legally allow for the items to be used as sweeteners. A sensory evaluation protocol has been developed by FEMA and has been published in Food Technology Magazine outlining this protocol. See GRAS, Non-Nutritive Sweeteners.

Moiety – A type of chemical structure. Hydrogen plus oxygen is an alcoholic moiety. See Chemical Structure, IUPAC, Comparative Flavor Chemistry.

Moist Heat Cooking – The procedure in which water is used to cook. This includes boiling, simmering, and poaching. Steaming is considered a dry heat method because the water is in the gaseous phase and can dry out the food. Moist heat cooking methods are characterized by a maximum of boiling water temperatures (212°F or 100°C). Microwave is considered by some to be a moist heat cooking because it reaches boiling temperatures only and does not caramelize. Others feel it is a category of its own. See Culinary Arts, Dry Heat Cooking, Combination Cooking.

Moisture (Content) Aw – The amount of water in a product. Water can exist in a product in many forms. It can be bound chemically as a hydrate like in cysteine hydrochloride monohydrate. It can be bound in a gum, absorbed in a matrix of starch or otherwise non-available. It can be in a micellular form in a water in an oil-type mixture. Free moisture, or water activity, is important because it can aid in mouthfeel flavor release and texture. Free moisture, or the existence of a high water activity, can also be detrimental. It can support microbial growth and furnish the necessary environment for adverse yeast, mold or bacterial growth. See Humectant, Water Activity, Bacteria, Microorganism, Bloom, Yeast and Mold, Hydration, Mouthfeel, Emulsion, Micelle, Gums and Thickeners.

Moisture Migration – The transference of active water between two different interfaces with a food product with different moisture content (Aw). This can develop a food defect where mold can form within the interface.

Mojonnier – A method using a Babcock test bottle to determine the fat content of a food, typically a dairy product. The food is extracted by ethyl ether and then evaporated to see the resultant fat obtained. The Rose–Gottlieb is similar in that the extraction uses ethanol denatured with methanol and ammonia and then treated in the same manner. See Fat, Analytical Chemistry, Rose–Gottlieb, Babcock Test Bottle.

Molasses (Saccharum officinarum L.) – Molasses is obtained after the crystallization of sugar from cane or beet syrup. Mother liquor is the product obtained from the initial removal of the sugar from the syrup. This product is subsequently concentrated to produce molasses. Molasses is colorful due both to browning reactions (Maillard) but mostly due to the caramelization of the sugars. Molasses can contain some lime and sulfur dioxide as a result of the sugar-refining procedure. Due to recent enhancements in sugar refining, the sugar content of modern molasses is usually lower than in the past. Treacle is syrup made by mixing molasses and sugar syrup. See Sugar(s) and Polyhydroxyl Compounds; Caramelization; Brown (Compounds); Browning; Rum; and Chart 240 – Molasses.

Molding Starch – Starch with added oil used with a molding system (usually multiple positive images to create negative gaps or images within the starch). This system then uses high temperature fluidity starches that solidify at room temperature and bear the impression of the mold. The coating of starch from the molding starch is then polished away to provide a smooth external form, and oil is added for sheen. The temperatures achieved use a jet cooker. Flavors can be greatly affected by these temperatures. See Fluidity Starch, Modified Food Starch, Candy.

Moldy –

1. Containing a significant amount of mold (including microorganisms like penicillium roquefortii growths on blue cheese).
2. Having the characteristic acids, blue (bleu) cheese ketone, and/or earthy characters that are typical of mold growth. See Earthy, Dirty, Ketones – Aliphatic.

Molecular Gastronomy® – Originally coined by the French scientist Hervé This and Hungarian physicist Nicholas Kurti, it simply means the use of science in the creation of culinary arts. From edible menus, near absolute zero freezing of foods, and a variety of other 'unique and perhaps bizarre' uses of science to create culinary delights, the restaurants that employ these techniques have grown in popularity over recent years. See Culinary Arts, RCA, Research Chef.

Molecular Structure Theory of Odors – The theory posed by Dr. John E. Amoore of Oxford University in 1952, which states that the shapes of the molecular odorivectors (aroma molecules) fit into specifically shaped molecular receptors. Upon the fit of the jigsaw-type structures similar to the action of an enzyme on a substrate, electrical signals are then sent to the brain issuing the cognition of a certain smell. See Molecular Vibration Theory of Odors.

Molecular Vibration Theory of Odors – The theory posed by Luca Turin 1996 and 2002 in which odor receptors detect the frequencies of infrared vibrations of odor molecules by electron tunneling. To date, there is no theory that fully explains human olfactory perception. See Amoore, Molecular Structure Theory of Odors.

Molecular Weight – The total weight including all mass weights of a molecule. Example: Water, or H_2O, has a molecular weight of 18. Two from the two hydrogens ($1 \times 2 = 2$) plus 16 from the oxygen. See Atomic Number, Mass.

Molecule – Molecules are combinations of two or more atoms joined by a covalent bond. These can be diatomic molecules where two of the same atoms are joined (example: Hydrogen gas – H_2 contains two atoms of covalently joined hydrogen), or ploya-tomic molecules where there is more than one type of atom present (example: Acetic acid – C_2H_5COOH contains carbon, hydrogen, and oxygen). See Organic Compounds.

Mollusks – Mollusks are invertebrate animals which either (1) are contained in hard shells (gastropods-snails) or (2) have two shells (bivalves-clams) or (3) have no shells (are cephalopods). Care must be taken as to the area that shellfish are gathered, because certain microorganisms like Gonyaulax tamarensis and Alexandrium spp., as well as many other parasites and pathogens could infect them. Nerve effects from paralysis to death could ensue upon the ingestion of any of these so contaminated foods. The main sources of mollusks for food are listed in Chart 453 – Mollusks.

Monarch Butterfly Story – A Cornell University report citing that the Monarch butterfly caterpillars showed a significant mortality rate (44%) when fed on milkweed leaves dusted with pollen from Bt corn. No caterpillars died that ate leaves dusted with regular (non-Bt) corn pollen or control leaves. Contenders of the test's accuracy cite that the study was made under conditions that do not reflect natural circumstances. First, they claim the Bt gene expressed in the pollen is made by a company that is no longer producing that type of system. Secondly, the caterpillars were placed in a contained system where all they could eat was the pollen with Bt genes. Thirdly, pollen will normally fall on the top of the leaf and caterpillars by their very nature will eat a leaf from the underside away from predators and not necessarily come in contact with pollen dust that usually settles from above. It was further cited that the monarch butterfly had a natural freezing kill in Mexico (approximately 80%) and they came back to their original population the next year proving the resiliency of the species. Furthermore, monarch butterflies feed on milkweed and not corn. They go on to say that the government held a study in which they invited parties from all sides to participate. The conclusion was that genetically modified products seemed safe. However, a little while after this conclusion, the advocates for non-GMO went out and demonstrated against the substance's use despite the favorable findings. This is an obviously controversial topic.

Monarda (Monarda punctuata) – See Horsemint and Appendix 2.

Monoammonium Glycyrrhizinate (MAG) – The purified essence of licorice root that has a clean, licorice/brown and sugary taste. See Glycyrrhizin.

Mono and Diglycerides – Mono and diglycerides are mixed varieties of monoglycerides (glycerine with one fatty acid attached) and diglycerides (glycerine with two fatty acids attached). See Chart 454 – Mono and Diglycerides.

Monoglycerides – A molecule of glycerine with one fatty acid. See Diglycerides, Fat, Oils.

Monograph – From the USP: 'A monograph is a written document, or standard, that describes an item'. See NF, USP, FCC, Regulations.

Monosaccharide – A simple sugar, made of one molecule of sugar. Some examples of monosaccharides are glucose (dextrose), fructose, galactose, and mannose. See Disaccharide.

Monosodium Glutamate (MSG) – The solubilized salt of a necessary amino acid, otherwise known as MSG. Intolerance to MSG has been attributed as the cause for Chinese Restaurant Syndrome by a recent FASEB report. Although glutamic acid is found in many foodstuffs as a natural ingredient such as tomato, meats, etc., the soluble form allows a greater amount to be added to foods. The FDA has decided that the severity and frequency of the disorder is not such to consider it a serious public health risk, so no further action is to be taken besides label disclosure. See Amino Acid, Acronyms – FASEB.

Mossy – Mossy aroma means an olfactory quality similar to aromatic lichens and mosses, for example oak moss or tree moss.

Mother Sauce – The special group of versatile sauces as described by Escoffier from which many sister or derivative sauces can be made. See Sauce.

Motherwort or Leonurus cardiaca – See Appendix 2.

Motivational Error – Test bias that can occur because the testant does not try hard enough to achieve the right answer. See Errors of Analysis, Logical Errors, Stimulus Error, Halo Effect, Expectation Error, Order of Presentation Error, Mutual Suggestion Error, Personality Errors (Capriciousness versus Timidity), Error of Habituation.

Mountain Balm – See Yerba Santa.

Mountain Maple – Maple, Mountain (Acer spicatum Lam.) – The most widely used version of this product is as a solid extract. It has become popular in the last 15 to 20 years and in some instances has replaced wild cherry bark extract in its uses. It is a typical brown flavor type with a slightly woody background character. See Maple Syrup, Fenugreek, and Chart 234 – Mountain Maple.

Mountain Pepper – *Tasmania lanceolata*. Found originally in the rainforest of southeastern Australia, this is also called Cornish Pepper Leaf in the UK. It is characterized by a strong peppery taste and is used in Asian cooking in China and Japan as well. See Tasmannia lanceolata Chart 501 – Mountain Pepper.

Mousselin – Ground meat used in emulsion force meats or in the making of a raft in a consommé.

Mouthfeel – A complex sensory attribute that encompasses feeling and trigeminal impulses of texture, pain, heat, coolness, sponginess, lubricity, sliminess, chalkiness, fullness, irritation, revulsion, hardness, mineral/chemical taste, dryness, wetness, bite, alcoholic taste, and other physical characteristics. See Spectrum Attribute Scales® – Texture Hardness Scale.

Mouth Lining – See Mucosa.

Mouthwash Flavors – Flavors specifically designed for mouthwash preparations. These usually fall into three main flavor categories: mint blends, cinnamon blends, and phenolic types. See Pharmaceutical Flavors.

MPID (Meat and Poultry Inspection Division of the USDA) – See PMC, PMC Letter, USDA.

MRI (Magnetic Resonance Imaging) – A combination of NMR (nuclear magnetic resonance) spectroscopy and photo imaging that is used as a medical diagnostic tool. Recent studies of the structures of the sense organs and brain functions have been aided by use of this technique. See Mass Spectroscopy, NMR.

MS – An abbreviation for a mass spectroscope. See Mass Spectroscopy.

MSDS – See Material Safety Data Sheet, SDS.

MSG – See Monosodium Glutamate.

MSM (Methyl Sulfonyl Methane) – See Appendix 2.

Mucine – The principal component of mucus besides water. Mucine is the proteinaceous ingredient that provides for the thickness and lubrication effects of the mucosa.

Mucosa – See Mucous Membrane.

Mucous Membrane – The soft, pink, skin-like layer that lines many organs throughout the body. The mucous membrane or mucosa located in the olfactory bulb area is an important structure to aid in the absorption of volatile chemicals received by and then that go on to stimulate nerve endings in the olfactory bulb. The mucosa is lined with mucus, the water-based liquid rich in nutrients, emollients, and enzymes. The mucosa is aqueous, and most volatile organics are oil soluble. The nature of this difference has much to do with the relative vapor pressures and subsequent perception of volatile organic materials in multi-phase systems as perceived by our olfactory organs. See Olfactory Bulb Area, Olfaction, Polar versus Non-polar Organics, Emollients.

Mucuna pruriens or Velvet Bean or Cow-hage – See Appendix 2.

Mucus – The water-based substance that lines the mucosa, the thick slimy substance that is produced by the mucous membrane and facilitates a number of bodily functions including lubrication, prevention of drying and chafing of sensitive membranes, and production of a vehicle for dilution and transportation of nutritive substances. See Mucous Membrane.

Muddy –

1. Having a significant amount of insoluble or suspended particles making the product opaque.
2. In teas, it is usually caused by over-fermentation. See Opacity, Opaque; Solution; Suspension; Suspended Matter; Clarity; Transparent, Transparency; Translucency.

Muira puama – See Appendix 2.

Mullein (Verbascum phlomoidea L., V. thapsiforme Schrad., V. thapsus L. or V. latius Dod.) – Bitter for use in alcoholic beverages. See Bitter, Chart 241 – Mullein, and Appendix 2.

Multiple Chemical Sensitivity – The syndrome or collection of symptoms attributed to environmental factors. Originally proposed by Dr. Theron G. Randolph, the causes are unclear and the symptoms are so varied that no clear cause and effect has yet been established. The condition has been called one of the following throughout the years: allergic toxemia, cerebral allergy, chemical sensitivity, ecologic ill-ness, environmental illness (EI), immune system dysregulation, multiple chemical sensitivity, total allergy syndrome, total environmental allergy, total immune disorder syndrome, toxic response

syndrome, 20th century disease, universal allergy, and many other names that suggest a variety of causative factors. Similar diagnoses have been made in correlation to the Gulf War syndrome, sick building syndrome, toxic carpet syndrome, and other politically controversial diagnoses. Symptoms include depression, irritability, mood swings, inability to concentrate or think clearly, poor memory, fatigue, drowsiness, diarrhea, constipation, dizziness, mental exhaustion (also called 'brain fog' or 'brain fag'), lightheadedness, sneezing, runny or stuffy nose, wheezing, itching eyes and nose, skin rashes, headache, chest pain, muscle and joint pain, urinary frequency, pounding heart, muscle incoordination, swelling of various parts of the body, upset stomach, tingling of the fingers and toes, and psychotic experiences associated with schizophrenia. (From the Internet: Multiple Chemical Sensitivity: A Spurious Diagnosis, Stephen Barrett, M.D.)

Multivariate Analysis – The description of more than one characteristic at a time. In multivariate analysis one could assess the trend of a new piece of equipment on the color (Cooking time), distribution of Chocolate chips (Chip Depositor), and size and shape (Dough Depositor) as a function of belt speed. See Analysis of Variance, Sensory Analysis.

Mung Bean (Phaseolus aureus or Vigna radiata) – Also known as green gram beans. Mung beans come mostly green, but are seen in other colors as well. See Gram Beans, Beans.

Muscadine – See Appendix 2.

Mushrooms (food) – The classes of fungus called mushrooms are characterized like other fungi in that they lack chlorophyll, flowers, roots, and leaves. From 1–2% of all mushroom species are toxic or hallucinogenic. Some of the commonly mass-produced mushrooms for human consumption are the Boletus edulis, pelurotus mushrooms, shiitake mushrooms, wood ears, and common button mushrooms (Agaricus bisporus). Mushrooms spread by filaments or gills that contain single-celled spores. These filaments called mycelia are typically found in the dark ribbing underneath the cap. Mushrooms grow in three stages. The first stage is a button mushroom, where none of the filamentous gills show. The second stage is the cup mushroom, where some of the filaments show. At this stage, the top is still rounded, and the edges of the cap are still sharp, and curve underneath. The third and last stage is the flat mushroom stage, where the cap edges round out, and the gills or filaments spread almost to the edge of the cap. The final stage also carries the most intense flavor. Darker varieties of the Agaricus species called the cremini mushrooms are tastier than the lighter variety. Mushroom varieties are as follows:

- Cremini mushrooms are a dark brown variety (Agaricus bisporus) with a pleasant flavor.
- Portobello mushrooms, with a distinct winey character, have grown in popularity of late, and are powerful additions to many sauces. (Note: Acceptable versions of the spelling are Portobella, Portobello, Portabella. However, the usage of Portabello has also been seen on the Internet as well.) It is claimed that one mushroom company had a lot of cremini mushrooms that were left unharvested and when the lot was found, they had already opened up. The mushrooms were cooked and found to have a very savory flavor. So the marketing personnel decided that they could promote them as a value-added product and came up with the name Portobello after the Italian town.
- Oyster mushrooms are chewy types with subtle flavor. Their flavor is unfortunately sensitive to heat.
- Enoki mushrooms (Flammulina velutipes) grow in clusters and have a long stem and a small white cap. The flavor has a slightly fruity undertone.
- Morels are very distinctive looking, and resemble a honeycombed brain-like, structure. They have a special nutty flavor. As they are harvested in the spring, and have a short shelf life, they are often dehydrated and stored for later use.
- Pleurotus spp. mushrooms grow on wood or non-fermented organic waste like vegetables, etc. The oyster mushroom (Pleurotus ostreatus) has a strong taste.
- Shiitake mushrooms also grow on wood and have a meaty-type flavor with a good slightly acidic flavor.
- Boletus spp. mushrooms grow in forest or woods, unfortunately those collected in the wild often are infested with insect larvae. Unlike the gills of other mushrooms, boletus mushrooms have tube-like pores. Some varieties are the king bolete, bragger's bolete, and painted slippery cap.
- Porchini mushrooms are another variety of Boletus that has a potent flavor, similar to the Portobello with a pleasant, fermented, acid character.
- Wood ear, tree ears, Jew ears, or cloud ears are the many names for the species Auricularia auricula.
- Judea mushrooms are found growing on trunks of beech, elder, and walnut trees. The flesh is gelatin-like and relatively tasteless when cooked. They are commonly added to Chinese soups and Oriental stir-fries providing texture as well as flavor.

- Chanterelle (Cantharellus spp.) is a mushroom that is more popular in Europe. The species Cantharelus cibareius has a slightly biting peppery taste. They are usually a beautiful orange and yellow color. The gray variety is called girolles.
- Horns of plenty are dark brown, almost black and have a funnel-shaped stem with a deep, rich flavor.
- Truffles, which are not really mushrooms but a different classification of fungi, are very difficult to find. Black truffles (Tuber melanosporum) are better tasting than white truffles (Tuber magnatum), although the white Italian type is felt by some to be the penultimate in truffle flavor. Another truffle type is Tuber aestivium. The fungi that are called truffles contain a chemical that is related to the human pheromone, androsterone, also found in dogs and boars, and is perhaps one explanation why boars and dogs are used to track the elusive mold.

See Androsterone, Alcohols, Unsaturated (Bond), Disulfram, Mushroom Toxins, and Chart 455 – Mushroom Extract.

Mushroom-like, Mushroomy – Similar to mushrooms in flavor. Containing one or more branch-chained saturated or unsaturated alcohol of the C7 to C9 molecular chain length. Example: 1 octene 3 ol. See Mushrooms (food).

Mushroom Toxins – Mushroom toxins can be categorized into four separate groups:

- Protoplasmic Poisons – The most serious that result in cellular destruction.
- Neurotoxins – Neurological symptoms including profuse sweating, coma, convulsions, hallucinations, excitement, depression, or spastic colon.
- Gastrointestinal Irritants – Nausea, vomiting, abdominal cramping, and diarrhea.
- Disulfram-Like Toxins – Non-toxic unless alcohol is consumed within 72 hours of ingestion whereupon a temporary but acute toxic syndrome manifests itself.

See Mushrooms (food).

Musks – The chemistry of musks is fascinating. There is no one chemical structure that creates muskiness. Likewise, one musk compound might have a strong musky odor. The addition of a chemical group may make the strength of a musk compound increase substantially, however, the addition of another chemical group might make the compound's muskiness disappear. Again, on another compound the effect might be totally different. Musks fall into four main categories: (1) Nitro musks; (2) Macrocyclic musks; (3) Indane musks; and (4) Lactone musks. Ambrette seed oil contains the macrocyclic compound omega 6 hexa decene lactone. Musk ketone, ambrette, and musk xylol were previously GRAS and were delisted. Musks have limited use in flavors because they are so pervasive and are therefore not widely used. Some flavors that have used musks are blackberry, pear, and maple. Musks have been recently looked at more closely from a toxicological standpoint because they seem to be poorly metabolized by the body and have been shown to build up in the body's fat tissues. Blood musk retention in the adipose of pregnant women is the greatest concern. See Chart 197 – Musks.

Musk Tonquin (Moschus moschiferus L.) (Musk Deer) – The costliest of all animal-derived musks, and perhaps of all available natural ingredients used in flavors. The Tonkin deer from which this product is derived is raised in a small area in Tibet, northern India, and southern China. Tens of thousands of deer are slaughtered to produce a few tons of pods. However, it has been proven that the deer do not have to be killed to obtain the pods. However, they still are to the point of possible extinction. Due to the high price of the ingredient, fear of adulteration is obvious. See Musks and Chart 242 – Musk Tonquin.

Musky – Musky means having a flavor profile like musk. See Musks.

Musk Yarrow – See Iva.

Mustard – Only the black and brown mustards (Brassica nigra and B. junica) yield the essential oil, not the white mustard. The production of the essential oil is similar to the production of bitter almond oil from Prunus, Amygdalus, and cherry species. An endogenous enzyme hydrolyzes a glycoside and the comminuted botanical is then added to water. The enzymes in this class are called myrosinases. These break down glucosinolates into isothiocyanates. The isothiocyanate-rich seeds are then distilled to obtain relatively pure allyl isothiocyanate. This chemical is a lachrymator and is quite pungent and irritating when smelled from the bottle. It is a powerful rubefacient (turns skin red on contact). Prepared mustard is made with mustard powder, water, salt, and vinegar. Dijon-type mustards are condiments made from mustard preparations, wine, etc. The seed can produce a household cooking oil (30–35% yield). Indian mustard is used like spinach and is a cross between mustard and a member of the cabbage family (Brassica rapa). See Lachrymator, Harsh, and Chart 243 – Mustard.

Mustard Oil – Allyl isothiocyanate. See Sulfur Compounds, Mustard, Pungent, Lachrymator.

Musty – Musty means reminiscent of damp, dank closets. The flavor profile can be considered a combination of earthy, moldy, and fermented notes. See Beety, Earthy, Moldy.

Mutagenic, Mutagenicity – Mutagenicity is the ability to mutate the genetic material of a cell. The implication is that exposure to a chemical of this sort could lead to the development of cancerous cells. The theory that mutagenicity implies carcinogenicity had been postulated by Dr. Ames and led to the development of the Ames Test. See Ames Test.

Mutarotation – The change that a sugar can undergo in a solution where it equilibrates into a blend of the alpha and beta phases. See Optical Rotation; Isomer; Sugar(s) and Polyhydroxyl Compounds.

Mutual Suggestion Error – The effect of the response of another panelist is directly proportional to his or her authority. This unfortunately is true, and is the reason, therefore, that for results to be accurate and unbiased, they must be recorded in privacy and anonymity. See Logical Errors, Stimulus Error, Halo Effect, Expectation Error, Motivational Error, Order of Presentation Error, Mutual Suggestion Error, Personality Errors (Capriciousness versus Timidity), Error of Habituation.

Mutation – The genetic alteration of a cell. When a chemical can affect a cell in this manner, it is called a mutagen. Mutations can be beneficial and can be selected to express a certain positive character. This is done by mating a mutant with an existing organism. Mutations can also be deleterious. Most detrimental mutations cannot survive and are not able to be viable once born. Recent recombinant DNA techniques are purposeful mutations at the gene site using a number of sophisticated techniques. It is envisioned that this new area of research will yield a variety of new flavor and food ingredients in the future. Genetically modified material production is a recently controversial topic wherein purposeful genetic mutations are done by recombinant techniques. See Genetically Engineered Foods and Flavors, Teratogenic, Recombinant DNA, GMO.

Mycelium – Mycelia are vegetative thread-like protuberances growing from a fungus.

Mycorrhiza – Fungi living in the tissue of the roots of higher plants as a symbiotic system. Roots supply needed nutrients for the fungi, and water, minerals, and enzymes within the fungi break down minerals in the rock to provide needed sustenance to the plant.

Mycotoxins – Toxins produced by fungus. Aflatoxin has been the most studied because it has been shown to be a very potent carcinogen. It is produced by the fungus aspergillus flavus. Foods potentially infected include corn, peanuts, cottonseed, milk, and tree nuts. Ergot toxin produced by Claviceps purpurea is found mostly in stored grains, especially rye. The chemical structure of the toxin (ergotamine) is similar to LSD (Lysergic Acid Diethyl Amide) and therefore explains the brain disorders and hallucinations associated with its effects. Gangrene is often associated with ergotism as well. The green skin and bizarre behavior might be a possible explanation to the host of strange occurrences during the Salem witch trials of 1692 in Massachusetts. Other mycotoxins of note are patulin and ochratoxin produced by penicillium and aspergillus; zearaenone, a mycoestrogen, which can be found in grains causing possible infertility in livestock; and fumonisin, formed by Fusarium verticilloides and F. proliferatum in maize and tomatoes, identified as causing esophageal cancer. See Yeast and Mold, Pathogenic (Pathological) Organism.

MyPlate – See ChooseMyPlate.

MyPyramid – Developed by the USDA, the MyPyramid graphic was used from April 2005 to June 2011 until it was replaced by the MyPlate graphic due to adverse consumer comments on the former. See ChooseMyPlate, Nutrition.

Myrcia Oil – See Bay Leaf, West Indian-Oil.

Myrrh (Commiphora molmol Engl. = Somalian Myrrh [C. abyssinica] [Berg.] Engl. = Arabian Myrrh and Other Commiphora Species) – Also known as Oppoponax. Myrrh is found in tear-shaped oleogum exudates from the above-mentioned plant. It is often cut with diethyl phthalate, a non-food grade solvent, so care must be used when using this sort of solvents. Myrrh essential oil is the steam-distilled product of the oleoresin and might prove to be a safer alternative. See Resinous, Balsam, Balsamic, Chart 244 – Myrrh, and Appendix 2.

Myrtle (Myrtus communis L.) – Myrtle is a strongly camphoraceous type of oil that is cultivated in the Mediterranean countries of Europe. See Camphor and Chart 245 – Myrtle.

N

N – See Normal Chain Molecule.

NAC – Acronym for natural aroma chemicals.

NACGM – National Association of Chewing Gum Manufacturers

NAFFS – National Association of Fruits Flavors and Syrups

NAFTA – North American Free Trade Agreement.

Nadihingu (Gardenia gummifera) – See Gardenia gummifera.

NAICS – North American Industry Standard Classification System. Developed by the United States Census Bureau, and formerly known as the SIC system (changed in 1997), these identification codes are assigned by company product type for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy. See Food Industry.

Nano Food – Food that is cultivated, produced, processed or packaged using ingredients the size of which is in the nano-scale.

Nanotechnology – The use of ingredients the size of which is in the nano-scale. A nanometer is a millionth of a meter and is roughly 1/50,000 the thickness of a human hair. One micron is 100 nanometers. Items in use in foods toady include nanometals. nanometal oxides, aluminum and aluminosilicates and nanoclays.

The main purposes of nanotechnology and its use in foods presently is for dietary, delivery, coating and preservation. Nanoclays including alumina are used as a dispersing aid, and alumino silicates are used as thickening and anticaking agents. In Europe the exclusion from organic is <200 nm and in the U.S. it is <300 nm. The 300 nm cut-off is used because it is the size limitation that can cross the placenta. See Food Safety, FDA.

Naphthyl Compounds – These compounds are generally warm. Esters have sweet undertones. See Chart 246 – Naphthyl Compounds.

Nappé – The quality or thickness of a sauce, its viscosity. Nappé is measured usually by dipping a non-porous wooden spoon into the liquid and running a finger down the length of the spoon's convex side. If the line remains and does not come together, the nappé is good. Another method is the drizzle method. Here some chefs drizzle the sauce into itself to see how quickly the drizzle dots coalesce into the sauce. See Culinary Arts, Viscosity.

Naringin – The bitter principle extracted from the blossoms and flavedo of the fruit. See Grapefruit Oil, Nootkatone, and Appendix 2.

Narino – A varietal coffee of Columbia. See Colombian Coffee.

Nasal Cavity – The open area starting at the nasal opening to the rear interior of the nose/throat wherein lies the olfactory organs. Aromas are sensed retronasally when in the mouth. See Olfactory Bulb Area, Olfaction, Smell, Anosmia.

Nasal Passage – See Nasal Cavity.

Nasturtium (Tropaeoleum majus) – Also called Indian cress due its sharp cress like flavor. See Cress.

National Association of Chewing Gum Manufacturers (NACGM) – See Gum, Chewing Gum

National Association of Fruits Flavors and Syrups (NAFFS) – Now called The National Association of Flavors and Food-Ingredient Systems.

National Confectioners Association – See NCA.

National Food Processors Association (NFPA) and NFPA-Safe Audit – See FPA, FPA – Safe Audit.

National Formulary – See NF (National Formulary).

National Institutes of Health – See NIH.

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National Nutrition Database (USDA) – A database developed by the USDA containing the nutritional analyses of a multitude of food products. See USDA, Nutritional Analysis.

National Oceanic and Atmospheric Administration (NOAA) – Defines Aquatic Toxins – See HAZCOM 2012, OSHA

National Restaurant Association – NRA – The other NRA. The National Restaurant Association states 'The National Restaurant Association (NRA) is the largest foodservice trade association in the world' – supporting over 500,000 restaurant businesses. In partnership with our state restaurant associations, we work every day to empower all restaurant owners and operators to achieve more than they thought possible. They have developed an education and training program called ServSaf® to limit the occurrence of Food Borne Illness. See Culinary, Restaurants, Chefs, Food Safety.

National Science Foundation (NSF) – The organization that reviews, studies, and researches some areas of concern such as general scientific questions, toxicological data, and scientific health issues.

Natto – A strong-flavored sticky fermented soybean commonly consumed by the Japanese at breakfast. It has an odiferous cheesy aroma and a slimy, thick consistency. The enzyme produced by the bacteria bacillus natto is called nattokinase and has been touted as having the ability to dissolve blood clots. Natto itself is purportedly extremely high in nutrients and has been used to prevent colon, prostate, and breast cancer, to lower cholesterol, and to prevent osteoporosis. See Nutraceuticals, Cheese.

Nattokinase – See Appendix 2.

Natural – There is no definition for natural Ingredients other than to define flavoring. Currently there is a legal request for the FDA to define natural products other than flavorings. Companies have taken it upon themselves to define their version of natural and some have published lists excluding certain items they feel is not within their definition of natural but this is purely a voluntary practice and does not currently have the force of law behind It other than labeling misrepresentation. See Natural Flavor, Labeling.

Natural Certification – A letter of guarantee written by a supplier that assures that if the flavor is labeled natural, all ingredients contained in the product are natural under the applicable law. Typically, this letter of natural certification is usually combined with a letter of continuing guarantee. See Continuing Guarantee Letter, Adulteration, Natural Flavor, Isotopic Analysis (Isotopic Ratio).

Natural Flavor – As is currently defined by the United States Food and Drug Administration, found in the Code of Federal Regulations as published by the government, the definition of natural favors is as follows in Title 21, Section 101.22 (a) (3): The term 'natural flavor' or 'natural flavoring' means the essential oil, oleoresin, essence or extractive, protein hydrolysate, distillate, or any product of roasting, heating, or enzymolysis, which contains the flavoring constituents derived from a spice, fruit or fruit juice, vegetable or vegetable juice, edible yeast, herb, bark, bud, root leaf or similar plant material, meat, seafood, poultry, eggs, dairy products, or fermentation products thereof, whose significant function in food is flavoring rather than nutritional. Natural flavors include the natural essence or extractives obtained from plants listed in Sections 182.10, 182.20, 182.40 and 182.50 and Part 184 of this chapter, and the substances listed in section 172.510 of this chapter. In June of 1997, IOFI adopted the natural definition as proposed originally by the FDA of the United States to include only those flavors developed by stovetop conditions. See Artificial Flavor, Incidental Additives, Characterizing Ingredients, Processing Aids.

Natural (Flavors) – See Natural Flavor.

Natural Ingredients – The only ingredients defined by the FDA as natural are flavoring ingredients. However, some companies choose to claim that non-flavor ingredients are naturally derived. This is purely voluntary. Then, all of the ingredients including the flavors must be derived from natural sources. See Marketing, Natural Flavor.

Nature Identical – A former labeling policy that was adopted mostly in Europe and in countries that adopt a European-style approach to food labeling. There are also countries that adopt both a combination of European-style regulations and the U.S. GRAS list styles. The nature identical concept states that any chemical found in nature can be used as long as the ingredient falls within good manufacturing guidelines. Therefore, if a flavor is made using the above guideline, it is inconsequential whether or not the vanillin used in a vanilla comes from vanilla beans, lignin, reaction of eugenol, or any other means. Although the status of Nature Identical is no longer used in Europe, some countries still adhere to the concept within their guidelines and have not changed to the new system. See GRAS List.

NCA (National Confectioners Association) – Organization of candy makers of the United States.

NCR Process – The patented coacervation process developed by The National Cash Register Company to microencapsulate inks for carbonless papers. Today, perfumes and flavors are similarly encapsulated in a system that is then adhered to paper by glue. By

scratching the matrix, the aromas are free to evaporate. This technique is called 'Scratch and Sniff'™.

NDSL – See Non-Domestic Substances List.

Nectarine (Prunus persica var. nectarina) – A freestone nectarine (scleronucipersica) and a clingstone nectarine (aganonucipersica) are two different types of nectarines. It was thought to be a hybrid between a peach and a plum, but recent information indicates it really is a mutation of a downy-skinned peach, and that it was consumed in China over 2,000 years ago. Flavor-wise, the intensity and character are greater than that of a peach, containing a greater amount of both esters and lactones. See Peach.

Neem or Azadirachta indica – See Appendix 2.

Negative List – A regulatory policy whereby ingredients that cannot be used in foods are listed. This is the opposite from a positive list like the GRAS list. See GRAS List.

Neroli Bigarade – See Orange Flowers, Bitter Orange, and Appendix 2.

Nerves – The nerves carry impulses to the brain. The chemical mechanisms of the electronic impulses via a sodium/potassium ion interchange. For this reason, the balance of electrolytes is crucially maintained in the body. Not only are sensory impulses sent to the brain, but the brain in turn sends impulses that are automatic (autonomic nerve system) regulating the involuntary life-preserving functions like heartbeat, breathing, and enzyme and hormone maintenance.

Nerve Receptor – A group of nerve endings that are activated by a stimulus and produce a response. Sensory receptors specifically respond to sensory stimuli. Recently many strides have been made as to the specific sites and their corresponding expression from DNA gene coding. According to Graeme Lowe of the Monell Center the human genome expresses approximately 350 distinct odor receptors. Receptors have been identified as to specific chemical responses. Taste receptors designated as TAS are also noted as T receptors. So TAST1R1 can also be called T1R1. The G protein-coupled receptor (Gustducin based or GPCR) of T1R1/T1R3 is the response site for Umami stimuli and the general class of T1R receptors (T1R1, T1R2 and T1R3 together) for the sweet taste. T1R3 alone has seen to be responsive to Calcium. MGluR4 or Metabotropic Glutamate Receptor 4 is a site related to learning, memory, anxiety and pain but is also involved with the perception of Umami stimuli. T2R receptors seem responsible for some bitter responses, although there are many different types of bitter stimuli so far identified. The TRPM8 receptor is responsible for cooling and menthol, and the TRPVR1 the capsaicin and vanilloid receptor for heat. Avoidance receptors such as the m Trace Amine Associative Receptors (mTAAR 1,2,3, and 4) are responsible for the avoidance of cadaverine (TAAR3) and Trimethylamine (mTaar5). See Taste Receptors, Gustducin.

Nettle (Urtica dioca, U. urens) – Although the uncooked plant has leaves and spines that can cause a skin rash, the cooked plant has a peppery flavor. Other names are bigstring, great nettle or stinging nettle (U. dioca), dog-nettle, or burning nettle (U. urens). The hollow tiny spines have a chemical similar to formic acid, which causes ant stings to burn. If dried and sieved, the active chemical is still present in the fine dust of the nettle spines. See Peppery and Appendix 2.

Neuron – Nerve cell. Most neurons do not regenerate like other cells. An exception to this is the olfactory nerve. It has been recently determined that 1,000 sites in our genetic structure determine the specific structures for odor recognition in the olfactory bulb. This makes up 1% of the estimated 100,000 gene sites in humans. This observation, coupled with the regenerative capabilities of the olfactory nerve found rarely in nerve cells, illustrates the importance of aroma recognition and detection to species. As odor impulses go directly to the limbic system then to the cerebrum, it has been postulated that there might be definite truth to the concept of aromatherapy. See Nerves, Aromatherapy, Limbic System, Cerebrum, Brain, Cranial Nerves.

Neutral – The absence of a trend, charge, or stance.

1. A neutral pH is a pH of 7.0.
2. A neutral charge is 0.
3. Neutral optical rotation is dl or racemic.

Neutrons – Atomic particles made from a combination of 1 electron and 1 proton, thus having a neutral charge, and an atomic mass of approximately 1.

New Jersey Department of Environmental Protection and Energy (NJDEPE) – The New Jersey State counterpart of the U.S. EPA.

Newtonian Flow – The movement of a thick substance that pours out in a steady stream. See Snotty, Gel, Non-Newtonian.

NF (National Formulary) – A compendium of information on drugs and some flavor materials that include specifications and monographs on the assurance of the quality of ingredients used by the American Pharmaceutical Association. See USP, Specifications, Purity, Food Grade, Grades, Spectrophotometric Grade.

NFPA – National Food Processors Association (NFPA) and NFPA Safe Audit. See FPA, FPA – Safe Audit.

Niacin – See Vitamins (B Complex).

Niaouli or Gomenol or Melaleuca viridiflora – See Appendix 2.

Nibs – See Cocoa.

Nicotinic Acid – See Vitamins (B Complex).

Nigella – An herb, also known as love-in-a-mist, devil-in-the-bush, or kalonji. The edible seeds are used in western Asia, the Middle East, and southern Europe. It is used sprinkled on breads, and has an aromatic, peppery flavor. See Aromatic, Peppery.

NIH (National Institutes of Health) – An independent organization that studies various areas of concern regarding health issues in the United States.

Niribine Oil – See Currant, Buds Black (Oil).

Nitrites – Salts of nitrous acid. These compounds are used in meats and other products as a bactericide. It is also responsible for the pinkish coloration in emulsion meats like sausages and hot dogs. The metabolite by-product of nitrite usage, called nitrosamines, has been linked to cancer. Nitrites are formed with ammonia and nitrates by nitrogen fixing bacteria in the soil. See Nitrosamines, Nitrogen, Nitrogen Fixing Bacteria.

Nitrogen – The 7th element in the periodic table of elements, with two stable isotopes, the most common of which is atomic number 14, thus comprising of a nucleus of 7 neutrons and 7 protons. It has an outside shell of three electrons and is in the non-metal group. It is the most common constituent of earth's atmosphere (75–78%) and exists in a diatomic state as N_2. It is not very reactive, therefore to make it chemically usable in nature nitrogen fixing bacteria located in root bulbs of legumes turn nitrogen in the atmosphere into nitrates. In organic chemistry, nitrogen has the ability to form many molecules in conjunction with carbon and is the necessary part of an amino acid, the ultimate building block of life. Often the nitrogen can give up electrons and act as a metal giving the molecule a plus charge at that site. This allows for many reactions with moieties such as carboxylic sites which can give up a hydrogen and become negative. This characteristic among other attractive mechanisms can result in the folding of proteins and the multivariate characteristics proteins can achieve. Nitrogen can react with an aldehyde to for a Schiff Base, one of the first steps in the Maillard Reaction. See Maillard Reaction, Amino Acid, Protein, Nitrogen Fixing Bacteria, Legumes, Chart 265 – Nitrogen Containing Non Pyrazine, Chart 264 – Pyrazines, Chart 266 – Pyrimidines, etc., Chart 35 – Anthranilates, Chart 29 – Amino Acids, Nucleus, Atomic Weight, Atomic Number, Valence, Electrons, Protons, Neutrons, Isotope.

Nitrogen Containing Flavor Chemicals – There are many important nitrogen containing flavor chemicals. Most of these are produced during the non-enzymatic browning known as the Maillard reaction. Many of the flavor characteristics range from meaty to caramel to nutty. See Chart 265 – Nitrogen Containing Non Pyrazine, Chart 264 – Pyrazines, Chart 266 – Pyrimidines, etc., Chart 35 – Anthranilates, Chart 29 – Amino Acids.

Nitrogen Cycle – The process of turning atmospheric nitrogen into ammonia, nitrites, nitrates and then back to nitrogen again dues to the action of microorganisms. See Nitrogen Fixing Bacteria, Nitrogen, Proteins, Amino Acids.

Nitrogen Fixing Bacteria – Found in bundles in leguminous plants in the soil and accompanied with nitrifying and denitrifying bacteria complete the nitrogen cycle turning atmospheric nitrogen into ammonia, nitrites, nitrates and then nitrogen again. See Nitrogen, Legumes.

Nitrosamines – Developed in the body when nitrites react with proteins and amino acids. Levels that are produced in this manner are far outweighed by normal bodily decomposition of proteins within the saliva and large intestines. Therefore, the body seems to be able to cope with these substances at these very low levels without apparent adverse effect.

Nixtamalization – Originally an Aztec word describing the soaking or cooking of ground corn in alkali, typically limewater. This process enhances the bioavailability of the vitamins, improves flavor, and texture, reduces mycotoxins (toxins from molds) and solubilizes hemicellulose loosening hulls, making the granules able to stick together. See Corn, Cornmeal, Teosinte, Hominy.

NGO – Non-Governmental Organization – Groups that are not affiliated with the Us Government and typically have a cause to promote. Examples are: Foodtank, Center for Science in the Public Interest, The GMO Project, Center for Consumer Freedom, Physicians Committee for Responsible Medicine, International Food Information, Council, Food and Allergy, Center for Food Safety, Pew Charitable Trusts and American Council on Science and Health to name a few. See FDA, FEMA.

NJDEPE – See New Jersey Department of Environmental Protection and Energy.

NLEA – See Nutritional Labeling and Education Act.

NOAA (National Oceanic and Atmospheric Administration) – Defines Aquatic Toxins – See HAZCOM 2012, OSHA

NOAEL – No Observable Adverse Effect Level – This terminology is used in Toxicological determinations of safety. A LOAEL or Lowest Observed Adverse Effect Level is used to calculate an RfD or Reference Dose. A reference dose is the maximum acceptable oral dose of a toxic substance. This terminology often determined by the EPA for pesticide residual determinations, are not enforceable standards but a risk assessment criterion. See Toxicology, Food Safety.

Noble –

1. In wine, a product whose flavor attributes are of the highest standards, the finest of the fine in flavor, color, character, and appearance.
2. As in noble gas or noble elements, the elements that have their outer valence ring filled and are not prone to non-metallic reduction reactions.

Noble Rot – Purposeful infection by the gray fungus Botrytis cinerea to produce distinctive wine flavors such as German Riesling, French Sauternes, and the Hungarian Tokay. The rot increases the sugar content and allows very characteristic profiles to develop.

NOEL – No Observable Effect Level – See NOAEL

Nonanal – (Aldehyde C-9) Another of the orange rind aldehydes (C-7 to C-12). See Aldehydes (Aliphatic).

Non-Beverage Alcohol – Alcohol that has been used in a product (flavor, etc.) that has been deemed non-potable, and is therefore fit for drawback.

Non-Compliance – See Non-Conformance.

Non-Conformance – Something that went wrong. This is usually concerned with a product, ingredient, system, equipment or other aspect of food production which is out of compliance with safety, legal or quality parameters. A non-conformance can result in as little as a rework and as major as an international recall. See Out of Compliance, HACCP, Food Safety, Critical Control Points, Critical Limits, Reportable Food Registry.

Non-Descript – A flavor character that is either absent, at too low a level to be accurately perceived, or of a type that is difficult to accurately describe. See Flavor Nomenclature Workshop.

Non-Disclosure Agreements – See Secrecy Agreements, Confidentiality Agreements, Intellectual Property, Public Domain.

Non-Domestic Substances List (NDSL) – The listing of ingredients identified under the Chemical Weapons Convention (CWC) that might be imported into the United States and would fall under the jurisdiction of the DEA.

Non-Enzymatic Browning – The best example is the Maillard Reaction. See Maillard Reaction, Processed Flavors, Enzymatic Browning.

Non-Fit (For Beverage Use) – The designation that a flavor is non-potable, and is eligible for alcohol tax drawback. See TTB, Drawback, Potable Potability, Non-Potable.

Non-Flavor Ingredients –

1. Those items, adjuvants, foods, and other ingredients that must be specified directly in the declaration label. (Anything that is not a flavor, a processing aid, an incidental additive.)
2. There are many items that are approved for use by the FDA as cited in the Code of Federal Regulations. There are many items on the GRAS list that are either bother flavorants, which perform another function, or are non-flavorants. The first ingredient FEMA number, 2001, is gum Arabic, one such ingredient. Other items, like foods, amino acids, etc., are food approved, and must be split out on the label, but are not flavoring agents as such. It is important that we understand the nature and function of these ingredients, because every change in the physical or chemical properties of the final food product can, in some way, affect the flavor chemistry, character, or nature. Some, like polysorbate-80, are listed in both.

See Adjuvant, Gums and Thickeners, Vitamins, Anticaking Agent, Processing Aids, Acidulant(s), Food, Antifoaming Agents, Emulsifying Agent, Antimicrobial Agents, Starter Cultures, Humectants, pH, Sequestrant, Non-flavoring Ingredient Declaration, and Chart 247 – Non Flavoring Ingredients.

Non-Flavoring Ingredient Declaration – If the flavor label cites the GRAS statement 'All ingredients found in this product are approved for use by the Food and Drug Administration, or a Food and Drug Administration recognized industry list,' then the rest of the non-flavoring ingredients would be split out in order of predominance. See Non-Flavoring Ingredients.

Non-GMO Project – From the website 'The Non-GMO Project, a non-profit 501(c)3 organization, offers North America's only third party verification and labeling for non-GMO (genetically modified organism) food and products.' See GMO, GE, Synthetic Biology.

Noni or Morinda citrifolia – A fruit indigenous to Hawaii. The fruit is thought to have some anticarcinogenic properties. See Appendix 2. Note: In Appendix 2, unfit for consumption is good, because prepaid alcohol tax can be partially refunded. In the final food product, the effective flavor usage level is much lower, and the flavor would come through properly. See Regulations, Drawback, Proof Gallon, BATF, Potability, BATF Restrictions on Use.

Non-Ionic – See Non-Polar, Oil Soluble, Lipophilic, Hydrophobic.

Non-Newtonian Flow – The movement of a substance, which flows in a jagged, short manner or which possess a snotty, gummy texture instead of an even flow. See Newtonian Flow.

Non-Nutritive Sweeteners – Substances derived synthetically or naturally that impart a real or perceived sweetness but contribute little in terms of nutrition

because of its non-caloric attribute or its enhanced sweetness strength and low usage. Artificial sweeteners are the sub-category that are those non-nutritive sweeteners derived via synthetic means. Other non-nutritive sweeteners that have come to light recently are naturally derived or extracted. Aspartame, or Nutra-Sweet™, a condensation of aspartic acid and phenyl alanine is about 200 times the strength of sugar, but degrades in both low pH and when exposed to prolonged heat. Some of the breakdown products of Aspartame include formaldehyde. Therefore, Aspartame is not approved in heated or baked products. Cyclamate, banned in the late 1960s because it was linked to cancer, is still in use in other parts of the world such as Europe. Saccharin (500 to 600 times as sweet as sugar) had been associated with bladder cancer in laboratory animals, but seems to be a negligible contributor in humans. Some believe the cyclamate results were in error because typical diet drink formulas were used as a test model. At the time used both cyclamates and saccharin were used in a typical diet beverage preparation, and saccharin has been shown to provide positive results for cancer in laboratory animals. It is thought, then, that the perhaps erroneous conclusion for cyclamate was really based on the effects of the saccharin present. The salts of saccharin (sodium, calcium, ammonium) are often used for solubility reasons. Saccharin, cyclamate, and Aspartame are virtually calorie free. Sorbitol and its relative, mannitol, are open and non-cyclized sugars. These are metabolized purely in the intestine and are therefore low in usable calories. However, it is this characteristic that makes sorbitol and mannitol unattractive as non-nutritive sweeteners. They both cause diarrhea because they tend not to be absorbed into the walls of the intestines, but pull fluids into the bowel channel instead. Other polyols that have been seen to be useful alternatives to mannitol and sorbitol are maltitol and xylitol. Many derivatives of Stevia have been recently GRASed, but care must be taken that these be used as FMP's and not at levels for their sweetening effect. Other recently GRASed sweetener types that must be used only as FMPs are; naringin dihydrochalcone, (FEMA 4495), Luo Han Fruit Concentrate (FEMA 4711) and Amacha Leaves Extract (FEMA 4755). See DE, FMPs, Enhancers, Modifyers.

Non-Polar – Oil soluble or oleophilic. Non-polar molecules are ones that have no dipole moment, no delocalization of electrons, no ionic character, and no structural characteristic that could morph to a shifting of electrons and achieve a polarity. Benzene is one such non-polar molecule because it exists in a symmetrical configuration, with both sides of the planar molecule equal in charge. The delocalized electron cloud assures that the charge is spread evenly throughout the molecule. This configuration is very stable and not prone to contortion. Non-polar substances are affected by the variation of fat in a food system because of their limited solubility in the saliva. See Polarity.

Non-Potable – Unable to be consumed. This terminology usually refers to alcoholic beverages, and hence the ability of the alcohol purchaser to get a partial refund on the prepaid alcohol tax. The BATF developed a list of ingredients that would make alcohol non-potable. It has now been incorporated into the Formulas Online System, a computer based registration system available through the Internet. See Formulas Online, TTB.

Non-Volatiles – Substances with little or no appreciable vapor pressure and/or odor at room temperature, potentially a tastant. See Tastant; Acidulant(s); Sugar(s) and Polyhydroxyl Compounds; Powders.

Nonyl Esters – See Chart 146 – Alkyl Esters Grouped by Alcohol Moiety.

Nootkatone – A sesquiterpene that characterizes grapefruit. As the story goes, the compound was discovered when a major peak way out on a GC chart was inadvertently noticed after a run was made on grapefruit oil and the chemist went out to lunch. Oxidizing valencene can make Nootkatone.

NOP – Natural Organic Products – The designation by the USDA for items regulated under the Organic labeling regulations. See Organic, USDA.

Nopal – Nopal Cactus or Nopal Verde (opuntia-indica). Nopales – Leaves of the prickly pear cactus. Found in Mexican cuisine. See Culinary Arts and Appendix 2.

Nori or Porphyra yezoensis – The Japanese name for red algae seaweed species porphyra (P. yezoensis and P. tenera). These seaweeds are formed into flat, paper thin sections, which are mostly used to wrap sushi. See Sushi, Seaweed, and Appendix 2.

Normal Chain Molecule (Straight Chain Molecule) – Designated as example in n-butyl. See Isomer, Iso.

North American Free Trade Agreement (NAFTA) – The agreement between Canada, the United States, and Mexico to open trade borders and cooperate with each other economically. Flavors sold into Canada or Mexico must follow a set of rules for declaration of place of origin.

North America Industry Standard Classification System (NAISC) – The organization that assigns and defined standard industrial classification codes. (SIC Code 2087 was the most common for flavors.) Soon the flavor industry will be assigned one of two numbers either NAICS 31193 (Flavoring Syrup Concentrate Manufacturing) or NAICS 311942 (Spice and Extract Manufacturing).

Norway Pine – See Pine.

Nose –

1. The organ that detects odors. It is not necessary to smell all the food we eat. While we eat, volatiles from the food evaporate up the nasal cavity to stimulate nerve endings in the olfactory bulb area. This procedure is called retronasal stimulation. The reason why it is claimed is that if we hold our nose while chewing on an apple, onion, and potato we cannot smell the volatiles retronasally and therefore we cannot determine the differences between these products purely by using cues obtained by the taste and texture of these products.
2. The top note of a flavor system like the nose of a good wine. See Retronasal, Olfactory Bulb Area, Smell, Olfaction, Volatiles, Aroma(s), Nasal Cavity.

Nuance – A casual flavor attribute, a slight character change from the main note or aroma profile.

Nucleic Acid – Two types of nucleic acids are of specific importance. Deoxyribonucleic acid and ribonucleic acid are fundamental to the propagation of all life and for the reproduction of the plan for a specific organism, its genetic code. There are only four bases or types of nucleic acids found in life on this planet: adenine, guanine, thiamine, and cytosine. In genetic shorthand, they are abbreviated A, C, T, and G. These provide the paired steps on the helical ladder of DNA, for example. It is the sequence of these four bases that makes up the genetic code. Currently there is a project to map the genetic code of the human body. This is called the 'Genome Project.' On July 27, 2004, the announcement was made that the entire human genone was decoded. See DNA, Genetically Engineered Foods and Flavors, and Chart 248 – Nucleic Acids and Related Compounds.

Nucleotide – A nucleotide is a single unit the combination of which makes up a nucleic acid like DNA or RNA. Chemically the structures of nucleotides comprise of a pentose – a five membered sugar, a nitrogen moiety and a phosphate group. Two nucleotides that have been identified as contributing a umami effect are disodium 5′ inosinate and disodium 5′ guanylate. See Umami Effect, I+G™ (Disodium 5′ Guanylate and Disodium 5′ Inosinate), Enhancers, Nucleic Acid.

Nucleus –

1. The 'brain' of the cell. Where the genetic code of the cell resides. This genetic code lies in the configuration of the DNA molecule that further makes up the chromosomal structure of the genes. A specific gene structure or piece, which carries the code for a function structure or trait, is called a genome.
2. The center of an atom containing protons, neutrons, and many subatomic particles.

Null Hypothesis – In sensory evaluation, the null hypothesis states that there is no correlation between two factors. In establishing a trend or relationship it is necessary to disprove the null hypothesis. See Sensory Evaluation.

Numb Tongues – Another terminology for low tasters. See Low Taster, Supertasters, Medium Tasters, Taste Buds, Tongue, PROP.

Nuoc-Mam – Fermented fish sauce from Vietnam and surrounding countries.

Nut(s) – Nuts make up a category of food products that are widely used and are favored among many chefs. They are used in all sorts of applications including snacks, cookies, confections, cordials, beverages, and other foods. Unfortunately, some of the most dramatic food allergies of any category of food exist amongst the nuts and legumes, especially with Brazil nuts, cashews, and peanuts. The body is allergic to the proteins. So potent are these allergies to the proteins contained in these foods, that the bodily response can often be fatal. Even the smallest amount of allergens can trigger an adverse reaction. In this sense, a de minimus amount for the three most potent allergens – tree nuts, crustacean shellfish and peanuts – has not been found. The fatal allergic response is called an anaphylactic shock and represents a severe collapse of the body's defense mechanisms. The body is allergic to proteins. Proteins are typically polar and are therefore ionic in nature, having a limited solubility in oils. However, some people are so sensitive to the allergen protein of peanuts, that they often display potentially fatal responses to the minute amounts of peanut allergen protein in peanut oil. There are also appearances of severe irritation responses as well, but these are not allergic reactions. An epi-pen, containing an injection of epinephrine, should be carried by anyone prone to anaphylactic reactions. Recently, the FDA included coconut, gingko nut, pine nut, sheanut, and several other nuts (19 in total) in the list of nut allergens. See Nuts and Seed Oils, Nut Flavors, Anaphylaxis, De Minimus, Allergens.

Nut Flavors – Nut flavors are usually a combination of a fatty profile and a brown, often astringent character contributed by pyrazines and polyphenols. Tannins and tannic acid can play a part as well as dienals, trans mono aldehydes, sulfur compounds, and solid extracts. According to the patent literature, pyrazines like methyl methoxy types make useful nut flavors, and are used in enhancing coffee flavor as well (Fenaroli). See Solid Extracts, Brown (Compounds).

Nut and Seed Oils – In the U.S., the two oils which by volume make up approximately 50% of the total oil consumption are soybean oil and palm oil, followed by rapeseed (approximately 15%), then sunflower oil (approximately 12%), then cottonseed. The following are descriptions of all the oils available worldwide. We will include peanut and soy, even though they are both legumes.

- Almond Oil (Persic Oil) – Pale oil made from sweet almonds, used in baking confectionery and coatings.
- Avocado Oil – Made from the pits of avocadoes. The oil has a faint anise flavor.
- Clarified Butter Oil – Clarified butter is used in culinary techniques and owes a higher stability to the removal of proteins that could brown and produce unwanted flavors.
- Coconut Oil – Obtained from dried coconut meat, it is high in saturated fats. It has a very sharp melting point, and is useful as a processing aid in this regard. Bad press about saturated tropical oils has lessened the use of coconut oil considerably.
- Corn Oil – One of the more economical, healthy oils with a high smoke point making it a versatile oil.
- Cottonseed Oil – Used in margarine and blended oils derived from the cotton plant.
- Grapeseed Oil – Very high in polyunsaturated fats, with a high smoke point, it is extracted from the seeds of grapes. It will not cloud when refrigerated making is therefore useful for mayonnaise applications.
- Hazelnut Oil – A highly flavored oil made from hazelnuts. It is used in high-quality salad dressings and vinegars, although its cost is prohibitive for general use.
- Palm Oil (Palm Nut Oil or Dende Oil) – High in color with a pleasant, nutty flavor, it is a useful oil, although it has a low stability and turns rancid quickly.
- Peanut Oil – Moderately high in unsaturated fats and low in saturated fats, peanut oil has a very mild peanut flavor. The oil is useful in salad dressings. It has shown to be a carrier of enough allergen to elicit a severe response in some people, but this seems to be isolated to the expressed oil, rather than the refined or purified form. Therefore, its use will probably lessen over the years, especially with such a wide variety of other oils from which to choose.
- Pine Seed Oil – It is produced almost exclusively in France. Having a fine flavor similar to pine seeds, the oil is quite flavorful.
- Pumpkin Seed Oil – It is dark brown oil produced from pumpkin seeds. Its use is localized predominantly in Austria.
- Rapeseed Oil (low erucic acid version) (canola oil) – Widely used in many applications due to its high smoke point, mild flavor, and minimal saturated fat content. Canola is a low erucic acid version of rapeseed oil (<1%) originally developed in Canada. The name is derived from Canada oil. Some claim the oil has hazardous effects on humans while others claim it is not only safe but healthy due to its omega fatty acid profile. Erucic acid is also found in broccoli but to a much lesser extent. Recent studies have shown that continued ingestion of canola might not be healthy for the cardiovascular system, having caused lesions of the heart and vitamin E deficiency in rats. Further studies will provide answers. Erucic acid is the fatty acid needed by the boy in the movie 'Lorenzo's Oil.' See BSE.
- Safflower Oil – Bright yellow with a strong flavor, it is the highest in unsaturated fats, the lowest in saturated fats, and a good source of Vitamin E.
- Sesame Oil – A nutty tasting oil with a high smoke point. Roasted oil versions have a more pronounced flavor and are often used as a base for oriental and other ethnic recipes.
- Soy Oil – A mild flavored oil of high quality that contains a sufficiently low amount of saturated fats to make it useful as a general purpose blending oil.
- Sunflower Oil – A milder flavored oil whose inexpensive cost, flavor, unsaturated fat content, and pale color make it a good all-purpose oil.
- Vegetable Oil – Vegetable oil is classified as a blend of any two of the approved oils.
- Walnut Oil – Made from walnuts. Availability is centered in France. The production is small, and therefore, the cost is high. Unfortunately, the stability is relatively poor, making shipment and distribution a problem. It has a wonderful nutty flavor. The oil blends well with most salads, baked goods, and other foods. See Legumes, Anaphylaxis, Food Allergy, Food Intolerance, Food Poisoning, Nuts and Seeds.

Nutmeg (Myristica fragrans Houtt.) – Nutmeg oil contains terpenes (alpha and beta pinene), alcohols (linalool, geraniol, terpineol), safrole, and eugenyl compounds. As the limonene in the oil is laevo versus dextro, the oil is often extended with lemon terpenes. The odor is somewhat similar to sweet marjoram oil. East Indian nutmeg oil is preferred somewhat because of its higher quality and strength versus West Indian nutmeg oil. Of all of the spice

oils, it has one of the subtler flavors and has a higher threshold value. The active constituent of nutmeg is myristicin that is a close chemical cousin to safrole and is also considered to be toxic at higher levels of intake. Myristicin makes up approximately 0.5–2.0% of the oil. Safrole is present at a range of about 0.2–1.0%. See Mace, Chart 230 – Mace, and Appendix 2.

Nutraceuticals – A term that was coined by Dr. Stephen DeFelice to mean products that are a combination of foods and drugs. Nutraceuticals are items that introduce a benefit from a nutritional/pharmacological standpoint as well as a food standpoint. Medically beneficial foods do not need a prescription and are usually supported by a history of use as a food staple somewhere in the world. However, disclaimers must appear on the packaging as in dietary supplements so that any implied or stated benefit is truthful and not misleading. This decision was first published in the Dietary Supplement Health and Education Act of 1994 (DSHEA). In the DSHEA, the definition of a nutraceutical is 'a dietary supplement, food, or medicinal food as respectively defined in paragraphs (f) and (ff) and section 5(b) (3) of the Orphan Drug Act. 21 U.S.C. 360 (b) (3).' Some nutraceutical type products could include the following:

- Ginseng root extract (Panax ginseng) – Active chemicals are called ginsenosides. Claims are that it helps the body cope with stress, although historically, it has been considered an aphrodisiac. See Ginseng – Siberian.
- Guarana (Paulina cupana) – From the seed of the climbing bush, it is considered a stimulant. Contains guaranine (some claim it is identical to caffeine), theobromine (as in cocoa), tannins, and theophylline. Also considered an aphrodisiac, stimulant, appetite suppressant, and gastrointestinal tract-healing agent.
- Yohimbe (Pausinystalia yohimba) – Derived from an evergreen grown in western Africa. A central nervous system stimulant and overall healthfulness enhancer, with suspected aphrodisiac claims as well.
- Soybean isolates – Contains isoflavones that could be an alternative to estrogen replacement therapy. Also have antioxidants that could retard aging and many other positive chemical compounds (saponins, phytosterols, phenolic acids, and lecithins).
- European Pine Tree Extract (Pinus maritimus) – Contains pycnogenol, an antioxidant that protects against free radical damage to the body, and improved immune function and cognitive skills.
- Tomato and Watermelon – Recent indications lead to the chemical lycopene and its ability to ward off prostrate problems in men.
- Marigold – Reduction of carotenoid-based pigments, especially lutein, has been related to the degeneration of muscular strength upon aging. Taking this component might help in this regard.
- Grapes, Wine – It has been long thought that something in wine has a tendency to ward off heart disease. Recently, anthocyanin-based oxidants have been pinpointed as causative agents.
- Ginkgo Biloba – One of the most researched herbs in the world. The herb is thought to increase blood supply, serve as an antioxidant, and has therefore been touted to prolong life. The nut is thought to lessen the symptoms of allergy and asthma.
- Echinacea (purple coneflower) – The herb is said to promote health by increasing the immune system. Others are Kava and St. John's wort.

See DSHEA (Dietary Supplement Health and Education Act of 1994) and Appendix 2, Nutraceuticals Overview.

Nutrient – A substance that provides nourishment. Nutrients include vitamins, minerals, carbohydrates, proteins, and fats.

Nutrient Agar – See Agar (Agar Agar).

Nutrient Claims – Chart 249 – Nutrient Claims is excerpted from CFR Title 27 Paragraph.

Nutrient Terms Summary – The information is based on serving sizes. Serving sizes are based on RACC (Reference Amounts Customarily Consumed). See Chart 459 – Nutrient Content.

Nutrition – The study and science of how the body absorbs nutrients and undertakes healthy metabolism. Proteins are needed for the growth and reparation of cells and organs, and carbohydrates are needed for energy. Fats provide both energy and a substrate for fat-soluble vitamins. Fiber provides a vehicle for healthy fermentation and digestion of nutrients in the intestines. Water is maintained as the basis of all life. Our bodies are approximately 60% water. Vitamins are chemical regulators for bodily functions. Minerals provide elements crucial for the development of other necessary functions and chemicals. See Nutritional Pyramid.

Nutritional Additives – As specified by the Code of Federal Regulations, nutritional additives are shown in Chart 250 – Nutritional Additives.

Nutritional Analysis – The breakdown of nutritionally important ingredients reported for compliance with the NLEA. Chart 459 – Nutrient Content lists the main nutrients and NLEA-related compounds and their RDI. The nutritional analysis is usually expressed as a percentage of RDI per serving. See Chart 251 – Nutritional Requirements Minimum Daily Requirements.

Nutritional Labeling and Education Act (NLEA) – The federal law that mandates nutritional labeling

information on the packages of all foods sold in the United States and standardizes the format for the declaration and minimum nutritional requirements. The Nutritional Labeling and Education Act states that product information and the total nutritional breakdown of RDA ingredients are to be labeled on the side of food packages. Furthermore, the regulation states that the format will be of a specified type and that the ingredients, serving size, and other pertinent information will be clearly designated. Passed in 1990, and coupled with the Food Guide Pyramid as published by the U.S. Department of Agriculture, it has increased the public's awareness of nutrition. As of the writing of this book, the FDA is considering changes of this ruling including the following proposed labeling changes:

1. Address 'added sugars' in a food product to help consumers know how much sugar has been added to the product.
2. More clearly reflect amounts people currently eat that could be consumed in one sitting.
3. Include 'per serving' and 'per package' calorie and nutrition information.
4. Address declaration of potassium and vitamin D. Vitamins A and C would no longer be required on the label, though manufacturers could declare them voluntarily.
5. Revise the Daily Values for nutrients such as sodium, dietary fiber and Vitamin D.
6. On labeling of fats, requiring 'Total Fat,' 'Saturated Fat,' and '*Trans* Fat' on the label, yet removing 'Calories from Fat'.
7. Refresh labeling format to emphasize certain elements.

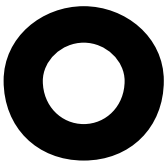
The changes FDA proposes would affect all packaged foods except certain meat, poultry and processed egg products, which are regulated by the U.S. Department of Agriculture's Food Safety and Inspection Service. See Nutrition, Food and Drug Administration, Regulations, Serving Size.

Nutritional Pyramid – A graphic description of the groups of foods versus the desired amounts to be consumed. Fruits, grains, and pastas are on the larger bottom of the pyramid representing the desire to consume more of them in our diet. Salt, pure sugars, and fats are placed toward the smaller top of the pyramid representing the need to reduce those items in our diets. See Nutrition, Vitamins, Deficiency Diseases, Regulations, Labeling.

Nuts and Seeds – The term nut is used to describe a fruit that has hard outer coating around a kernel. Seeds are contained in the fruit of a plant that is capable of propagating the species. The most important of commercially grown nuts and seeds are the coconut, almond, walnut, hazelnut, cashew, and pistachio. The peanut is not a nut, but a legume. Nuts are usually high in fats, called fixed oils. Most nut oils have a sufficient amount of unsaturated fats to be healthy, however, coconut oil classified as a tropical oil, contains mainly saturated fats. Nuts can have a fiber content; however, seeds are usually quite high in soluble fiber. Some other nuts and seeds are pecan, cola nut, macadamia nut, Brazil nut, pine nut, ginkgo nut, chestnut, beechnut, sunflower seeds, pumpkin seeds, poppy seeds, and other spice seeds like caraway, cardamom, peppercorns, coriander seeds, tarragon seeds, dill seeds, and celery seeds. See Botanicals, Nut and Seed Oils.

Nutty –

1. Characteristic of the dry, brown, fatty, and pyrazine-rich flavor of nuts.
2. A crisp, almost salty taste, found in some of the white wines and sherry.



Oak (Quercus robur L.) – Bitter woody character used in WONF and for use in alcoholic beverages. It is the quercitins that are the main tastants in oak extract. One of the more popularly used solid extracts is oak extract. See Bitter, Solid Extracts

Oak Barrel Aging – There has been much study on the difference in flavor profiles for wine as an example aged or not aged in oak barrels. One study cites the 10-fold increase in flavor volatiles by aging in an oak barrel. It is obvious that a charred oak can contribute phenols and other smoke substances into the liquid being aged, but vanillin coming from the lignin in the wood, tannins, and other macromolecules as well as the subsequent interactions and catalysis that goes into the aging process makes for a wonderful end result. See Alcohols – Aromatic, Phenols, Smoke, Oak.

Oak Moss (Evernia prunastri [L.] Ach., E. furfuracea [L.] Mann and Other Lichens) – Oak moss is lichen, which produces a fine warm/green and rich-flavored extract. The absolute is even better in quality with subtle phenolic notes. The botanical should not be confused with tree moss (Evernia furfuracea or Usnea barbata) also called fir moss, both of which are not food approved. The rich background profile can be used in many formulations where a deep, almost vegetable-like green/mossy character is appreciated. See Herbaceous, Green, and Chart 270 – Oak Moss.

Oak, White Chips – Oak Bark (Quercus alba L.) – Oak chips are used to replace the flavoring effects of the aging process when items are stored in wooden containers. See Woody, Chart 269 – Oak Quercus Alba and Robur, and Appendix 2.

Oat (Avena sativa) – Oats are commercially prepared by a number of different methods, including cutting them (with steel blades), boiling and rolling them, employing a process of quick cooking, or instantizing them (partially cooked and rolled). Seasoned, flavored oats are called oatmeal. Oat bran is the outer layer of the oat grain. Recent press indicated that the ingestion of oat bran and other fibers reduced serum cholesterol. Other studies showed questionable results. To date, the verdict is still out in this regard. See Grains.

Oat Bran – The hard outer layer of the oat grain. This structure contains the cellulosic materials. Brans have prebiotic benefits to the diet. Due to recent promising studies, the Food and Drug Administration has allowed the following statement to food manufacturers to be added to their packaging for products using oat bran: 'Oat bran, alone or as a part of oatmeal, has been shown to reduce the risk of coronary heart disease when part of an overall diet that is low in saturated fat and cholesterol.' See Prebiotic, Probiotic, and Appendix 2.

Objective Analysis – The testing procedure that attempts to eliminate emotion and feeling, and analyze facts and quantitative comparisons among subjects. A paired comparison of thickness and mouthfeel is an example. The opposite would be subjective interpretation, wherein the likes and dislikes toward a subject are crucial. An attribute test is one that would be exemplary of this type of test. See Comparative Tests, Double Blind Study.

Oblique Cut – See Knife Cuts.

Occupational Safety and Hazard Admi-nistration (OSHA) – The governmental agency that regulates safety in the workplace. See DOT (Department of Transportation), MSDS (Material Safety Data Sheet), Hazard Communications, Hazardous Materials, Flammable, Flashpoint, Corrosive.

Dictionary of Flavors, Third Edition. Dolf De Rovira, Sr.

Octyl Esters – See Chart 146 – Alkyl Esters Grouped by Alcohol Moiety.

Odor – A singular or complex stimulation of the olfactory senses. An odor is comprised of volatile chemicals that by nature are odoriferous, and can therefore be perceived by the olfactory system. Flavor is made up of odor and taste. See Olfaction, Volatility, Olfactory Epithelium, Aroma.

Odorant – A chemical that causes an odor to be perceived in the human olfactory system. See Odorivector, Odoriphore, Osmophore.

Odoriferous – Odiferous means having a significant odor.

Odoriphore – A particular molecular structure that produces an odor. Most all of the phenyl ethyl structures will be perceived as a honey-like character in some way; therefore, the phenyl ethyl structure is a honey-type odoriphore.

Odorivector – The volatile odors that eventually stimulate nerve endings in the olfactory nerve (bulb) area. See Volatiles, Odor, Nasal Cavity, Aroma(s), Olfactory Bulb Area, Odorant, Odoriphore, Osmophore.

Odor Masking Flavors – Flavors that cover up off odors/flavors of a base or those developed through processing or by other means. Odor-masking flavors are usually employed in the pharmaceutical or nutraceuticals industries, and in animal feeds or pet foods. See Masking.

Odour – The spelling used by Great Britain and countries in the European Community (EC), or those countries that deal more with non-U.S. regulations or flavor systems, and more with those of the U.K.

Oenanthic Ether – Also called ethyl oenanthate. See Chart 146 – Alkyl Esters Grouped by Alcohol Moiety.

Offal – The by-product meat derivatives of meat slaughter that can be further processed (hydrolyzed) through the use of enzymes to make meat digest.

Off Odor – Any aroma profile or nuance that appears incongruous or objectionable in an odor profile. Often this can be a matter of taste.

Oils – Those substances that are not water soluble. See Essential Oil, Fats and Oils, Fat, Vegetable Oils.

Oil Content – 1. The amount of fat in a food; 2. The percentage of flavoring 'oils' in a spray dried product. See Fats and Oils, Spray Drying.

Oil Orange SS – THIS IS NOT FOOD GRADE. I mention this item in this dictionary because when searching through toxicology references, Prop 65 data and other sources, oil of orange ss sounds so close to orange oil that it can be mistaken for it. It is an azo based compound and is suspected to be carcinogenic. It has no place in food flavorings whatsoever. See Safety, FDA, Chemical Nomenclature. Chemical Structure, Nitrogen.

Oil versus Water Solubility – Different food and beverage systems require different solvent systems. Oil soluble types include: Chocolate and compound coating, margarines and other fats and oils and hard candy for example. See Water Solubility.

Oja Santa – A herb used in many Mexican dishes including those cooked in Oaca, also called the root beer plant. It is used as a wrap, in tamales, and is used in the recipe called Anchote Chicken (Anchote Yucateco [spiced anchote seed paste]).

Okra (Hibiscus esculentus and Abelmoschus ecsulentus) – Flavor similar to the eggplant, with a subtle green and creamy vegetable nuance and slightly bitter background. See Eggplant, Green, Creamy.

Oleocanthol – The bitter principle in Olive Oil. Olive Oil is the crucial part of the Mediterranean Diet that shows improved heart disease rates over U.S. diets. See Mediterranean Diet.

Oleophilic – See Lipophilic.

Oleophobic – See Lipophobic.

Oleoresin – Modern usage for the term is the oil-soluble extractant produced when certain solvents are used on botanicals. These solvents might include hexane, petroleum ethers, and other solvents that would solubilize the oil extractable substances. This differs from a solid extract in the sense that in that case, solvents are chosen (ethyl alcohol, isopropyl alcohol, etc.). Solid extracts are solubilizations of the water-extractable substances. Older terminology would classify oleoresins as purely oil-soluble plant exudates, and the term resinoid is the modern usage of oleoresin. Some of the more popular and commonly used oleoresins in the industry include those listed on Chart 252 – Oleoresins. See Tincture, Extraction.

Olfaction – The act of smell. The sensation of odors through the olfactory nerve area (olfactory bulb) via the olfactory nerve to the brain. See Odor, Nasal Cavity, Volatiles, Nose, Anosmia, Odorivector, Stem Cells.

Olfactory Bulb Area – See Olfactory Nerve Area.

Olfactory Epithelium – The Olfactory epithelium is made up of four types: 1. Olfactory cells; 2. Supporting cells; 3. Basal cells; and 4. Brush Cells. See Taste.

Olfactory Nerve Area – Also known as olfactory bulb. The area at the top of the nasal cavity where the olfactory nerves are exposed, providing sites at which stimulation from odorants can occur. See Odor, Olfaction, Odorant, Odorivector, Anosmia, Nose, Nasal Cavity.

Olibanum (Frankincense) (Boswellia carterii Birdw. and Other Boswellia Species) – A natural oleo-gum resin, like myrrh, with a woody, balsamic, oily, green character that can be used in green apple, lemon,

and banana flavors, etc. It is used as incense in Catholic churches. See Myrrh, Resinous, Balsamic, Chart 271 – Olibanum, and Appendix 2.

Olive (Olea europea) – Untreated, the vegetable is quite bitter, containing a pungent glycoside that does harm to the digestive tract. Green olives are harvested when they are unripened. Here they are characteristically 'olive green' in color. After ripening, olives turn dark brown to black. The Greek process, used for the ripe olives uses brine soaking only, as no caustic is allowed in the process in Greece. The Spanish method takes the olives while still green, soaks them first in caustic, then in brine, allowing for a fermentation of the sugars. The American process is the same as the Spanish process, but no fermentation step is employed. The internal pit is either removed or left inside the fruit, or replaced with a garnish such as a bell pepper slice. The black olive derives a fermented, somewhat mushroomy character, owing to trace quantities of branch chained and unsaturated alcohols, and lactones. A dish called tapenade is made from olive, anchovies, capers, and garlic blended into a paste. See Olive Oil; Green; Vegetable, Vegetative.

1. Olive Oil – Olive oil is the by-product of olive production. Olive oils are rated according to level of acid present. (Oleic acid is the most commonly found acid in virgin olive oil.) The higher the acid levels the better the flavor. Extra virgin olive oil contains only 1% maximum acidity. Fine virgin olive oil has an acid maximum of 1.5%. Virgin olive oil has a maximum of 3% acidity. Pure olive oil has a maximum of 3% but is also a mixture of other grades of oil. Olive oil comes mostly from Italy, Spain, Greece, and France. The flavor of olive oil is due to many complex unsaturated alcohols, aldehydes, and ketones as well as sulfur components and other trace aromatics.
2. Olive Leaf – Olive leaves are used in certain cultures as cooking wraps. Examples are common in Greek cooking. See Appendix 2.

Omega (Greek, Ω, ω) –

1. As in end, the last letter of the Greek alphabet. In lactones, it signifies that the lactone ring is the entire molecule, or in other words, that the lactone connection is at the terminal carbon. See Lactone, Musk, and Chart 197 – Musks.
2. In chemical IUPAC terminology, a fatty acid begins from the COOH moiety. In nutrition, they count from the terminus or omega end. An omega 3 fatty acid is then a double bond three away from the end.

Omega 3 Fatty Acids – Unsaturated fatty acids that contain a double bond at the omega or end 3 carbon. The most important to human health, specifically heart health, are alpha linolenic acid (ALA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA). These are considered essential fatty acids because the body needs them, but cannot synthesize them directly but must obtain them from foods. See Fatty Acids, Nutrition, Oxidation, Antioxidants, Double Bond, and Appendix 2.

Oncology – The study of cancer, its cause and effects. See Carcinogen, Expert (Select) Panel, Toxicology.

Onion (Allium cepa L.) – Onion comes in many varieties: Spanish onion, red onion, white onion, and green onion. Its aroma comes from a mixture of isothiocyanates, monosulfides, disulfides, and trisulfides. Its yield is lower than garlic oil and is usually more expensive. Its obvious use is in savory flavors, but it is used as a sulfur contributor to other products. These include fruits, vegetables, and dairy products that when used, low levels provide unique notes for natural WONFs. See Sulfur, Garlic, Leek, Chart 272 – Onion, and Appendix 2.

Onion Brûlé (Onion Brule) – A caramelized onion half used to colorize culinary preparations. See Culinary Arts.

Onion Clouté – See Onion Piqué.

Onion Piqué – Studded Onion – A half an onion with basil and clove buds used in the preparation of a béchamel sauce. See Béchamel, Culinary Arts.

Oniony – Oniony means simply that which resembles onion in flavor profile. See Onion.

On the Nose – A tea terminology that indicates an aroma.

Opacity, Opaque – The physical state that does not allow any light to pass through. See Translucency; Transparent, Transparency.

Opopanax (Bisabol Myrrh, Sweet Myrrh) (Opopanax chironium Koch [True Opopanax] or Commiphora erythraea Eng. var. glabrescens) – Originally produced from the plant Balsamodendron kafal, now from the trees Commiphoria or Opopanax, it is a natural gum oleoresin like Myrrh and Olibanum. It is slightly reminiscent of celery or lovage and can be used in soups, maple flavors, nut flavors, etc. It has an undertone resembling a musky animal character and makes it an interesting component in meaty, savory products. The gum resin, when used in perfumery, can be diluted by perfume-grade solvents like diethyl phthalate. (See Myrrh and Olibanum). Therefore, the nature of any solvent used and the reporting of any residual levels of non-food grade substances are important information. Using the distilled essential oils often resolves the issue. See Myrrh and Chart 273 – Opopanax.

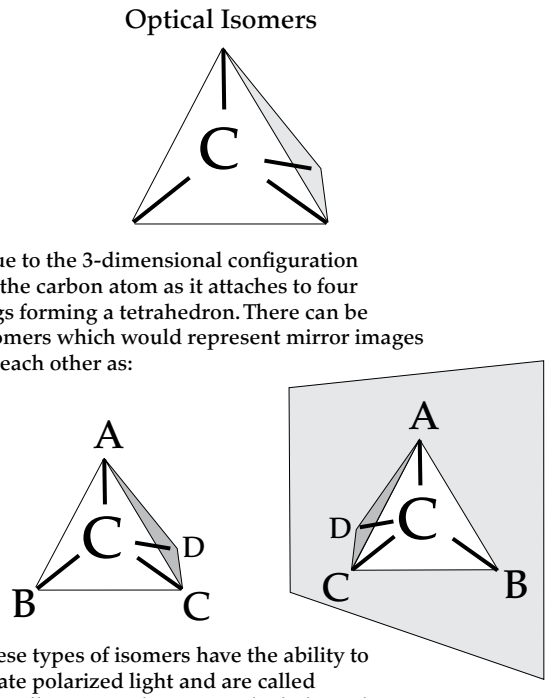
Optical Activity – When an asymmetric carbon is present, optical activity is the ability to rotate polarized light.

Optical Isomers – Chemical structures that differ in their ability to rotate polarized light. Polarized light passing through an optically active compound can rotate in a clockwise direction or in a counter-clockwise direction. These compounds are called dextrorotatory (counterclockwise) or laevo-rotatory (counterclockwise). Optical isomerization can occur when there is an asymmetric tetrahedral carbon. See Isomer, Racemic, Enantiomer, and Figure 25.

Optical Rotation – The act of rotating polarized light. See Optical Isomers.

ORAC – See Oxygen Radical Absorption Capacity.

Orange, Sweet (Citrus sinensis L. Osbeck and C. aurantium var. dulcis L.) – The orange is a very old fruit going back over 4,000 years. The bitter orange, citrus aurantium, or Seville orange is the ancestor of today's sweet orange. The sweet orange citrus sinensis, is juicy, sweet, and has a good acid level. The Valencia orange now is about 50% of the U.S. crop. The juice is considered the highest quality. The navel orange has a protrusion on one end and is much easier to peel than other types. Also, it has a juicy pulp and is almost always seedless. Orange oil is one of the most popular if not the most prevalent of flavor essential oils and is used as both a solvent source and base for many fruit-based flavors. Orange terpenes distilled from the oil are used for both the solvents of weighting agents and the cloud source for the disperse phase for clouding agents. Orange essence oil is that which is obtained as a by-product from the orange juice industry. When the peel is squeezed, the sacs in the flavedo in the peel are ruptured and the oil results. As it is lighter than water, the oil comes to the top and is easily collected. The fact that this oil is so prevalent, that it is a by-product, and that it contains important juicy notes that can be added back to orange juice, this oil has become very important as a starting material for many natural chemicals. It must be noted here that because natural chemicals and fractions that are made from these oils come from orange juice, their return to juice does not affect the labeling of the juice in any way. These finite fractions contain chemicals like ethyl butyrate, acetaldehyde, hexyl aldehyde, octanol, and others. These fractions can be used as sources of natural chemicals. These natural materials can also be used in WONFs. The citrus fruit the color of which bears its name. Orange oil is derived by expression of the peel of the orange or recovery from orange juice processing. The latter is called orange (essence) recovery oil. Orange oil is primarily made up of dextro limonene with the characterizing aldehydes being octanal, nonanal, decanal, and dodecanal. See Optical Rotation, Peel, Characterizing, Dextrorotatory, Laevorotatory, Lemon, Chart 275 – Orange Sweet, and Appendix 2.



Due to the 3-dimensional configuration of the carbon atom as it attaches to four legs forming a tetrahedron. There can be isomers which would represent mirror images of each other as:

These types of isomers have the ability to rotate polarized light and are called optically active. They rotate the light to the same degree one way right (dextrorotatory) and the other one left (laevorotatory). If one isomer predominates it will have an optical rotation in that direction. If both are equal the optical properties will be nullified. it will not rotate the light in either direction. This is called a racemic mixture.

Figure 25

Orange Flower, Bitter (Citrus aurantium L. subspecies Amara L.) – One test of pure recently distilled oil is to add it to ethyl alcohol, where it takes on a blue fluorescence. In older oils, this test is not as reliable (probably due to an anthranilate degradation reaction possibly with an aldehyde). The presence of anthranilates and other sweet compounds makes it a very effective product for use in natural fruit WONFs, although considerations of cost make it necessary to use smaller amounts of this somewhat powerful material. During the steam distillation of the product, the water removed has some of the aroma carried over. This is called orange flower water and can be further refined or used as such. Bitter orange oil is used in Triple Sec™ or Orange Sec™ products. See Schiff Base, Neroli Bigarade, and Chart 274 – Orange Flower.

Orange Oil – The oil derived from the orange fruit. This oil is derived usually by expression, either directly by squeezing the peel or by recovery from the orange juice processing industry. The latter is also known as orange essence recovery oil. See Citrus Oils, Lemon Oil, Lime Oil, Tangerine Oil, Mandarin Oil, Grapefruit Oil.

Order of Presentation Error – The following types of errors can occur during an evaluation according to differences in the order of presentation:

1. Contrast or Ordered Halo Effect – Similar to the halo effect in that the unknown before or after will tend to pull adjacent unknowns up or down in quality according to the attributes of those before and after it in a sequence.
2. Group or Group Haloed Effect – Similar to above, but where an unknown is dragged up or down because of the characteristics of the group or a sufficiently large amount of unknowns in the group.
3. Error of Central Tendency – The middle sample of a triangle test tends to be selected as the odd one. Middle choices in a field tend to be preferred.
4. Pattern Effect – The searching of any cues in an array, be they significant or not, to help in the identification of the odd unknown(s).
5. Time Error Bias – In a short-term test, the bias will be toward the first tested. In a long-term test or one with many unknowns, the bias will be toward the later unknowns. As in any of the above, randomization of identification tags, position, subjects, and other variables will aid in more accurate conclusions.

See Logical Errors, Stimulus Error, Halo Effect, Expectation Error, Order of Presentation Error, Mutual Suggestion Error, Motivational Error, Personality Errors (Capriciousness versus Timidity), Error of Habituation.

Oregano (Mexican Oregano) (Lippia spp.) – Mexican oregano is organoleptically indistinguishable from Origanum vulgare L. or Coleus ambionica. Both have the characteristic odor of carvacrol. Oregano is a key ingredient in Italian cooking and is especially important in pizza flavors. See Herbal, Green, Italian Cuisine, Pizza, Chart 276 – Oregano, and Appendix 2.

Oregon Grape or Berberis vulgaris – See Appendix 2.

Organic –

1. A chemical compound that contains the element carbon.
2. A new marketing designation that states the ingredients are grown organically. The definition cited by Ruth Leverton of the USDA in 1974 was foods grown without the use of pesticides or artificial fertilizers and whose soil has been enriched through the introduction of organic matter. Organizations whose interest is in the standardization and regulation of 'organically grown and labeled foods' include ATTRA (Appropriate Technology Transfer for Rural Areas) funded by the U.S. Department of the Interior, National Organic Standards Board, Organic Trade Association, and others.

Organic Chemistry – The study of matter that makes up the building blocks of life. The branch of chemistry having to do with molecules that contain carbon. See Organic Compounds; Figures 26 and 27.

Organic Compliant – As of the writing of this edition, there is a clause in the USDA organic regulations that allows for an exemption for flavorings and allows for use in organic products labeled as category 2 organic (not certified or wholly comprised of) generally known as the 95/5 ruling. This allows for an all-natural flavor devoid of any synthetic solvents, catalysts or contact with synthetic ingredients

General Organic Chemistry

Organic compounds are those that have a carbon atom associated with a hydrogen (hydrocarbon) or a hydrogen and an oxygen (example carboxyl). A carbohydrate is a molecules where the Carbon number is x and for every x a ratio of H_2O in the Hydrogen and Oxygen applies. In other words the empiral formula would be $C_xH_{2x}O_x$. A molecule where Carbon and Hydrogen are the only elements is an alkane (all single bonds), an alkene (a double bond), and an alkyne (a triple bond). If there are multiple unsaturated bonds it would be an alkadiene, alkatriene, etc.

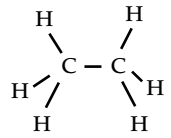


Fig 26a
Alkane = Ethane
C_2H_6

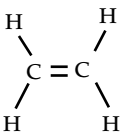


Fig 26b
Alkene =
Ethene or Ethylene
C_2H_4

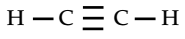


Fig 26c
Alkyne =
Ethyne
C_2H_2

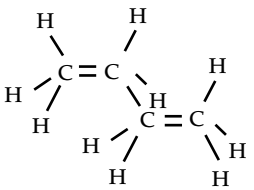


Fig 26d
Alkadiene =
Propadiene
C_3H_{10}

Figure 26

General Organic Chemistry
Continued

Depending on the configuration of the Carbon, Oxygen and Hydrogen Atoms, different types of molecules with their own chemical and perhaps organoleptic properties emerge. An "R" indicates some other structure attached.

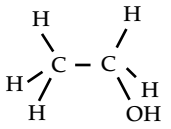


Fig 27a
Alcohol
Ethanol
C_2H_5OH
ROH

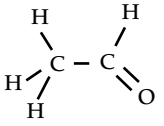


Fig 27b
Aldehyde
Acetaldehyde
C_2H_5OH
RCHO

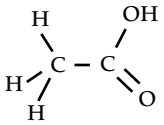


Fig 27c
Acid
Acetic Acid
CH_3COOH
or $C_2H_4O_2$
RCOOH

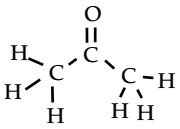


Fig 27d
Ketone
2 Propanone
C_3H_8O or
CH_3COCH_3
R1COR2

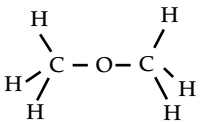


Fig 27e
Ether
Ethyl Ether
Diethyl Ether
C_2H_5OH
R1OR2

Note:
R1 could be the same as R2

Figure 27

to be able to be used at a level of 5% in the final organic labeled product. The further caveats are that no ingredient in the flavor uses sewage sludge, was irradiated or utilized genetically engineered items or processes. See USDA, FDA, Organic, Organic Labeling, Natural

Organic Compounds – Those chemical structures that contain carbon. See Organic Chemistry.

Organoleptic – Organoleptic means having to do with the sense of smell.

Organoleptic Analysis – The testing of a material using terminologies and methodologies relating directly to the sense of taste and smell. See Sensory Evaluation.

Organoleptic Duplication – The process of duplicating a target sample either with the aid of instrumentation or without instrumental support at all. Gas chromatographic analysis can aid in duplication only so far, and with anomalies, artifacts, wrong directions, etc., many flavorists prefer to do duplications without the aid of any instrumentation whatsoever. In the final analysis, to this date, no instrument has been developed to even come close to the sensitivity of the human olfactory system. See Instrumental Analysis.

Organoleptic Profile – The flavor description of a product.

Origanum (Origanum vulgare L. and Other Origanum spp. or Thymus capitatus, 50% Carvacrol) – Although the origanum oils are considered to be in the oregano family of flavor ingredients, their harsher character lends to their lesser use versus lippia oils. See Oregano.

Ornamental Kale – See Kale.

Organic Labeling – (From the USDA Website) – **Organic Products** 1. 100% ORGANIC – All ingredients must be certified organic, any processing aids must be organic, product labels must state the name of the certifying agent on the information panel, may include USDA organic seal and/or 100 percent organic claim, must identify organic ingredients (e.g., organic dill) or via asterisk or other mark. 2. ORGANIC – Raw or processed agricultural products in the 'organic' category must meet these criteria: All agricultural ingredients must be certified organic, except where specified on National List. – Non-organic ingredients allowed per National List may be used, up to a combined total of five percent of non-organic content (excluding salt and water), product labels must state the name of the certifying agent on the information panel, may include USDA organic seal and/or organic claim, must identify organic ingredients (e.g., organic dill) or via asterisk or other mark. 3. MADE WITH ORGANIC – Multi-ingredient agricultural products in the 'made with' category must meet these criteria: At least 70 percent of the product must be certified organic ingredients (excluding salt and water), any remaining agricultural products are not required to be organically produced but must be produced without excluded methods, non-agricultural products must be specifically allowed on the National List, product labels must state the name of the certifying agent on the information panel, may state 'made with organic (insert up to three ingredients or ingredient categories)', must not include USDA organic seal anywhere, represent finished product as organic, or state 'made with organic ingredients', must identify organic ingredients (e.g., organic dill) or via asterisk or other mark. See USDA, NOP, Regulations Organic Compliant.

Orphan Drug Act – Passed in 1983, allowed for the approval of many medicinal foods, natural herbs and preparations, and other nutraceutical products that show to be effective in curing or preventing diseases. The term nutraceuticals was spawned from this act. See Nutraceutical, Dietary Supplement Health and Education Act (DSHEA), Natural, Vitamins.

Orris (Iris germania L. and Other Species and Varieties) – The extracts and essential oils contain alpha irone, a powerful ionone-type compound. Therefore, they are useful in all berry flavors, particularly raspberry, blackberry, currant, and even strawberry, peach, or apricot. See Floral, Irones, and Chart 277 – Orris.

Ortho – Two groups attached that are situated next to each other on a benzene ring.

OSHA – See Occupational Safety and Hazard Administration.

Osmanthus (Osmanthus fragrans Lour.) – Osmanthus has a warm herbaceous character similar to Davana and patchouly (patchouli) and therefore finds itself useful in enhancing woody, herbaceous profiles of tea flavors, berry flavors, and brown flavors like cocoa, vanilla, etc. Osmanthus is especially suitable for blackberry notes used in cordials and brandies. See Herb; Green; Vegetable, Vegetative; Alcoholic Beverages; and Chart 278 – Osmanthus.

Osmics – The science of smell.

Osmophore – See Odoriphore.

Osmyl – An odorant.

OTC – See Over the Counter.

Ounce Goods – Terminology in the carbonated beverage industry describing the dilution or throw rate of a concentrated syrup. When sugar syrup is used for instance it contains the concentrated flavoring and coloring and other Ingredients which must be diluted at the time of sale. This is done automatically by using a pressurized container of carbon dioxide, the syrup and water. These are mixed at the throw rate or dilution prescribed by the end product. This is either one plus five (1/6) or one plus 4 (1/5) yielding 16.66% or 20% sugar syrup typically at 66 brix or a final sugar % of 11% or 13% respectively. Recent sugar percentages very widely so this terminology is not used as often. The ounce goods part means how many ounces are added to the syrup concentrate at what throw rate so the instructions would be 1/2-ounce flavor at a 1 plus 5 can be said 1/2 ounce goods at a 1 plus five. See Beverages, Carbonated Soda.

Out of Compliance – The state of a food product that exists out of the range of acceptance. An out of Compliance product would be subjected to rejection, recall, withdrawal, rework, or destruction depending on the circumstances. An out of compliance condition could initiate a corrective action report, or a report to the CDC/FDA in the reportable food registry. See Non-Conformance, FDA, Recall, Withdrawal, Rejection, Destruction, Reportable Food Registry, Corrective Action, CDC.

Outbreak – A localized recurrence of a disease. See Epidemic, Pandemic.

Outlyer – A statistical anomaly, a data point that does not fit the 'curve' or the trend of other datapoints. See Statistics, Statistical Analysis; Sensory Evaluation.

Oven –

1. The heater in an instrument such as a gas chromatograph.
2. An oven is an enclosed compartment for heating, baking, or drying.

Overall Difference Test – A sensory analysis that determines not only if there is a difference but attempts to analyze and rate the degree of difference on a sliding scale. See Difference from Control Test, T Test, Hedonic Test, Attribute Tests, Discrimination Test.

Overrun – The percentage amount of product that expands over the original volume amount due to the beating of air into the system. Ice cream is described in this manner. Example: A 20% overrun means that the ice cream expanded to 120% of its original volume.

Over the Counter (OTC) – Those items that are sold directly to consumers.

Oxazole – A six-membered ring formed by an oxygen, a nitrogen, and three carbons. The nitrogen and the oxygen are ortho or beta away from each other. The ring contains one double bond, next to the nitrogen, in between the nitrogen and oxygen. For convenience, we have lumped all oxazoles and oxazolines in with the pyrazine chart. See Chart 265 – Nitrogen Containing Non Pyrazine.

Oxazoline – A five-membered ring formed by an oxygen, a nitrogen, and three carbons. The nitrogen and the oxygen are ortho or beta to each other. This compound contains one double bond at the one position (next to the nitrogen but away from the oxygen). See Chart 265 – Nitrogen Containing Non Pyrazine.

Oxidation – The class of chemical reactions that includes any reactions in which electrons are transferred.

1. When a product combines with elemental oxygen.
2. When an element becomes an anion (positively charged ion).
3. When a charge becomes more positive.
4. When an element loses electrons (becomes less negative). Example: When an aldehyde becomes an alcohol, it loses electrons to the hydrogen and is said to have oxidized. When the alcohol (C–OH) combines with oxygen to become an acid (COOH), it is further oxidized. But when the acid solubilizes in water and become the ionic form (COO–), it is said to have reduced.

5. Enzyme-based oxidation can occur naturally. An example is the formation of hexanal, an active flavor component in tomatoes or cucumbers derived from the lipoxygenase activity on methyl linoleate. The oxidation sequence is as follows: saturated chemicals → unsaturated chemicals → alcohols → ketones or aldehydes → acids. The reduction sequence is reversed. See Oxidizing Agent, Reducing Agent, Oxygen, Fat, Rancid (Rancidity).

Oxidized – A usually negative descriptive terminology that often describes terpenes, fat, or oils that have combined with oxygen to develop off characters.

Oxidized Oils – A description typical of citrus or highly terpenated oils that have combined with atmospheric oxygen. Some of the compounds that are responsible for this odor are terpineol, carveol, and limonene epoxide.

Oxidizing Agent – A chemical that causes another ingredient to oxidize. See Reaction, Oxidation, Catalyst.

Oxireductase – See Enzymes, Oxidation, Reduction.

Oxygen – The element whose atomic weight is roughly 32 and whose atomic number is 16. One of the more common non-essential elements to organic compounds. Oxygen is essential to sustenance of higher life forms through breathing and is in the air around us. It combined with hydrogen and carbon to form many important chemical compounds. When it combines with hydrogen, it is a hydroxyl group (–OH). When this hydroxyl group is attached to an organic structure, it becomes an organic alcohol. Attached to a benzene ring, it becomes a phenol. When oxygen combines with carbon and hydrogen, it becomes a carbonyl group (C=O). If the carbonyl is found in the middle structure of a molecule, it can either be a ketone (R1–C=O–R2) or when it is combined with another oxygen in the center of a molecule, it is an ester (R1–C=O–O–R2). When oxygen is combined with two other carbon units, it becomes an ether (R1–O–R2). When a carbonyl is also combined with hydrogen and sits at the terminus of a branch of a molecule, it is an aldehyde (R1–CH=O). When a hydroxyl group also joins this terminated carbonyl group, it becomes an acid (R1–C=O–OH). Chemicals that combine with oxygen (i.e., the unwanted by-products of fats that have combined with oxygen), can be quite problematic from a flavor standpoint. To protect against this, one might employ a packaging approach (plastic film laminate-type oxygen barriers) or one might add a protective antioxidant to the material. See Oxidation, Reduction, Elements.

Oxygen Radical Absorption Capacity (ORAC) – A test that determines the antioxidant potential of a product. This has been used in foods to measure a food's ability to scavenge free radicals. It has been postulated that free radicals in the body contributes to cellular destruction and an accelerated aging process. Therefore, the higher the ORAC value of foods, the more the anti-oxidant properties it has. Anthocyanins, the class of compounds that contribute the colorant in berries and vegetables is one example of an ingredient which contributes to increased ORAC value. See Nutraceuticals, Anthocyanin, Oxidation, Aging.

Oxygenated Components – Those compounds that contain oxygen and represent the characterizing ingredients of citrus oils. Aldehydes, like decanal, yield the rindy character of orange oil. Terpene alcohols, like alpha terpineol, contribute the green lollipop-type character of a distilled lime oil, and the terpene aldehyde, citral contributes the lemon furniture polish-odor typical of a rindy lemon. See Folding of Extracts and Essences, Citrus Oils.

Oxygen Scavenger – 1. A chemical having the property of absorbing oxygen. 2. A packet usually of a small size that is placed in a larger food package to absorb oxygen in products prone to oxidation or rancidification. 3. Oxygen scavengers absorbed in our bodies are thought to inhibit the formation of free radicals, some believe responsible for the aging process.See Antioxidants, Oxidation, ORAC.

Oyster Plant – See Salsify.

Ozone – Currently used and approved as GRAS for bottled water. Use as a general sanitizer is currently being reviewed.

P

Packaging – Any one of a number of containers that is used in the food industry. In the flavor industry there are certain types and sizes used. These include: plastic bottles, jugs, drums and totes, glass bottles, jugs, aluminum cans, metal (polymer coated insides) cans also erroneously called tins, drums, metal totes, and plastic lined boxes, all in one packages with spouts, and totes. Larger railcars and tanker trucks are also used for very large shipments. Lot designation and control of packaging for the purpose of recall is one of the requirements of FSMA. The issues of packaging can be quite complex. Aspects of chemical migration, oxygen barriers, tamper evidence, lot traceability, color for extraneous matter detection, storability, DOT requirements, printing issues, size, shape, material, damage resistance, stackability, palletizeability shrink wrapping, shelf life, water heat and chemical resistance, might all come into play. See FSMA.

Packaging Control – Part of the prerequisite program, packaging control includes the use of food grade packaging of a consistency to be able to be shipped properly, avoid leakage or reasonable damage, and be sealed properly. A lot system should be in place to assist in a recall of the packaging. The system will also include handling of pallets, labels, shrink wrap and closure. See HACCP, Prerequisite Programs.

Packed Column – A gas chromatograph column that is filled with an immobile substrate like diatomaceous earth called the inert, supportive or stationary phase, and a reactive substance like Carbowax™ or silicone or other derivative, which allows for the separation of materials in the column, called the active phase.

Packing –

1. The inside immobile phase of a gas chromatographic column.
2. The inside material of a distillation column used to facilitate separation during distillation. See Theoretical Plate Count, Distillation.

Packing Requirements – Department of Transportation mandates for the transportation of hazardous materials. The packaging must be UN approved and be able to withstand the rigors of shipping. Hazmat packaging often requires added costs to ship and requires special packaging and handling. See Hazardous Materials, Code of Federal Regulations, OSHA, DOT.

Paired Comparison Test – A discrimination test that pits two samples against each other to be rated based on a directional analysis (more of/less of) of a predefined characteristic. This test is often used when samples are unsuitable for multiple presentations, for example, those with strong or lingering flavors, physically unstable products, or other difficult and complex attributes. Serving sets are AB, AA, BA, and BB. See Discrimination Test.

Paired Difference Test – See Paired Comparison Test, Sensory Evaluation, Sensory Analysis, Discrimination Test.

Pak-choi – See Chinese Cabbage.

Palatability – The pleasing quality of a consumed product. See Pet Palatability Flavors, Palatability Testing.

Palatability Testing – The examination of the pleasing quality of a food product. PT is usually designed for the examination of the desirability and subsequent prediction of performance of pet foods on the marketplace. Experimental controls are used. The choice

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of animals is important, and breed choice might affect the results. (Beagles, for example are not at all finicky and will give high ratings in general.) Pre-weighed plates are usually presented to the animal and are measured at set time intervals to establish a predominance of choice of one over the other. Because animals can be either right pawed or left pawed (similar to left-handedness or right-handedness in humans), this might affect the choice pattern, thus, the plates are usually rotated. See Pet Palatability Flavors.

Palatable – Pleasing, having an agreeable flavor.

Palate – The roof of the mouth. The front of the palate is hard tissue; the rear of the palate is made of soft tissue (mucosa).

Palatone™ – See Maltol.

Pallet Control – Part of the HACCP system but not the HACCP plan, the pallet control is a prerequisite program that includes the inspection of pallets, limitation of use of wooden pallets, assurance of absence of pests (such as wood borer beetles, rodents, insect larvae), and general condition, material, size and construction. See HACCP, Prerequisite Program.

Palm (hearts) – Palm hearts are the soft inner pulp of young palm trees. They are often pickled to further soften them for ingestion. The flavor of palm hearts is very similar to artichoke. See Artichoke.

Palmarosa (Cymbopogon martini Stapf. var. motia) – The oil contains nerol and geraniol. It was used in tobacco flavorings. The East Indian oil has a lesser alcohol content than that of the Indian variety. See Tobacco Flavors, Geraniol, Chart 279 – Palmarosa, and Appendix 2.

Pan Coating – The production technique that rolls a matrix around a target material so the target material picks up the matrix on the outside.

Panelist – A person who engages in either a discrimination or descriptive sensory evaluation test. See Sensory Evaluation.

Pan (Tray) Drying – Trays dehydrated sometimes under vacuum. Particles are amorphous and larger than spray drying. Hydroscopicity can be an issue.

Pandemic – A widespread disease recurrence spread over an extremely large area, usually involving many countries worldwide. It is believed by some at the time of the writing of this book that a strain of avian flu will mutate into a human disease type and create a pandemic similar to the one that killed many people at the turn of the twentieth century. Estimates by some are in the expected neighborhood of 30% mortality rate. They go on to claim that it is not a matter of 'if' but 'when.' It is obvious that it is an extremely serious concern, and it is undoubtedly on the minds of the WHO (World Health Organization) of the United Nations as well as the United States CDC (Center for Disease Control). See Epidemic, Outbreak.

Pansy (Viola tricolor) – Formerly used as a bittering agent in alcoholic beverages, it has been recently studied for its nutraceutical characteristics. See Nutraceuticals, Chart 280 – Pansy, and Appendix 2.

Pantothenic Acid – See Vitamins (B Complex).

Papaya (Carica papaya) – Although the plant can grow to 33 feet tall, it is not really a tree. Propagation is easy and currently the crop has expanded from its original Latin American origins to throughout the world. The unripened fruit contains latex that contains the proteolytic enzyme papain. Papain can attack both living tissue and dead tissue, unlike bromelain (made from pineapple), which has unique properties as a protease in that it attacks only dead tissue. Other typical fruit enzymes are bromelain in pineapple, ficin in figs, and actidin in kiwis. The latex can also be used in chewing gum. Mountain papaya (Carica pubescens) and bamboo (C. pentagonia) are just a few of the less common varieties, most of which are inedible. In Hawaii, the solo variety is grown. The pulp is yellow-orange and reddish, depending on the ripeness. The pulp of the fruit resembles both the texture and flavor of a cantaloupe. The NAS # for the juice concentrate is 6664. See Enzymes and Appendix 2.

Paper Chromatography – The separation of components that can be visually analyzed by spreading a liquid system along paper. A paper is first dipped into, for example, a mixture of colors. After a while the colors will separate into bands according to their respective rates of dispersion along the paper, and a separation of individual colors will appear.

Papery – A descriptive term meaning reminiscent of the taste of paper.

Papillote – Aluminum foil or a greaseproof paper in which food is cooked in to ensure the retention of flavors. Because there is an addition of some liquid in the form of water, stock, wine, etc., this is considered a moist cooking technique. Browning should take place beforehand to assure good flavor and caramelization/Maillard conditions. Tender cuts of meat and vegetables should be used.

Paprika – Also called tomato pepper, tomato squash pepper, pimiento, tomato pimiento, pimenton, Hungarian paprika, noble paprika, sweet paprika. Paprika slices are used to stuff green olives. See Color (Colorants), Capsicum.

Para – Two groups that are opposite one another on a benzene ring are considered in the para position to each other. See Ortho, Meta.

Paraselsus – A Swiss/German Renaissance scientist who founded the science of Toxicology. He is known

for his famous quote; paraphrased 'Everything is a poison; it depends on the dose'. See Toxicology.

Paraffin Wax – Paraffin is used as an adjuvant, added as a coating, antisticking agent, and for many other uses. It also has seen use as a 'cutting agent' in certain concretes. Here it must be declared. See Waxy, Adjuvant, Candelilla Wax, Beeswax, and Chart 281 – Paraffin Wax.

Parageusia – Parageusia is the confusion of taste stimulation. Tasting one type of stimulus while being exposed to a completely different one as a result of mixed sensory signals to the brain. See Parosmia.

Paraguay Tea – See Maté.

Parasite – An organism that lives off another (host) and gains sustenance from it. Parasites can usually be killed by freezing. Sashimi and sushi are typically prepared by fish that was first frozen to kill harmful parasites. See Sushi, Sushimi.

Examples of parasites follow:

- Protozoa – Toxoplasma – From eating undercooked pork and lamb. Also potentially contracted from infected cats.
- Cryptosporidium – Raw produce, cider from contaminated apples.
- Cyclospora – Imported raspberries, salad greens, basil.
- Giardia – Number one cause of parasitic diarrhea. There are an estimated 2 million cases per year.
- Worms – Flatworms:
  - Trematodes.
  - Clonorchis.
  - Liver fluke from raw fish.
  - Fasciola – Liver fluke from unwashed salad greens. Both have been associated with liver cancer.
- Worms – Tapeworms:
- Taenia/Pork Tapeworm: Can grow up to 15 feet long. Lives inside the intestines.
- Diphyllobothrium/Fish Tapeworm: Can grow up to 30 feet long. See Pathogenic (Pathological) Organism.

Parching – The precooking of the rice granules imparting a nutty flavor as in the Pilaf Method. See Pilaf Method, Risotto Method.

Parisienne –

1. A style of cooking.
2. Spice Parisienne includes a mixture of the following: white pepper, allspice, mace, nutmeg, cloves, cinnamon, bay leaves, sage, marjoram, and rosemary. See Culinary Arts.

Parosmia – Parosmia is the confusion of odor stimulation. Smelling one type of odor while being exposed to another one due to conflicting and mixed signals to the brain. See Parageusia.

Parsley (Petroselinum sativum Hoffman.) – Parsley herb oil, aka parsley leaf oil, is a fresh green herbal character. The oil can be used in all types of fruits, spice blends, and vegetable flavors where a fresh green top note is appreciated. The seed oil, however, is more like carrot seed oil or celery seed oil in character. However, parsley seed is spicier and woody and less fatty and oily than the other two. The oil contains apiole, which is methoxy myristicin, and also a bit of myristicin, which is the active constituent in the aroma profile of nutmeg. There are a few types of parsley. These include curly parsley, Italian parsley, and turnip-rooted parsley, also known as Hamburg parsley. One of the characterizing compounds of fresh parsley is 1,3,5 Undecatriene. This compound is also found in many fruits including the tropical types. See Green, Garnish, Chart 282 – Parsley, and Appendix 2.

Parsnip (Pastinaca sativa) – Parsnip has a nutty flavor reminiscent of hazelnut. See Nutty.

Particle Size – The measure of an average granule of a powder, or suspended or emulsified micelle or piece within a liquid system. See Sieve Analysis.

Partially Hydrogenated Vegetable Oils – Also called PHOs, PVOs. Has been delisted as GRAS additives in 2015 by the FDA and producers of food products have been given a three-year period to remove PHOs from their products. See Hydrogenated Oils.

Particle Physics – Although pure chemistry is only one factor in the creation of chemistry, it is important to keep up-to-date with the latest definitions and concepts. I insert this discussion of particle physics because I came from a time when life was simpler and electrons, protons and neutrons were the only things I had to remember. I will not get into brane theory, string theory or the fact that not only do we live in a multidimensional universe with at least ten dimensional lengths, but only describe the particles that make up everything we know. Today, the theory that explains that which makes up the universe is called the Standard Model. Recently, there has been a shift to explain unexplainable observations using that theory and there is a likelihood the Standard Model will be refined or rewritten and become the 'Theory of Everything'. Instead of my conformable three things that make up an element there are now 24 standard particles each of which is defined by 12 paired fermion having particles of opposite spin (half spin). These are called antiparticles. Together with many other particles that stand alone such as the Boson of which the newest Higgs Boson or 'God Particle' is an example, the family tree of particles comprises the 'Particle Zoo' physicists now know. I will just mention that the

discovery of the Higgs Boson might explain fully why all these energetic structures have a mass and why matter even exists, thus the name 'God Particle'. See Chemistry, Physics.

Particulate Matter – Fine insoluble materials that are suspended in a liquid, adding to the mouthfeel of the overall product. See French Press, Mouthfeel, Full.

Partitioning – The selective solubility of flavor volatiles. Fatty acids like acetic acid, butyric acid, hexanoic acid, etc., will selectively dissolve in both the fat and aqueous media of a dairy system. The dissociated ionic form of the acid will appear in the aqueous phase, and the non-dissociated whole molecule will dissolve in the lipid phase. This selective partitioning occurs in a few days. An observation is that this takes longer to occur as the relative amounts of either phase decreases. For instance, it has been observed that some flavor systems with low moisture activity but with a significant fat content do not develop until 30 days. In most cases, partitioning produces a better flavor because it simulates what occurs in nature. Some of those in the margarine industry, for instance, have observed this effect and do not evaluate experimental flavor systems until 4 or 5 days after flavor application. See Acetic Acid, Butyric Acid, Hexanoic Acid, Lipid, Butter, Margarine, Fatty Acids.

Passionflower (Passiflora incarnata L.) – Passionflower can be produced by the enfleurage process, as is used for the production of jasmine derivatives. Passionflower has a floral character similar to that of hydroxycitronellal, although that particular compound is not found in nature. See Jasmine, Chart 283 – Passionflower, and Appendix 2.

Passion Fruit, Passionfruit (Passiflora species) – There are many varieties of this fruit, all of which contain a thick inedible peel. Inside the peel is a gelatinous pulpy mass. This mass is quite variable in color ranging from yellow, green, yellow-orange, white, or even colorless. The flavor is very juicy, only slightly sour and fragrant. The flavor is quite sulfury as well, and has a very peculiar top note. The use of buchu oil, thiomenthone, or currant bud extracts allows the flavorist to capture this elusive characteristic note, which some describe as cat urine-like. See Buchu, Tropical Fruits, and Chart 284 – Passionfruit.

Pasta – The food product made in part with durum wheat and other flours, as well as flavors, vegetables as coloring agents (spinach for green, tomato for orange to reddish), or artificial colors, and other ingredients. Pasta is made from finely ground particles of wheat (semolina) and or high gluten durum wheat. Pasta dough is very stiff with a moisture content of about 25%. Bread is typically closer in moisture to about 40% by weight. Less water is needed to make pasta out of semolina, which has no damaged starch competing with the protein to absorb moisture. The kneaded dough is matted, extruded, or otherwise shaped into all various sizes and configurations. Some of the configurations are lasagna (flat wide strips, ribbed, and often curled along the edges), spaghetti (long thin rods), rigatoni (ribbed, hollow short tubes), farfalle (bow ties), penne (longer smooth, hollow tubes), fettuccine (flattened long, thin strips), macaroni (small, short, hollow, curved tubes), fusilli (spiral short screw shaped), and ziti (wide, short, smooth tubes). Often the pasta is stuffed with meat, cheese, etc., like tortellini, fettuccine, and ravioli. Asian noodles are based on wheat, and occasionally eggs or rice. They are usually long, signifying long life. Japanese wheat noodles are called somen if thin and udon if thick. Rice vermicelli is fried in peanut oil. Japanese buckwheat and wheat noodles are called soba. Noodles made from flour derived from mung beans are transparent. Egg noodles have at least 5.5% egg solids by weight. Pasta should be cooked al dente. For homemade more fragile pasta, cooking time is critical as the pasta cooks more rapidly. See Gluten, Al Dente.

Pasteurization – Applying heat to a food to lessen the presence of harmful microorganisms. Unlike sterilization, the Pasteurization process reduces organisms to a point where given proper storage; the product will be consumed before the date of expiration. The high temperature of sterilization affects flavor quality and is less commonly used in foods. See Aseptic Processing, Retorting, Food Safety, Thermal Kill Step, HACCP, HTST (and related times and temperature).

Patchouly (Patchouli) (Pogostemon cablin Benth. and P. heyeanus Benth.) – As an ingredient, patchouly (patchouli) is very characteristic and is unlike other oils in the presence of the compound patchouloinol (a tricyclic alcohol-$C_{15}H_{26}O$). Patchouly (patchouli) also includes cinnamic aldehyde, eugenol, and benzaldehyde. Patchouly (patchouli) possesses a unique, warm character that works very well in a multitude of flavors including tea, cocoa, cola, berries, vegetable flavors, and other products where its middle to background profile can be appreciated. Its subtle woody character makes it an interesting differential ingredient for a wide variety of natural WONFs. It used to be used in the Sen-Sen™ type of licorice and is effective as a masking aroma for sulfury garlic and onion odors. See Differential Compounds, Colas, Chart 285 – Patchouli, and Appendix 2.

Pâté – A culinary preparation made from cooked ground meat, fat and spices, made into a spreadable paste. See Culinary, Charcuterie.

Pathogen – Pathogenic (Pathological) Organism – A living thing that produces a disease. In 2011, the FDA did a survey of pathogens versus illness, hospitalization and mortality rate. The top pathogens listed were; Bacillus cereus, Clostridium botulinum, Cryptosporidium, Escherichia coli O157, Hepatitis A, Listeria monocytogenes, and Norovirus. In 2011, the FDA did a study outlining the most common and severe pathogens. These include Bacillus cereus, Clostridium botulinum, Cryptosporidium, E. coli O157, Hepatitus Virus A, Listeria monocytogenes, Norovirus, Salmonella (non-typhoidal) and Staphylococcus aureus. Out of the group, the Norovirus had over 5 million outbreaks, with close to 150 deaths, and Salmonella with over 1 million outbreaks and 378 deaths, clearly the cause of the greatest concern. With only 1,500 cases of food poisoning, Listeria had 255 deaths, again although the numbers are low in prevalence the rate of mortality is alarmingly high. Listeria is obviously another area of grave concern. Due to the nature of the listeria organism, it is of concern mostly in refrigerated food systems. See Food Safety, HACCP, Food Code 2013 – Annex 4, Salmonella sp., Listeria, E. coli 0157-H7, Streptococcus aureus, Staphylococcus, Listeria monocytogenes, Food Safety Assessment, Pasteurization, Thermal Kill Step, Microbiological Assay, FSMA.

Pathology – Pathology is the study of disease.

Pau D'Arco (inner bark of Tabebuia avellanedae) – See Appendix 2.

Paysanne – See Knife Cuts.

PCBs – See Polychlorinated Biphenyls.

Pd (Proportion of Discriminators) – The maximum proportion of a population that a tester is willing to tolerate as truly being able to tolerate differences. See Alpha Risk, Beta Risk.

Pea (Pisum sativum) – This general food category includes the green pea or garden pea, snow pea (p.s. var. saccharatum and macrocarpon), wrinkled pea, and the fresh pea. When the dicotyledonous seeds are separated, they are called split peas and are used to make split pea soup. The intense green flavor comes from unsaturated fatty acid precursors that oxidize through the action of an endogenous enzyme called lipoxygenase. Pea powder is available commercially in both lipoxygenase active and non-active forms. See Green, Enzymes, Chlorophyll.

Peach (Prunus persica Sieb et Zuc. [kernels only] and P. persica L. Batsch) – The species describing peach is named persica because Persia is where Alexander the Great was supposed to have first discovered the fruit. It is a close relative of the apricot, almond, cherry, and plum. All of these fruits are potential amygdalins containing pits. The pit is called a stone. Amygdalin is the precursor for the amygdalin glucosidic reaction with the enzyme amygdalase in the formation of naturally occurring benzaldehyde and HCN. Clingstone peaches are defined as those whose pit adheres to the pulp of the fruit, and semi freestone and freestone peaches are defined as those peaches whose pits fall out easily from the pulp. The skin of the peach is soft and fuzzy. To produce a good characteristic peach flavor, a flavorist almost by necessity has to use lactones. The controversy lies whether to use some lactone types over others. Some flavorists prefer the creamier delta lactones to gamma lactones. However, historically the first lactone to gain in popularity for peach was the peach lactone, also known as peach aldehyde or Aldehyde C-14 (so-called). Chemically, the compound is gamma undecalactone, a C-11 chemical and not C-14 at all. It was first discovered as an ingredient in heated castor oil where the lactone was produced by the interesterification of hydroxy acids present. See Lactone, Aldehydes (So-called), Apricot, and Chart 286 – Peach.

Peak – 1. In chromatography the top of the curve, the point at which the slope inverts; 2. In meringue the type of consistency; 3. The optimum flavor character as in peak of perfection. See Gas Chromatography, Meringue, Flavor Quality, Shoulder (GC).

Peanut (Arachis hypogea L.) – Not really a nut, the peanut falls into the legume family. The peanut is a very popular food product and is prepared in many ways. It can be roasted, mixed with spices such as a barbecue blend, flavored with honey, cinnamon, or many other types, smoked, or just salted. However, one of its main uses is in peanut butter. Grinding peanuts to a fine paste produces peanut butter. This paste would then have other ingredients added like sugars, molasses, emulsifiers, salt, fruit jams, etc. Unfortunately, peanuts are susceptible to contamination from the Aspergillus flavus mold that generates aflatoxin, a toxin that seems to be a potent liver carcinogen. Do not eat peanuts that are old, rancid, discolored, or moldy. Another issue with peanuts is the potential allergic severity that some people seem to develop to them. The ingestion of peanuts can produce the most powerful allergic reactions in some people – anaphylaxis. Even tiny amounts of exposure can be fatal. Even where one would think protein would be almost non-existent as is the oil produced from the food, the amount of allergen in unrefined peanut oil appears to be enough for some people to develop a severe reaction. Most allergists

believe that refined oils pose little threat, but this author has yet to find a peanut oil-producing company that will certify their refined peanut oil to be allergen free. This is probably due to fears of legal exposure and the impossibility of assuring an absolute negative. See Food Allergy, Legumes, and Chart 287 – Preanut.

Pear (Pyrus communis) – The pear is related to the apricot, almond, and apple. Pears should be picked before fully ripened lest the skin become granular. Some types have a gritty pulp (stone cells). When pears are picked, starch is enzymatically converted into sugars even under refrigeration. Some of the varieties are the Anjou (a short-necked variety, which is juicy with a creamy texture), the Bartlett (with a good sweet flavor), the Bosc (whose skin is thicker than most, whose size and amount of stone cells are above average, and whose flavor is strong and floral), the Comice (which is juicy and flavorful and considered by most to be the finest in flavor), the conference pear (which is sweet and resembles the Bosc pear in character), the Packham (which is juicy and sweet), the Passe-Crassane (which has a creamy texture and does not brown as quickly as the others), and the Rocha (whose flesh becomes very soft as it ripens). See Unsaturated Esters and Chart 288 – Pear.

Pearls – The small globular structures that result in the grating and subsequent dehydration of vegetables like cassava. Tapioca (cassava) pearls are used to make tapioca pudding. See Cassava.

Pearson's Square – Originally a formula developed by a mathematician named Pearson, from the University of Pennsylvania, which was used in the food industry originally to calculate milk fat in milk. Recently, however, it has become more useful in the calculation of citrus fold calculations, emulsion systems, and other questions where blends of concentrations are needed. The general configuration is to be reported by volume. An example of using the Pearson's Square to mix two specific gravities, A and B to get C, follows:

1. SpG A = Known SpG of sample A.
2. SpG B = Known SpG of sample B.
3. SpG C = Resultant or desired SpG of blend.
4. Factor or ratio of A = SpG B – SpG C = Af.
5. Factor or ratio of B = SpG C – SpG A = Bf.
6. Formula = 100% of SpG C = Af/(Af + Bf) × 100% of SpG A + Bf/(Af + Bf) × 100% of SpG B.
7. If weight is to be used, then the reciprocal of the SpG is calculated.

Pecan (Carya spp.) – Native to the southern U.S., the pecan has an internal structure similar to the walnut, in that it contains two ridged sections separated by a cellulosic membrane containing bitter principles. The oils in the pecans can turn rancid a little sooner than walnuts, so care must be taken to keep the nuts fresh. The flavor is subtler and pyrazinic than walnuts with a less fatty flavor. See Nuts.

Pecan Shell Flour – GRAS# 4385, CAS# is pending. Used as a dry matrix for flavor systems and potential absorbant of aroma chemicals. It is claimed that the flour granules contain vesicles that can absorb aroma volatiles, but it is not certain how these can be released as the flour is not water soluble.

Pectin – A substance found in citrus fruits, beet pulp, and apples that is refined, isolated, and can be used to make fruit jams and jellies.

Pectinase – See Enzyme Hydrolysis.

Peduncle – The peduncle is the stem of a berry like a raspberry.

Peel – The rind or the outside covering of a food. Usually harder than the inside to protect a soft internal area. Citrus peels are the site where flavor is produced in structures called the flavor buds, but in other food peels, such as mango, apple, peach, pear, grape, no similar function takes place. See Pith, Albedo, Flavedo.

Peel Oil – Refers to an essential oil obtained from a peel as in citrus. See Citrus.

Peely – Usually referring to citrus, peely means aldehydic. Citral is the peely note found in lemon, and decanal and other aldehydes contribute to the peely note of orange. See Citrus.

Peking Duck – A unique dish typical of northeast China characterized by a sauce called plum sauce. Peking duck is prepared by hanging the cooked duck in a cool area. This procedure allows for drainage of the excess fat and provides for a better final flavor. The finished dish is made of four items: the duck meat and duck fat, the plum sauce, and scallions wrapped in a soft tortilla-like pancake. Hoisin sauce is a soy sauce blend produced with the five-spice mixture. When hoisin sauce is mixed with sesame oil and sugar it becomes plum sauce, the sauce used in the pancake sandwich of Peking Duck. See Ethnic, Chinese Five Spice.

Pekoe – Pekoe is a variety of tea.

Pelagra – Niacin (Vit. B3) deficiency. See Vitamin Deficiency Diseases.

Pennyroyal (Hedeoma pidegioides (L.) Pers. = American Pennyroyal) (Mentha pulegium L. = European Pennyroyal) – Both varieties contain a significant amount of pulegone that is the oxidized form of menthol. Historically, menthol was produced in that manner before the recrystallization technique using Mentha arvensis. The profile is

somewhat green, vegetable, and herbaceous. It is of lesser significance in modern flavors. See Chart 289 – Pennyroyal.

Pentyl Esters – See Chart 146 – Alkyl Esters Grouped by Alcohol Moiety.

Peony or Paeonia suffruticosa, Paeonia lactiflora, Paeonia veitchii – See Appendix 2.

Pepino (Solanum muricatum) – The fruit belongs to the eggplant, pepper, tomato, and potato family. The fruit looks like a small melon, colored green to yellow with purple streaks. The seeds are edible, and the flavor of the pulp is also similar to a melon's, however a bit more floral. See Eggplant, Tomato, Pepper, Potato.

Pepper (Piper nigrum L.) – Black pepper consists of a whole berry. It is dried and used as a spice in whole and ground form. The black type is more popular in the United States than in Europe. The Europeans use more white pepper. Black pepper is the strongest variety of pepper. Black pepper is picked when the berries are half-ripened and on the verge of turning red. When they dry, the berries shrivel and turn black. The difference between the white and black pepper is that black pepper contains an outer layer while white pepper is just black pepper whose outer layer of the mesocarp and epicarp have been removed. The process of removing these layers is called decortication. White pepper is harvested when the berries are very ripe. The berries are then soaked in salt water and the shell is removed. White pepper is subtler in flavor than the black pepper variety. The outer layers that are removed to produce white pepper do contain flavor. They contain the essential oil of black pepper that, among other ingredients, contains piperidine and terpenes. The inner berry contains the active ingredient piperine that is the heat principle of the black pepper. The oleoresin is produced by the solvent extraction of the piperine. In the oleoresin, the extraction of the inner berry produces a piperine content of roughly 50%. The oleoresin has a green cast and a dark oil phase. One of the main constituents of the oil portion of the oleoresin is phellandrene. Chavicine, the stereoisomer to piperine, also contributes to the pepper pungency within the oleoresin. Green pepper is harvested while the pepper is still unripened. It has a fruity flavor and is not very spicy. It has a limited use except in multicolored blends. Gray pepper is black pepper that is only slightly washed. The gray variety is mild and not commonly seen. Pink or red pepper is from schinus mole. This product is not really a pepper but is found as 'pink pepper' in colorful pepper blends. See Schinus Mole and Chart 290 – Pepper Black and White.

Pepper Grass – See Cress.

Peppermint (Mentha piperita) – Peppermint is a popular flavoring oil and is used in a wide variety of alcoholic beverages, health care products, chewing gums, and candies. When the oil is first distilled from the plant, it is quite obnoxious and sulfuraceous in odor, but upon aging (up to 2 to 3 years) or by distillation or similar treatment, the product becomes very pleasant. One of the first peppermint oils to be developed for commercial use came from England, where it was first identified. Colonists then transplanted mint to the United States where it grows wild in the northeast, especially in the New England states. Then the major growing regions were developed. Although there are many areas of cultivation for mints today, there still remains two basic major growing regions in the United States: the Midwest (Kennewick) area and the far west, in the Madras, Willamette, and Yakima valleys. The quality of peppermint oil can be gauged by the menthofuran content, less being better. Menthofuran is a characteristic of the Northwestern varieties versus the Midwest varieties probably due to climactic conditions. The peroxide breakdown products of the menthofuran yield objectionable aftertastes and provide lower grade oil upon aging. Although selective fractionization through distillation is costly and therefore infeasible, one company removes the menthofuran by hydrogenation using a catalyst. As with geranium Bourbon oil, the terpenes contain a significant amount of dimethyl sulfide, and can be used as a source for the natural product. Menthol, the characteristic cooling compound in mints, ranges from 50–60%; however, pure l-menthol is usually produced by recrystallization of Mentha arvensis otherwise known as Brazilian corn mint oil. Mint facts follow:

1. Of all the essential oils, mint seems to be the more variable versus growing area.
2. There are 14 states in the United States and two Canadian provinces that now produce peppermint to some extent. Of these, six areas could be considered major sources of oil and have unique characteristic profiles.
3. The flavor profiles are reported by Douglas Walker of Essex Labs. The following comparative charts list the main sources of peppermint and their corresponding comparative profiles. See Chart 423 – Peppermint by Regions.
4. Mint varieties are listed in Chart 482 – Mint Varieties.
5. Peppermint is listed in Chart 292 – Peppermint.
6. Peppermint is also listed in Appendix 2.

Pepper, Red – See Capsicum.

Pepper, Sweet (Capsicum annuum) – The vegetable is soft, shiny skinned, and somewhat hollow. Also

called bell pepper. It first appears green, then yellow, orange, and then red as it goes through the ripening process. One of the active constituents in the aroma profile of bell pepper is the green bell pepper pyrazine, known chemically as 2 methoxy 3-isobutyl pyrazine. See Bell Pepper, Green Bell Pepper Pyrazine, and Chart 291 – Pepper Sweet Bell Types.

Peptidase – See Enzyme Hydrolysis.

Peptide – Peptides are amino acids (two or more) bound with an amide linkage. The amide linkage takes place when a hydroxyl of the acid portion of the amino acid combines with one hydrogen from another amino acid's amino group (similar to esterification). It is obvious that this can go on and on with other amino groups and carboxyl groups from other amino acids forming complex structures of indeterminate molecular weight. Some peptides are responsible for the bitter off notes produced by the enzyme modification of cheese. One peptide of particular interest is the beefy meaty peptide, an octapeptide made from (H-Lys-Gly-Asp-Glu-Gly-Ser-Lau-Ala-OH) eight amino acids. BMP has an umami-type odor like MSG without the salty taste. BMP has been identified in papain-digested beef. Peptides are not nucleotides. Nucleotides are a special class of organic compounds, related to substances found in the nucleus of cells. GMP and IMP are phosphates containing nucleotides based on guanylic and inosinic acid glucosides (amino acid plus phosphorus plus a sugar molecule).

PER (protein efficiency ratio) – PER is the measurement of the body's biological absorption of a protein from native protein (in a food product) to usable protein. Included in milk protein are casein and the protein in whey (provided commercially as whey protein concentrate). They have the highest PER at 3.2, indicating that the body most easily absorbs them. For this reason, whey proteins make excellent sources for protein for infant foods, and amino acid supplements. Whey protein concentrate (WPC) is mainly beta lactalglobulin and alpha lactalbumin along with immunoglobulins. WPC can absorb water, bind, and gel. For this reason, WPC is used in surimi. See Nutrition.

Percentage Solids – In an emulsion to be spray dried, the amount of carrier plus oils, etc., divided by the total (including the water) times 100%. See Fix, Load, Spray Drying.

Perception – The process of becoming aware of a stimulus. Perception is the interpretation of a sensation. See Stimulus.

Percolation – The continuous running of steam, extremely hot water, or another appropriate solvent through a flavorful mass to extract the aroma and taste materials. See Extraction.

Perfume –

1. As opposed to a flavor, any product that is used solely for the purpose of providing an aroma or fragrance and is not meant to be ingested. Perfume ingredients are ruled by different regulations. There are many ingredients that are common to flavors and fragrances, but their purity and food-grade status can be quite different. Some solvents that are commonly used in fragrances are not food grade. One solvent commonly used in fragrances that has a definite toxicity is diethyl phthalate. Therefore, care must be taken to make sure ingredients such as dilutions of absolutes and other fragrance-derived compounds are food grade. This is especially true from foreign sources, where U.S. regulations may not be as clearly understood.
2. In wine, the aroma of the aged wine. See Regulations.

Pericarp – The pericarp is the outside coating of a seed or husk. See Mesocarp, Endocarp.

Perilla (Perilla frutescens) – The oil contains perilla aldehyde, aka dihydro cuminaldehyde at approximately 50%. The oil has recently been made GRAS. Perilla aldehyde is otherwise known as dihydro cuminaldehyde. Cuminaldehyde is the active constituent of cumin seeds and cumin oil. In Chinese cooking, perilla is called shuo. See Appendix 2 and Chart 466 – Perilla Oil.

Periwinkle or Vinca major, Linn – See Appendix 2, Vinca Minor (Lesser Periwinkle).

Permeability – The ability for a fluid (liquid or gas) to pass through a solid. Semipermeable membranes are used for membrane filtration. Oxygen permeability is measured in packaging to avoid product oxidation and potential spoilage.

Peroxide Value (PV) – The analysis that determines the amount of peroxides present in an oil, a measurement of its quality.

Persic Oil – Apricot or peach oils. See Apricot, Peach, Vegetable Oils, and Chart 437 – Persic Oil.

Persillade – A mixture of parsley leaves and garlic chopped finely and sautéed.

Persimmon (Disopyros spp.) – Related to the ebony tree, the persimmon includes many species including the Asian persimmon (D. khaki) and the American persimmon (D. virginiana). Other Asian varieties are the hachiya and fuyu. In Israel, the fuyu is also called Sharon. Japan has adopted the khaki as the national fruit. The pulp is viscous and liquid with a fragrant flavor. The flavor profile is reminiscent of a date or fig with tomato-like/citrus kiwi undertones. Aldehyde C7 seems to be present, reminding one of the insides of a fresh pumpkin. See Chart 13 – Aldehydes Aliphatic & Keto Aldehydes & Cyclic Ald.

Personality – The complex characteristics of a person, a flavor, food, etc. See Creativity, MBTI.

Personality Errors (Capriciousness versus Timidity) – This error manifests itself especially in hedonic scales where some people tend to give wide ranges in ratings, and others give small ranges. For this reason, the scores must be analyzed on a day-to-day basis relative to each individual tester. See Logical Errors, Stimulus Error, Halo Effect, Expectation Error, Order of Presentation Error, Mutual Suggestion Error, Error of Habituation, Motivational Error.

Personality Types – The study of psychometrics or personality testing has been approach from many different aspects. As it revolves around flavor development and creativity as well as sensory evaluation, it is an obvious aspect we should consider. Some tests are; Meyers Briggs, Keirsey Temperament Sorter, and 16 Personality Types. See Creativity, Sensory Evaluation, Capriciousness versus Timidity, Errors of Analysis.

Peru Balsam (Peruvian Balsam) (Myroxylon pereirae Klotzsch) – Peru balsam is used quite extensively in flavors, especially in brown flavors such as vanilla where it can contribute a warm background synergizing with existing vanilla and vanillin notes, used to enhance many brown-type flavors, colas, butterscotch, chocolates, maples, etc. See Solid Extracts and Chart 293 – Peru Balsam.

Peruvian Mastic – See Schinus Mole.

Peruvian Pepper Tree – See Schinus Mole.

Pesticide – A substance that kills pests.

Pest Control – A qualified Pest Control Program is crucial to a well-run Flavor Facility. Monitoring activities, well placed bait stations, pesticides kept off site and an annual reporting are all part of a good Pest Control System. See HACCP, GMP.

Pesto Sauce – A popular all-purpose dressing or sauce made from pounded basil, garlic, pine nuts, Parmesan cheese, and olive oil.

Pet Food Flavors – Comes in two main categories:

1. Pet Palatability Flavors, Pet Attractants.
2. Pet Food Odor Masking Flavors.

See Pet Palatability Flavors.

Pet Palatability Flavors – Flavors that when added to a food product will increase the desirability of a pet food. Masking flavors are added to pet foods to cover up unpleasant odors to the human consumer, although these same odors might be very pleasant to the pet. Examples of types of unpleasant odors are those that come from digests of meat and offal (organs and other by-products of meat slaughter).

Pet Palatability, Pet Attractants – The measurement of the degree of dog or cat, or other pet and its preference to a food in question. For example, two dishes are typically presented to a dog at the foot of its run, and measurements are made as to any difference in product consumption. These dishes are switched so left- or right-handedness is accounted for. Hedonic testing techniques are applied to the results.

Petri Dish – A pair of shallow glass or plastic plates that fit one on top of the other, which are approximately 1/2–3/4 inch deep. The petri dish is usually used with a nutrient media for the purpose of growing microbiological cultures. Petri dishes are usually first sterilized to avoid chance external contamination, and then a nutrient-rich gelling substance (usually made from agar) is poured in the bottom dishes, each of which is called a plate. This agar based substance provides a rich culture for microorganisms to grow. Often the substrates used are prepared using different techniques and/or substrates to foster the growth of a certain type of organisms. Some media are developed to grow yeasts and/or molds, and some are developed to grow normal bacteria, others still are developed to inhibit all but pathogenic bacteria. Using these techniques, specific assays and identifications can be made. When inoculated, the larger top plate is placed over the bottom, and the incubation period begins. The media is then removed and the colonies of microorganisms are then counted and identified. Colonies can be identified by simple visual inspection, because the size, shape, and general appearance of yeast and molds take on a different configuration than other types of colonies. Both qualitative and quantitative microbiological identification can be further accomplished by analysis under the microscope (shape of colonies, i.e., rods, spheres, chains, etc.) and by differential staining (Gram or Wright stains). The result is usually reported in colonies per gram. See Microbiological Assay.

Pe-Tsai – See Chinese Cabbage.

Petitgrain, Lemon – See Petitgrain and Chart 294 – Petitgrain.

Petitgrain, Mandarin – See Mandarin.

Petitgrain (P. bigarade or Paraguay Petitgrain) – Petitgrain (alternate spelling petitgrain) is defined as the steam distillation of the leaves and twigs of a citrus tree. Therefore, mandarin petitgrain, lemon petitgrain, and this citation are all different forms of petitgrain derived from different sources. Petitgrain bigarade, which comes from the bitter orange tree, is often referred to as the true petitgrain, and the others as petitgrain mandarin, etc. See Chart 294 – Petitgrain, and Appendix 2.

pH –

1. A scale measuring acidity versus alkalinity. Low pH means the product is acid; high pH means the product is alkaline or basic. A neutral pH is 7.

2. The logarithmic value of the concentration of hydronium ions.
3. pH is an important factor in foods, because it determines what state some of the chemicals are in, be it ionic or not. It also can determine the microbiological stability of the product because many harmful bacteria are sensitive to low pH. Bacteria that are not sensitive to low pH are called acidophiles.

See Microbial Assay, Acidophilic Micro-organisms, Bacteria, Gram Negative Bacteria, Gram Positive Bacteria, Anaerobic Organisms, Aerobic.

PHA – See Polycyclic Heterocyclic Amines.

Pharmaceutical Flavors – Flavors usually developed to cover up the off characters that are introduced into a drug or pharmaceutical preparation (pharmaceutical industry) by an active ingredient or necessary adjuvant or additive to the active ingredient. Because these bases can be pharmaceutically potent and also potentially harmful, care must be taken when one is working on flavor projects for the pharmaceutical area. One must avoid tasting the base to see a flavor's effectiveness to minimize exposure of the taster to harmful pharmaceutically active agents, if not preventing exposure altogether. Tasting and then spitting out is not necessarily a safe answer because some types of medicinal components might be absorbed buccally (through the mucosa of the mouth and directly into the bloodstream). See Masking Agent, Health Food Industry, Nutraceuticals.

Pharmacology – The study of natural products and their effect on the body. This includes the study of natural extracts and botanicals. See Appendix 2.

Phase(s) – Oil phase or water phase, the character of the environment in which an ingredient is found. See Partitioning.

Phenol – The subcategory of aromatic alcohols that in simpler forms elicit burnt, tar-like, or smoky flavors. Phenols are bacteriostatic (i.e., they hold down the growth of bacteria). For this reason, phenolic substances are added to plastic bandage strips both for its clean antiseptic aroma effect and its ability to retard bacterial growth. The chemical listing in this book is included in the general category of alcohols (aromatic) due to all of the potential variations in odor of these compounds in conjunction with other moieties (i.e., ethers, carbonyls, acids, aliphatic alcohols, etc.). See Burnt or Burned; Tar-like, Tarry; Smoky, [Alcohols, Aromatic], Ethers; Carbonyl, Acid, Moiety.

Phenolic – Having a flavor characteristic typical of the phenols (i.e., tar-like, burnt, smoky, and charred).

Phenyl Acetates/Phenyl Ethyl Esters/Phenyl Ethyl Ethers – For the most part, phenyl acetates and phenyl acetic esters are honey like, somewhat floral, and find their way into many exotic fruit flavors, and even brown characters where a honey nuance is useful. These include chocolate and cocoa flavors (especially the isoamyl and butyl types). They are relatively heavy and have lower vapor pressures than most of the other GRAS compounds by virtue of their larger molecular weight. The phenyl acetate moiety can thus be abbreviated as POAC, similar to acetates that can be abbreviated as OAC. Odorwise, phenyl acetates and phenyl ethyl esters are somewhat interchangeable by molecular weight as are the alkyl esters. The phenyl ethyl esters are somewhat more floral than their corresponding phenyl acetates. In other words, ethyl phenyl acetate (C-2+POAC) and the compound phenyl ethyl acetate (POAC+C-2) are relatively the same in strength. Note the group of phenoxy acetates is listed here as well due to their relative similarity to phenyl acetates. See Chart 254 – Phenyl Ethyl Compounds and Phenylacetates.

Phenyl Propyl Esters/Phenyl Propionates and Phenyl Butyl Esters – Similar to phenyl ethyl esters in character. However, as these chemicals have correspondingly higher molecular weights, they are typical lower in relative vapor pressure resulting in aromas that are heavier. See Phenyl Acetates/Phenyl Ethyl Esters, Floral, Perfumey, and Chart 255 – Phenyl Propyl and Phenyl Butyl Esters.

Pheromone – Mostly detected through the vomeronasal organs, a pheromone can be a small molecule or a macromolecule with a low vapor pressure, but which can be detected at extremely low levels in the air. Pheromones are substances that elicit a response in the organism that secreted it or in another organism that detects it. In humans, the pheromone so far discovered is a complex and large molecule. It is chemically related to the hormone testosterone and is called androsterone. Androsterone has been identified as the human pheromone present in the urine. Androsterone is also the pheromone that is present in truffles and active as a sex pheromone in pigs, boars, and dogs. It is for this reason that dogs and boars are effective in hunting down truffle sites. Androsterone is a curious odor substance in that different people can perceive it differently. Some detect it as a fruity/grapey character, others as a camphoraceous or aromatic type, others as a urine-like or sexy/musky aroma, and still others cannot perceive it at all. The degree of perception is also quite varied. Some can detect it in very low concentrations. One example of the result of powerful pheromonal influences on our lives is the observation of coincidental menstrual cycles in women that work closely together. A recent fragrance, which used

androsterone, was promoted as a possible sex attractant. See Androsterone, Vomeronasal Organ.

Phloretin – 3-(4-Hydroxy-phenyl)-1-(2,4,6-trihydroxy-phenyl)-propan-1-one – Obtained from the decomposition of phloridzin and used in the treatment of malaria as a quinine replacer. Studies have shown it inhibits protein kinase C and effects the sodium/potassium transfer across membranes. It is found in the root bark of apple trees as a glucoside called phloridzin. One study concerned its effect and treatment of the disease cystic fibrosis; others pointed to its uses as an antagonist of prostoglandins in the reduction of inflammation and general skin disorders. See Alcohols (Aromatic), Ketones (Aromatic), Nutraceuticals, and Appendix 2.

PHO see Partially Hydrogenated Vegetable Oils.

Phosphates – Phosphates are used for a variety of reasons. Tricalcium phosphate and disodium phosphate are used as anticaking agents. Both sodium hexa meta phosphate and tetrasodium pyrophosphate are good at tying up proteins to shield them against acid denaturization (also known as granulation). No living organism is capable of synthesizing the phosphate ion; therefore, it must be absorbed through the food supply. See Chart 256 – Phosphates and Figure 28.

Phospholipids – A lipid that contains nitrogen and phosphorus. Example: Lecithin.

Photogyric – See Optical Rotation.

pH Stabilizers – See Buffer.

Phthalide – A lactone connected to a benzene moiety, phthalides tend to be warm, brown, and celery like, reminiscent of lovage with a maple-like undertone. Because of this, phthalides can be used in any product where a brown, maple/nutty nuance is beneficial as in maple, nuts, vanillas, chocolates, rums, etc. See Maple, Chocolate, Brown (Compounds), Nutty, Ethers, Lovage, and Chart 257 – Phthalides.

Physical Analysis – The testing of products by physical means as opposed to instrumental or wet analysis. This would include specific gravity, sieve analysis, optical rotation, refractive index, bulk density, and other physical non-electronic tests. See Sensory Analysis, Instrumental Analysis, Wet Analysis.

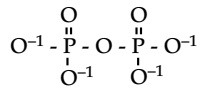
Physical Characteristics – As opposed to chemical or biological characteristics, physical characteristics could include flowability, bulk density, color, particle size, solubility, and crystallinity. See Bulk Density, Solubility, Color, Particle Size, Sieve Analysis.

Physics – From Merriam Webster Dictionary; 'The science that deals with matter and energy and their interactions in the fields of mechanics, acoustics, optics, heat, electricity, magnetism, radiation, atomic structure, and nuclear phenomena.' See Chemistry, Particle Physics.

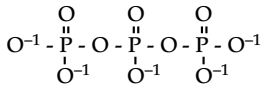
The Chemical Structure of Phosphates

Phosphate
$(PO_3)^{-3}$

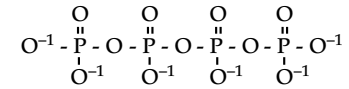
Diphosphate
or Pyrophosphate
$(P_2O_7)^{-4}$



Triphosphate
$(P_3O_{10})^{-5}$



Tetraphosphate
$(P_4O_{13})^{-6}$



Hexametaphosphate
Typically, chemistry favors a more stable ring structure.
$(P_6O_{18})^{-5}$

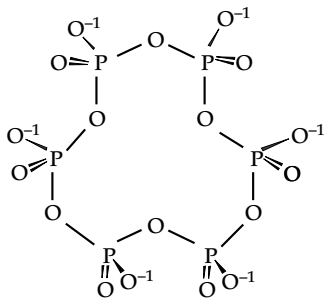


Figure 28

Phytic Acid – An acid found in grains that would normally block the absorption of calcium in the body. However, phytase is present in most of these grains and allows for the hydrolysis of phytic acid by the body as well, nullifying the effect. See Grains.

Phytochemical – A bioactive ingredient found in many natural extracts of plant origin. Nutraceuticals are a class of phytochemicals. These are classified as components of natural origin that have nutritional or pharmaceutical effects. The following are identified or suspected phytochemicals: 6-Gingerol, 10-Gingerol, 8-Gingerol and 6-Shogol, all found in Ginger Oleoresin. See Nutraceuticals.

Phytoestrogen – Naturally occurring chemicals that can act like the female hormone estrogen when eaten. These include isoflavones (flavonoids) in soy and other legumes, lignans (non-flavonoids) in grains, fibers, seeds, berries, and nuts. Flavonoids include isoflavones (genistein, daidzein, glycitein, formonoetin, biochanin A, etc.), flavonols (quercitrin, kaempferol, rutin, and others), flavones (naringenin, hesperidin, etc.), flavanols/catechins

(epigallocatechin 3 gallate, etc.), anthocyanins/stilbenes (cyanidin 3 – glycoside [C3G], kuromanin, trans reservatrol, etc.), coumestans (coumestrol, etc.) found in legumes and prenyl flavanoids (8 prenylnaringenin, xanthohuimol, isoxanthohumol, etc.). True risks or effects are currently unknown. See Isoflavones, Flavonoids.

Phytosterol – A chemical found naturally in foods that has the ability to lower cholesterol absorption in the digestive tract thereby lowering overall cholesterol levels in the bloodstream. See Nutraceuticals, HDL, LDL, Cholesterol, and Appendix 2.

Pica – The craving of non-food substances. Pica occurs occasionally during pregnancy and in infants.

Pickle – See Cucumber, Pickling.

Pickling – The process of soaking in an acid, like vinegar, or a flavorful acidified media. The term pickling has also been used for soaking in a basic media as well as in the process of pretzel making. The exposure to an acid media breaks down some of the more complex molecules, starches, proteins, etc., and makes the food product easier to digest. It is a process that has been used for the preservation of foods for centuries. See Acetic Acid.

Pico – One trillionth in the metric system.

Picrorhiza kurrua or kurroa – See Appendix 2.

Pictograms – The graphic designations of the hazard group as defined under the HAZCOM 2012 OSHA regulations. The pictograms are white filled red lines squares on end with graphic representations in the center. There is typically a chart with word descriptions further explaining the subcategories. The six categories are: 1. Health Hazard (Carcinogen, Mutagenicity, Reproductive Toxicity, Respiratory Sensitizer, Target Organ Toxicity, aspiration Toxicity); 2. Flame (Flammable, Pyrophoric, Self-Heating, Emits Flammable Gas, Self-Reactive, Organic Peroxide); 3. Exclamation Mark (Irritant (skin and eye) Skin Sensitizer, Acute Toxicity (harmful), Narcotic Effect, Respiratory Tract Irritant, Hazardous to Ozone Layer (non-Mandatory); 4. Gas Cylinder (Gas Under Pressure); 5. Corrosion (Skin Corrosion/Burns, Eye Damage, Corrosive to Metal); 6. Exploding Bomb (Explosives; Self-Reactive, Organic Peroxide); 7. Flame Over Circle (Oxidizer); 8. Environment (Non-Mandatory) (Aquatic Toxicity); 9. Skull and Crossbones (Acute Toxicity – fatal or Toxic). See HAZCOM 2012, OSHA.

Pignoli – See Pine Nut.

Pilaf Method of Rice Cookery – Rice Is first precooked either dry or coated with a fat imparting a nutty character. Then water is added, it is cooked covered and then fluffed before eating. See Risotto Method, Rice.

Pimento (Pimenta, Allspice, Jamaican Pepper) (Pimenta officinalis Lindl.) – The reason why it is called allspice is because it is reminiscent of pepper, clove, nutmeg, and cinnamon. Pimento is also known as Jamaica pepper or myrtle pepper. Oil from the berry is far superior in flavor quality to oil derived from the leaf, but because of its significantly lesser yield, is also costlier. The oil contains eugenol, methyl eugenol, caryophyllene, phellandrene, and cineole, an aroma and chemical profile similar to that of the cinnamon (non-cassia) and clove oils. Because it has a sweet, spicy subtle character, it can be used in all types of fruit flavors. See Pepper, Sweet (Pimiento) and Chart 295 – Pimento.

Pimiento – See Pepper, Sweet.

Piña Colada – A beverage, usually alcoholic, that is a blend between coconut and pineapple usually with a rum base.

Pine (Pinus spp.) – The Pinus species is a varied group. The P. mugo variety contains small amounts of lower aliphatic aldehydes that give it a unique profile. The P. sylvestris variety contains borneol and bornyl acetate with phenols and acids that give it a warm balsamic pine-like profile. Lighter fractions of pine oil are called wood turpentine. The main constituents are terpineol, ketones, estragole, fenchone, fenchyl alcohol, and borneol. P. sylvestris has a sweeter character than P. mugo or P. strobus. With a turpentine background. See Pine Nut and Chart 296 – Pine.

Pineapple (Ananas comosus) – Pineapple is the fruit of an herbaceous plant. Its name is derived because of its appearance and similarity to a pinecone. The fruit is made of a series of small individual fruits called eyes. The juice at the base of the fruit is usually sweeter. Pineapple is often sliced and sweetened. This fruit has a long history of cultivation, and has many varieties throughout the tropical world. Cross breeding and cultivation are a constant process in major plantations such as those in Hawaii. Varieties include the Cayenne pineapple (juicy, tart, and sweet), which is the most common variety; the Queen pineapple, which is actually small, less acidic, and not as sweet; the Red Spanish pineapple, with a purplish skin, very aromatic, and acidic; and the Pernambuco pineapple, which is moderately acidic, tender, and sweet. See Chart 461 – Pineapple.

Pineapple Sage (Salvia elegans) – A herb that tastes a lot like pineapple or Piña Colada. It can be used in fruits salads or drinks.

Pine Bark Extract (Pinus sp.) – See Appendix 2.

Pine Nut (Pinus spp.) – The pine nuts are the seeds from the stone pine (P. pinea) (also called the umbrella pine). The nuts are usually hand harvested, and are therefore expensive (unless around

the area of production). Pignoli nuts, as they are called in Italian, are used in many of the country's recipes. Use of the nuts in an almond- or marzipan-flavored cookie is a popular use of pine nuts. These cookies are called pignoli cookies. The araucaria (A. araucana) is another variety of pine nut that is somewhat larger and originated in Chile. See Nut(s).

Pine Tar (Pinus palustris and other Pinus species) – Although in the CFR pine tar is considered an artificial flavoring, both FEMA and EUFUS state that the product is solely derived from Pinus spp. and is therefore natural. See Smoky; Botanical – Smoke; Tar-Like, Tarry; and Chart 296 – Pine.

Piney – Reminiscent of the profile of pine. See Pine.

Piperine – The active ingredient in pepper oleoresin. See Pepper.

Piper longum – Indian Long Pepper or Catkins. See Appendix 2 and Chart 488 – Piper longum.

Piperonal (Heliotropine) – A widely used chemical that is found in vanilla extract as well as other natural products. Heliotropine has a clean, sweet, sugary vanilla cake-like profile. It is useful in flavors like marshmallow, chocolate, as well as a modifier in all non-citrus-type fruit flavors. It can be used as a modifier, rounding out brown-type flavors and is generally useful as a sweetness enhancer with compounds like vanillin, ethyl vanillin, Maltol™, Ethyl Maltol™, the furanones, and some of the solid extracts and balsams (Balsam Peru, Fenugreek solid extract, and St. John's bread solid extract). See Chart 258 – Piperonyl Esters.

Piperitenone Oxide (PO) – Isolated from a species of the Spearmint Plant, Mentha spicata L. variety viridis, PO has been looked at for its effect on the malarial-causing mosquito Anopheles stephnsi. It has been seen to kill the larva and the eggs, deter the laying of eggs, kill the developing larva, and have an effect at other stages of the mosquito as well. It also has been seen to help digestive problems and diarrhea with blood in the stool. See Nutraceuticals, Botanicals, Pathogenic (Pathological) Organism, Disease, Chart 479 – Piperitenone Oxide.

Pipette – A glass or plastic tube that is used to transfer or measure materials, usually liquids. Pipettes can be purely for the transfer of material or it can have finely marked graduations used for measuring precise amounts.

Pipsissewa – Chimaphila umbellata (LINN.). See Nutraceuticals, Chart 297 – Pispsissewa, and Appendix 2.

Piquant – Piquant means pleasingly spicy and sweet.

Pistachio (Pastiche vera) – The seeds are green with a nutty character. The shells are initially cream colored, but take on a pinkish hue when dried. The U.S. food industry colors the shells a further brilliant red through the use of FD&C dyes. Pistachio flavor, as is used in ice cream, is more of a brown/green almond character than the true taste of the pistachio nut. See Ice Cream, Benzaldehyde.

Pith – The usually soft inside of a food as in the soft fluffy portion in the center of a citrus fruit or in the center of a berry.

Plain –

1. In tea terminology, without characteristic flavor, or overly simple with just a sour taste.
2. A very low or uninteresting flavor profile. See Flavor Quality, Subjective Analysis, Objective Analysis.

Plantago major – Plantain is the fruit of a banana-type tree. The plantain is the cooking banana rather than the typical yellow banana Musa nana and cannot be eaten raw due to its higher starch content. However, upon cooking, the starch in the plantain converts to sugar and then becomes edible. See Banana and Appendix 2.

Plantain (Musa paradisiaca) – Plantain or Broadleaf plantain, Lanceleaf plantain, Ribwort or Plantago lanceolata.

Plant Culture – Cells that have been grown in a petri dish. Used for further manipulation, cloning, hydroponics, recombinant work or research, etc. Also called a plant cell culture.

Plant Disease – A concern in the propagation of fruits and vegetables, plant diseases effect not only cost and efficiency of the final product but quality and reproducibility of flavor profile. Some examples of concern are the citrus Greening disease or huonglongbing (HLB) effecting citrus crops, phylloxera from microscopic sap sucking insects, and different diseases of grapes brought about by infestation of the glassy-winged sharpshooter.

Plasticity – A physical property that refers to the degree of softness, flexibility, and moldability of a fat or other malleable substance at a given temperature and pressure.

Plasticizers – Chemicals that affect the texture of a food, chewing gum, etc. These ingredients usually improve on the chewiness, smoothness, shininess, and resiliency of the substance.

Plasticky – Having a flavor reminiscent of plastic. (Usually connoting solvents and lower esters or alcohols like ethyl acetate, amyl acetate, acetone, isopropyl alcohol, etc.).

Plate, Plating – The liquid on powder dispersion by mechanical means. Plating increases the surface area tremendously, therefore the liquid is far more prone to oxidation and volatilization. Spray drying is the far more preferred method of dehydration. See Spray Drying.

Plum (Prunus spp.) – There are 300 varieties of plums. The earliest cultivated species were sour and low in flavor and sweetness. Some examples include:
- French plum or Agen plum – The variety used in Europe is more often used to make prunes.
- European plum (Prunus domestica, the common plum) – Sold fresh canned or as prunes. Coloration is blue or red, thick skin, greenish or yellowish flesh.
- Japanese plum (Prunus salicina) – Used fresh or canned with a higher apex. Color purple to green to yellow, with green or green-yellow flesh.
- American plum (Prunus americana and others) – Amber colored skin.
- Damson plum (Prunus institia) – Acid, tart, used for jellies. Blue skinned.
- Mirabelle plum (Prunus institia) – Also known as the ornamental plum.
- P. cerasifera – Used to make jams and jellies. Red color.
- Wild plum (Prunus spinoza, Prunus nigra) – Very tart. Small, round, blue-black color.

See Fruity, Chart 298 – Plum.

Plum Sauce – A unique mixture of sweet, savory, salty, and spicy characters, which uses the Chinese Five Spice mixture, and is one ingredient in the preparation of Peking Duck. See Chinese Five Spice, Peking Duck.

PMC – Proprietary Mix Committee of the Meat and Poultry Inspection Division of the United States Department of Agriculture.

PMC Letter – Until recently, a letter written by the PMC that approves the description, composition, and labeling of a flavor or seasoning to be used in a USDA-regulated product.

PO (Provocative Operation) – Used to propose an idea but makes no judgment as to the soundness of the idea. See Lateral Thinking, Creativity, MBTI, Personality.

Poach – To poach is to simmer in a liquid. The liquid media should be on the acid side of the pH scale. As in fish, for instance, this treatment reacts with the amines to moderate the typical fishy character. Braising uses a similar technique, although the amount of liquid is much less. A shallow poach uses a smaller amount of liquid and the liquid is usable. It is called a caisson. A deep poach uses a cort bouillon that is high in acid and is usually not used.

Point –
1. In tea terminology, a positive characteristic.
2. A rating on a magnitude estimation scale.

Point of Sale Testing – Marketing surveys that are conducted at the place where the product is bought. A well-designed questionnaire could reveal a person's opinion as to why they bought the material, either premeditated or upon impulse, etc.

Poison – A substance that interferes with normal bodily functions. A toxin is a poison that is generated by an organism. Some GRAS ingredients are considered to be poisonous at higher levels but at the levels of intended use for flavors, they are far below toxicity levels and are therefore considered GRAS. See Paraselsus, Toxicology, GRAS.

Poisoning – The act of ingesting a toxin or poison. See Food Poisoning, Endotoxin, Toxin, Enterotoxin, Exotoxin.

Polarity, Polar – The characteristic of polar versus non-polar (or ionic versus non-ionic). Chemical polarity describes whether or not a substance with a specific molecular configuration lends itself toward the development of a dipole moment. A dipole moment is an electromagnetic characteristic that develops in a molecule by virtue of its electronic configuration or structure. For example, a molecule is introduced into a polar solvent such as water, allowing it to ionize and lose an electron. A positive charge is generated at the site of a lost electron. This charge is then counteracted by a negative charge of electrons that then develops on the other side of the molecule. In this instance, the molecule could be likened to a small magnet with different poles at either end. A molecule such as this could undergo further reaction. A molecule that does not ionize and therefore has no charge is called non-polar and would typically be oil soluble. Benzene, which is non-polar and salt (sodium chloride) that is polar, are good examples of the extremes. See Solubility.

Polarized Light – Light is multidirectional due to reflection, refraction, and other effects on light waves as they are generated and travel from a source. If light is allowed to pass through a translucent substance known as a polarizing filter, this filter blocks all the rays except for those in a specific plane or angle (90 degrees from the plane of the filter). The light coming through this filtration system is called polarized light. Polarized light is used to determine a chiral chemical's relative ability to rotate the light in either a counterclockwise or clockwise rotation. This quality is called optical activity or stereo isomerization. See Optical Activity, Stereoisomers, Optical Isomers.

Polar versus Non-polar Organics – The comparison between a formulation's water-soluble (polar) components and its oil-soluble (non-polar) components. See Partitioning, Solubility, Solvent, Dipole Moment.

Polenta – A dish made from cornmeal. See Corn, Cornmeal, Nixtamalization.

Political Issues – Sometimes the regulations of a country affect the source of a raw material. This can change radically, and is something to be considered when developing a flavor. Membership to FEMA or NAFFS is one way to keep In touch with worldwide developments. See Regulations.

Pollution – Contamination of the environment by chemical substances, waste, organisms, or radioactive substances otherwise known as potential pollutants. See ECRA, EPA, NJDEPE, Effluent, Clean Air Act, PCBs, Dioxin.

Polychlorinated Biphenyls – Used in insulators, electrical storage devices, and transformers for their unique conduction and antiburning properties. PCBs conduct heat but not electricity. PCBs can be stored in the fat tissues of animals, eggs, and milk, so it is a serious pollution hazard. Besides showing a tendency to developing liver cancer, it appears that the chemical is a potent disruptor of reproductive hormones. If incinerated, however, PCBs develop the even more dangerous chemical dioxin. See Dioxin. Pollution.

Polycyclic Aromatic Hydrocarbons – See Polycyclic Heterocyclic Amines.

Polycyclic Heterocyclic Amines (PHA) – Potent carcinogens formed by the action of heat on meat proteins. Polycyclic Aromatic Hydrocarbons are similar compounds. They are formed during the cooking process and vary according to how much time and heat are applied, distance to the heat source, and whether or not fat is allowed to drip onto the heat source. Benzopyrene has been studied in smoke applications and especially in smoke extracts. The chemical [6-phenyl-2-amino-1-methylimidazo[4,5-f] pyridine (PhIP)] is formed by the action of creatine and l-Phenylalanine. The amounts of PHAs present in meats in the normal cooking process far outweigh any contribution from meat used (meat digests, for example) in natural flavors. See Chart 462 – Polycyclic Heterocyclic Amines.

Polygonum cuspidatum or Japanese Knotweed – See Appendix 2.

Polygonum multiflorum – See Appendix 2.

Polyhydroxyl Compounds (Polyhydric Alcohols) – See Sugar(s) and Polyhydroxyl Compounds.

Polymer, Polymerization – The formation of larger molecules by combining bits of smaller molecules together. This is the way plastics are formed. Some chemicals have a tendency to polymerize. One of these is phenylacetaldehyde, and care must be taken if phenylacetaldehyde has become thick, because it has probably lost a significant amount of its flavor impact. See Shelf Life.

Polyphenol – A class of chemical compounds including tannins, lignins, and flavonoids. They have been seen to have antioxidant properties, which are believed to absorb free radicals, which in turn are believed to cause cellular damage and general aging. See Nutraceuticals, Antioxidants, Lignin, Flavonoids.

Polyphenyl Oxidase – Polyphenoxidase and Laccase. The former is responsible for enzymatic or table browning. Ethylene catalyzes the enzymatic reaction, so ripening fruits kept in a refrigerator will catalyze other fruits to quicken their ripening process due to the production of the catalyst ethylene. Antioxidants (Vitamins A, C), pH lowering agents (acidulants), and protective measures against oxygen can help avoid this if necessary. See Fruit, Enzymes, Oxidation, Reduction; Ripe, Ripening; Table Browning, Non-Enzymatic Browning.

Polysaccharide – A complex sugar or carbohydrate like a starch, multiple sugars, or a fiber. A polysaccharide is defined as a molecule made of at least three molecules of simple sugar. The classes known as fibers are polysaccharides that include cellulose, hemicellulose, pectin, and lignin. Cows, goats, and other ruminating animals, which chew their cud, have cellulases that break down these types of compounds. However, humans do not. But humans do need these fibers to aid in digestion and facilitate proper bowel development, and aid in gastrointestinal function. Cellulose is the molecule that makes up wood and the outside cell wall of plant matter. It is found in large quantities in vegetables and legumes. Pectin is found in apples, squash, cabbage, and citrus products. Pectin is also used as a gelling agent to make pectin jellies. Hemicellulose is the fiber found mainly in cereals and aids in the digestive function. Mucilages are similar to pectins in their effect and are found in legumes, oats, and barley. Lignin is not a carbohydrate, but is found as a fibrous material in the cell walls of certain vegetables. It is also found as a binder of wood cells and is a by-product of the paper industry. Lignin was used as a starting material to produce vanillin. Vanillin can be produced as a direct product of simple lignin oxidation. However, recent environmental regulations have made this process difficult if not extremely costly, and less vanillin is made from the lignin process than in the past. See Fiber, Vanillin, Modified Food Starch.

Polysorbates and Sorbitan Esters – These compounds are used as emulsifiers although they typically have soapy off flavors, and yield an oftentimes unwanted foam if the final product is agitated. The CFR cites the general uses of polysorbates as (1) diluents for colors (73.1, 733.1001); (2) synthetic flavoring substances 172.515; and (3) emulsifiers and surfactants

either alone (178.3400) or in combination with carrageenan (172.623). See Chart 259 – Polysorbates and Sorbitan Esters.

Polyunsaturated (Fat) – A fat that has one fatty acid containing multiple double or triple bonds. Many oils are made up of polyunsaturated fatty acids as their 'arm' in the trialcoholic ester branch. It is generally viewed that polyunsaturated oils are healthier. Chemically they are less stable, have a lower melting point, contain more potential off flavor, can readily oxidize, and would have a higher iodine value. See Iodine Value, Glycerides, Fat, Fatty Acid.

Pomade – Any fat that is saturated with aroma and fixed oils. A few different extraction processes, one of those being the enfleurage process, produce pomades. See Enfleurage.

Pome Fruits – A group of fruits including the apple, loquat and quince, and pear. The seeds of pome fruits contain an amount of amygdalin although they are too small to be commercially feasible sources of bitter almond oil as in the Prunus sp. group. See Bitter Almond Oil.

Pomegranate (Punica granatum L.) – Pomegranates have had a long history of popularity. They were mentioned in the bible, reside in ancient mythology, and appear in ancient paintings and manuscripts. Recently, however, the main use for the fruit is as produce. The flavor is high in esters, almost cherry-candy like, and sweet with a fruity acidic character. The internal seeds are covered with a covering around which the flavorful juices are held. The juice contains many taste ingredients including tannins and alkaloids. The juice is used to make Grenadine™-type products that are colored with red dyes. This syrup is used as a component in many mixed drinks. See Alcoholic Beverages, Color (Colorants), Chart 146 – Alkyl Esters Grouped by Alcohol Moiety, Chart 299 – Pomegranate, and Appendix 2.

Pomelo (Citrus maxima) – Also known as a pummelo, or shaddock, the pomelo is either spherical or pear shaped, is less juicy or flavorful than a grapefruit, and is often very acidic. The pomelo is often candied or cooked. See Citrus, Grapefruit Oil.

POP (Persistant Organic Pollutants) – Chemicals that are resistant to degradation by natural processes. These chemicals often are fat soluble and can be stored in the fat layers of animals reaching dangerous to lethal doses. Some of these substances are potent genotoxins and can develop tumors in the animals or effect genetic changes, which can mean mutation in their offsprings. See Pollution, Genotoxin.

Popcorn Lung – The degenerative disease caused by the improper exposure to diacetyl first reported by workers in a butter popcorn flavored producing company. See Bronciolitis Obliterans.

Poplar (Populus balsamifera L. and Other Populus Species, Populus tremuloides [MICHX.]) – Before the leaves open up in the spring, they are protected by a hood and have a very thick resinous substance. It is this substance that is quite fragrant and is used in alcoholic beverages. See Resinous, Fragrant, Chart 300 – Poplar, and Appendix 2.

Poppy Seed (Papaver somniferum L.) – It is the unripened poppy that has powerful narcotic effects. Ripened, the seeds are used to top many baked items and salad dressings. Poppy seed is also called maw seed. Seeds vary in color from yellow to brown (Turkish) or slate blue (European). See Garnish and Chart 301 – Poppy Seed.

Poria cocos – Also known as Fu-Ling. Used to treat a number of general ailments. See Appendix 2.

Positive List – A listing of acceptable materials (flavoring materials). A positive list system has been adopted in many countries; The United States, The EU, Japan and many others. See GRAS List.

Post-Op or Post Operational Procedures – Part of the HACCP system but not the HACCP Plan that includes the prerequisite programs after the batch is finished. See Allergen Control (Protocol), Label Control, Pallet Control, Equipment Cleaning, Food Safety, HACCP, Packaging Control, Shrink Wrapping.

Potable, Potability – The ability to be consumed (usually referring to alcoholic beverages). The previous test was to taste the flavor. This has been modernized to use an ingredient based system now computerized called Formulas Online. See TTB, Non-Potable, Non-Beverage Alcohol, Drawback, Flavor Non-Fitness Worksheet, Formulas Online.

Potato (Solanum tuberosum) – Potatoes come in 3,000 different varieties including all blue types, white Marfona potatoes, red Desiree, Idaho, and early potato types. The outside covering, or peel, contains eyes from which new sprouts will form. Potatoes are rich in starch and when iodine is dropped onto a peeled spot, or any other starch-containing food product, it will turn dark brown. The sulfurous substance known as potato aldehyde, methional, or beta methyl mercapto propionaldehyde gives the boiled or cooked potato its flavor. The substance is derived as a Strecker aldehyde formed from the degradation of the amino acid methionine during the Maillard Reaction. During Passover, there is a religious restriction against the use of grains in the Jewish religion. Therefore, potato starches or a tuber-based product called tapioca starch can be used to replace corn or other grain-based thickeners. Solanine is an alkaloid produced by the plant to protect against invasion by insects around areas

where potential sprouting might occur. Solanine is a poison and has a fairly low lethal dose. Green potato areas must not be eaten, therefore. Light initiates the production of solanine. Potatoes should be stored in a dark, cool, well-ventilated area. New potatoes should be used within a few days. A warm environment will initiate sprouting and drying out. Too cold an area will result in the potato's conversion of starches to sugars and the result will be brown spots in the final product due to Maillard browning. Idaho or russet potatoes have a low moisture content and a high starch content. They are good for French fries and baking, but not for boiling, steaming, roasting, or stewing. New potatoes have low starch content and are good for those methods. Sweet potatoes and yams are other tubers that are similar to potatoes, but are actually related closer to carrots. Acid will inhibit discoloration due to Maillard Reaction. Potatoes can also react with free iron and turn gray to black. Acid can again help in this case. See Strecker Degradation, Methional, Methonine, Religious Regulations, Kashruth, Kosher, Passover, Sweet Potatoes.

Potato Chip – A thin slice of potato, which is then fried, yielding a flavor that is a combination of Maillard ingredients, Strecker aldehydes (methional), and fried components (unsaturated aldehydes and acids). It is the legend that a customer complained that the fried potatoes served were too thick, so a chef produced a paper-thin fried potato and thus created the chip. See Fried (Oil) Flavor, Free Radicals.

Poterium sanguisorba or Sanguisorba minor – See Appendix 2.

Poultry – One of a group of edible fowl including capon, chicken, cockerel, duck, hen, goose, guinea fowl, pheasant, pigeon, quail, and turkey. Salmonella contamination is a problem with most poultry products; therefore, care must be taken when handling any of the above. The flavor of poultry as with most meat products has been the topic of extensive study. Except for a small amount of flavor volatiles coming from the proteinaceous part of the meat, most of the flavor really comes from the fat portion (dienals in the fat). See Egg, Fat, Sulfur.

Pound – 453.592 grams. The measurement of weight typically used in the U.S. Although it was attempted by the United States to convert to the Metric System it did not entirely succeed. In 1968, Congress initiated the U.S. Metric Study, the Metric Conversion Act's efforts in 1975 but was disbanded in 1982. There are still some holdouts. In the supermarket metric unites are often found in parentheses, nonalcoholic and alcoholic beverages are sold by the liters, and measuring devices often have both scales. See Units of Measurement, Weight, Mass.

Poundage Survey – The Flavor and Extracts Manufacturers Association conducts this periodic query of its members to determine the usage of GRAS ingredients in the food supply. This helps in the allocation of resources for future studies. See FEMA.

Powder – A solid with fine granulation. A powder can be attained by grinding, spray drying, dehydration, or other drying methods. See Liquid, Spray Drying, Dehydration, Grinding, Sieve Analysis, Mesh Size.

Power – The probability that a true difference will be detected. The formula for power follows:

$$\text{Power} = 1 + \text{Beta}$$

Where Beta is the probability of not noticing a difference when there really is one. See Beta Factor, Beta Risk.

ppb (Parts Per Billion) – The threshold of many aroma chemicals in water, a part per billion is equivalent to a square inch postage stamp in 1 thousand football fields or a drop of milk in the full capacity of a Boeing 747 or the largest railroad tank car. See ppm, ppt, threshold.

ppm (Parts Per Million) – One useful use of ppm is as follows: The threshold range of most aroma chemicals is from 1–20 ppm. Therefore, if one drop is roughly equivalent to 0.025 gram, then 1 drop of a 1% solution of a chemical dissolved in a liquid solution filled to 250 cc is equivalent to 1 ppm, and 20 drops is equivalent to 20 ppm. A part per million is equivalent to a square inch postage stamp in a football field, or 1 inch versus 16 miles. See Solution, Suspension.

ppt (Parts Per Trillion) – A part per trillion is the amount of certain aroma chemicals, typically sulfur flavorants that can be detected in the air. A part per trillion is equivalent to the area of a typical desktop versus the map of the United States including Alaska. See ppm, ppb.

Prebiotic – Non-digestible food ingredients that form a matrix upon which beneficial microorganisms can flourish in the digestive tract, this providing positive nutritional and overall health. See Probiotics, Nutraceuticals.

Precipitation – Precipitation is the occurrence of solids coming out of solution. Menthol can be produced by the cold precipitation of Mentha arvensis (cornmint) oil.

Precursor – Components that will form other components under certain conditions. Amino acids and sugars, for instance, will yield Maillard pyrazines and other compounds when heated to appropriate temperatures, and under proper pH and moisture conditions in a food product. Amino acids can be considered precursors to brown notes. See Maillard Reaction.

Precursor List – See Chart 29 – Amino Acids.

Preference – The desire to encounter one taste over another. See Pre-Natal Flavor Preference.

Preference Test – Often employed in animal studies, two choices are presented to the subject and depending on the consumption of one over the other statistics are used to determine if there is a reasonable preference for one over the other. Due to left or right handedness (pawedness?) the product is switched.
See Sensory Testing.

Pregastric Esterase – See Enzymes.

Pre-Natal Flavor Preference – In the womb it has been determined that the fetus develops preferences based on chemicals in the blood and amniotic fluid. Preferences for anise, garlic, ethanol, mint, vanilla, blue cheese and unfortunately cigarettes have been studied. See Preference.

Pre-Op or Pre-Operation Procedures – Within the HACCP System but outside the HACCP Plan, Pre-Op Procedures is a prerequisite program that includes for example: Label Control, Allergen Cleaning Pre-Op, Equipment Maintenance and Observation, Pallet Exchange (Plastic from Wood), Cleaning and general GMP issues. See GMP, Allergen Control (Protocol), Cleaning Procedures, HACCP, Corrective Action, Post-Op or Post Operational Procedures.

Prerequisite Program – The World Health Organization defines prerequisite programs as 'practices and conditions needed prior to and during the implementation of HACCP and which are essential for food safety'. They are outside the HACCP Plan but within the HACCP system. Examples of prerequisite programs are; Production Control, Raw Material Control, Sanitation and Maintenance, GMPs and Pest Control.

Preservation (Chemical) – The preservation of foods can be accomplished in several ways. Because many microorganisms do not function well at lower pHs, acidification of foods is one of the more effective ways to preserve. Acetic acid, citric acid, lactic acid, or other acidulants can be used. A pH of 4.5 to 7.0 is the optimum for many microorganisms, so keeping the pH below a pH of 4.5 is generally the optimum range. However, with acidophilic organisms, they can strive at pHs even down to 2.0 or less. Oxygen removal is another mode of preservation. Several types of microorganisms require oxygen for their growth; thereby, if oxygen is removed, they cannot function, and they die. Some microorganisms can survive at very low oxygen pressures; these are called anaerobes and can be very dangerous organisms. One of two methods accomplishes removal of oxygen by either evacuation of existing air or by replacement of that air by another gas (purging). The process of hot sealing, and then allowing the headspace to cool forms a semi-evacuated system. This occurs because as the temperature of a gas decreases, the pressure decreases. Other ways to prevent oxygen from coming in contact with food is to protect the food from the air by coating, encapsulating, compressing, or enrobing in fat or another coating substance. Chemical preservatives are used such as sodium benzoate (prevents mold growth and some spoilage bacteria), potassium sorbate (prevents yeast growth), and many other ingredients. Sodium benzoate provides for undissociated benzoic acid (that is, the active agent in preservation). This occurs in a system after sodium benzoate is added and then the system is acidified (pH 2.0 to 4.5). Carbonation has been seen to promote the benzoate's effectiveness against certain bacteria. Also, hydroxy benzoic acid and its derivatives are also effective. Hydroxy benzoic acid is often preferred in some instances as it imparts a cleaner taste than does the straight benzoate. These products are generically known as parabens. Sorbic acid added is used in such the same way as potassium sorbate. Sorbic acid and potassium sorbate seem more useful against spoilage in fruit juices. Propionic acid or propionates can be added either as such or as a result of inoculation by propionibacterium. Propionic acid or propionate addition is another useful mode of preservation, especially in dairy products. Sodium diacetate has been used with similar results. Similarly, dihydroacetic acid can be used as an antifungal ingredient. Sulfur dioxide is used in preserving fruits and vegetables. It is also used in fermented products such as wines, apple cider, etc. Recently, peroxides have been studied as potentially effective alternatives to the above compounds because the resultant metabolites are simply water and oxygen. Nitrites are often used in wines and meats. Nitrosamines, which are the metabolites of added nitrites, were recently recognized as a source of concern. However, it has been determined that nitrosamines are also formed in the body naturally as normal decomposition products in the digestion of proteins. Comparisons were made of the levels of nitrosamines developed in the body versus the levels of introduced nitrosamines. The levels in the body seemed to be greater than those introduced by nitrite-added meat products. Therefore, the body seems to be able to counteract any adverse effect of these compounds at those levels. Besides the potential for microbial spoilage, other types of spoilage must be considered. Another type of spoilage is

oxidation and subsequent rancidification of fats to aldehydes and acids. Here, antioxidants must be used. See Canning, Botulism, Preservation (Non-Chemical), Antioxidants.

Preservation (Non-Chemical) – Food additives that maintain the integrity of the food and prevent it against spoilage. Early examples of preservation include smoking, drying, processing using lye, and salting. (Salt is considered a seasoning and is not considered a chemical form of preservation.) Fermentation is basically the development of alcohol. The alcohol produced then can act as a preservative. Fermentation as a preservation technique has a long history of practice. Lactic acid-producing bacteria that reduce the pH are used to preserve meat and are another example of fermentation. Fermented sauces made from fish (nuoc-man from Vietnam and nam-pla from Burma), fermented eggs, and fermented meats are examples. In the Scandinavian countries, spoilage is less of a problem due to the low temperatures. Here, fermented meats are popular. Freezing is another form of preservation. Both freezing (Siberia) and freeze-drying (Peru and Bolivian Pre-Columbian Native Americans) have been techniques used for centuries. Other forms of preservation include fat embedding (pemmican by Native American Indians), sugar preserving (syrups and coated fruits), and pseudo-chemical preservation. Pseudo-chemical preservation is when chemicals in natural or local mineral sources are used. One example of this is mustard. Mustard got its original name as a preserver of grape must by the Egyptians and then the Romans. Mustard seeds were added to the grape must. In Scandinavia, local lime deposits (calcium carbonate) is used in the curing of fish. Today, many of those techniques used in the past, are still used in one form or another. Canning, however, is a modern invention. The process of canning was developed first by Nicolas Appert in 1809. Louis Pasteur developed the use of pasteurization. Drying, including spray drying, and other methods of dehydration are widely used to prevent spoilage by lowering the water activity. All of these, plus chemical preservation and other modern methods, have enabled the public to consume a safer food supply. See Spoilage.

Preservatives – See Preservation (Chemical) and Preservation (Non-Chemical).

Preserves – Home processing of food for safe non-refrigerated storage. The making of preserves is a process that has been in use for a long time. Food should be first packed in airtight glass containers with special rubber seals that provide for a vacuum seal in the container when proper procedures are maintained. The product should be cooked in a pressure cooker at 250 °F to assure sterilization. See Sterilize, Sterilization; Food Preservatives.

Prickly Ash – Prickly ash or Toothache tree, American prickly ash, Zanthoxylum clava-herculis, Zanthoxylum americanum. See Ash Bark and Appendix 2.

Prickly Pear (Opuntia ficus-indica) – Prickly pear is also known as the Indian fig, tuna (Spanish word having nothing to do with the fish), or Christian fig. The fruit is found on the opuntia species cactus plant, and has a subtle, acid flavor reminiscent of a plum with a pulpy consistency that is soft and grainy, similar to a pear. See Nopal, and Appendix 2.

Prill – A particle typically made through a process of agglomeration made to address Issues of particle size, solubility, dispersibility or segregation. See Agglomeration.

Primary Alcohol – Terminal alcohol with an OH attached to only one carbon. Primary aliphatic alcohols include ethanol and the mixture called fusel oil. Primary aromatic alcohols include phenol. See Fusel Oil, Phenol, Alcohol.

Primary Amines – A chemical where an amino group is attached to the terminus of the molecule (NH_2). Primary amines usually have a protein degradation odor like spoiled fish or shrimp. See Secondary Amine, Tertiary Amine, Ammoniacal.

Primary (Grown) Yeast – A yeast that is grown directly and is not a by-product of another process. Baker's yeast is grown on molasses and is an example of a primary grown yeast. See Secondary Yeast.

Primary Odorants – Those volatile ingredients that have odors that are unique and cannot be replaced by other single odoriferous compounds or mixtures of odoriferous compounds. See Odor, Secondary Odorant.

Principal Component Analysis – A statistical analysis methodology that enables one to plot like results so that trends might be displayed, evaluated, and graphed.

Prion – Short for infectious protein, an infectious agent that is made entirely of a protein structure linked to contracting spongiform encephalopathy in animals and humans. It is linked to BSE, CWD, Scrapie, and vCJD. The normal brain has a similar chemical called PRP-C. This structure is erroneously called a prion. The proliferation of plaque on the brain tissue is due to the erroneous folding of the protein structure called PRP-SC (SC is the designation for Scrapie). Eventually the plaque deposits replace healthy brain cells and the brain takes on a subsequent spongiform or sponge-like consistency. See

Mad Cow Disease, BSE, CWD, Creutzfeldt–Jakob Disease, Scrapie.

Priorities Chart – Chart 303 – Time management issues must be considered. Those projects that are important and urgent, [A], should be given the highest priority. Those projects that are important but not urgent, [B], should be assigned long-term programs. Those projects that are urgent but not that important, [C], should be weeded out because they will deplete important time that should be allocated to the first two. The last quadrant, [D], that represents those items that are not important and also non-urgent should be rejected altogether. See Time Management and Chart 303 – Priorities Chart.

Priority – A time management-based assignment to a function or task. In this customer service-based, highly competitive climate, it is quite typical that every project ends up being a priority. This is not only a poor use of resources, it takes away needed time from quality projects for the sake of what might be those of lesser importance, thus, the need for time management. If one considers a four variables type of time management chart, the concepts might become clearer.

Proanthocyanins – See Appendix 2.

Probability – The likelihood of something occurring. See Sensory Evaluation, P-Value.

Probability Value – See P-Value Probability Value.

Probiotic – Dietary supplements that contain useful flora that are introduced to colonize and subsequently replace less desirable microorganisms in the digestive tract. Lactic acid bacteria such as lactobacillus in yogurt is one such example. See Prebiotic, Nutraceuticals.

Processed Cheese – Processed cheese is a specially defined cheese product (also includes processed cheese food) that uses enzyme-modified cheese as a flavorant. See EMC, Cheese.

Process Control – Process control includes the practice of monitoring of the system of flavor production. This can include: temperature monitoring, dehydration procedures, sieve and particle control (sieve size), color development, solubility, particle size (emulsion). See HACCP, Food Quality.

Processed Flavors – Also known as reaction flavors. Processed flavors are typically thermally developed results of using the Maillard Reaction and other browning reactions in a controlled fashion.

Processing Aids – Ingredients that can be regarded as insignificant when used at levels in the flavor, additive, or food that extrapolate to insignificant levels in the final food product, and therefore need not be declared (see Incidental Additives for Regulation). See Regulations – Incidental Additives.

Processing Conditions – Flavor volatiles are susceptible to reduction or elimination by the heat introduced during food processes, and they are often susceptible to pH, viscosity, masking effects, synergies, cover ups by off flavor development, and other processing resultant factors. Processing conditions, therefore, are very important to the proper development of the flavor system. Information such as this is crucial for the flavor lab to consider. If so, the appropriate balance of volatiles necessary to compensate for adverse processing conditions can be developed. Confidentiality of customer formulations and project information can be an issue. Many companies view the protection of new food product secrecy as paramount. Confidentiality (or secrecy) agreements signed by suppliers, like a flavor house, is one answer. But most agree that the final issue rests on trust between the parties. See Pasteurization.

Product Approach (to Marketing of Flavors) – The policy or approach to marketing that considers flavors to be developed as members of a given class of product types. Classes include fruit flavors, savory flavors, or can be further refined to include citrus flavors, cheese flavors, or specified as flavor characteristics, like natural flavors, dry flavors, reaction flavors, etc. Usually this approach is adopted as a technology-driven marketing plan. This is the opposite of an industrial approach to marketing. See Industrial Approach (to Marketing of Flavors).

Product Development – The creation and subsequent manufacture of (food) products. This procedure can take many different steps according to the nature and size of the company. A food technologist or a chef is typically employed to produce a product with shelf life, food safety, and quality in mind. Then the product is tested in production to see if the item developed in the lab holds true to quality as produced. Changes are made and the product is approved after many possible iterations. See Production Issues, Production Methodologies, Food Technology, Culinary Arts.

Product Difference Test – See Simple Difference Test.

Product Specifications – A document that usually includes the following product information:

1. Name
2. Number
3. Description
4. Microbiological assay
5. Ingredient statement
6. Usage level
7. Price
8. Depending on the system, fat, salt, moisture, total nitrogen, color, refractive index, optical

rotation, specific gravity, sieve analysis, GC profile, specifications.

Production – The activity of producing flavors. The production area in a flavor plant can include the kettle, heat exchanger, conveyor belt, sizer, packaging equipment, dryer, heater, holding tank, pasteurizer, homogenizer, heat exchanger, mixer, boiler, sifter, metal detector, shrink wrapper, loading dock, dust collector, automated flavor applicators, ribbon blender, cutter/slicer, just to name a few. See Production Control, HACCP, GMP.

Production Control – Production Control is in essence Good Manufacturing Processes. This includes procedures such as Equipment Cleaning and Maintenance, Allergen Control and identification, environmental monitoring, process control, overall sanitation and formula control. See HACCP, GMP, Process Control.

Production Issues – See A La Minute versus Industrial Scale Production.

Production Methodologies – Different procedures used to produce a batch of flavors in production. These may include heating the solids, grinding, centrifugation, filtration, spray drying, mixing, chill dewaxing, separation, neutralization, etc.

Profile, Product Profile – See Flavor Profile.

Proof – The amount of alcohol in a liquid. One percent alcohol = 2 proof. Therefore, because water azeotropes with alcohol at about 5%, distilled alcohol from spirits is no more than 190 proof. Alcohol from synthetic means can be made 100% or 200 proof. See Grappa, Ethanol.

Proofing – When something is left aside to allow changes to occur. Typically, as in bread baking, it is the time allowed for gas to form from active yeasts. This is done at elevated temperatures. Dough can be relaxed when it is kept at cooler temperatures. This loosens its gluten bonds after first forming. Chill proofing is when solids within liquids are allowed to settle at cooler temperatures to avoid subsequent separation during cold weather, storage, or shipment.

PROP – A chemical known as 6-n propyl thiouracil. Some people can taste this compound as being bitter; others cannot. This ability seems to be passed on genetically. The ability to taste PROP has been linked with the tendency of individuals to be supertasters. Supertasters are those with more fungiform papillae than the average person. Supertasters seem to be extremely sensitive in not only taste and have more food dislikes, but they also seem sensitive to trigeminal input as well. Trigeminal input includes the detection of stimuli such as mintyness/coolness, capsicum heat, black pepper bite, the bitterness of saccharin and sodium benzoate, etc. Another related chemical is PTC (phenyl thio carbamide). Approximately 30% of the population is taste blind to PROP. See Supertasters, Moderate Tasters, Taste, Taste Buds, Tongue.

Prop 65 – See Proposition 65.

Propenyl Guaethol (Vanitrope™) – Used as a vanilla enhancer, although it does contribute an often-unwanted phenolic character. See Chart 260 – Propenyl Guaethol.

Proportion of Discriminators – See Pd (Proportion of Discriminators).

Proposition 65 – A California state bill that regulates the use of certain substances that are known to the state to cause cancer or reproductive toxicity. The items that are on this list and are also GRAS as of September 1, 1996, are included in Chart 261 – Proposition 65. See Regulations, Delisted (Ingredients).

Proprietary – Proprietary Information – The quality of being secret and confidential. It is the proprietary nature of information in the flavor industry that allows it to survive. Formulas that are patented are so easy to get around using different ingredients that it does not make patenting a viable solution to protect a company's trade secrets. See Public Domain, Intellectual Property.

Proprietary Mix Committee – The branch of the USDA's Meat and Poultry Inspection Division (MPID). Until recently, the PMC group of USDA has ruled on flavor and seasoning formulations for use in meat. Currently, through a program developed by the USDA PMC committee in cooperation with the Flavor and Extract Manufacturers Association (FEMA), this process has been greatly streamlined. See Regulations.

Proprietary Mix Committee Letter – The letter that was issued by the PMC that delineated a flavor's label information for use in a meat-containing food product.

Propylene Glycol and Derivatives – Propylene glycol and its derivatives are used as solvents and emulsifiers. PG as it is usually known is the most widely used solvent in flavorings because it has good solvation properties, is relatively inexpensive, has a good flash point and is water soluble. Some opponents suggest that PG is unsafe because it is used as antifreeze. This is reverse logic because the fact that it is used as environmentally safe antifreeze as a replacement for toxic ethylene glycol which is toxic shows how safe it is. See Chart 262 – Propylene Glycol Derivatives.

Propyl Esters – See Chart 146 – Alkyl Esters Grouped by Alcohol Moiety.

Prostaglandin – Prostaglandins are unsaturated fatty acids that, over the short term, act like hormones in

helping to regulate basic body processes. This includes the control of blood pressure or smooth muscle contraction. PGE1, one particular prostaglandin, contributes to dilating blood vessels, inhibiting blood clotting, reducing inflammation, and, among other significant functions, lowering cholesterol. See Nutraceuticals.

Protease – See Enzyme Hydrolysis, Protease.

Protein – Proteins are one of the basic building blocks of life. Proteins are derived from amino acids linked together by peptide bonds (polypeptide). They are polymers made from up to 20 different amino acids. The formation of these proteins from amino acids is encoded in the genes of an organism. These genes made up of DNA are found in the nucleus of the cell. As an example AUG or adenine uracil guanine is the code for methionine the amino acid whose Maillard–Strecker degradation product yields methional, the potato like compound. Proteins can be described as having one of four structure types: Primary (linear), Secondary (sheets and strands), Tertiary (Twists), and Quaternary (folds). It is due to this complex arrangement of twists strands and folds due to hydrogen bonding attractions that proteins can take on an almost limitless range of structural and reactive possibilities. Proteins can be enzymes, catalysts, emulsifying and stabilizing agents, can join with other chemicals like sugars and fats to form still other complexes. These can produce other chemicals and so and on. The world of proteins is fascinating and ultra-complex. As an example it is the proteins in mustard flour that can stabilize an emulsion. The caloric value of proteins is considered to be 4 calories per gram. See Protein Hydrolysate, Protein Expression, Recombinant DNA, Genetic Engineering, Protein Kinase, cGMP, Calories, Enzymes, Stabilizers, Emulsions.

Proteinaceous – Proteinaceous describes the taste properties of proteins similar to Umami.

Protein Cross Linking – Treatment of proteins so that strands of amino acids are connected. DNA is made up of strands of protein linked together in a ladder-like formation. The whole molecule is twisted to form a double helix shape.

Protein Denaturing – When a protein becomes irrevocably changed due to the presence of heat, acid, enzymes, solvents (like alcohol), or other reasons. See Solubility, Protein.

Protein Efficiency Ratio – See PER.

Protein Expression – The DNA within the nucleus carries the instructions on how to produce proteins. It is the genes within the nucleus that undergo a process called gene transcription. The information on how to make a protein is sent to RNA or ribonucleic acid (DNA is deoxy ribonucleic acid), and when it exits the nucleus and enters the cytoplasm of the cell itself, the code that has been transcribed onto it is decoded by structures called ribosomes and then the process of combining free amino acids to build the protein begins. Recombinant DNA is used to make up 'novel proteins' in this manner.

Protein Hydrolysate – The generic term for protein substances that have been modified to make them more soluble in water. This includes acid hydrolysis that is used to develop hydrolyzed vegetable proteins (HVP) and enzyme hydrolysis through the use of proteases. Proteolytic enzyme hydrolysis is accomplished by the incubation of the substrate protein at the proper enzyme activity conditions. These conditions include the proper range of temperature and moisture. When the enzyme process has come to completion, a deactivation of the enzyme usually is necessary. The process of enzyme hydrolysis would include a number of steps. First, the pH is adjusted by the use of buffering salts, etc. Secondly, the proper amount of enzyme, substrate, and mixing is made. Then a proper elevation of temperature is maintained (incubation). Finally, after the enzyme has done its job, one approach to stop the continual action of the enzymes might be to raise the temperature to kill the enzymes. Another way to kill the reaction might be to add enzyme inhibitors. Enzymes can be immobilized, that is, attached to inert carriers. This way, the enzymes might be removed by filtration, etc. Enzymatic derivation of flavor materials is considered to be a natural process (CFR Title 21 101.22 – Definition of a Natural Flavor). Yeast autolysis occurs with endogenous enzymes and is therefore also considered a natural process. When Kehldahl Nitrogen Assay is used to determine the protein content, the common practice is to use a factor of 6.25 for soy protein and 5.7 for wheat gluten. See Yeast Autolysates, HVP, Hydrolysis, Autolysis.

Protein Kinase – A protein kinase is an enzyme that phosphorylates a protein (adds a phosphorous group), thereby changing its function. Different kinases do different things. Kinases can be enhanced by cGMP (Cyclic Guanosine Monophosphate) and can initiate lipid hydrolysis (Kinase C) or increase immune function. Enzyme Derived Isoquercitrin has been seen to be effective in this regard. See cGMP, Isoquercitrin, Protein, Immune System, Protein Expression, Enzymes, Nutraceuticals.

Proteolysis – Proteolysis is the action of a protease on a protein substrate.

Proton – A proton is an atomic particle having a mass number of 1 and an electronic charge of +1. Therefore, a hydrogen ion is a proton. See Neutrons, Electrons, Atom.

Provencal (Provençal) – A style of cooking related to techniques and ingredients typical of Southern France.

Prune (Prunus domestica) – Only a few plums are suitable for drying. The Agen or French plum is one, as is the European (P. domestica). Prunes used to be dried in the sun, but recently they are produced in a drying oven. See Plum and Chart 438 – Prune Juice Concentrate.

Prunus sp. – The group of fruits that include peaches, sweet almonds, bitter almonds, apricots, plums, and cherries. The fruit is classified as a drupe with a large stone. Peaches are classified as clingstone or freestone. Prunus sp. fruits have amygdalin in their pits, which can be used to produce bitter almond oil. See Bitter Almond Oil; Amygdalin; Peach; Almond, Bitter; Apricots, Plums, Cherries.

Prussic Acid – See Hydrogen Cyanide.

Psychometrics – The study of psychological measurement. Of issue in flavors and sensory evaluation are sensory capabilities, attitudes, and personality traits. See Personality Errors (Capriciousness versus Timidity), Creativity, Personality Types.

Psyllium Seed – A seed from the psyllium plant that swells upon hydration. Used as a thickener and laxative, however, its cost prohibits use as a general thickening agent. See Gums and Thickeners and Chart 164 – Gums and Thickeners.

Ptomaine (Poisoning) – A term for food poisoning that is no longer in scientific use. Food poisoning was once thought to be caused by ingesting ptomaines, the decomposition produced by bacterial putrefaction of protein. It was once customary to classify all food-related illnesses as 'ptomaine poisoning,' but it was later discovered that ptomaines do not cause illness. Food poisoning can nonetheless be very serious. The symptoms can include abdominal pain, vomiting, diarrhea, headache, and prostration. In the more serious cases, toxemia by disease-causing organisms can result in permanent disability or death. See Pathogenic (Pathological) Organism, Food Poisoning.

Public Relations – In recent times, non-governmental organizations (NGOs) have been questioning the safety of flavorings and other food additives. The Science of Public Relations is a complex one, indeed. FlavorFacts.org is one internet site that addresses this concern. The issue of public relations has much to do with the definition of the stakeholders; their level of power and level of interest. The standard 2 by 2 block chart illustrates the level of power versus the level of interest. One reference states the high power low interest sector is the latent group, the high power high interest sector the promoter group, the low power low interest group the apathetic group and the high interest lower power group the defenders. Primary stakeholders are those directly affected by a brand; secondary stakeholders are those indirectly affected by a brand; key stakeholders can be either of those but are the important influences to brand or concept reputation. Another reference listed consumers as: enthusiastic, image seeking, savvy shoppers, traditionalists, satisfied sippers, or overwhelmed depending on their personalities. Bloggers are seen as important influences in the PR arena. Mommy Bloggers are a group of bloggers that have a significant following. One PR firm defines 'Moms' as falling into one of four categories: inquisitive people who seek out the facts and will alter their behavior according to convincing information (40%); reactive people who react to the choices of others, i.e. friends and family (25%); activists who will contact companies, write letters, etc. (15%); and adaptive people who are the least to react and maintain the status quo (20%). See NGOs.

Pu-Erh – A variety of tea that has undergone a fermentation as well as an oxidation. It has a unique characteristic flavor. Assam, Darjeeling and Keemun teas are oxidized and not fermented. Pu-Erh is an example of a fermented tea because it goes through a microbial process.

Pulegone – See Chart 196 – Menthol and Menthone Derivatives.

Pulegyl Esters – Esters of pulegone maintain the minty sweetness of the alcohol. See Pulegone, Chart 196 – Menthol and Menthone Derivatives.

Pulp, Pulp Sacs – Soft parts of food products such as the insides of citrus products. The pulp sacs are individually bundled within the slice of the central citrus fruit. These pulp sacs are the teardrop-shaped cells that contain the juice. Within these slices are occasionally found the seed.

Pump – A device that transports fluid material from one point to another. Types of pumps follow:

- Centrifugal Pump – A pump that has a wheel with slots in it allowing product to be pumped by centrifugal force.
- Vacuum Pump – A pump that works on vacuum.
- Paristoltic Pump – A pump that uses a collapsible tube (Example: Tygon™) and squeezes product through as in the paristoltic action in the esophagus.
- Diaphragm Pump – A type of positive displacement pump that uses the reciprocating action of a rubber or Teflon diaphragm and check valves to pump a fluid.

Pumpkin Curcubita pepo, Curcubita mixta – Also included can be Curcubita moschata, Curcubita maxima. Pumpkin is the hard-shelled gourd of the genus

Curcubita. Since some squash share the same botanical classifications as pumpkins, the names are frequently used interchangeably. Pumpkin extracts have been used for prostrate and urinary problems. Pumpkin flavor is sulfury and can be described as somewhat potato like, but is often considered aldehydic and green. Pumpkin spice is a mixture of sweet and spicy oils like cinnamon, clove, allspice, nutmeg, ginger, lemon, etc. See Appendix 2 and Nut and Seed Oils.

Pumpkin Seed – The seed of Curcubita pepo and other varieties:

1. Pumpkin Seed – The seeds inside the pumpkin gourd are often dried, salted with seasonings sometimes added, and eaten as a snack. See Seeds and Appendix 2.
2. Pumpkin Seed Oil.

Pungent, Pungency –

1. The terminology that indicates that there is an irritation of the mucosa in the nasal or oral tissue as perceived by the trigeminal nerves.
2. Extreme pungency borders on lachrymacy (from the word lachrymator or tear inducer).
3. In tea terminology, it indicates astringency without bitterness. This is a very desirable characteristic in tea.

Public Domain – That which is owned by everyone as opposed to Intellectual property which is owned by the entity that developed it. See Proprietary Information, Secrecy Agreements.

Pulse – A member of the legume family it is generally accepted that the term pulse means the dried seed and not the entire bean. See Legumes, Nitrogen Fixing Bacteria.

Purchasing – Purchasing Issues – There are many issues facing the purchasing of ingredients used in flavors. Consistency, price increases, shortages, alternate supply, flavor quality, allergen issues, microbial issues, color, ORAC value, natural certification, GMO status, kosher status, oil solubility versus water solubility, organic status, fold, solids content, pH, shelf life, refrigeration requirements, shipping issues, flash point, Hazard Class, freezing point, melting point, polymerization issues, packaging requirements, shipping requirements, availability, delay, minimums, just to name a few (Whew – deep breath taken). See Consistency, Price Increases, Shortages, Alternate Supply, Quality, Allergens, Food Safety, Color, ORAC Value, Natural Certification, GMO, Kosher, Oil Solubility versus Water Solubility, Organic, Fold, Solids Content, pH, Shelf Life, Refrigeration Requirements, Shipping Issues, Flash Point, Hazard Class, Freezing Point, Melting Point, Polymerization, Packaging Requirements, Shipping Requirements, Availability, Delay, and Minimums.

Purge – The release of water from a meat system. This is typical in lower fat systems. Carbohydrates can be used to bind water. The higher the level of purge the lower the yield.
See Marinades.

Purification – The process of increasing the purity or percentage of a material in a mixture. The purification of a material can be accomplished in a number of ways by membrane filtration, distillation, recrystallization, extraction, etc.

Purity – An important characteristic in the determination of food grade status and is also a necessity in determining FCC, USP, NF, or other specification-related status. See Grade.

Purslane (Portulaca oleracea) – The leaf of the plant has an acid, peppery character and is harvested before flowering. It is used in a Middle Eastern dish called fattouch. It has a slippery mouthfeel and might be used as a fat substitute in low fat salad dressings. See Pepper, Black.

Putative Allergens – See Allergens.

PV (Peroxide Value) – A measurement done by titration to determine the number of moles of peroxide present in a fat. These peroxides are developed and accumulated due to oxidation of unsaturated fatty acids. Peroxides are developed in an intermediate step in the sequence of oxidative rancidity. Aldehydes and fatty acids (unsaturated types as well as saturated) are the next group of chemicals developed in this sequence, and indicate the fat has gone through the last phases of rancidification. Another typically used test of fats that provides information on its potential toward rancidification is the iodine value. The iodine value measures the potential to oxidize based on the degree of unsaturation and the ability of a double bond to chemically bind with iodine. See Iodine Value, Saponification Value, Rancid (Rancidity), Oxidation, Fat.

P-Value – Probability value. The probability of attaining a test result. It is used to measure the significance of the result obtained. This can be set at 0.01 or 1% probability for extremely conservative goals or 0.05 or 5% probability for more reasonable outcomes. The decision on what p-value is comfortable to a decision is based on the severity of the outcome. Can one accept a 5% chance of getting into a car accident or a 1% chance of losing millions of dollars in a new product launch? Often management must stick their 'Neck out' on these decisions based on reasonable likelihoods and outcomes. See Sensory Evaluation, Statistics.

PVO – see Partially Hydrogenated Vegetable Oils.

Pycnometer – An accurately measured vessel made usually of glass for use in determining specific gravity.

A slightly cooled liquid is added to the pycnometer, and brought to a specified temperature (for example, 25 °C). If the liquid then expands, excess liquid is removed. Once the standard temperature is reached and the liquid is removed from the lip of the pycnometer, the remainder is weighed. The tared pycnometer minus the total weight divided by the known volume yields the density or specific gravity when the density is compared to the density of water. See Density.

Pygeum or Prunus africanum – See Appendix 2.

Pyrazines – Double nitrogen heterocyclic ring structures with alternating double bonds, produced mainly through the Maillard Reaction are responsible for the roasted, nutty notes in nature. Some pyrazines, such as 2 methoxy 3 isobutyl pyrazine (green bell pepper pyrazine) are some of the most powerful approved aroma ingredients. See Appendix 2.

Pyridine – Five carbon six-membered ring with one nitrogen molecule and three double bonds. See Chart 265 – Nitrogen Containing Non Pyrazine.

Pyrazole – Five-membered ring with two nitrogens and three carbons and two double bonds with one nitrogen only at a double bond. See Chart 265 – Nitrogen Containing Non Pyrazine.

Pyrazoline – Five-membered ring with two nitrogens and three carbons and one double bond at one of the nitrogens. See Chart 265 – Nitrogen Containing Non Pyrazine.

Pyrrolidine – Five-membered ring with one nitrogen and four carbons but no double bonds. See Chart 265 – Nitrogen Containing Non Pyrazine.

Pyrrole – Five-membered ring with two double bonds, one nitrogen, and four carbons. See Chart 265 – Nitrogen Containing Non Pyrazine.

Pyrimidine (Pyrimidines, Dithiazines) – Similar to a pyrazine containing four carbons and two nitrogen atoms with three double bonds; however, instead of the nitrogens being across or para from each other, they are two away or meta to each other (1, 3 position). See Chart 265 – Nitrogen Containing Non Pyrazine.

Pyroligneous Acid – Excerpt for Code of Federal Regulations Title 21 paragraph 101.22 (h)(6): Any pyroligneous acid or other artificial smoke flavors used as an ingredient in a food may be declared as artificial smoke flavor. No representation may be made, either directly or implied, that a food flavored with pyroligneous acid or other artificial smoke flavor has been smoked or has a true smoked flavor, or that a seasoning sauce or similar product containing pyroligneous acid or artificial smoke flavor and used to season or flavor will result in a smoked product or one having a true smoke flavor. See Smoke Flavor and Chart 302 – Pyroligneous Acid.

Pyrones – See Ketones (Aliphatic).

Pyroxidine – See Vitamins (B Complex, B6).

Pyruvates – Esters of pyruvic acid (keto propionic acid). See Keto and Hydroxy Esters and Chart 267 – Pyruvates.

Q

QA – See Quality Assurance.

QC – See Quality Control.

QDA™ – See Quantitative Descriptive Analysis™.

Qualified Individual – Recent regulations call for a qualified individual to assess, run or coordinate Safety and Regulatory functions. It is generally accepted that a qualified individual is one who by training (Certification or Education) or hands on experience can qualify in this manner. It is up to the individual company to determine these requirements based on good judgment and GMPs. See Regulations, HACCP.

Quality – The positive nature of a product. The quality of a product can be divided into microbial quality, sensory quality, stability quality, reproducibility, etc. See Quality Assurance.

Quality Assurance – A program that assures the positive attributes and nature of a material will be consistent and acceptable in quality from batch to batch. See Sensory Evaluation, Microbial Assay.

Quality Control – A program that monitors the quality of materials both received and shipped. For a good quality control program to succeed, a correlative quality assurance program must be administered. Tests performed would include those that test consistency of flavor profile, color, etc., as well as a test that indicates safety and a healthy microbiological profile, etc. See Quality Assurance, TQM, ISO 9000.

Quantitative Descriptive Analysis™ –

1. The QDA method was first developed by Tragon Corporation. The QDA graph resembles a spider web in shape. Therefore, it is often known not only as an attribute chart but a spider web curve as well. The data plot depicts the results of specially trained panelists and their magnitude estimation of the intensity of a given trait. QDA analyses must be product or attribute specific. Oftentimes, the terms, attributes, and parameters are very specific. Therefore, the panelists are often trained intensively. Sometimes when the test changes, the panel must be either retrained or different panelists should be chosen and trained.
2. In Europe, QDA is a general terminology that indicates the method of using attributes versus a rating scale. Results are reported as spider web-type curves or other configurations. See Flavor Nomenclature Workshop, Time Intensity Profile, Magnitude Estimation, Attribute Tests.

Quantitative Flavor Profiling™ – Developed by Givaudan Roure, a system by which panels of experts use a 100-millimeter scale to refer to standard samples of 25 flavor descriptors. The results of the profile are analyzed using a statistical method called principal component analysis. See Descriptive Analysis, Flavor Descriptive Analysis, Dynamic Flavor Profile Method.

Quantitative Structural Analysis Relationship – A type of regression analysis used to interpret the quantitative relationship between the biological activities of a particular molecule and its structure. This technique is often used in drug development and in toxicological studies. See Toxicology.

Quantum Mechanics – See Particle Physics.

Quassia (Quassia amara L. or Picrasma excelsa [Sw.] Planch.) – Contains quassin, an extremely bitter alkaloid. See Chart 339 – Quassia.

Quebracho (Aspidosperma quebrachoblanca Schlecht or Schinopsis lorentzii [Griseb.] Engl.) – See Aromatic and Chart 340 – Quebracho.

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Quick Card – An OSHA based item designed to be given out to employees that use hazardous materials outlining the important points of the HAZCOM 2012 standard.

Quick Grass – See Dog Grass.

Quillaia (Quillaja, Soapbark, Panama Bark) (Quillaja saponaria Molina) – Used as a foaming agent, but must be used at lower levels due to its bitter taste contribution. See Foaming Agents, Antifoaming Agents, and Chart 341 – Quillaia.

Quills – A quill is a piece of cinnamon bark rolled up into a shape resembling a stick. See Cassia.

Quince (Cydonia oblonga Miller.) – The quince essential oil was used in ancient times. The quince doesn't ripen well on the tree and is usually picked early. It is rich in tannin and pectin and browns quickly. Quince paste is called cotignac. See Fruit and Chart 342 – Quince.

Quinine – Quinine is the oldest drug used in the treatment of malaria. Currently, other antimalarial drugs are used. Quinine and hydrochloride are extremely bitter and are used in tonics, and as other bittering agents. See Bitter, Quinine, and Chart 304 – Quinine Compounds.

Quinoa (Chenopodium quinoa) – Quinoa (pronounced 'keenwa'), goes back to the days of the Incas. The invading Spanish conquistadors banned its use to control the natives. Recently crops have again been established, and consumption has resumed. The outside coating contains saponin, which is a natural soapy resin that must be removed before being eaten. See Bread.

Quinoline – A benzene ring connected at two carbons with a ring made up of three carbons and one nitrogen containing two double bonds. See Chart 265 – Nitrogen Containing Non Pyrazine.

Quinoxiline – A benzene ring connected at two carbons with a ring made up of two carbons and two nitrogens containing two double bonds. See Chart 265 – Nitrogen Containing Non Pyrazine.

R

R (Dextrorotatory) – A designation for a dextrorotatory (R in Latin for rectus or right) optical isomer. See S, RS, Optical Isomers.

Racemic – Racemic means having an equal mixture of both D and L optical isomers (otherwise called DL). The designations have been expanded to use the letter R for D, S for L, and RS for racemic. See Optical Isomers.

Radiation – The two types of radiation are ionizing and non-ionizing. Ionizing radiation can force an electron from an element; non-ionizing radiation cannot. Ionizing radiation includes X-rays, gamma rays, and particle radiation. In terms of its effect, it can cause significant damage to cellular structure. Non-ionizing radiation (NIR) on the other hand only penetrates superficial layers of the epidermis and causes less direct damage to cells. However, this form of radiation can alter the structure of RNA and DNA molecules that can in turn cause skin cancer. The most prevalent form of non-ionizing radiation is ultraviolet light, most of which comes from sunlight. Other forms of NIR are magnetic waves and ultrasound. See Irradiated Foods.

Radicchio (Cichorium intybus var. foliosum) – A variety of red chicory with a slightly acid and bitter flavor. See Chicory.

Radish (Raphanus sativus) – Varieties are black radish (var. niger), white radish (daikon or Japanese Radish), and red radish (used often as decorations in foods as well as flavoring). The pungent character is due to allyl isothiocyanate and related compounds that exist just below the skin's surface. The inner part of the plant is somewhat milder due to a much lower concentration of those aroma chemicals. The black radish, originally from Europe, has been gaining in popularity in the United States. It is much larger than its smaller red counterparts. See Bitter, Alliaceous, Allyl Esters, Allyl Isothiocyanate.

Raft – The coagulated mass on the top of a consommé. See Culinary Arts, Consommé.

Raisin (Vitis spp.) – Raisins are dehydrated grapes. The practice of drying grapes enabled them to be kept off-season. Table grapes, rather than wine grapes are used, because their skin is usually thinner. Muscat, Sultana, Thompson Seedless, and Malaga grapes are usually used and to a lesser extent, Corinthe grapes also called Zante currants. See Grape and Chart 343 – Raisin.

Rambutan (Nephelium lappaceum) – Rambutan is also called the hairy lychee. Related to both the lychee and the longan, the rambutan is an egg-shaped fruit with hairy, spiny protrusions. The inside pulp is translucent and is sweet, fragrant, and slightly sour. See Lychee, Loganberry.

Raman Spectroscopy – Similar to infrared, visible, and ultraviolet spectroscopy, using a laser source in the visible, near infrared, or near ultraviolet range.

Ramen –

1. Chinese-style wheat noodles served in a bone and vegetable stock and flavored with soy sauce, with a slice or two of roast pork and some dried Chinese bamboo on top.
2. Asian instant-style deep-fried noodles that are usually sold in cellophane packages, sometimes with bits of dehydrated vegetables and broth mix.

Rancid (Rancidity) – Rancidity is typically a negative attribute describing a fatty substance or oil that has oxidized. Rancidity describes the development of an off flavor with a corresponding reduction in the

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nutritional value. Rancidity usually occurs due to long-term exposure to air, heat, or light.

Rancidification – Rancidification is the process of becoming rancid. See Rancid (Rancidity).

Ranking Test – A sensory evaluation that pits two or more subject products in an order according to a preconceived attribute. Example: Place these in order of color intensity.

Raspberry (Rubus spp.) – The first cultivated species was Rubus idaeus. Light fruity esters, green notes, and ionones typify the flavor of the fruit. Raspberry ketone and many of its homologues and isomers characterize the fruit. Often other berries are added to enhance the flavor of raspberries. Dimethyl sulfide is an important top note to enhance the naturalness of the fruit. This is why molasses that contains a significant top note of dimethyl sulfide as well was often used in classical types of raspberry WONFs. See Ketones – Aromatic, Raspberry Ketone (and other phenyl butanones).

Raspberry Leaf – Rubus idaeus. See Chart 344 – Raspberry and Appendix 2.

Rasping or Raspiness – Rasping describes the perception analogous to the wearing away of fine tissue layers. Raspiness is harsh and is often irritating to the point of being objectionable. It is associated with chemical irritation or mouthfeel as detected by trigeminal nerves. See Trigeminal Nerves, Harsh, Irritating.

RAST Inhibition Test – A blood test to determine the presence of allergens in the bloodstream. RAST stands for Radio Allergo Sorbent Test. Unfortunately, some physicians who specialize in allergic reactions claim that the RAST test is not as sensitive as the skin test. However, with food-type allergies, even the slightest subcutaneous inoculation or exposure can result in serious and often fatal anaphylactic reactions. See Anaphylaxis, Food Allergy, Food Intolerance.

Rau Ram (Polygonium odoratum) – Also known as Vietnamese Coriander. An essential ingredient in many Vietnam dishes and has a coriander, cilantro, lemony flavor. It is also found in Latin American dishes.

Ravigote Sauce – A dressing made from vinegar or lemon juice, olive oil, black pepper, capers, shallots, parsley, tarragon, chervil, and chives.

Raw –

1. Unrefined, as in mint oils that have an objectionable flavor profile when first coming off of the distillation of the leaves. To eliminate this raw character, mint oils are aged for a period of 1 to 3 years. Other techniques, including distillation or extraction or aging, can be used to remove raw or unwanted characteristics. Thus, treated products would then be described as aged, cured, refined, distilled, extracted, or processed.
2. In tea terminology, raw means harsh or bitter. See Distillation, Essential Oil, Harsh, Extraction, Aging, Bitter.

Raw Material – One of the ingredients that is combined with other materials to make a finished flavor or finished food product. See Ingredient, Formula.

Raw Material Control – Brought to light because of recent developments of adulteration by foreign suppliers, the passage of FSMA and other news, Raw Material Control is an important part of the overall HACCP system. Foreign Supplier Verification is a crucial point within the FSMA law. Consideration of Raw Materials includes: Purity, Food Grade Acceptability, GMO presence or absence, Microbial Specifications, Kosher Availability, Halal Availability, Prop 65 considerations, Color, Texture, Source Country, Irradiation, HACCP systems in place, consistency, continued supply, political issues, crop to crop deviations, sustainability, warehousing, export costs, shipping requirements, HAZMAT considerations, border inspections, timing and delay at the border, nutritional aspects, Natural versus Artificial Labeling, and documentation (Certificates of Analysis, Safety Data Sheets, and Specification Sheets). See Purity, Food Grade, GMO, Microbial Specifications, Kosher, Halal, Prop 65, Color, Texture, Country of Origin, Irradiation, HACCP, Consistency, Continued Supply, Political Issues, Crop to Crop Deviations, Sustainability, Warehousing and Storage, Export Considerations, HAZMAT, Border Inspections, Nutritional Analysis, Natural versus Artificial Labeling, Documentation, Certificates of Analysis, Safety Data Sheets, and Specifications.

RDA – Recommended daily allowance (of nutrients). The Food and Drug Administration lists the vitamins and nutrients that humans must consume in order to remain healthy. Nutrient labeling must appear on the outside of the package as designated by the NLEA (Nutritional Labeling and Education Act). See RDI, NLEA, Nutrition, Nutrient, DRV.

RDI – Reference Daily Intake (of nutrients). The following information in Chart 305 – RDI is taken from the CFR Title 21 Paragraph 101.9 (IU = International Units).

Reaction –

1. The change of one or more chemicals into one or more new chemical(s).
2. An allergic response to a foreign body by an organism.

See Flavor Reactions and Interactions.

Reaction Flavor – Better described as a processed flavor. Includes the Maillard Reaction, Schiff base reaction, and other beneficial flavor reactions. Reaction flavors can be developed at room temperature or at elevated temperatures. Some Schiff base reactions as well as most acetal and ketal reactions provide fewer useable products, and these would not be considered reaction flavors. Mixing valeraldehyde and propylene glycol shows an example of this. The compound valeraldehyde p.g. acetal will then be formed. This acetal has a pungent and obnoxious odor and often has little benefit in the typical brown flavors in which valeraldehyde is usually used. Acetals and ketals are usually reversible in acid media. Therefore, this reversible aspect can compensate for detriments in the final product. Any product that has developed this kind of objectionable off flavor usually never gets to the point of approval and subsequent use. See Processed Flavors, Acetals, and Ketals.

Reactionary Flavors – A misnomer used by those who would overthrow flavor chemists. See Processed Flavors, Reaction Flavors.

Ready To Eat (RTE) – A category of convenience food where the preparation time is extremely short and convenient, to where the product is prepared in advance and can be eaten as sold.

Recall – Once a product is in the marketplace and has the potential to cause serious harm to the public, a recall is necessary. During the year each food company should perform a mock recall to assure the proper response to this unfortunate but rare occurrence. A recall typically would initiate a report to the Reportable Food Registry of the CDC, whereby the Food and Drug Administration will most likely be called in to inspect the plant, products and records and might put the entire operation on hold until the Issue is resolved. This is different than a withdrawal which is when product has possibly been produced but none has been distributed to the public and the items may just be returned, destroyed or handled in another safe manner. See Mock Recall, HACCP, Pathogens, Food Safety.

Receptacle – The long, soft, white, fleshy center of the raspberry fruit around which the flavorful droplets are attached.

Receptor – See Nerve Receptor.

Recipe – As opposed to a formula. The term recipe is usually used by culinarians and the term formula is usually used in technical circles. From a Research Chef's perspective, a pinch of this and a dab of that is not recommended for large-scale potential batches as opposed to restaurant or institutional 'a la minute' presentations. Therefore, the use of weights is more appropriate for a research chef recipe. Therefore, in food industry circles, actually the two terms are interchangeable. See Culinary Arts, Research Chef, Culinology, Research Chefs Association.

Recognition – The sensory reaction wherein a currently perceived stimulus reminds one of a previously encountered stimulus. Recognition is important in flavors because certain sensory cues are necessary or are characterizing of a specific flavor. A vanilla would be difficult if not impossible to produce without the use of vanillin or another related brown compound.

Recombinant DNA – The resultant compound produced when a part of a DNA molecule of one organism has been spliced onto the DNA sequence or structure of another. One method is to use the shotgun method. Here bits of DNA are shot into cells at high pressure, in the hopes that the DNA structure will be taken on by the host cell, usually E. coli. See Genetically Engineered Foods and Flavors, DNA, Genetic Engineering, Asilomar Conference.

Recommended Daily Allowance – See RDA.

Recommended Storage Conditions – The appropriate environment in which to keep a flavor or food product so that it might attain the greatest degree of shelf life. See Accelerated Storage Conditions.

Reconstituted – Brought back to its original state by the addition of something like water.

Recrystallization – The process of precipitating a solid by lowering its solubility in a solution. This can be accomplished by a number of means, such as evaporation, cooling, salting, etc. Menthol is recrystallized from mentha arvensis by cooling the oil down and recrystallization of l-menthol 1.

Rectification – The process of blowing over or rapidly distilling a product while leaving the very dense substances behind. An example of rectification is when mineral oil or any another suitable substance is added to an essential oil and then distilled. Here the essential oil distills over quickly at increased vacuum and temperature conditions, and the heavier mineral oil remains. Similarly, the heavier compounds found in the essential oil also remain behind. These heavier compounds are usually highly colored, insoluble, and bitter or are unstable themselves. Rectification can produce a clear product without these potentially problematic ingredients. However, rectification is not always a beneficial technique. Many higher molecular weight polyterpenoids that might not come over during the process of rectification might also act as natural antioxidants for the oil. Removal of these natural antioxidants might develop an oxidative instability that was not there before. See Distillation.

Red Clover or Trifolium pratense – See Appendix 2.

Red Reishi (Ganoderma lucidum) or Linghzi – See Appendix 2.

Red Sandalwood – See Sandalwood.

Red Saunders – See Sandalwood, Red.

Redox Reaction – A chemical reaction where one or more substances will lose one or more electron(s) (oxidize) while others in the reaction gain the same number of electrons (reduce).

Reducing Agent – A chemical or component that oxidizes and therefore allows another component to reduce in a redox reaction. See Oxidizing Agent.

Reducing Sugar – A sugar that is prone to oxidation. Reducing sugars are substances that are part of the Maillard Reaction. Reducing sugars include xylose, arabinose, dextrose, and fructose.

Reduction –

1. Chemically, the absorbing of electrons and subsequent reduction in electronic charge. Example: Gaseous oxygen is reduced to a O^{-1} ion in the presence of metallic sodium.
2. The lessening of volume of a liquid food product and the name of the resultant product derived. A demi-glace is made by the reduction of an espagnole sauce with the addition of a brown stock further reduced (such as a brown veal stock). See Culinary Arts.

Reference Daily Intake – See RDI.

Refined Vegetable Oils – Oils that have undergone a process by which off flavors, off colors, flocculation, and the like are eliminated. Filtration and other mechanical steps are usually taken. See Purification, Filtration, Fat.

Reflux – The state in a distillation where as much of a product is boiling off as it is condensing. Usually accomplished in a vertical distillation column, the physical point of reflux is indicated by a ring of continually condensing vapor. See Distillation, Condensation, Evaporation.

Refraction – The bending of light as it passes from one material to another. An example of this phenomenon is when a spoon or straw seems to split in a glass full of liquid. See Refractive Index (Index of Refraction).

Refractive Index (Index of Refraction) – A measurement of a substance's ability to bend incidental light as the light passes through it. Instruments called refractometers measure refractive indices. These refractometers can come in handheld units or as instruments that resemble microscopes. When the liquid is added to the measuring device, a clear line of demarcation forms. This line develops when light passes through the substance. The line typically shows a darker area on one side and a lighter area on the other. This line is then read against a hairline scale within the instrument that delineates the refractive index scale (or Brix scale in the other case). Handheld units are typically less accurate in the measurement of refractive index, and are more effective in measuring soluble solids or Brix than refractive index. Although some of the more expensive handheld models can now do both. The degree of Brix is often used to test syrups and juices. See Optical Rotation, Brix.

Refractometer – An instrument that measures refractive index. See Refractive Index.

Refrigeration – Temperatures in the range of 40 degrees F or below versus freezer temperatures of below 32 degrees F. However, it is optimum to keep freezer temperatures to –10 degrees F to –20 degrees F to preserve quality. When temperatures of 0 to 32 degrees F are maintained foods will deteriorate more rapidly than at the lower temperatures. Self-defrosting freezers can also affect the food quality. Foods kept at more than 40 degrees for over 2 hours should not be consumed according to the USDA. Lower temperatures retard the growth of many pathogenic organisms, however if Listeria is present, the absence of other more prolific microorganisms enables the Listeria to grow. As Listeria has an extremely high mortality rate, this is a great concern for foods kept at refrigeration temperatures. See Freezing.

Regulations – The laws and rules that govern the development, production, use, labeling, and production of flavors in the United States and other countries. See BATF (TTB), USDA, FDA, DOT, OSHA, FEMA, CFR, IATA, Legislation, How a Bill Becomes a Law.

Rehmannia or Rehmannia glutinosa or Chinese Foxglove – See Appendix 2.

Reishi or Red Reishi (Ganoderma lucidum) or Linghzi – See Appendix 2.

Rejection – The classification of an out of compliance product. Rejections typically take place on site well before final product is produced and distributed to the public. Rejected product can be handled in many different ways; rework, modification, destruction or treatment depending on the cause for the rejection. See Quality Control, HACCP, Rework, Food Safety.

Relative Humidity (RH) – Important to the processing of powdered flavors, especially protein types like HVPs and yeast autolysates because these products tend to be very hygroscopic. A loosely adhering coating (LAC) can be added to a fruit for example. The effectiveness of the coating (be it plastic, wax, lipid, etc.) is dependent on thickness and permeability. A tightly adhering coating (TAC) depends on

pore blockage. In either case, the result is an effective modification of the atmosphere within the fruit. See Modified Atmosphere, Oxidation, Fermentation.

Relative Retention Time (RRT) – The time it takes for an ingredient to elute, that is, to go through the entire length of a column or other chromatographical substrate. The RRT is measured in a chromatograph relative to an internal standard so that an accurate identification of the elution time versus known standards can be compared. See Standard, Kovat's Index, Ester Series, Internal Standards.

Relaxing – To allow gluten strands developed to soften up. Usually done at cooler temperatures after the first gluten strands are formed.

Religious Restrictions – See Kosher Super-vision or Halal Supervision.

Relish –

1. To savor or appreciate a flavor.
2. A mixture of sweet and sour condiments. See Chutney.

Remoulade – A tartar sauce-like condiment usually added to fish or other items where the sauce is not made from the cooking technique itself. See Deglazing, Sauce, Culinary Arts.

Remoullage – Rewetting bones and simmering with fresh aromatics and herbs to effect a re-extraction for a stock. The flavor of a remoullage is typically not as good as the first extraction, but can be used instead of water as a more flavorful starting material. See Culinary Arts, Remoulade.

Rendering – The process of melting down a complex fat so that the higher melting point fat components coalesce with the lower melting point fat components, plus other substances present. Then, a homogeneous mass will develop upon cooling. See Fat.

Rennet – The extract of calf stomachs. Rennet is used as a coagulating enzyme in the process of making cheese. Because it is animal derived, this procedure is non-kosher for making cheese products (dairy). Chymosin, the naturally derived, biosynthesized replacement for rennin, is a useful alternative for the production of kosher enzyme-derived dairy products. See Kosher Supervision, Rennin.

Rennin (Chymosin) – The active constituent in rennet. Chymosin converts milk to a semisolid like cottage cheese, allowing it to be retained for longer periods in the stomach. For this reason, chymosin secretion is maximal during the first few days after birth so nutrient absorption is enhanced in newborns. Later, production of chymosin is replaced by the secretion of pepsin as the major gastric protease. Pepsin is a hydrolase and breaks down proteins into simple amino acids. See Rennet, Enzymes.

Replacements – A product category that included substances that impart a combination of functionality and/or flavor so that a specified material can be either partially or fully replaced. The typical reason or desire to replace the original product is usually due to legal, marketing, cost, availability, or some other driving force. Example: HVP replacers were developed in order to meet a U.S. labeling demand. The demand grew due to a number of factors including bad press from the discovery of potentially harmful by-products found in HVPs called monochloro- and dichloro-propanols as well as the bad press from reports of reactions called the Chinese Restaurant Syndrome. Both of these incidents brought pressure on the food industry. This demand to replace HVPs has resulted in the development of new HVP replacement systems. While developing these products, one must consider both the functional characteristics as well as the organoleptic attributes of the product to be replaced. HVP replacement represents some interesting challenges. Of the attributes that one would consider include the proper salt content, the proper mouthfeel, the right taste and enhancement profile, and the right trace aroma profile. All of these characters must be in proper balance for the replacement product to be useful as an across-the-board system. One alternative approach is to replace a specific ingredient, like a certain type of HVP from a certain company. In this regard, the challenge is easier, but the rewards would be less. Raw material cost issues are obviously an important consideration. See Salt, Marketing.

Replacers – See Replacements.

Replication – The satisfactory duplication of a flavor system. The flavor replication would have the appropriate functionally and sensorially equivalence. A replication of a flavor is one that might or might not have identical flavoring components, but does the job in the final food system.

Reportable Food Registry – Now part of the FDA National Institute of Health (NIH) Under the Food and Drug Administration Amendments act of 2007, section 1005 states that manufacturers must report under the Reportable Food Registry any occurrence that might result in serious adverse health consequences or death to humans or animals. See FDA, CDC, Food Safety, Recall.

Research Chef – An individual that has been trained or has had experience in culinary techniques and works in the food industry, in a restaurant that uses the concepts of Molecular Gastronomy®, or a similar vocation. The research chef would be the person typically developing the 'Gold Standard.' See Gold Standard, Molecular Gastronomy®, Research

Chefs Association (RCA®), Culinary Thickening Techniques.

Research Chefs Association – RCA® – An organization started by a number of research chefs to identify their craft and expand the concepts of Culinology®. See Culinology®, Culinary Thickening Techniques, Gold Standard, Certified Research Chef, Certified Culinary Scientist.

Research Institute on Fragrance Materials (RIFM) – The organization that works together with FEMA on toxicological data and helps furnish information for the GRAS lists.

Reservatrol – Resveratrol was first isolated from Cassia quinquangulata, a Peruvian legume. Later it was also identified in red grapes, peanuts, and mulberries. It has been cited by some to be one of the compounds responsible for wine's proven ability to protect against atherosclerosis and coronary heart disease. See Nutraceuticals.

Resin Absolute – The alcoholic extraction of a gum or oleoresin. See Absolute.

Resinoid – See Oleoresin.

Resinous – A flavor profile similar to the odor of a resin. This is typically a harsh, heavy, piney character. The descriptor 'resinous' is often associated with characteristics of fir balsam, Siberian pine needle oil, glyceryl esters of wood rosin, and some of the sesquiterpenoids. See Piney.

Resinous Herbs – As opposed to fine herbs, those herbs that need a good bit of extraction to release their fragrant aroma. They would be put in the beginning of a stock to allow the extraction to take place over time. These include rosemary, marjoram, sage, savory, bay, lemon verbena, and thyme for example. See Fines Herbs.

Resolution – The degree of separation of a GC curve. A good degree of resolution is essential for an accurate visual interpretation of the GC graph or trace to be made. Today, computers have been used to determine where elution changes in curve direction peak. This is done by mathematical integration of the curve. When the derivative of the curve is 0, the curve is either at its maximum or its minimum. The interpretation of GC data is complex and often fraught with many potential areas of inaccuracy, confusion, coelution, etc. In the past, gas chromatographic interpretation was done exclusively by hand. Experienced analysts could often interpret signals and clues and arrive at an intuitive answer. Now that the computer is used almost exclusively in this interpretation, the accuracy of the interpretation is reflective of the ingenuity and accuracy of the computer algorithm. See Gas Chromatograph (GC).

Restaurants – In ancient Greece and Rome there appeared in some cities a Thermopolium that were restaurant type bars serving food and drink. In China, food catering establishments developed from the traveling visitor business and the tea house culture. In Europe, as travelers stayed at inns, and then wanted to eat, taverns sprung up, but it wasn't until Boulanger a Frenchman, set up separate tables and a menu serving a restorative soup, that the true 'restaurant' came into being. See Culinary, History.

Retention Time – The time it takes for an ingredient to elute (go through the column of a gas chromatograph and exit the port through the detector). See Gas Chromatography (GC), Relative Retention Time.

Retort, Retorting, Retortion – Pasteurization of a food by the use of sufficient heat to destroy harmful microorganisms. See Preservation (Non-Chemical), Pasteurization.

Retrogradation – A negative effect meaning the giving up of water by a bound system, usually a starch, due to the action of an enzyme, multiple freeze thaw cycles, or a realignment of molecules of starch. The process is called syneresis, or weeping, and is in effect when a starch loses its gelation properties. See Amylopectin, Amylose, Modified Food Starch.

Retronasal – Migration of aromas up the nasal cavity that then stimulate organoleptic organs (olfactory nerves) is called retronasal stimulation. This normally unavoidable effect is the reason why many people think foods 'taste' good, while what they mean to say is that foods 'flavor' good. It is not just taste that we perceive when we put food in the mouth but both taste and odor due to retronasal effects. Only if one holds their nose, does the retronasal effect become nullified and the flavor of the food boils down only to textural, trigeminal, and taste cues. See Taste, Aroma, Volatiles, Nose, Tongue.

Revulsion – The reflex action to spoiled food. The nerve mechanism responsible for this reaction possibly resides in the caudate nucleus of the brain. This is the same area that is responsible for cognitive thinking and movement. See Disgust.

Rework – Adding out of compliance or slightly out of specification product into good product at a rate that will produce a product that is still within specifications and compliance. This decision must be made by competent authorities who will weigh the costs and risk versus benefit of this decision. Because of the nature and uniqueness of flavors oftentimes only like unto like rework is acceptable and only under very specific circumstances. See Quality Control, Recall, Rejection, Food Safety, HACCP.

RH – See Relative Humidity.

Rhatany Root (Krameria) – Rhatany root contains calcium oxalate, other oxalates, and oxalic acid. Cooking the root detoxifies it for use, similar to the treatment of rhubarb. See Rhubarb and Chart 345 – Rhatany Root.

Rheology – The study of flow and texture, typically of liquids or semi-liquids. Newtonian flow is the measurement of flow rate at a given temperature. Although the flow usually increases with increased temperatures, it does not decrease with increased pressure or shear. Products with a non-Newtonian consistency change with pressure or strain. See Texture, Viscosity, Consistometry, Thickness, Gums and Thickeners, Bostwick Consistometer, Analytical Chemistry.

Rhodinyl Esters – Rhodinol is derived from geranium oil and is chiefly citronellol. Therefore, rhodinyl esters are for the most part citronellyl esters. See Chart 306 – Rhodinyl Esters.

Rhodiola or Rhodiola rosea – See Appendix 2.

Rhubarb (Rheum officinale Baill., R. palmatum L.) – Slightly bitter, colored red and green, the stem is first cooked to make it edible. The stem contains oxalic acid. See Rhatany Root and Chart 346 – Rhubarb.

Riboflavin – See Vitamins (B2).

Ribose – Ribose is a common pentose (a 5 membered sugar) found in all human cells. Adenine Triphosphate, part of the ATP cycle is the energy system of the body. ATP is made of three basic parts: 1. D-ribose that provides the structural foundation upon which ATP is built. It is the ribose that starts the process of ATP synthesis in the body. 2. Adenine – an amino acid and 3. Triphosphate, i.e. three molecules of phosphate. The ATP gives up one phosphate plus to become ADP plus the production of energy to keep the body going and with energy from food turns back into the triphosphate form. It is the sugar ribose which undergoes the browning reaction with amino acids in a steak or chicken meat. See Food Energy, Maillard Reaction, Non-Enzymatic Browning, Enzymatic Browning.

Rice (Oryza sativa) – Rice is an annual grass that grows in the tropics. Although rice can grow in areas that have not been purposefully flooded, most of the rice crop grown worldwide is done so under water. O. sativa is the common white rice. O. glaberrima is called African rice. There are many varieties of rice that are more physical than varietal differences. These include short grain rice or round grain rice, medium grain rice, long grain rice, brown rice (also called cargo rice), and white rice. Arborio rice is rice grown in Italy that is hard rice that absorbs a lot of moisture, oil, and subsequently flavor. Some rice has flavors or seasonings added. One of these types is called perfumed rice. Jasmine rice is an example of perfumed rice. See Risotto; Rice, Wild.

Rice, Wild (Zinzania aquatica) – Wild rice is really a seed of a marsh reed growing around lakes in North America. It is difficult to harvest. The nutty flavor is useful in gourmet dishes. See Grains.

Rice Bran – See Appendix 2.

Rich –

1. Full bodied.
2. High degree of flavor perception.
3. Roundness of flavor profile.

Rickets – The disease developed from a deficiency of vitamin D. Vitamin D enables the absorption of calcium from the intestines into the bloodstream building strong bones. Today, in the United States, rickets is rare due to vitamin D enrichment in milk, vitamins, and food products. See Vitamins.

RIFM – See Research Institute on Fragrance Materials (RIFM).

Right To Know Act – The state of New Jersey was the first to pass a 'Right to Know Act,' which states that the people in the area of a business have the right to be able to find out what, if any, hazardous materials are being used in their area. This type of legislation encompasses the purchase, handling, production, development, shipping, and disposal of waste and cleanup of all potentially hazardous and large volume materials. Other states have followed, the most recent of which is Massachusetts. Due to the nature of the legislation, the rules are usually tied into OSHA regulation, DOT regulation, and the FTC ruling (assignment of CAS numbers to chemicals substances).

Rind – Outside coating of food products like citrus or a cheese. See Pericarp, Zest, Pulp, Albedo, Pith, Flavedo, Washed Rind Cheese.

Rindy – A character that is reminiscent of a rind. In the case of orange, the characteristic would be similar to octanal. In the case of lemon, the characteristic would be similar to citral. In the case of watermelon, the characteristic would be similar to (E) 2 (Z) 6 nonadienal. See Rind.

Ring Compounds – Ring compounds are interconnected molecular structures. A five-membered ring made up of carbon and hydrogen ring is called cyclopentane. A six-membered carbon and hydrogen ring is called cyclohexane. These are both aliphatic rings, which means they are not formed onto a benzene ring. A benzene ring is an especially stable structure where a six-membered carbon ring has alternating double and single bonds. The location of these bonds is not static, but the electrons shift. The dissociation of the electrons in the molecular plane is called an electron cloud and makes for a stable molecule. Structures of this sort are called aromatic rings, and compounds containing aromatic rings are aromatic

compounds. The term aromatic is not to be confused with an aromatic odor. This term is often used, however, due to the above chemical structural designation, it is somewhat confusing. The term, an aromatic odor, typically has been used to mean a warm and heavy compound with either a camphoraceous, balsamic, or spicy-type background character. See Molecule, Aromatic, Aliphatic, Structure.

Ringing – The effect of oil-soluble substances that are insufficiently weighted coming to the surface of a beverage and forming a ring around the edges of the meniscus. See Weighting Agent, Meniscus, BVO, Emulsion, Ester Gum.

Rioy – The coffee off odor that is attributed to the present of trichloroanisole developed through higher than acceptable moisture content in storage and subsequent microbial contamination. See Coffee.

Ripe, Ripening –

1. Ripeness is the measurement of the age of a food. In a ripened fruit or vegetable, the mechanisms prepared for the development, growth, and nurture of the seed. At this time, the more complex carbohydrates such as starch, pectin, cellulose, and hemicellulose depolymerise through an enzymatic and other processes. Once these macromolecules have been broken down, overall nutrient levels rise to furnish nourishment for the new plant to come. Enzymes responsible for this include; polygalacturonase, pectin methyl esterase, lyase and rhamnogalacturonase. This point in time is usually associated with a drop in the perception of green compounds, and the increase in esters in the case of fruits and/or sulfur compounds in the case of vegetables. Brown-type compounds are associated with the initial stages of fermentation as well as the alcohols and the aldehydes. A fermentation that has gone on for a while will produce a greater amount of acids.
2. In tea terminology, it also means full.
3. In wine, one that has gone through a sufficient aging process. A wine that has been stored in (wood) caskets (usually oak) long enough for an interaction of all the chemicals in the wine to occur. These reactions that take place over time include oxidation, interesterification, transesterification, etc. Also, the flavor characters found in the caskets are leached into the wine and contribute a subtle woodiness that makes the wine's profile quite complex. See Green, Fermentation, Brown (Compounds), Full, Senescence.

Risk – The amount of statistical gamble that someone (usually management) is willing to take against a loss. That loss can for example be either in profits, reputation, market share, or franchise.

Risk/Care Assessment – Some audit protocols call for the safety evaluation of the products produced. These include Low/High-Care/High-Risk decisions based on the many aspects of ingredients, infrastructure, processing conditions, equipment, and other factors. See HACCP, CCP, Food Safety, Third Party Audits, Low Risk/Low Care, High Risk/High Care, Sensory Evaluation, P-Value (Probability Value).

Risk Chart – A table used for determining the desired sample size and number of judges needed to make a decision within a given alpha and beta risk. See Alpha, Beta, Sensory Evaluation, Risk.

Risotto – A short grained Arborio type rice that is cooked by the risotto method. See Rice, Pilaf Method.

Risotto Method – As opposed to the Pilaf Method, rice is first cooked in a fat then a liquid often stock is added In stages until the rice is cooked to al-dente consistency. See Pilaf Method, Rice.

Roast, Roasting –

1. To cook under temperatures high enough to cause browning (350–450 °F).
2. A cut of beef that can be roasted or stewed, as in roast beef or pot roast.
3. To expose a food on the grill, a wood, brick, or other type of direct fire, or the direct heat of an oven.

Roasted (Notes) –

1. Having the characteristic flavor profile of something that has been roasted.
2. Containing pyrazines, thiazoles, sulfur components, and phenolic compounds typical of that which are found in a food that has been roasted. See Maillard Reaction.

Robust – In wine, one that contains a high degree of tannins, which might initially make it appear that the product has not been sufficiently aged, but which might mellow in time. See Aging.

Robusta (Caffea robustica) – A variety of coffee bean that is less expensive and grows in more difficult types of soil conditions. Robusta does not typically have as good a flavor as its smaller cousin, the arabica bean (Caffea arabica).

Rocket – See Arugula.

Rock Salt – Also known as halite, rock salt is a mined mineral salt.

Rondelle – See Knife Cuts.

Rooibus, Roibus, Honey Bush, Red Bush (Aspalathus linearis [N.L. Burm.] R. Dahlgr.) – A recent entry into the 'tea' market. The tea (tisane or herbal tea) is made from the leaf of the 'red bush' (South African = Rooibus). Rooibus teas are red colored and fruity tasting with a good amount of acidity. They

contain antioxidants such as aspalathin and nothofagin, have a low caffeine level, and are low in tannins. See Appendix 2.

Root Beer – The simulation of the flavor profile of Sarsaparilla drink made usually from extracts of Sarsaparilla and Sassafras (containing safrole, a toxic substance). Root beer typically contains methyl salicylate along with other spices, and brown and tangy notes.

Rose (Rosa damascena Mill., R. alba L., R. centifolia L., R. gallica L.) – Rose is an important flavor ingredient. It is a natural source of geraniol as well as phenyl ethyl alcohol. Stearopten is present in the absolute (rose waxes), but these are mostly removed during the process of converting the concrete to the absolute. It shows widespread use as a modifying character in many WONFs. The definition of rose water and 'rose water, stronger' are originally USP monographs. Apricot, strawberry, almond, and apple are just a few flavors that have historically used rose in WONF preparations. It is a key ingredient in certain punch flavors. It can be used as a differential item in almost all fruit flavors at low levels for its warm floralcy that blends well in the background. As soralins are found in the true product, they are good markers for non-replaced non-adulterated absolutes. When rose absolute is dissolved in alcohol, the soralins form elongated milky strands, confirming their presence. See Floral, Absolute.

Rose–Gottlieb – An analytical test similar to the Mojonnier test using methyl alcohol denatured ethanol and ammonia as the extractant media. The fat extraction is then determined by evaporating the resultant fluid. See Mojonnier, Analytical Chemistry, Extraction.

Rose Hips, Rosa canina – A good source of vitamin C. See Vitamins, Chart 347 – Rose, and Appendix 2.

Rose Geranium – See Geranium and Appendix 2.

Roselle (Hibiscus sabdariffa l.) – A fruity-flavored extract, rich in Vitamin C. It has been used in Africa to reduce blood pressure. The extract is approved for use in alcoholic beverages only, but can be used as a supplement as well. It is known as a good source of flavonoids, protocatechuic acid, anthocyanidins, and isoflavonoids. The extract has been purported to provide excellent antioxidant protection for the cardiovascular system and the brain. One study showed effectiveness as an antibacterial to existing drug resistant strains of harmful bacteria. See Chart 348 – Roselle and Appendix 2.

Rosemary (Rosmarinus officinalis L.) – At normal levels, the oil, extract, and oleoresin are used in many flavors specifically for savory dishes including chicken, beef, and pork, stew, gravies, and sauces. Studies have shown some ingredients in rosemary to have antioxidative properties. Therefore, an extract and purified derivative of this botanical have been developed for such a use. See Antioxidants, Spice, Aromatic, Chart 349 – Rosemary, and Appendix 2.

Rosenpaprika –See Paprika.

Rosewood – Otherwise known as Bois de Rose, is similar in flavor profile to linaloe. Recently, rosewood has been put on the endangered species list and is basically unavailable as a raw material. See Bois De Rose, Linaloe Wood, and Appendix 2.

Rosin – Rosin is a calcium salt of partially dimerized rosin. See Glycerated Esters of Wood Rosin (Ester Gum) and Chart 463 – Rosin.

Rouille – A garlic-flavored mayonnaise thickened with bread or potatoes. Often colored with saffron, tomatoes, or red pepper; these ingredients give the name of the sauce, which means rust or red colored. See Culinary Arts, Garlic, Aioli.

Round, Rounded –

1. A flavor profile that has an increasing profile in the middle characters and a decreasing profile in the background characters. A round profile would appear circular or elliptical in a time intensity profile curve. Roundness is also associated with little or no drastic changes in flavor profile. In tea terminology, the term rounded is analogous to a full flavor.
2. See Disjointed, Time Intensity Curve, Middle Ground, Background.

Round Out – To manipulate the flavor profile by addition of ingredients, aging, heating, or otherwise causing a change to occur so that the flavor profile is more rounded. See Rounded, Flavor Profile, Time Intensity Curve.

Roux – A unique base often prepared by a chef, which uses flour, butter, oil, or a little water, exposed to high heat. Light roux is used mainly as a thickener in light sauces like Béchamel. The flavor is described often as buttery. Blonde or pale roux is used in medium-colored sauces like Velouté where flavor and thickening are in balance. The flavor of blonde roux is often describes as being reminiscent of buttered popcorn. Brown roux is used in brown sauces like Espagnole used to make demi-glace. This roux has little thickening power and contributes mostly flavor. The flavor is often described as having a peanut or peanut butter flavor. A dark roux is used in Cajun cooking and has a dark chocolate-like flavor and no thickening whatsoever. The flavor is often described as being chocolate like. The reason for the differences in flavor is due to the caramelization and Maillard Reactions that occur at continuing

higher temperatures. For best results, a cold roux is added to a hot liquid, and a hot roux is added to a cold liquid. See Culinary Arts, Maillard Reaction, Brown (Compounds).

RS – Equivalent to DL, or optically racemic. RS designates a mixture that contains an equal amount of both laevorotatory and dextrorotatory chiral substances. See Racemic, Optical Isomers.

RTE – See Ready To Eat.

RTK – See Right To Know (RTK).

Rub – Typically a dry system added to the outside of a meat product to provide flavor, it also can contain ingredients that improve shelf life, color, and texture. See Marinades, Injection, Meat and Savory Industry.

Rubescence – Rubescence is the ability of a substance to cause a reddening effect on the skin. This typically is a factor with skin sensitivity and the perfume/cosmetic industry, but can come into play with flavors that have become popular for use in those products.

Rue Oil (Ruta graveolens L.) – Rue is GRAS as long as usage is within guidelines stated in the citations in the CFR (Code of Federal Regulations). Must be used at less than 10 ppm in baked goods, baking mixes, frozen dairy desserts and mixes, and soft candy. In all other food products, it must be used at less than 4 ppm. Contains methyl nonyl ketone and methyl umbelliferone. It is useful as a source for natural methyl ketone. These chemicals are typically used in a variety of natural WONFs, especially dairy and cheese flavors. Although methyl ketones are found in most cheeses, they are typical of the blue (bleu) cheese types. Penicillium spp. strains are inoculated into the cheese after it is formed, thus producing methyl ketones. Also, some of the 'yellow' cheeses like cheddar (note the yellow is usually an added coloration) have methyl ketone character as well. See Blue Cheese, Ketones – Aliphatic, and Chart 350 – Rue.

Rum – An alcoholic beverage made from a distillation of fermented molasses. Rum is often seasoned with clove, cinnamon, or other spices, and aged in a smoked wooden barrel (often oak). Bay Rum is spiced in that manner. Rums are usually aged in smoked oak or other wood caskets. The first rum was claimed to have been developed in Barbados at a distillery now known as Mount Gay. See Alcoholic Beverages, Rum Fusel Oil, Fusel Oil, and Chart 351 – Rum.

Rum Ether – The recipe is as follows: Ethanol, pyroligneous acid, acetic acid, propionic acid, furfural, amyl alcohol or fusel oil, diacetyl, or acetyl methyl carbinol, St. John's bread, potato starch, manganese peroxide, and concentrated sulfuric acid are set aside to digest for 24 hours. The product is then distilled. Rum ether is also called ethyl oxyhydrate. See Oenanthic Ether and Chart 352 – Rum Ether.

Rum Fusel Oil – See Fusel Oil.

Russian Mustard – See Mustard.

Rutabaga (Brassica napus var. napobrassica) – Rutabaga is a cross between a savoy cabbage and turnip developed in Sweden during the middle ages. See Cabbage, Turnip.

Rye – Rye is a grain that has a dozen or so varieties. Rye does contain gluten as does wheat and triticale. (Triticale is a hybrid of rye plus wheat.) By containing gluten, rye can be used effectively to make bread. However, because the amount of gluten present in rye is less than either in triticale or wheat, the dough does not raise as much as the other two. This resulting bread is denser. Rye bread is often flavored with fennel seeds. Pumpernickel bread is made using darker varieties of the grain plus the occasional addition of molasses. Rye plus wheat flour is called maslin. 'Rye' is also the alcoholic beverage made from the fermentation of rye grain plus other grains. A fungus called ergot can contaminate rye as well as some other grains causing a peculiar toxicity called ergotism. See Ergotism and Chart 353 – Rye.

Rye Bread – Bread made with caraway seeds (the natural characterizing flavoring of which is d-carvone). See Carvone, Optical Isomers, Dill, Spearmint.

S

S – The designation indicating laevorotatory chirality. The designation of left or counterclockwise comes from the word sinester, which means left in Latin. See Optical Isomers.

S-adenosylmethionine or SAM-e – See Appendix 2.

Saccharide – See Sugar(s) and Polyhydroxyl Compounds.

Saccharin – A non-nutritive sweetener. Any time that saccharin is used in a food product, a label must be attached to the food product and must appear as follows: 'Use of this product may be hazardous to your health. This product contains saccharin which has been determined to cause cancer in laboratory animals.' (CFR Title 21 Section 101.11.)

Saccharomyces cerevisiae – The yeast that is widely used in the baking and brewing industry. It is the fermenting agent in beer, wine, ciders, and other common fermentation products. It and other wild strains of saccharomyces occur naturally on the peels of fruits. This is why apple cider that has not been sterilized or otherwise treated to kill these yeasts will readily ferment to hard cider. S. cerevisiae is also the yeast grown on molasses to produce primary grown yeast for baking. S. cerevisiae produces carbon dioxide as a metabolite as it grows, and therefore acts as a leavening agent in baking. Baker's yeast is called a 'primary grown' yeast because it is purposely grown for use as a food additive. The yeast is grown on molasses. Brewer's yeast is called a secondary yeast because it is obtained as a by-product of the brewing industry. However, in both cases, the yeast in question is S. cerevisiae. Yeast can also be treated to produce a yeast autolysate or yeast autolysate extract for commercial application as a flavor enhancer, flavoring, or protein; vitamin; or an amino acid source. See Kluveromyces fragilis, Candida utilis, Baker's Yeast, Brewer's Yeast, Autolyzed Yeast, Whole Yeast, Autolysis, Cell Wall.

Sachet D'espice – A bag or sachet of spices used to infuse flavor into a stock. The items in the sachet are typically thyme, garlic, cracked black peppercorns, and bay leaf. See Bouquet Garni, Culinary Arts.

Safe Harbor – A provision in a law or regulation that allows for the reduction or elimination of liability under that statute if certain conducts do not violate a given rule and the performance was conducted in good faith. See Regulations.

Safe Serve – **See ServSafe®**

Safety – See Food Safety.

Safety Data Sheets – The newly defined document according to regulations promulgated by The Occupational Safety and Health Administration called HAZCOM 2012. See HAZCOM 2012.

Safflower – Safflower and Safflower Oil or Carthamus tinctorius L. [Fam. Compositae] or American. See Vegetable Oils and Appendix 2.

Saffron (Crocus sativus L.) – The stigma or stamen of the crocus plant is handpicked resulting in a high cost of the material. The stigma is the upper extremity of the pistil – the long tube in the center of some flowers. The structures corresponding to species of safflower blossoms, arnica, or marigold is fraudulently sold as pure saffron. One hundred and fifty thousand crocus flowers must be harvested to produce only one pound of saffron. Saffron contains the chemical safranal (2,6,6 trimethyl 4,6 cyclo hexadienal) that imparts its powerful aromatic flavor profile. The compound is derived in nature by the degradation of a glycoside found within the plant.

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Also used as a colorant, saffron imparts a strong yellow color to foodstuffs. An example of its use is in the Spanish dish paella. The coloring nature of this material is due to the presence of crocin. In cooking, acid seems to better release the color into the food. See Color (Colorants), Chart 354 – Salicylates, and Appendix 2.

Safranal – The active chemical in the flavor essence of saffron (2,6,6, Trimethyl Cyclohexa 1,3 Dienyl Methanal or Dehydro Beta Cyclo Citral). See Saffron.

Sage – Mexican sage (Salvia leucantha), pineapple sage (Salvia elegans), or common sage (Salvia officinalis), (Dalmatian Sage, English Sage). Sage contains the chemical thujone. Thujone was responsible for the toxic side effects of absinthe, a drink banned in France around the turn of the century. See Rosemary, Spice, Aromatic, Clary Sage or Dalmatian Sage, Chart 355 – Sage, and Appendix 2.

Saigon Cassia – See Cassia and Chart 356 – Saigon Cassia.

Saint Bartholomew's Tea – See Maté.

Saint John's Bread (St. John's Bread) – St. John's bread is also known as carob or locust bean. See Carob; Solid Extract; Gums and Thickeners; Locust Bean.

Saint John's Wort (St. John's Wort) (Hypericum perforatum L.) – This herb has recently received much attention due to its reported effectiveness as a calming agent. See Nutraceuticals, Chart 357 – St. John's Wort, and Appendix 2.

Saki – Saki is rice wine that is often consumed warm.

Sala Cider – Sala cider is a drink common to the Far East that is usually colored red and contains a flavor that is typically high in esters such as ethyl butyrate, amyl acetate, etc. See Chart 146 – Alkyl Esters Grouped by Alcohol Moiety.

Salad – A mixture of greens, dressing, and other accompaniments that might include nuts, fruits, reduced stocks and other liquids, herbs, spices, other greens, flowers, meats, seafood, or other edible items. See Salad Dressing, Greens, Composed Salad.

Salad Burnet (Poterium sanguisorba or Sanguisorba minor) – A leafy herb that is used in salads imparting the green flavor of watermelon rind or cucumbers with a slight astringent aftertaste. It is used in French, Italian, and English dishes. It was known to control hemorrhages and internal bleeding. In the early times, soldiers would drink a tea made from salad burnet in the hopes that any wounds inflicted on them would be lessened in severity.

Salad Dressing – A mixture of typically salty, spicy, sour, and sweet flavored liquid that is added to a salad. Can use vinegars, wine, spices, herbs, sugar, fruits, fruit concentrates or juices, salt, herbs, and other ingredients. See Herb, Salt, Sugar, Sweet, Culinary Arts.

Salad Greens – See Greens.

Salamander – A piece of kitchen equipment that relies on heated elements from above to cook food. This technique is called broiling rather than grilling, which relies on heat from the bottom. The exact source of the word salamander is not certain. Some say it came from the name of the inventor and others refer to the mythical beast that is made of fire and is related to dragons. See Grilled, Culinary Arts.

Salicylates – A salicylate is one of the more characterizing single aroma chemicals. The best known of these is methyl salicylate. It is the predominant aroma component of wintergreen. Likewise, most of the salicylates have varying degrees of the sweet, cooling, tangy character similar to the methyl ester. See Mint (herb); Cool(ness), Cooling, or Mintyness; Tangy; Wintergreen; and Chart 307 – Salicylates.

Salicylic Aldehyde – Also known as 2-hydroxy benzaldehyde, similar to benzaldehyde with a nut-like, shoe polish-like aroma. See Nutty and Chart 308 – Salicylic Aldehyde.

Saline – A saline solution is a solution of salt and water. A normal saline solution is one that has the same salt content as human blood.

Salisbury Steak – A spiced ground meat dish similar to a spiced, flavorful hamburger meat.

Saliva – Saliva is the water-based glandular secretion produced in the mouth by the salivary glands. Saliva contains a number of enzymes including amylase. Studies show that salivary secretions can begin even at the thought of food. See Enzymes, Amylase, Mucosa, Mucine.

Salivary Glands – The organs that produce saliva, located at the sides of the face. Saliva aids in the digestion of food. As for flavors, saliva is an important carrier for volatiles. Being aqueous, saliva affects relative vapor pressures of non-polar volatile organics. Three pairs of glands produce saliva. These include the parotid gland (the largest) located over the jaw and under and in front of the ear, the sublingual gland (under the tongue), and the submandibular gland (under the jaw or mandible). Saliva is often emitted at the mere sight of food. Olfaction is tied into our pleasure centers deep within our brain called the limbic system. Therefore, flavors and food systems stimulate basic bodily functions and probably have major overall effects on our pleasure centers, hormonal balance (enzymes), emotions (limbic), and other fundamental positive results. Research is currently being conducted on proving these theories. Such a scientific response would tend to invalidate negative claims against the flavor industry. See Feinberg Principle.

Salmonella – Salmonella is a pathogenic bacterial flagellate (bacteria with a tail) responsible for one of the

more common foodborne infections in the United States. Salmonellosis is commonly transmitted in meats and eggs. A type of salmonella, S. typhi, is responsible for typhoid. However, this disease is more common in underdeveloped countries. Salmonella is destroyed by cooking food for 20 minutes at 140°F or for 3 minutes at 149°F. See Microorganisms; Sterilize, Sterilization.

Salsify (Oyster plant) (Tragopogon porrifolius = Salsify) (Scorzonera hispanica = Black Salsify) – Both vegetables have a fishy almost oyster-like character, hence the name oyster plant. The black salsify is more savory. See Fishy and Chart 358 – Salsify.

Salt (Salt Replacement) –

1. Chemically, the product of an acid plus a base. Therefore, a salt forms by the combination of any inorganic metal and an inorganic non-metal. An organic salt like calcium oxalate is an inorganic salt of an organic acid or base. Example: Sodium benzoate (sodium salt of benzoic acid).
2. In the food industry, salt typically means table salt or sodium chloride. It is one of the four primary taste sensations as perceived by the sodium-sensitive taste buds on the surface of the tongue. Recent studies of the perception of saltiness by the taste buds on the tongue indicate that the perception of saltiness is transmitted via nerve pathways sent through our bodies as a sequence of potassium/sodium ion exchanges. These sodium/potassium ion interchanges are the fundamental system of electronic nerve impulses for living organisms. For this reason, the sensation of salt is therefore irreplaceable, and salt replacers are a particular challenge. As a confirmation of this finding, salt replacers using potassium, ammonium, calcium, or other ion replacements have showed to be lacking. The few ways in which salt has been successfully enhanced is through the use of synergists. This uses other taste components to enhance the saltiness, such as the umami effect of amino acids. Some organic acids like butyric acid and acetic acid and stinging/burning compounds like allyl iso thiocyanate, pepper, pepper compounds, acetaldehyde, etc., can also be effective. Compounds such as these that produce trigeminal stimulation have shown some success. However, they perform only by enhancing what salt is already there. Sugar, acid, and bitter principles are tastants that can often be used to synergize with the salt present. Some natural products that contain amino acids like yeasts, HVPs, dairy products, meat extracts, etc., have also been used to enhance a product's existing saltiness. See Replacements, Enhancers, Marketing Trends, Sea Salt.

Salts (Organic) – Salts are metallic ions that have neutralized organic acids. Salts of organic acids are not only useful in replacing items in a flavor that would normally be found in nature like citric acid salts in fruit juices, but also for buffering. The buffering of organic acids has a rounding-out effect. See Phosphates, Organic, Citric Acid, Buffer, Round-out, Juice, and Chart 309 – Salts.

Salvia Root or Acanthopanacis radicis – See Appendix 2.

SAMI – Supermarket and Allied Market Institute. Publishes a service report that tracks distribution of materials to supermarkets. See GMA.

Sanchal – Black salt. See Salt, Black Salt.

Sandalwood, Indian Sandalwood, Santalum album – Sandalwood has a flavor profile with a definite woody character. The oil comes from different parts of the world and is available in different varieties. Amyris is West Indian sandalwood grown in Jamaica and Haiti, not on the island of Mysore near India. This oil contains approximately 90% santalol, giving the oil its strong pervasive woody note. It was used in Sen-Sen™-type flavors. Its woodiness can obviously be of great flavor benefit to any food substance that is associated with wood. This would include alcoholic beverages or other substances that are aged in wood. It would also include foods, especially fruits, with a woody pulp or pit like apple, cherry, pear, and those foods with a woody shell like peanuts, nuts in general, coconuts, etc. Remember that woodiness can be augmented by the dryness of tannins. See West Indian Sandalwood, Tannic Acid, Chart 359 – Sandalwood, and Appendix 2.

Sandarac (Tetraclinis articulata [Vahl. Mast]) – Also known as juniper gum (misnomer). Sandarac has a balsamic, turpentine-like character. It is a natural oleo gum resin. See Balsamic, Turpentine, and Chart 360 – Sandarac.

Sandstedt–Keen–Busch Units – See Lintner.

Sanitation and Maintenance Program – Part of the overall GMP and HACCP system, the sanitation and maintenance program includes the maintenance of the equipment and overall sanitation of the plant and equipment. One acceptable methodology is to rinse the equipment contact surfaces with hot water, followed by chlorine and then a quaternary ammonium compound. Microbiological Monitoring to verify that the cleaning is done properly is run periodically, and a quantitative test to verify allergen cleaning is also performed. See GMP, HACCP, Sanitary Standard Operating Procedures, Microbiological Assay, Microbiological Sampling Plan.

Sanitation Standard Operating Procedures – SSOP – The methods whereby a facility undergoes an acceptable cleaning program. See HACCP, GMP.

Sangre de Drago, Sangre de Grado or Croton Lechleri – See Appendix 2.

Santalol – The woody sesquiterpene alcohol that is found in sandalwood oil. See Sandalwood.

Sansho – Also called Japanese pepper, although the botanical is not a true pepper. See Japanese Seven Spice Mixture (Shichimi).

Santalyl Esters – Santalyl esters are esters of the alcohol santalol. The phenyl acetate is such a large molecule, it is doubtful that it has much odor at all, but some report that sandalwood and honey characters are detected. This compound is a good example of how the odor of a raw material might be coming more from leftover starting raw ingredients in the synthesis of the final product than the product itself. See Sandalwood Oil, East Indian, Amyris, and Chart 310 – Santalyl Esters.

Sapid – A substance that is sapid is said to have the ability to affect a taste receptor.

Sapodilla (Manilkara zapota) – Sapodilla is also known as the naseberry. It should not be confused with the sapota that is a different fruit. The fruit secretes a white latex from which chicle is extracted. Chicle is a major ingredient in the manufacture of chewing gum. The inside of the fruit contains a translucent brownish to yellow-brownish pulp, which has a somewhat grainy texture like the pear and cherimoya. The pulp is very flavorful, sweet, and juicy, which is reminiscent of the lactonic character of apricots and honey. The inside of the seeds can be used to make a tea. The unripened fruit contains a high amount of tannins. Therefore, it is inedible unless it is ripe. See Chicle, Chewing Gum.

Saponification – Saponification is the reaction of a fat with an alkali-forming soap. Example: Glyceryl stearate-based fats react with sodium hydroxide to form sodium stearate (common soap) and glycerine.

Saponification Value – Saponification value is the number related to the chemical structure of a fat. It is equal to the number of milligrams of potassium hydroxide needed to hydrolyze an ester like a glycerol fatty acid ester (fat). This method is listed in the Food Chemicals Codex. See Food Chemicals Codex, Analytical Chemistry.

Sap Sago – A sage-flavored cheese from Switzerland. See Cheese.

Sarcodactylus – Citrus medica L. var. Sarcodactylis swingle, Fingered Citron, or Buddha's Hand. It is all rind and very little pulp. The zest is often candied and tastes lemony. The pith is not as bitter as other citrus fruits. See Citrus, Lemon, Appendix 2, and Chart 474 – Sarcodactylus Oil.

Sarepta – See Mustard.

Sarsaparilla Extract – The sarsaparilla extract was used in beverages bearing its name. Actually, the extract did little from a flavor or functional standpoint. It just had a good name. The real active flavor ingredients were sassafras, wintergreen, anise, and usually an aromatic compound like camphor, thymol, eucalyptol, benzaldehyde, etc. Sassafras contains safrole, a chemical related to myristicin. During the late 1940s to early 1950s, safrole was found to be not only toxic but caused liver damage, and later was thought to be a carcinogen. The FDA banned its use. Today, extracts of sassafras for use in foods must be safrole free. When the sassafras was originally removed, it was effectively replaced by vanilla, methyl salicylate, anise, camphor, or other aromatics. Today, this replacement beverage continues and is called root beer. See Root Beer, Food Safety, Delisted Chemicals, Extract, FDA, GRAS, Chart 361 – Sarsaparilla, and Appendix 2.

Sashimi – Sashimi is a thin slice of raw fish that is added to wasabi (Chinese mustard) or ginger instead of rice. This product is often used as an appetizer or generally served with other sushi.

Sassafras (Sassafras albidium [Nutt.] Nees) – Although its use in the past was mostly in teas, its use had diminished considerably when the ban on safrole-containing products occurred with the institution of the Food and Drug Act. Although with the advent of desafrolization, the tea in loose form seems to have made a slight comeback. Another use for the botanical is in Cajun cooking. The leaves are dried and then ground to make a fine powder, which is then used as a thickening agent in gumbos. See Sarsaparilla and Chart 362 – Sassafras.

Satay Sauce – A dressing made from peanuts, onions, garlic, clove, coriander, fennel, turmeric, cumin, coconut milk, chili sauce, sugar, lemon juice, and salt.

Sated, Satiation – Sensory overload. See Saturated (Satiated).

Satiereal™ – A patented satiety suppressor derived from saffron. See Saffron.

Satiety – The feeling of fullness. See Hunger, Appetite.

Saturated (Satiated) –

1. Sensory overload (sated) – The sensory saturation point is the total aroma concentration at which odors or tastes can no longer be perceived.
2. Solubility overload – The saturation point of a solution is the concentration at which no more solute can be added to a specific solvent at a specific temperature.
3. Containing no double or triple bonds. See Solubility, Saturation Point.

Saturation –

1. Saturation (In Solution) – The state at which at a certain temperature, no more solids can be dissolved. An increase in temperature usually increases the ability to dissolve further solids, but there is a limiting factor characteristic of each combination. See Solution, Solubility.
2. Organoleptically, the point of saturation is the point at which a person can no longer taste or smell or discern different tastes or odors. See Anosmia, Agustia, Temporary Anosmia, Specific Agustia, Specific Anosmia, Temporary Agustia.
3. Devoid of double or triple bonds. See Chemical Structure, Unsaturated (Bonds).

Saturation Point – The saturation point in the amount of solids, at a given temperature, where no more can be solubilized in a given liquid.

Sauce – Any variety of usually flavorful liquid substances or preparations. Sauces are made from stocks, flavored oftentimes with spices and herbs, and pan drippings (fond). Sauces can be thickened with cornstarch, roux, or other thickeners such as grains, juice concentrates and purees, reductions, or gums. In the nineteenth century, the chef Antonin Carême classified sauces into four families or Mother Sauces: Allemande based on stock with egg yolk and lemon juice; Béchamel based on flour and milk; Espagnole based on brown stock, beef, tomato, and other items; and Velouté based on a light broth, fish, chicken, or veal. In the early twentieth century, the chef Auguste Escoffier updated the classification, replacing sauce Allemande with egg-based emulsions (Hollandaise and mayonnaise) and adding tomato. The Mother Sauces are as follows:

- Béchamel – Milk or cream thickened with a white roux flavored with an onion piqué.
- Espagnol – Tomato, demi-glace, flavored with a sachet d'espice, brown roux, browned tomato paste (tomato pincé), Mirepoix (carrot, celery, onion), and brown stock.
- Tomato – Tomato, Sachet d'Espice, and brown stock thickened with a blond to brown roux and/or tomato pincage.
- Hollandaise – An emulsion made with fat, egg yolks, shallots, and herbs reduced au sec (to dryness) with a liquid, usually wine.
- Velouté – A white stock, usually veal, thickened with white or blonde roux.
- Demi-Glace – Means half sugar literally, or to reduce by half so the solids are twice as concentrated.

See Stocks, Spice, Herbs, Pan Drippings, Fond, Roux, Purees, Reduction, Juice Concentrates, Gums and Thickeners, Culinary Arts, Mother Sauces, Onion Piqué, Demi-Glace, Sachet D'Espice, Mirepoix, Hollandaise.

Derivative or sister sauces are sauces made from the Mother Sauces. There are hundreds of other sauces derived from the Mother Sauces. These are some examples:

- Alfredo Sauce – A creamy, cheesy sauce made from Parmesan, Romano, onion, and pepper. Made from a béchamel.
- Béarnaise Sauce – Like a Hollandaise only using tarragon and tarragon vinegar.
- Mornay Sauce – Béchamel and cheese.
- Crème Sauce – Mornay sauce with cream and reduced.
- Glace de Viand – A meat stock reduced to up to 1/10 the volume.
- Sauce Paloise – Like Béarnaise but using fresh mint rather than tarragon – good for pork.
- Sauce Chasseur – Mushrooms, shallots, white wine, and tomato concassé to sauce Espagnole.

Other sauces follow:

- Dijon™ Sauce – Made from Dijon™ mustard.
- Tabasco™ Sauce – A fermented hot pepper sauce.
- Barbecue Sauce – An extremely variable sauce made for application on top of grilled products, most commonly called barbecue, or mixed in with items like beans to give it a flavorful character. Barbecue sauce usually includes tomato, smoke, molasses, sugar, salt, some acidulant, pepper, onion and/or garlic, sweet spices like clove or cinnamon, and vinegar.
- Asian Sauces, including Soy, Teriyaki and Plum Sauces – Based on soybeans fermented with Aspergillus oryzea (soy sauce), with added flavorful items.
- Pesto Sauce – A blended mixture of basil leaves, pine nuts or walnuts, olive oil, garlic, and Parmesan or Romano cheese.
- Tomato Sauce (Marinara) – An extremely variable home-cooked recipe that includes tomatoes, spices, with and without sugar, cooked for a while to fully develop a nice flavor. Oftentimes flavored with a bone, meatballs, or other proteins. A marinara sauce is usually confined to usage in the United States. It generally means a quicker sauce that can be used as a dipping or topping sauce, and can be lighter than a heavy tomato sauce cooked for a long time.
- Clam Sauce – A white sauce made from garlic and/or onion, clam juice, other seasoning, and milk or cream.
- Sweet and Sour Sauce – An extremely flavorful sauce that combines a fruit concentrate or puree with an acidulant such as vinegar, lemon juice, or

citric acid, with spices and other flavorful additives.
- Salsa – Coarsely chopped tomatoes or other fruits or vegetables with salt, hot pepper, vinegar, and herbs, used for dipping with crackers or chips, and oftentimes used as an antipasto.
- Tartar Sauce (Rémoulade) – Made from mayonnaise, herbs, spices, salt, and other flavorful items. Used as a dressing for seafood and other items that do not usually produce a sauce from their cooking technique. See Culinary Arts, Poaching, Frying Methods.
- Apple and Other Fruit Sauces – Pureed fruits oftentimes with spices added.
- Steak Sauces – A complex sauce similar to a sweet and sour or barbecue sauce developed for steaks particularly. Uses fruit pastes, anchovy pastes, and other flavorful items as well.
- Worcestershire Sauce – A sauce used in meats, gravies, soups, and vegetable juices, and as a table condiment. Worcestershire is an essential ingredient in the cocktail called Bloody Mary. The sauce is usually made up of garlic, soy sauce, tamarind, onions, molasses, lime, anchovies, vinegar, and seasonings.

Sauerkraut – Cabbage that has acid and salt added to it, developing a typical sulfury character rich in methyl mercaptan, dimethyl sulfide, and similar aroma compounds.

Saunders, Red – See Sandalwood, Red.

Sausage – In the culinary realm of Charcuterie, sausage making is an art. When spiced meat and fat is added to the casing (called force meats) it can be subsequently smoked. From a food safety perspective, the smoking does not necessarily reach times and temperatures that would kill microorganisms, so temperature control and sanitation is critical. There are many types of sausages including; Pierogis, Kielbasas, Frankfurters, Sausages, Liverwurst, and many others. See Charcuterie, Culinary.

Sauté – To pan fry foods over a high heat with a relatively small amount of butter or oil. Sautéed foods are often breaded or have a thin layer of flour to control moisture in the pan. The literal translation means to jump. It describes the action of moisture within the food to be sautéed when it is placed on the sauté pan. For safety reasons, the food should be dipped slightly to see if the pan is hot enough (a sauteuse) and then gently laid down away from you so the oil does not splatter in your face. Also to assure high temperatures for proper cooking and flavor development, the pieces should be separated in the pan to assure no trapping of moisture, which would lower the temperature and result in a tough meat. For large quantities, a tilting skillet can be used. See Culinary Arts, Sauteuse, Sautoir, Standard Breading Procedure.

Sauterne – Sauterne is a white wine with characteristic acid taste and an accompanying, green/acid/ester aroma profile. See Wine and Chart 363 – Sauterne.

Sauteuse – A slant sided pan. A mnemonic or memory device is 'S' is for slant, or the word can be split into 'sauté' and 'use' to show its usage. The slanted sides enable moisture to escape from the cooking process. It is not therefore appropriate to use a sauteuse for poaching or frying. See Sautoir, Sauté, Culinary Arts.

Sautoir – A straight-sided pan used for cooking. A mnemonic or memory device is 'R' is for rectangular. This type of pan is useful in retaining liquids as opposed to a slant-sided sauteuse. A sautoir is appropriate for use in pan frying and poaching.

Savory –
1. The spice (noun) called summer savory.
2. The description (adjective). The word savory describes a food product, class of food products or flavors to which salt would normally be added rather than sugar. Examples of flavors or food products that would fit into the savory category would be meats, vegetables, fish, most dairy products (butter), sour cream, and cheeses. Products manufactured in this industrial segment are called savory products, and the manufacturing and development arm of the food industry in which these products lie is called the savory industry. Snacks are usually treated as a separate industrial category called the snack food industry.
   See Sweet Goods Industry, Beverage Industry, Industrial Approach to Marketing, Product Approach to Marketing, Savory, Summer and Savory Winter.

Savory Summer and Savory Winter – Both spices have a medicinal, camphoraceous-type character. See Chart 364 – Savory.

Saw Palmetto or Serenoa repens, Sabal serrulata – See Appendix 2.

Scallion (Allium fistulosum) (cibol) – A scallion is a green stalk vegetable with a green sulfury flavor vaguely similar to onion. See Onion, Green.

Scalping – The absorption of aroma volatiles into the packaging material.

Scampi –
1. A shellfish – See Fish (Scampi).
2. A dish made with a scampi sauce.
3. A sauce made of garlic, butter, usually wine, and herbs.

Scarlet Runner Bean (Phaseolus coccineus or Phaseolus multiflorus) – The scarlet runner bean

was in use by the Mexican and Central American Native Americans for 9,000 years. Runner beans are flattened and convex with red or black spots. See Beans.

Scent – See Odor.

SCFA – Sort Chain Fatty Acids – Short chain fatty acids are C-5 or less. See LCFA, Fats.

Schiff Base – A Schiff base is a class of compounds that are derived by the chemical condensation between a primary amine with aldehydes or ketones. The most commonly used ingredient for Schiff bases useful in perfumery is methyl anthranilate. Unfortunately, some Schiff bases produce undesirable color reactions and must be avoided. The Schiff bases using food-approved ingredients are amyl cinnamic aldehyde and methyl anthranilate; anisic aldehyde and methyl anthranilate; cinnamic aldehyde and methyl anthranilate; citronellal and methyl anthranilate; decanal and methyl anthranilate; and hydroxycitronellal and methyl anthranilate. These combinations are not necessarily GRAS, and they are mostly mixed and developed for use in fragrances. The Schiff Base reaction that is the first step in the Maillard reaction forming an n-substituted glycosylamine is the first step in the Maillard reaction. In this the amino acid is the nitrogen source and the carbonyl of the fatty acid or reduced sugar is the carbonyl source. See Amines – Primary, Anthranilates, Maillard Reaction, Browning, Enzymatic Browning, Non-Enzymatic Browning.

SCHIFT – The acronym that describes the attributes of good plating techniques, as follows:

S – Size and Shape: Shapes and cuts should be uniform or interesting and should complement the dish. They should not be contrived or look artificial.

C – Color and Contrast: The plate or the items should have pleasing, colorful, and eye-catching harmony. Be aware of a fish-decorated plate used for a beef dish, for example.

H – Height: Good height for the main item leads the eye to the main attraction.

I – Items/Item number: One train of thought is that even numbers are not complementary and that 1, 3, or 5 are the numbers that should be used. Others disagree. In competition, exact shapes, consistency, and complexity are judged.

F – Flavor/Form: The flavor of the items should be complementary. Wine pairing is a way to enhance the experience. Fresh flavors should be developed from fresh ingredients, and layering effects should work in harmony.

T – Texture: – Textures should also be complementary, and the texture of the items should properly reflect the cooking technique. A variety of textures will make the dish look more eye-appealing. The theories behind good plating are an ever-evolving collection of ideas. What was trendy in the 1960s is certainly not acceptable today. Some no-no's in today's current ideas are items like sauces or powders spread all over the rims (servers fingers can leave thumbprints), sprigs of rosemary stuck in place (non-edible garnishes are frowned upon), items that are not part of the meal (current thoughts include the use only of items that are part of the dish made in edible form), super high dishes (cumbersome), smiley face arrangements (three items separated looking like something you would get in a 1950s diner, and extraneous carvings (tomato roses and other similar items). Time, of course, will change things as usual. Asymmetric balance versus symmetric balance should be considered. Either is acceptable, but asymmetry creates a more interesting combination. The focal point should be the main protein. A pleasing flow of shapes, colors, and textures should be achieved. As mentioned before, non-functional garnishes should be avoided. Finally, the plate should not only be dramatic and have 'wow' appeal but should be appetizing and make the guest want to dig in and enjoy. See Culinary Arts.

Schinus mole (Peruvian Pepper, Peruvian Mastic, or California Pepper, Red Pepper, Pink Pepper) – The schinus mole pepper is used as a red or pink pepper in three-pepper mixes. The oil can be used to replace and extend black pepper oil, as both contain caryophyllene and phellandrene. See Pepper, Black, and Chart 365 – Schinus Mole.

Schizandra or Schisandra chinensis – See Appendix 2.

Science (versus art) – Science is the study of natural things. Flavor chemistry is a science. The practice of a flavorist or flavor chemist is an art, although there is an unwritten designation between what some think of as a flavor chemist versus a flavorist. Some characterize a flavor chemist as one who has a background in chemistry or uses chemistry to develop flavors. A flavorist on the other hand is one who some claim does not need or usually does not try to use chemistry as a background in making flavors. This author feels very strongly that the development of sound flavors is a finely balanced blend of both art and science. In today's technical and complex business world, the ignorance (and I mean that in both senses) of science will not yield flavor creations that could last in the marketplace and have long-lasting merit. The Society of Flavor Chemists does not make a distinction between the types of flavor creative personalities.

Sclareolide – See Musks.

SCOGS – Select Committee on GRAS Substances (FDA) – A committee appointed by the Food and Drug Administration to review all substances added to food products and their determination of safety. See FEMA GRAS, FDA GRAS.

Scombroid (Poisoning) – Scombroid poisoning is effectively histamine poisoning. Foods such as Swiss cheeses and spoiled fish can contain a high amount of histamines. Ingestion of these foods can elicit a histamine-like reaction in the person. This is considered to be one of the most common forms of fish poisoning in the United States. See Histamine, Allergy.

Scorched – See Burnt or Burned.

Scorzonera – See Black Salsify and Salsify.

Scots Pine – See Pine.

Scrapie – A TSE (Transmittable Spongiform Encephalopathy) found in goats and sheep. See BSE.

SDS – Safety Data Sheets – See HAZCOM 2012.

Sea Buckthorn or Hippophae rhamnoides L. – See Appendix 2.

Sea Kale (Crambe maritina) – Like endive, sea kale can be 'forced' to retard development of green harsh tastes. See Forcing.

Seal –

1. To seal in the juices of a meat, fish, or other food by quickly cooking. This is actually a myth. See Sear.
2. To prevent from contamination to or from the environment as in plastic coatings, bags, wraps, or closures.
3. A closure that prevents the contents of a package from being contaminated. A seal will assure that the package has not been previously opened. Some seals are clearly indicated in this regard and are called tamper-evident seals. Others prevent the migration of moisture or air and are called air or watertight seals. Still others prevent a child from opening a package and are called childproof seals.

Sear – To cook the outside of a food. It was thought that this method kept flavorful juices trapped inside the food; however, this is not the case. Searing does provide for flavor development from the Maillard Reaction and is an important step to provide good flavor especially in cooking methods that would not otherwise reach Maillard temperatures such as braising, poaching, steaming, and en papailotte (paper steaming) as examples. Also, searing is an important step in roasting so a flavorful outside coating is even throughout a large cut of meat.

Sea Salt – A gray-colored version of salt colored by dissolved minerals. Some sea salts were originally obtained from the Red Sea, Dead Sea, or the Great Salt Lake and are thought of as being a special high grade of salt. However, salt produced by evaporation basins, exposed to sun, wind, air, and perhaps other environmental exposure lends one to question the purity and subsequent healthfulness of some all 'naturally dehydrated' sea salts. See Rock Salt, Salt.

Seasoning – Usually represented by a mixture of spices, herbs, taste components, and colors for use in augmenting the flavor impression of a food. Example: A typical barbecue seasoning is a mixture of salt, sugar, and acid, colored reddish brown, with an appropriate amount of dry carrier, and anticaking agent. The flavor portion is usually based on a savory spice like onion, garlic, with pepper, smoke, and other herbs and spices. See Flavor.

Seaweed – See Algae.

Seaweed Agar Agar – Comes in red and white varieties and is used mostly for thickening and as a substrate for bacterial cultures. Types of seaweed follow:

- Hijiki – Usually precooked before drying, similar in appearance to a curly wakame.
- Konbu, Giant Sea Kelp – Rolled as wrappings for rice and used as a foundation for broths or stocks (Dashi).
- Nori – Wrapping for sushi and used in Europe (called laver).
- Wakame – Similar in appearance to a long strand of spinach. It is dark green in color and mild in flavor.

See Gums and Thickeners, Sashimi, Surimi.

Seaweedy – The characteristic of being reminiscent of seaweed, or having a slightly phenolic, vegetable, very slightly earthy/fishy odor. See Flavor Descriptors.

Sebacates – Sebacates are esters of octane dicarboxylic acid, are fairly high in molecular weight, and have a subtle, fatty flavor. See Fatty/Green, Chart 311 – Sebacates.

Sec –

1. Sec is an abbreviation for secondary, a structural term meaning a carbon connected to two other carbons. See Tert(iary), N(ormal).
2. It is also used in the term 'au sec,' a French term meaning to dryness as in the culinary art of preparing a beurre blanc.

Secondary Alcohol – A hydroxyl group (oxygen plus hydrogen) whose oxygen is attached to a non-terminal carbon. An abbreviation for this designation is sec. See Isomer, Primary Alcohol, Alcohol.

Secondary Amine – An amino (nitrogen plus hydrogen) group whose nitrogen is attached to a non-terminal carbon but is attached to two carbons and is directly attached to a hydrogen atom. By comparison, a tertiary amine is attached to three carbons and no hydrogen. A pyrazine is a double

nitrogen secondary amine. See Tertiary Amine, Primary Amine, Isomer, Amines – Secondary, Amines – Cyclic.

Secondary Odorant – An odor that can be defined by two or more primary odorants. Example: To simulate the flavor profile of ethyl vanillin, one can use a combination of a primary vanillic substance like vanillin plus a brown flavor nuance like Maltol™. Recent studies indicate that there are about 1,000 different nerve sites in the olfactory nerve region located at the rear roof of the nasal cavity. These sites are responsive to specific chemical structures, and might be able to explain the above phenomenon. The scientific data currently observed indicates that reality is not that far off from the original jigsaw piece interlocking puzzle theory hypothesized by Amoore. See Primary Odorant, Volatiles, Odor, Olfactory Nerve Area, Amoore's Theory.

Secondary Yeast – A by-product yeast like brewer's yeast. See Brewer's Yeast, Baker's Yeast, Yeasts, Saccharomyces cerevisiae, Primary (Grown) Yeast.

Secrecy Agreements – Confidentiality Agreements – Legal documents holding one or more parties to the non-disclosure of intellectual property owned by the other party. This can be one sided or mutual and usually acknowledges information in the public domain, or information known before the agreement was enacted. Oftentimes this agreement comes with legalese providing penalties for disclosure and other remedies. See Public Domain, Trade Secrets.

Seed – The ripened ovule of a gymnosperm or cone-bearing plant or an angiosperm or flowering plant. See Seed Savers Exchange.

Seeds – See Nuts and Seeds.

Seed Savers Exchange – One of many non-profit organizations whose goal it is to save and exchange heirloom seeds. See Heirloom Foods.

Seedy – A seedy taste is one that is reminiscent of the taste of seeds typically found in certain fruits, nuts, or pits. See Descriptive Analysis, Flavor Nomenclature Workshop.

Segment – A segment is an internal slice of a fruit. A segment is a compartment inside a fruit where a separation such as a membrane isolates one edible portion from another. Seeds are often found within. Albedo is the white soft cushion-like substance underlying the zest or the outer layer. At the center of concentric segments as in citrus fruits, a pith is located. This pith is made of the same substance as the albedo. See Albedo.

Segregation – The act of separation of granules or particulates based on outside factors. This is due to differences in bulk density, shape, electrostatic characteristics, or other attributes.

Seitan – Seitan is a spongy food made from gluten derived from durum wheat flour. See Wheat.

Select Panel – See Expert Panel.

Selenium (Se) – An important element that helps preserve the elasticity of bodily tissues. Selenium, whose chemical symbol is Se, also helps in blood coagulation and blood pressure. The element appears in trace quantities in the body. Prolonged depletion of selenium results in heart disease or muscle aches. See Minerals.

Self GRAS – See GRAS, GRAS Self-affirmation.

Self-Limiting – The ability to detect some aroma compounds is so acute that the concentrations measure in the parts per trillion. An analogy of this ratio is the square footage of a typical desktop area to the map of the mainland United States. Because of this the concept of G.R.A.S. is based as the amount of a typical approved flavor substance would be totally intolerably strong if it even vaguely approaches anything near toxic levels as ingested. Therefore, flavor ingredients are considered self-limiting and generally recognized as safe within their Intended use. Conclusion; A person would clearly spit a food out that was over-flavored and even that level would be far below any unsafe levels. See GRAS, FEMA, Expert Panel, FLEXPAN, FDA GRAS.

Semolina – Semolina usually means the ground form of wheat, rice, corn, or other grains. In its most commonly used term, it means ground endosperm of hard durum wheat.

Sencha – A fine green tea exported from Japan. See Green Tea, Black Tea.

Senescence – Senescence is the ripening and aging of foods. In general, during senescence, metabolic rate slows down. The exception to this is during a time called the climacterium. At this point, the food's metabolic rate increases, tannic acid is lessened, and carbon dioxide is formed. Starches then break down into sugars, and heat develops. During the climacterium, it is most crucial to keep the temperature low during commercial handling, so as not to spoil the food. During storage, some sugars can be reconverted back into starches. An example of this is seen when, during long storage of sweet corn, a dramatic decrease in sweetness can occur upon storage. See Shriveling; Ripe, Ripening.

Senna (Senna acutifolia Nect. = Alexandria Senna, Senna medicinalis Bischoff = Tinnevelly Senna) – Used mainly as a purgative. Active ingredients are sennosides. The leaves are sometimes used for skin ailments like acne. See Nutraceuticals, Chart 366 – Senna, and Appendix 2.

Sensation – A feeling or impression that enters the consciousness from an applied stimulus. Various

receptor sites are located throughout the body and react to these stimuli. Nerve impulses pass through neurons and eventually send most of the information to the sensory areas in the cerebral cortex, eliciting a conscious response. One exception is olfaction. The nose first sends impulses to the limbic system, a ring-shaped area in the center of the brain correlating with autonomic functions (breathing, heartbeat, and glandular secretions), emotions, and the sense of smell. For this reason, the sense of smell seems to be the most fundamental of all of the five senses in that it is hot-wired into our most basic maintenance mechanisms. By comparison impulses relaying the sensation of taste and texture go through the brain stem to the thalamus then on to the sensory area of the cerebral cortex.

Senses – The five senses are each of the human features that respond to external stimuli or changes in the environment. For the detection of flavors in foods, these include the sense of smell and the sense of taste. Complementary to these stimuli are the sense of touch (texture, pain, mouthfeel, heat), sight (cloudiness, color), and sound (crunchiness or carbonation). The detection of capsaicin, the heat principle of capsicum peppers, is accomplished via the trigeminal nerves associated with the sense of touch. Therefore, when we eat hot peppers we perceive the sense of touch not flavor (odor and taste). See Trigeminal Nerves, Flavor, Smell, Odor, Taste, Nose, Tongue, Anosmia, Agustia, Olfaction, Gustation.

Sensitization –

1. The initial exposure of the body to a substance will generate a specific response.
2. The initial response to allergens, irritants, or those ingredients to which the body is intolerant. See Food Intolerance, Allergies, Irritants.

Sensory Analysis – Sensory analysis is the science of measuring sensory perception. See Compared or Comparison Tests (Triangle Test, Duo-Trio Test, Simple Difference Test, Difference from Control Test), Attribute Tests (Directional Test, Ranking Test, and Paired Comparison Test), Descriptive Analysis, and Dynamic Flavor Profile Test, Senses, 2-AFC, 3-AFC, Sensory Evaluation, Tetrad Test.

Sensory Evaluation – Sensory evaluation is the process of testing using the senses in a scientific and documented manner. In discrimination testing, studies in monkeys have shown that the parietal lobe and specifically the lateral intraparietal cortex neuron in the brain are involved this decision making. See Attribute Tests, QC, QA, Discrimination Test, Objective Analysis, Dynamic Flavor Profile Method™, Degree of Difference, Descriptive Analysis, Sensory Methods Analysis, Errors of Analysis, Null Hypothesis, Tetrad Test, Duo-Trio, Triangle Test, Analysis of Variance (ANOVA), Multivariate Analysis, A not A, 3-AFC, 2-AFC, Subjectivity versus Objectivity, Tetrad Test Psychometrics.

Sensory Fatigue – The growing lack of ability to determine sensation as exposure continues. Sensory fatigue is usually a temporary affliction ameliorated by time. See Temporary Anosmia, Temporary Agustia, Errors of Analysis.

Sensory Testing – **See Sensory Analysis**

Separation –

1. The splitting of immiscible liquids into layers.
2. The degree of difference or distinction between response peaks in a chromatogram. The degree of separation or resolution is dependent on many factors. These include the size of the sampling, the nature or purity of the peak, the type of column, column packing and length, instrumental calibration, pressure, and flow rate, etc. See Liquid Chromatography, Gas Chromatography (GC), Mass Spectroscopy, Resolution.

Separatory Funnel – A glassware device used in the laboratory for the separation of immiscible liquids. A separatory funnel is usually glass stoppered. The funnel has a wide top end and tapers down to a funnel-like spout. A glass or plastic valve structure is situated just above the bottom to control the flow of the contents to be separated. A separatory funnel is used to make solvent plus substrate extracts, two-phase extracts, or to separate two immiscible liquids. An example is a procedure known as washing citrus oils. In this procedure, a citrus oil, such as orange oil, is made more soluble in water by extracting the more soluble, more stable, and more powerful oxygenated components of the oil into an alcohol/water phase. See Extraction, Immiscible, Washed Oils, Phases, Oxygenated Components.

Septic – Septic means poisonous, or microbiologically contaminated. See Aseptic Packaging, Aseptic Processing.

Septum –

1. The cartilage in the nose that divides the nostrils. Subjects with a deviated septum, that is, one that is offset to a major degree, have claimed some degree of anosmia (difficulty in perceiving odors).
2. The rubber disk used in the injector port of a gas or liquid chromatograph. Septa are used to separate internal temperatures and pressures from external temperatures and pressures. An injector needle is used to pierce through the septum introducing the sample to be analyzed by the instrument. See Anosmia, Gas Chromatography (GC).

Sequestrants – Chemicals that tie up other chemicals, either loosely or firmly. Phosphates can act as sequestrants with proteins so that low pH systems cannot granulate or denature them. EDTA can sequester iron ions so that they cannot form the maltol, iron chelate that is bright orange. A list of FDA GRAS sequestrants is provided in Chart 312 – Sequestrants.

Serpenteria – See Snakeroot.

Serrapeptase – See Appendix 2.

Serum Cholesterol – See Cholesterol, Nutraceuticals, Blood.

Serumy – Serumy is a descriptive term meaning an aroma reminiscent of beef broth or rare steak. See Dimethyl Sulfide.

ServSaf® – A training and certification program developed by the National Restaurant Association developed to prevent the spread of foodborne Illness and safe handling of foods in restaurants. Many restaurants have adopted this protocol. See Food Safety, Microbiology, Culinary, NRA.

Serving Order – The sequence or arrangement of samples used in a sensory test, usually a discrimination test. This order is designed to increase the randomness and thereby the accuracy and effectiveness of the test. See Sensory Analysis, Discrimination Test, Order of Presentation Error, Errors of Analysis.

Sesame (Benne) (Sesamum indicum L.) – The use of these seeds goes back a few thousand years. Ground into a paste, sesame butter can be used like peanut butter. With a higher amount of sesame oil, the paste is called tahini. Sugar can be added to the ground paste and made into a confection. Halva™ is one of these types of confections. A mixture of sesame oil and chickpeas is called hummus, a Lebanese staple. The seeds come in three-color varieties including black, brown, and white. Roasted sesame seed oil has become more popular lately due to the prevalence of Far Eastern foods and its use therein. Recently explored for their nutritive benefits, sesame seeds and sesame oil have shown promise. See Appendix 2.

Sesame oil and sesame seed details follow:

1. Sesame Oil – Used as a cooking medium. See Fats and Oils and Appendix 2.
2. Sesame Seeds – Often eaten as a decoration or topping on bread and other baked products, sesame seeds can be made into a paste and flavored. See description above and Chart 368 – Sesame.

Sesquiterpene – One-and-one-half of a terpene whose empirical formula is roughly C15H30. A sesquiterpene could also be considered three isopentene molecules put together. Examples are caryophyllene, bisabolene, and valencene. These chemicals are often found in essential oils because they have a small enough molecule to be able to distill over at steam-related temperatures. See Folding of Extracts and Essences, Rectification, and Chart 327 – Terpenes and Related Compounds.

Sesquiterpeneless –

1. Without sesquiterpenes (the theoretical definition).
2. Left with a little amount of sesquiterpenes (the practical definition).

   Although the industry accepts the term sesquilterpeneless as being an achievable goal, for all practical purposes, it is not. The temperatures needed to reach a sesquiterpeneless state even with sufficient evacuation would destroy much of an oil's flavors and antioxidant properties. Furthermore, the percentage of waxes and other products would become so great as to significantly and negatively affect the flavor of the oil further. See Distillation, Vacuum, Folding of Extracts and Essences, Concentrated or Folded Oils, Solubility, Stability.

Seven HACCP Principles – HACCP principles were first implemented in meat and poultry plants in 1998. The concepts of HACCP have been endorsed by the National Academy of Sciences, and the National Advisory Committee on Microbiological Criteria for Foods (MACMCF). The seven principles include: (1) Hazard Analysis; (2) Critical Control Point Identification; (3) Establishment of Critical Limits; (4) Monitoring Procedures; (5) Corrective Actions; (6) Record Keeping; and (7) Verification Procedures. See HACCP, Hazard Analysis, Critical Control Point Identification, Establishment of Critical Limits, Monitoring Procedures, Corrective Actions, Record Keeping, and Verification Procedures, GMP, Prerequisite Program, Environmental Monitoring, Food Safety, Allergens.

Seven Stage/Seven Step Principles/Seven Step Analysis (of HACCP) – See Seven HACCP Principles.

Shallots (Allium ascolonicum) – Varieties are the Jersey shallot, the gray shallot, and the cuisse de poulet shallot (elongated type resembling an onion). See Onion and Chart 369 – Shallots.

Sharp –

1. Temperature – As in melting point, or other temperature related concepts, meaning a change or endpoint that clearly occurs at a very small range in temperature.
2. Line – As in an instrumental reading, like the line displayed by a refractometer. A blurry line is difficult to read, a sharper line is easier to compare against the line scale. Darker substances have a problem in this regard.
3. Odor Profile – One that has some aspect of trigeminal irritation as well as odorous principle. Sharpness is akin to a stinging or an irritating sensation.

Sharp Metal Objects – Identified in the HACCP system, sharp metal objects are to be minimized, controlled and identified. See Sieve, HACCP, Metal Detectors.

Shea (Vitellaria paradoxa, syn. Butyrospermum parkii, B. paradoxa) – Shea is a tree indigenous to Africa. The shea nut is ground often by hand, and the butter is extracted. Often used as cosmetics, shea butter is thought to have healing properties. The oil has been reported in foods as well as in indigenous African cuisine. The African name for shea is karité meaning 'life' indicating how important the product is to them. It is considered under the tree nuts for allergens, however, and must be declared as such. See Allergens, Fats and Oil, and Appendix 2.

Shelf Life – See Shelf-Life Stability.

Shelf-Life Stability – The length of time a product's quality remains upon standing, given a certain set of environmental conditions. Example: A flavor has a shelf life of 8 months when kept in cool dry conditions between temperatures of 45–65 °F. This means that after 8 months, the flavor's quality will fall below desirable levels of acceptance. See Flavor Quality.

Shelf-Life Testing – The process of determining the trend of diminishing quality of a product over time. Testing should be used to recommend appropriate conditions and time constraints to assure a product's quality. Many sensory, chemical, and instrumental testing procedures can verify these results. See Accelerated Storage Stability Testing.

Shellfish – A general description meaning all crustaceans and mollusks. As the allergies to crustacean shellfish are typically far more serious and far more prevalent, the FDA has required the labeling of 'Allergens – Crustacean Shellfish' to appear on the labels of food products that contain them according to the Allergen Labeling Law. See Food Allergen Labeling and Consumer Protection Act of 2004, Shellfish Toxins.

Shellfish Toxins – As shellfish feed on planktonic algae including dinoflagellates, toxins are often accumulated. The four types of shellfish poisoning are:

Paralytic Shellfish Poisoning (PSP) – Symptoms are varying degrees of paralysis.

Diarrheic Shellfish Poisoning (DSP) – Symptoms are varying degrees of diarrhea.

Neurotoxic Shellfish Poisoning (NSP) – Symptoms are varying degrees of neurotoxic distress.

Amnesic Shellfish Poisoning (ASP) – Symptoms are varying degrees of memory loss.

Shepard's Purse or Sheperd's Purse or Shepherd's Purse (Capsella bursapastoris) – See Appendix 2.

Sherbets – See Sorbet.

Shichimi – Japanese seven spice mixture including sansho, seaweed, chili, orange peel, poppy seeds, and white and black sesame seeds. This seasoning is used in soups or on top of noodle dishes. See Sushi, Oriental.

Shiitake Mushroom or Lentinula edodes – See Mushrooms (food), Fungus, and Appendix 2.

Shipping – There are many issues involved with the shipping of good either Incoming or outgoing. Refrigeration of products coming in and geographical routes (freezing of materials going over the mountains) might affect storage and quality, locked or sealed trucks are an Issue that might have to be in the overall HACCP plan with documentation as to contents and verification of codes and Identity, costs and load requirements are obvious Issues as well as co-shipped prohibitions such as poisons and other items that can damage product. See Cost of Goods.

Shipping Cost – It is crucial to know the actual cost of a raw material and understand how minimum quantities, shipping costs and other costs (customs, etc.) will effect ingredients and their contribution to a formula.

Shipping Documents (Papers) – The Document that identifies the Shipper, Customer, UN Number, Lot Number, Flash Point information, and other DOT pertinent information. See DOT, UN Number, HAZMAT 2012, Flash Point, Flammable.

Shipping and Receiving Protocols – Shipping Requirements – Within a well-run HACCP system, documentation of the quality of the truck that either ships product or delivers raw materials is crucial. Notations of the quality of the truck itself, the driver, co-shipments within the truck (non-poisonous, non-radioactive), the quality of the shipments packaging, and other notations and documentation are to be made. See HACCP.

Shortages – See Crop Shortages.

Shortening – Fat not only acts as a coating agent and a sensory lubricant but also acts as a shortener for baked products. As the fat coats the starch molecules and gluten in the flour, the structures become less tough and crumblier. Partially hydrogenated cottonseed oil, soybean oil, or peanut oils are commonly used shortenings for these purposes. See Fat.

Short Textured – Having a non-Newtonian or gel-like texture, also called snotty textured in the starch trade. See Texture.

Shoulder (GC) – In the printout (digital or otherwise) of a gas chromatograph, the characteristic of shouldering is when two peaks co-elute so one shows a

bump on the side(s) of another. The problem with shouldering is the calculation of the area under the curve. This is the calculation of the relative mass of the elutant. If a line is theoretically dropped at the point where the slope changes, some of the peaks area will be lost and given up to the secondary or middle peak. See Gas Chromatography.

Shrink Wrap – Shrink Wrapping – A polymer made of polyolefin, polyvinyl chloride, polyethylene or polypropylene that shrinks when heat is applied. This serves as a protective seal for food grade products. See Packaging.

Shriveling – Water loss and subsequent reduction in firmness or bulk causing a diminished size and a corresponding onset of wrinkles or similar defects.

Shuck – A coating. Example: The smooth, sticky green husk covering the nut of a walnut.

Shoyu – See Soybean, Soy Sauce.

SIC Code 2087 – The industrial classification that most flavor companies fell within prior to January 1, 1998. The two new classifications in the new NAICS system are NAICS 31193 (Flavoring Syrup Concentrate Manufacturing) and NAICS 311942 (Spice and Extract Manufacturing).

Sieve – A mechanical device with measured holes for the purpose of determining the particle size of a powder. A sieve is often a crosshatched wire. The determination of a powder's granulation size is called a sieve analysis or mesh size. The sieve analysis is reported as product passing through a mesh per inch (60 mesh means 60 mesh per inch), or in standard numerical sieve sizes. See Sieve Analysis.

Sieve Analysis – A series of differing sieve sizes are placed one on top of another. A sieve analysis is usually done positioning the pans from largest holes (above) to finest holes (below). The powder is placed on the top sieve. The stack is then tamped or vibrated to facilitate the movement of the powder downward. The product is thus separated. Then the percentages remaining on each sieve are calculated as a percentage, reported as a total to 100%. Example: Ninety percent through a 50-mesh sieve and 5% through a 100-mesh sieve. This means that the product is mostly 50 mesh, but has 5% fines that are smaller than 100 mesh. See Mesh Size.

Signal Words – Within the HAZCOM 2012 protocol, the identification of the hazard severity of the product is described by the signal word. Signal words are either: Danger (used for more severe hazards) and Warning (used for less sever hazards). See HAZCOM 2012, OSHA, Hazardous Goods.

Significant Vulnerability – The aspect of a Food Defense Plan that describes what in HACCP terms would be a Hazard. This is the area, process or aspect of a company where intentional food adulteration could occur. See Food Defense Plan, Focused Mitigation Strategy, Purposeful Adulteration, HACCP.

Silica and Silicates – A material made of silicon dioxide that is usually prepared as a fine powder. Silica or silicates are often used as anticaking agents. When a hydroscopic or already moist powder has had silica or a silicate added, this process might result in improved powder flowability. See Anticaking Agent, Clumping, Moisture Content, and Chart 313 – Silica and Silicates.

Silicone – A silicon-based substance used as a substrate or packing material in a gas chromatography column. Silicone is often used in the detection and isolation of volatile materials. See Carbowax™, Columns, Gas Chromatography (GC).

Silverskin –

1. Term for the thin, pearlescent membrane found on certain cuts of meat, such as a tenderloin. Silver skin is very tough and must be removed (with a sharp knife) to prevent the meat from curling during cooking. Silverskin is made of a substance similar to myelin, an organic phospholipid that otherwise electronically insulates nerve cells. Myelin is an outgrowth of the glial cells.
2. It is also a species of garlic Allium sativum.
3. It is a type of small onion also known as a Welsh onion developed by the technique of burying the bulbs thickly and deeply in rich dense soil. It is similar to a pearl onion that it is often confused with, however, it is a different species.
4. It is a characterizing name for many other food varieties.
5. Silverskin is also one of the layers on the coffee bean that creates an extremely thin dust and contributes to the chaffe that can cause flue fires. The bean is covered by the parchment, the silverskin, the pulp, and finally the fruit skin or cover of the coffee cherry.

See Meat, Tissue, Texture.

Silymarin – See Milk Thistle and Appendix 2.

Simaruba (Simaruba amara L.) – A bitter extract, used as a medicinal herb in the later stages of dysentery. See Chart 370 – Simaruba and Appendix 2.

Simple Difference Test – A sensory method that asks simply 'Are the two samples the same or different?' This test methodology is not very accurate, and measures differences in products with strong sensory attributes or anaesthetizing effects. See Triangle Test.

Simulation versus Duplication – Adequately replacing a product by organoleptical means or instrumental identification of the ingredients and subsequent

replacement, alteration, and simulation by equivalent food-approved substances. Instrumental duplication can often be confusing and can be fraught with artifacts, errors, and blind directions. It can also be a time-consuming method, whereas the organoleptic approach can be much quicker. Flavorists often choose the organoleptic approach to duplicate products and use instrumental analysis more for quality assurance programs. See Organoleptic Analysis, Organoleptic Duplication, Replication.

Sinesal – A lesser quantity but pleasantly characteristic terpene aldehyde found in the essential oil of orange. It has a warm aromatic odor and taste. Sinesal occurs in orange oil as alpha and beta form at 200–2,600 ppm and 100–1,300 ppm, respectively. See Orange Oil on Chart 275 – Orange Sweet.

Single Bond – A normal bond between atoms. In carbon, a single bond is a covalent bond between two atoms, each sharing a pair of electrons.

Single Fold Oil – The normal oil as it is distilled or expressed from the fruit or botanical.

Sip – The act of taking slight amounts of water into the mouth. It is generally regarded by most tasters that in order to obtain the greatest organoleptic stimulation, a liquid should be sipped or slurped. The act of sipping facilitates the movement of aroma volatiles retronasally. See Retronasal, Slurping.

Skatole – Skatole is a benzopyrrole. This chemical structure is typified by a benzene ring attached to a C4 unsaturated cyclic secondary amine. Skatole is found where protein has decomposed. In dilution, skatole is reminiscent of fecal or rotten aromas. In higher concentration, it has an unpleasant camphoraceous character. See Indole.

Skullcap or Scutellaria galericulata L. – See Appendix 2.

Slimy – Slimy is a descriptive quality or touch sensation relating to textural cues where a fatty simulation or pseudo salty texture is present. Sliminess is characteristic of high amounts of vegetable gums like guar, carrageenan, etc. Sliminess usually connotes a negative character. The positive counterpart imparted typically by a fat is called lubricity. See Slippery, Texture, Mouthfeel.

Slippery – Slippery textures are similar to slimy. Not necessarily negative.

Slippery Elm or Ulmus rubra Muhl. – Ulmus fulva Muhl. See Appendix 2.

Sloe Berries (Blackthorn) (Prunus spinosa L.) – Used to flavor the alcoholic cordial known as sloe gin. This is then used to make sloe gin fizz by mixing with Grenadine™ syrup and orange juice as well as other popular mixed 'tropical' drinks. See Cordials, Tropical, and Chart 371 – Sloe Berry.

SLR – Scientific (Systematic) Literature Review.

Slurping – Slurping is a technique used in tasting liquids to enhance the perception of subtle flavors. To slurp, one takes a liquid or semi-liquid into the mouth with such force as to cause an audible noise. The practice of slurping forces air to rush into the mouth. This facilitates the delivery of aroma volatiles retronasally for a greater appreciation of the flavor profile. See Illusory Elution, Retronasal, Organoleptic Analysis.

Slurry –

1. A type of suspension whose particles can be stabilized by increasing the viscosity of the liquid.
2. A temporary solid in liquid blend used often to 'wet' a gum or starch. In culinary arts, a cornstarch slurried in water is used to thicken a juice in a pan, creating a jus lié. See Jus Lié, Culinary Arts.

Small Dice – See Knife Cuts.

Smell –

1. To perceive an odor (verb).
2. An odor (noun). The sense of smell is a dramatic example of biochemistry. Receptor sites at the olfactory bulb area are sensitive to specific structures on a molecular level. In fact, the sense of smell is so acute, that it has been determined that only four molecules are needed to elicit certain odors. Receptor cells are located at the terminus of the olfactory nerve region where cilia (hair-like structures) are exposed. It is at these cilia where the chemical fit takes place. Each of the ciliated receptor cells is held in place by supporting cells. The nerve then branches from the olfactory nerve and enters into the bulb region as axons through gaps called the lamina cribrosa. Each fit corresponds to a specific defined genetic command, and it is estimated that there are approximately 1,000 sites. Currently it is accepted that the total human genome is made up of 100,000 genetic structures. This means that nearly 1% of all our genetic make-up defines the sense of smell. See Odor, Volatiles, Odorivector, Aroma(s), Fragrance, and Figure 29.

The Sense of Smell

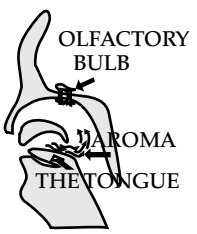

Figure 29

Smoke – The process of smoking takes place when a food product is in direct contact to the fumes of a smoking substance. The procedure uses wood like mesquite, maple, or oak. The aromatic substances emitted by the burning wood are absorbed by the food, thus flavoring it. Not only used for the development of smoke flavoring, the process of smoking is also used as a method of preserving meats and fish. Historically, smoking was very important before the advent of refrigeration.

Smoke Extract – The flavor-rich product that is produced by the absorption of the aromas of the smoke of woods like cedar, mesquite, etc. See Smoke Flavor, Smoke.

Smoke Flavor – An extract of oil or water or other suitable solvent that has come in contact with a smoking substance and therefore absorbs the aromatics present. Smoke flavor is made by the oil or water extraction of smoke derived from wood. The woods often used are maple or oak, and recently mesquite. The mesquite smoke generates a much sweeter smoky character. See Phenol, Smoky, Chart 372 – Smoke Flavor.

Smoke Point – The temperature at which a fatty substance begins to smoke and is prime for combustion. At this point fat flavor deteriorates. The smoke point is similar to and appears just before the flashpoint of the oil as defined by DOT and OSHA. In cooking oils, the lowest smoke point is butter, then clarified butter, then olive oil. See Clarified Butter, Vegetable Oils.

Smoking – The act of igniting a tobacco product and inhaling the subsequent smoke and vapor to obtain the nicotine as it is absorbed into the lungs. There has been much attention both legal and public as to the safety of this practice in the past decades and much has transpired because of it. See Hunter List, E-Cigarettes, Safety, Tobacco, Cigarettes.

Smoky – Smoky means reminiscent of smoke. See Acrid.

Smooth –

1. A generic terminology that can mean a creamy aroma or a fatty, slippery texture. The presence of a smooth characteristic is almost always a positive characteristic. Texturally, it is the lack of friction of a substance on the tongue and epithelial tissues of the mouth and throat. This effect is also called lubricity.
2. In tea terminology, smooth is analogous to full.
3. A flavor profile that is without apparent or drastic flavor changes. See Creamy, Descriptive Terminology.

Snacks – Snack Food Industry – The large segment of the food and beverage industry that includes chips, crackers, extruded snacks, pretzels, nuts, and popcorn. See Industry.

Snakeroot (Snake Root) (Asarum, Wild Ginger) (Asarum canadense L.) Serpentaria (Virginia Snakeroot) (Aristolochia serpentaria L.) – Snakeroot has a flavor profile similar to ginger. Snakeroot imparts a complex flavor with a spicy woody character. Virginia Snakeroot, on the other hand, is a different plant. It was used for a wide variety of ailments such as snakebites, to treat convulsions, and promote menstruation. Extracts are used as a gastric stimulant; however, research has shown aristolochic acid to be a carcinogen and kidney toxin. Therefore, in 2002 its use in herbal supplements was recently banned. See Woody, Spicy, Virginia Snakeroot, and Chart 367 – Snakeroot and Virginia Snakeroot Serpentaria.

SNIF NMR – Specific Natural Isotope Fractionation-Nuclear Magnetic Resonance – This is an instrumental analysis that determines the ratio of isotopes at a specific molecular sites. It is a useful tool in the determination of natural products versus synthetic products. Carbon 12 versus 13 versus 14 is the atom of interest in proving naturalness. To illustrate this point, as water evaporates, the more volatile H_2O evaporates faster than its isotopic counterpart HDO (with a deuterium atom). At the equator, more HDO exists than H_2O, so a SNIFR NMR analysis would show that a higher level of HDO shows the water came from the tropics. There is approximately 90 ppm in water at the South Pole versus about 160 ppm at the equator. See Carbon 12, Carbon 13, Carbon 14, Isotope, Isotopic Analysis (Isotopic Ratio).

Snotty – A short-textured appearance. See Non-Newtonian.

Society of Flavor Chemists – The organization began in 1959. The society was initiated to promote, advance, and educate its members in the art and science of flavor chemistry. The society's headquarters are in Washington, DC. Most of the meetings are held in the New Jersey area with one Midwest meeting typically in the spring. The rules for joining the Society of Flavor Chemists are specific. The basic criterion for full and active membership includes an apprenticeship under a certified member for 7 years. Some long-term accommodations are available for those who are creative flavorists and have not worked under a certified member for the required amount of time, namely after 5 years, a creative flavorist may join as an apprentice member. In either case, there is currently a test conducted to ascertain the credentials of the applicant.

Soda –

1. Indicating the presence of elemental sodium as in baking soda or sodium bicarbonate.
2. A carbonated water as in soda water.

3. A carbonated drink, aka soda pop or pop.
4. A thin, usually square cracker leavened slightly with baking soda.

Sodium – An element that, along with potassium, is responsible for the transfer of nerve impulses along the neurons. The two elements also help regulate the body's water balance. Most foods contain sodium, and therefore sodium deficiency is rare. Excessive use of sodium has been recently cited as being a causative agent in hypertension or high blood pressure. However, recent findings illustrate this is perhaps not the case. For patients that already have hypertension, sodium must be regulated. Excessive sodium can cause potential heart problems, stroke, or kidney damage. Excess salt (sodium) is removed from the body through the kidneys. See Salt.

Sodium Benzoate – The most commonly used preservative in flavors. It retards the growth of microorganisms. See Yeast and Mold, Potassium Sorbate, Standard Plate Count.

Sodium Diacetate – A condensation product of sodium acetate and acetic acid by the removal of water forming a loose hydrogen bond between the acetic acid and the sodium acetate molecule. Used in snacks for salt and vinegar. It is also considered a fungicide and bacteriocide, but does not need any specific regulation because it dissociated with water into the acid and salt of acetic acid. See Chart 473 – Sodium Diacetate.

Soft Ball – See Hard Candy Manufacturing.

Soft Crack – See Hard Candy Manufacturing.

Solanine – The toxic chemical produced around new growth to protect a plant from insect attack. In foods of the nightshade family (Solanum) such as potatoes and tomatoes. This often accompanied by a concentration of chlorophyll, hence the green coloring as an indication of potential problem. It is always good to cut away the green spots in a potato. See Culinary, Toxin

Solid – The state of matter that retains its structure. Liquids, on the other hand, flow and gases expand. Some solid aromatic chemicals have an odor. These sublimate into vapors at room temperature. See Sublimation.

Solids – Typically referring to dissolved solids with a liquid system, the solids content or Brix, of a system refers often to the sugars dissolved in a syrup juice or similar product. See Brix, Aw, Refractive Index.

Solid Extract – (SE) – A product that is produced by the water-soluble extraction of plant matter. The extract is subsequently concentrated by removing the solvent either by recovery or elimination. To produce a solid extract, the solvents chosen yield a water-soluble product. If the end result is an oil-soluble product, then the product derived is called an oleoresin. Solid extracts are popular forms for flavor use. They are second only to the essential oils. Solid extracts provide aroma compounds and tastant compounds (non-volatile). Some of the differences in solid extracts are subtle; combinations of two or more of them often synergize and tend to increase the body of the flavor. The choice of solvent systems can greatly affect the end result. Using more ethanol versus water will extract out more of the oil solubles and alkaloids. Vanilla extract has a standard of identity, and the choice of solvents are specified. See Vanilla (Extract). Some of the most popular ones follow:

St. John's Bread SE – Brown flavor used anywhere a brown note is needed, such as ripe fruits, cocoa, coffee, chocolate, vanilla, butterscotch, maple, birch and root beer, malted milk, nut flavors.

Fenugreek SE – Similar to St. John's bread with a definite maple-type syrup character.

Oak Chip SE – A brown character with a slightly woody, bitter note.

Cherry Bark SE – A warm, brown character with a background similar to oak chips.

Mountain Maple SE – Similar to Fenugreek SE with a more tannic or bitter note.

Cocoa SE – Characteristic of cocoa.

Coffee SE – Characteristic of coffee.

Licorice Root SE – A pleasant, sweet characteristic flavor. Fluid extracts can be made by direct extraction. However, they are usually produced from solid extracts. Fluid extracts are typically nothing more than solid extracts in water or alcohol, other solvents, or combinations thereof. In some instances, where the system must be alkalized, a direct fluid extract is the process of choice. This is the case with annatto extract, and also for the colorant, bixin. See Extraction, Fluid Extract, Household Extract, Tincture, Absolute, Concrete, Washed Oil, Vanilla (Extract), Saint John's Bread, Fenugreek.

Solin Oil – A low linolenic acid flaxseed oil/linseed oil. See Flaxseed Oil, Linseed Oil.

Solubility – The characteristic describing the ability of a solid to mix into a liquid. The ability of a liquid to mix with another liquid is more appropriately described as miscibility. A solid product (solute) can be slightly soluble, dispersible in a suspension, or insoluble. See Precipitation, Suspension, Emulsion.

Solute – The solute is the item to be solubilized. See Solvent.

Solution – The result of a solid (solute) totally dispersing into a liquid. Conversely, if two liquids will mix, they are called miscible, and if they cannot mix, they are called immiscible. A solid that can go into solution

is called soluble, in that liquid. If the solution reaches a point where no more solid will dissolve, and just falls to the bottom, it is called saturated. If the liquid is heated, more solids can be dissolved; if it is then cooled, the liquid can hold more than it normally would have and the solids do not fall out. In this case, it is called super saturated. The point below which any further amount of product added will fall out of the suspension is called the saturation point. This point varies from solvent to solvent and also from solid to solid. It also varies with heat. When a solid is added to a liquid and heat is then emitted, the solid is said to have a positive heat of solution in that solvent. When a solid is added to a liquid and the product becomes cool, it is said that in that case the particular mixture has a negative heat of solution. If a product is made up of two insoluble phases stabilized by either a gum or another type of stabilizing agent, it is called an emulsion. If a solid can be suspended by shaking, but will soon fall out, it is called a suspension. A solid ingredient that is made insoluble in a liquid ingredient is called a precipitate, and the act of falling out is called precipitation. Solutions of potent ingredients are used in the flavor industry. This is due to two reasons:

1. so that they are more easily dispersible and
2. so they can be presented at a level representing a usable strength.

However, the technique of keeping products in solution on the shelf should be avoided for long periods because they may develop unwanted acetals and ketals. See Precipitation, Suspension, Acetals, Ketals, Miscible, Immiscible Liquids, Solvent, Microemulsion, Solute, Emulsion, Heat of Solution, Macroemulsion.

Solvent – A solvent is a necessary ingredient for use in flavors. Solvents are used to adjust the level of otherwise powerful aroma and taste substances to levels similar to those that exist in nature and are therefore in sensory-perceptible concentrations. The determination of a good flavor solvent is as follows:

1. A solvent must have as bland a flavor as possible.
2. It is to be used at large percentages in a formula so it must be fairly inexpensive to make the final flavor feasible.
3. It must be readily available.
4. It must be readily miscible with other solvents and other liquid aroma compounds.
5. It must be able to solubilize solid flavor ingredients readily.
6. Lack of formation of acetals is a plus but not necessary criteria. See Bland, Miscible, Acetals, and Chart 314 – Solvents.

Solvents Challenge Studies – There has been a study done on the anti-microbial properties of ethyl alcohol, triacetin and propylene glycol, common solvents in the flavor industry. See Flavor Safety Assessment, Antimicrobial, HACCP.

Somatosensation – The group of stimuli that Include the non-volatile non-taste types; Chemesthesis, Texture, and Temperature. Texture includes such things as chew, rubberyness, brittleness, and other textural descriptors. See Sensory Evaluation, Trigeminal, Odor, Taste, Flavor.

Sophistication – A polite way of saying adulteration. See Adulteration.

Sorbates – Esters of 2,4 hexanedienoic acid are fruity and slightly harsh. See Chart 315 – Sorbates.

Sorbet – Originally an Arabic word meaning syrups chilled with snow. See Sherbets.

Sorbitan Monooleate – See Polysorbate and Sorbitan Esters, Emulsifying Agent.

Sorbitan Monostearate – See Polysorbate and Sorbitan Esters, Emulsifying Agent.

Sorbitol – A polyalcohol that is used as a non-nutritive sweetener. See DE, Dextrose Equivalence, Mannitol, Non-Nutritive Sweeteners.

Sorrel (Rumex spp.) – From an old French word meaning sour, sorrel is high in ascorbic acid, tart and astringent in flavor, and is similar in profile to rhubarb. Other names include garden sorrel, wild sorrel, French sorrel, or round-leaved sorrel (Rumex scutatus). Spinach dock or Rumex patienta is of lesser use. Sorrels were used in ancient Egypt. Sorrel is used to make soups, added to fish, and used to offset the taste of rich foods in general. See Sour, Acidulant(s).

Soufflé – A light custard-like substance, which, when mixed with other ingredients such as meats, vegetables, etc., rises to the top when cooked.

Sour – Sour is one of the primary tastes. The detection of low pH is called the state of being sour. See Acid, Sweet, Bitter, Umami, Odor, Taste, Tastant.

Source – Source Country – The originating country of a raw material. Recently issues from certain countries have elicited requests for course country information. As this information is proprietary, IT issues are an important consideration for the disclosure of this information. See Intellectual Property.

Sour Cream – Sour cream is cream that has been fermented by the bacteria Streptococcus lactis and Leuconostoc citrovorum. The flavor of cream is a characteristic green/fatty odor profile with a volatile and non-volatile acid and fatty character. See Cheese, Dairy Products, Lactobacillus, Starter Cultures.

Soursop (aka Guanabana) – See Guanabana.

Soxhlet Extraction – Using a device invented by Franz von Soxhlet, the apparatus is used to determine fat content. This process is a distillation versus the static extraction processes of the Mojonnier or Rose–Gottlieb analytical methods. See Fat, Extraction, Distillation, Rose Gottlieb, Mojonnier, Analytical Chemistry.

Soya Sauce – See Soy Sauce.

Soybean – Soy –

Glycine soja – (Glycine max) – The word soy comes from shoyu (Japanese). The soybean has been cultivated for over 13,000 years. It and all of its corresponding by-products and preparations is a popular staple in many cultures. Soy sauce is a cultured soy product using Aspergillus oryzea as the fermenting agent. See Soy Sauce and Appendix 2.

Uses for soybeans follow:

Ground soybean – Added to many dishes for the addition of nutrients, flavor, and thickness.

Soybean sprouts – Used in many Far Eastern dishes as a replacement for or in combination with mung bean sprouts or alfalfa sprouts.

Soybean flour – Does not contain any gluten so it will not rise, and contains 2 to 3 times the protein and 10 times the fat of wheat flour.

Roasted ground soybeans – Is used in some parts of the world as a non-caffeine coffee replacer due to its similarity in taste.

Soymilk – A milk-like substance made from crushed soybeans. Some nutrient-fortified infant formulas are designed around this product as an alternative substitute for milk for lactose-intolerant babies. A similar approach is taken for milk substitutes for adults. The residue of this process is called okara. See Okara.

Tofu – Soymilk curd. A soft vegetable cheese, although it is not a dairy product. It has a subtle milky, cheesy/salty flavor that absorbs most other flavors in which it comes in contact. It is neither fermented nor aged like cheese. Developed in China over 2,000 years ago, it has become an important food in Far Eastern cooking. To develop the curd from the soymilk, either acid or salt is used. Nigari has its curd developed by using a natural sea salt containing magnesium chloride. Other salts or acids like calcium chloride, calcium sulfate (gypsum), and magnesium sulfate (Epsom salts), vinegar, or citrus juices can be used.

Tempeh – Contains soybeans mixed with other legumes that are inoculated with a fermenting agent Rhizopus oligosporus, a fungus. White mold spreads throughout the product making it look like Camembert or Brie.

Textured Vegetable Proteins – TVPs, derived from soy, are also blended with non-soy products. Soy is a beneficial ingredient due to its cost, nutritional characteristics, and flavor. When TVPs first came out, off flavor was a concern; however, the problem has recently been greatly ameliorated by the extraction of potential oxidation-prone residues.

See TVPs, Soy Sauce.

Soy Sauce – Soybeans are first ground with water to form a milky substance. A fungus is then added like Aspergillus oryzea, which Japanese and Chinese keep cultivated on a rice ball. The Japanese-type soy sauce is a lighter version than is the Chinese style. Chinese-style soy sauces are made by the addition of molasses and infusion of straw mushrooms, giving the sauce a rich flavor and a darker coloration, and are usually aged for a longer period of time, upward of 2 years. The Japanese style uses more wheat in their sauce and less aging time (no more than 6 months), resulting in the lighter variety. Comparatively, the darker Japanese sauces are still equivalent to the lightest of the Chinese types. Some soy sauces undergo a secondary fermentation where many aromatics are formed. From the fermentation of sulfur containing amino acids including dimethyl sulfide and methyl mercapto propionaldehyde, other trace sulfur chemicals are produced. Acids and brown notes (Maltol™, furfural, furanones) are typical of fermented processes and are thus derived. Tamari is a western term used for Japanese-style soy sauces of all types. Toyo mansi is a light type of soy sauce produced in the Philippines. Ketjap manis is a thick and sweet type of soy sauce developed in Indonesia. Hoisin sauce is a soy sauce blend produced with the five-spice mixture. When hoisin sauce is mixed with sesame oil and sugar, it becomes the sauce used in the pancake sandwich typical of Peking duck. See Soybean, Five Spice Mixture, Ethnic (China).

Spaetzle – A type of pasta that is made by drizzling viscous dough into boiling water. See Culinary Arts.

Spanish Origanum – See Thyme.

Spear – The edible shoot of a vegetable, like asparagus. See Asparagus.

Spearmint (Mentha spicata Houds or L.) – Spearmint is the sweet, cooling botanical from which spearmint oil is derived. Spearmint contains an appreciable amount of l-carvone (the minty optical isomer of carvone). Two main varieties of spearmint are native spearmint and Scotch spearmint. The Scotch variety has a peculiar vegetable green character but is sometimes used in the higher priced cordials and chewing gums. The much more prevalent variety,

native spearmint, is far less expensive. Native spearmint has a cool minty character with a clean overall profile. A recent study showed that vanilla flavor is the most popular, orange oil is the highest selling volume flavor, and the one people seem to feel has the most pleasant flavor profile is spearmint. It was used in the Far East and mixed with tea. This beverage was originally called chai. This is not to be confused with the term chai as it is accepted today. Modern chai is a spicier version and is represented by a specific blend between clove and other spices along with sweetening flavor components and creamy mouthfeel components. As is with peppermint oils, geographical regions seem to have a significant effect on the flavor profile. Chart 374 – Spearmint and Varieties provides a comparison of the flavor profiles between native and Scotch oils versus Far West and Midwest regions (courtesy of Doug Walker, Essex Labs).

Far West Scotch – Floral, fragrant-fruity, warm, buttery, slightly sweet, light hay.

Midwest Scotch – Floral, fragrant herbal, warm, sweet candy, slightly chemical, slightly heavy, slightly sour.

Far West Native – Spicy, robust, woody, tea-like, slightly floral, slightly green.

Midwest Native – Spicy, fruity, woody, warm, slightly sweet. See Native Spearmint, Scotch Spearmint, L-Carvone, Optical Isomers, Mint (herb), and Appendix 2.

Specific Agustia – Specific agustia is the inability to taste certain ingredients, either under certain conditions or permanently. See Agustia, Temporary Agustia.

Specific Anosmia – Inability to smell certain ingredients, either under certain conditions or permanently. See Anosmia, Temporary Anosmia.

Specification – A document that itemizes pertinent information about a food, flavoring, or other ingredient. The specification sheet usually contains the name of the product, all numbers and codes associated with that name, and a description. The rest of the information varies according to the nature of the product and its intended use. For flavors, items could include salt or sodium content, fat content, moisture, solubility, microbiological assay, specific gravity, weight per gallon, optical rotation, refractive index, color, clarity, ingredient statement, non-flavoring ingredient declaration, mesh size, solubility, some nutritional data, sieve analysis, usage level, or other pertinent chemical or physical data. See Product Specifications, Specification Sheet, Non-flavoring Ingredient (Declaration), Nutritional Analysis.

Specification Sheet – A specification sheet is a form that documents the characteristics of a product. In the flavor industry, a specification sheet would have color, description, flashpoint, solubility, labeling, usage level, and other pertinent product data. See Specification, MSDS.

Specific Gravity – Specific gravity is abbreviated SpG. The specific gravity of water is defined as 1.000. The specific gravity of all other ingredients is measured by calculating the ratio between the density of the ingredient divided by the density of water at a specific temperature. Hence, if a substance measures 9.00 pounds per gallon and water is 8.33 pounds per gallon, then the substances SpG or specific gravity would be 9.00/8.33 or 1.08. See Density, Bulk Density.

Spectrum Attribute Scales® – From Sensory Spectrum, a method using standards for attribute testing based on commonly available items. An example is a Texture-Hardness scale. See Descriptive Analysis, Flavor Nomenclature Workshop, and Chart 316 – Spectrum Attribute Scale®.

Speedwell – See Veronica.

Spice – As defined by the United States Food and Drug Administration, spices are defined as in CFR Title 21, Subpart B, section 101.22 (a) (2), the term 'spice' means any aromatic vegetable substance in the whole, broken, ground form except for those substances that have been traditionally regarded as foods, such as onions, garlic, and celery; whose significant function in food is seasoning rather than nutritional; that is true to name; and from which no portion of any volatile oil or other flavoring principle has been removed. The CFR states: Spices include spices listed in Section 182.10 and Part 184 of this chapter, such as the following:

- Allspice, Anise, Basil, Bay Leaves, Caraway seed, Cardamom, Celery Seed, Chervil, Cloves, Cinnamon, Coriander, Cumin seed, Dill seed, Fennel seed, Fenugreek, Ginger, Horseradish, Mace, Marjoram, Mustard flour, Nutmeg, Oregano, Paprika, Parsley, Pepper, Black, Saffron, Sage, Savory, Star anise, Tarragon, Thyme, Turmeric. Paprika, Turmeric, and Saffron or other spices which are also colors, shall be declared as 'spice and coloring' unless declared by their common or unusual name. See Natural Flavor, Artificial Flavor, Food.
- Spice Blend – A blend of spice ingredients. When spices are added to carriers, mouthfeel agents, tastants, flavorings, colorants, and other ingredients, it is known as a seasoning or seasoning blend.

See Seasoning, Spice, Natural Flavor, Artificial Flavor.

Spicy –
1. An aroma characteristic that is reminiscent of the spices.
2. A product that has in its profile one or more of the same characterizing chemicals found in spices like eugenol, anethole, carvacrol, caryophyllene, cinnamic aldehyde, estragole, etc. See Flavor Nomenclature Workshop, Descriptive Analysis.

Spike Lavender – See Lavender, Spike, Lavandin.

Spikenard (Nardostachys grandiflora D.C.) – Spikenard is an herb that is used as a sedative, and to treat insomnia, flatulence, difficulties during childbirth, and other minor maladies. See Chart 375 – Spikenard and Appendix 2.

Spinach (Spinacia oleracea) – A leafy vegetable with a characteristic green, sulfury, and slightly bitter flavor. Dehydrated spinach powder is quite green and is used to color pasta products. Uses of spinach in recipes are usually referred to as 'à la Florentine.' See Culinary Arts.

Spiro – A configuration where two moieties are linked together by a mutual bond to a heteroatom and not linked directly. See Spiroaromatic Ring, Heteroatom.

Spiroaromatic Ring – A chemical configuration where two aromatic ring structures are linked by a single atom (usually a heteroatom) and not a mutual bond between them. See Heteroatom, Aromatic.

Spirulina or Spirulina platensis – See Algae and Appendix 2.

Splitting –
1. The process of breaking down of an emulsion forming two distinguishable phases. This process of splitting is not always problem free. It is a necessary operation when doing a two-phase separation, extraction, or distillation. Problems that can occur when splitting is desired are an indeterminate split line, foaming, etc. Sometimes applying salt to the water phase is useful in enhancing an oil/water separation. Sonic waves help split foams as do defoaming agents, etc. Adding a weighting agent to the oil can solve adverse splitting otherwise known as ringing.
2. The use of two columns in a gas chromatograph often requires two different types of packing materials. See Separatory Funnel, Gas Chromatography (GC).

SPME (Solid Phase Micro Extraction) – SPME is used as a vapor-absorbent material for headspace analysis of aromas. It is placed in a volatile environment where the material absorbs aromas and then it is extracted, concentrated and injected into a GC or GC-MS for analysis. See Gas Chromatography (GC), Headspace Analysis.

Spoilage (Food) – To a lesser degree, food spoilage can be considered harmless deterioration of the flavor quality, stability, appearance, eating properties, or other characteristics that make the food less than optimum. However, severe spoilage can occur by a variety of means as follows:
1. Macrobial – Insects and mites, rodents, other non-microbial organisms.
2. Microbial – Bacterium, fungus, phage, or protozoa.
3. Chemical – Color changes, enzymatic, non-enzymatic, pesticides, other (contamination, reaction, etc.).
4. Physical – Breakage, bruising or crushing, cutting or dismemberment, splitting of emulsions.

Spray Atomizer – The part of the spray dryer which converts the spray dry media into a fine mist. The action of a slow moving pump action (typically a peristaltic pump) and a metal end with an extremely fine orifice (in different shapes to affect the stream) achieves this goal. See Spray Drying, Centrifugal Head Atomizer.

Spray Drying – The dehydration method most used by the flavor industry. A liquid is emulsified and pump (often a peristaltic pump). This is then dispersed in a heated atmosphere through a centrifugal or spray atomizer and collected. Care must be taken to optimize the encapsulation of the flavoring and flow rate, base, oil content, temperature control and even atomizer configuration and chamber size and shape should be carefully considered. See Dehydration, Drying Techniques.

Sprig – A sprig is a soft delicate branch, usually of a spice, like fennel, parsley, etc.

Spruce – See Hemlock.

Squash (Cucurbita spp.) – Squash varieties are divided into summer squash (short shelf life) and winter squash (long shelf life). Types of squash are quite varied; the popular varieties follow:

Summer Squash – C. pepo var. – Zucchini (usually dark green, elongated, and ribbed).

Marrow Squash or Vegetable Marrow – C. melopepo f. var. – Torticolis – Crookneck squash and straight neck squash (usually yellow).

C. melopepo f. Clypeiformis var. – Pattypan Squash (saucer shaped with variable coloration).

Spaghetti Squash var. – Fibrous insides can be used like spaghetti after it is cooked.

Winter Squash – C. moschata var. – Butternut squash (sweet tasting with high carotene content and bright yellow color).

Hubbard Squash (varied in color, round or oval in shape).

C. maxima turbaniformis var. – Turban Squash (sweet, hazelnut-like flavor).

Buttercup Squash (similar to butternut variety and very difficult to break open).

Acorn Squash (flavor similar to hazelnut with a bell pepper character).

C. maxima var. – Banana squash (elongated and yellow).

C. maxima var. – Autumn squash (similar to pumpkin and mammoth squash), peduncle protruding at base.

C. maxima var. – Mammoth Squash (similar in shape to pumpkin, color varied, can grow to very large sizes), peduncle oval and nonridged, no protrusion at base.

C. pepo var. – Pumpkin (usually orange and can also grow to very large size), peduncle smooth at base and five ridged (pentagonal cross section). See Squash Blossom.

Squash Blossom – A long pointy flower that is used in cooking. It can be either stuffed or used to flavor dishes like quesadilla. Typical in Mexican cuisine. See Culinary Arts, Ethnic Ethnicity (Ethnic Foods) – Mexican.

Squaw Vine or Mitchella repens – See Appendix 2.

SQF – Safe Quality Foods – One of the approved audit systems within the GHS (Global Harmonized System) or GFSI (Global Food Safety Initiative supported by the World Health Organization of the United Nations. See SQF, Iso 900, AIB.

Sriracha – Named after the coastal city of Thailand, Si Racha, this sauce is made from hot chillies, garlic, vinegar, sugar and salt. It is also called rooster sauce due to the logo of a popular sriracha supplier. See Trends, Marketing, Culinary.

Stability – The property that refers to the nature of a substance or of a mixture of two or more substances as defined by a specified criterion. Flavor stability would refer to how long it takes for a flavor's strength and flavor character to noticeably depreciate over time. See Shelf-Life Stability, Quality Assurance.

Stabilizer – An ingredient that causes an unstable system to become stable. Example: the egg yolks used in a Hollandaise sauce has lecithin which have both positive and negative chemical sites causing a hydrogen bonding attraction to the system forming stable micelles and thus forming a more stable emulsion. A stabilizer can stabilize a system as in the following examples: (1) Increasing viscosity; (2) Causing hydrogen bonding or other chemical attraction to occur; (3) Forming micelles in an emulsion; (4) Acting as a chemical catalyst in a reaction. See Emulsion, Micelle.

Stable Emulsion – See Coalesce, Unstable Emulsion.

Stainless Steel – The food surface contact surface of choice due its ability to be cleaned and the corrosion resistance of some approved alloys. The 300 series of alloys are used in food processing plants and restaurants. 304 Stainless 18/8 means steel alloyed with 18% chromium and 8% nickel. This blend is commonly used in kitchen ware. 316 Stainless is more commonly used in production areas and is an alloy blend of steel, 16–18% chromium, 10–14% nickel, 2% manganese and other elements such as carbon, silicon, phosphorous, nitrogen and molybdenum. This is called marine stainless because of its extreme resistance to corrosion and makes an excellent surface for multiple cleaning procedures and foods which tend to be on the acid side of pH. See Food Safety, Cleaning Procedures, HACCP, Pre-op Procedures, GMP, Prerequisite Program.

Stalky – The term stalky, when used in the wine industry, means a flavor profile reminiscent of damp twigs. See Viney, Green.

Stamen – The flower parts that hold the colorant and flavoring refined as saffron.

Standard – See Internal Standards, Specifications, Legislation, HACCP.

Standard Breading Procedure – The goal is to have an evenly coated food item to retain moisture and have an attractive eye appeal. The procedure follows:

1. Dry the item well and dredge it first in flour. Shake off any excess flour, and transfer the food to a container of egg wash (milk or water and eggs).
2. Switch hands, and coat the food in the egg wash on all sides.
3. Transfer the food to the bread crumbs using your dry hands to pack the bread crumbs evenly and shake off any excess. See Culinary Arts, Frying Methods, Dredging.

Standard Deviation – Standard deviation quantifies the amount of variation of a set of data values. The standard deviation of a probability distribution is the square root of its variance. See Statistics, Statistical Analysis, Sensory Evaluation, Multivariate Analysis.

Standard of Identity – A specification of one of the United States regulating bodies that determines one or more of the following: the nature, composition, labeling, packaging, and use of a certain product.

Standard Plate Count – The number of bacterial colonies per gram that grow by inoculating an unknown in a nutrient agar after a period of incubation.

Staphylococcus – See Pathogenic (Pathological) Organism.

Star Anise – See Anise, Star.

Starch – A starch is a carbohydrate made up of amylopectin (branched chained) and amylose (straight chained). Straight starches and modified food

starches are widely used in the industry. Starches can absorb water and subsequently swell. They usually need heat to swell fully (full cook). Overusing a starch or undercooking a starch can contribute to an adverse starchy taste in a food product and therefore greatly affect the flavor profile. The varieties dent corn, waxy maize, and tapioca starches are the most prevalent. Starches can be made to be freeze thaw stable, instantized, film forming, coating agents, dispersing agents, encapsulating agents, diluents, plating agents, etc., according to the different treatments allowed by the FDA (CFR 172.892, 178.3520). See Modified Food Starch, Carbohydrates.

Starchy – The term starchy refers to a textural and taste profile reminiscence of raw starch.

Star Fruit – See Carambola.

Starter Cultures – Starter cultures are microbiological strains that are added to foods, especially dairy products to produce cheese, butter, etc. These include:

1. Starter Cultures – See Pathogenic (Pathological) Organism, Fermentation, Cheese, Butter, and Chart 317 – Starter Cultures.
2. Starter Distillate – The following is an excerpt from the Code of Federal Regulations Title 21 – Starter Distillate: CFR Title 21 Paragraph 184.1848(a). Starter distillate (butter starter distillate) is a steam distillate of the culture of any or all of the following species of bacteria grown on a medium consisting of skim milk usually fortified with about 0.1% citric acid – Streptococcus lactis, Streptococcus cremoris, Streptococcus lactis subspecies diacetylactis, Leuconostoc citrocorum and L. dextranicum. The ingredient contains more than 98% water, and the remainder of the product is a mixture of butter-like flavor compounds. Diacetyl is the major flavor component in starter distillate. See FDA, CFR Starter Cultures. See Chart 317 – Starter Cultures, Chart 376 – Starter Distillate..

Statistics, Statistical Analysis – The mathematical study of probability, data interpretation, trends, randomness, etc. Statistical analysis is used to interpret sensory data and similar subjective results. The tests include: (1) Hedonic or Affective Test – rates the quality or liking of the product on a central weighted scale, using as many points to the positive against neutral as to the negative. Smiley faces are used for children taking this test. This is typically done on one product. (2) Self Explicated Test – Here consumers are asked what are the important attributes of a product and what order of importance they might ascribe to each attribute. (3) Ranking Test – Here a consumer is asked to view more than one item in comparison to the other(s). This is a variation of the Hedonic Test using more than one product to be explored. (4) Discrimination test – A host of comparative tests which include Triangle Test, Duo-trio test, A not A test, Tetrad tests, all of which are presented to the testers (assessors) to determine the presence or degree of difference of two or more products. (5) Descriptive Tests – show the presence and measure of defined attributes. Here the 'Spider Web' type test, the Dynamic Flavor Profile Method® and the Quantitative Descriptive Method® are examples. See Sensory Evaluation, P-Value (Probability Value), Risk Assessment.

St. Bartholomew's Tea – See Maté.

Steam –

1. Gaseous water (noun).
2. To cook meats, vegetables, or fish with steam. This sort of cooking will degrade proteins, fats, and other substances in the food without them undergoing a Maillard Reaction, typical at higher temperatures.
3. A method used to extract some aroma or taste materials from flavorful substances, such as steam distillation. See Distillation.

Steam Distillation – See Steam.

Steep – Allowing a solid to stand or steep in a liquid is a technique used to extract desired flavor characters from the solid to the liquid phase. Tea is usually steeped or brewed in hot water. The solute is the tea. The solvent is the hot water. Maceration is a solid steeped in a liquid producing a liquid or solid extract.

Steep Water – The nutrient-rich broth that is a by-product of the corn steeping process. Steep water is produced as the initial stage of the corn wet milling process.

Stem Cells – Stems cells are non-differentiated cells that can differentiate into other cells. They can divide themselves to other stem cells by mitosis. In the basal layer of the nasal epithelium, olfactory stem cells are found. One researcher has been exploring the use of these stem cells implanted into spinal nerve cells that regenerate not into olfactory nerves but spinal nerves. This potentially opens up an entire possible treatment for paraplegic disorders. Taste stem cells have also been recently identified as taste buds regenerate regularly. The average lifespan of a taste cell is about 10–16 days. See Taste, Odor.

Stench – An extreme malodor typically represented by a sulfur compound. According to Brillat (1825) 'almost all harmful substances have a stench'. Bad odors are typically stronger than good odors. These are protective mechanisms built up by man to avoid these ingredients. See Toxicity.

Stereo Isomerization – Optical Isomerization – See Optical Isomers.

Steric Hindrance – Steric hindrance is a description of a molecule's physical state. It describes an overcrowded condition usually resulting in an unstable structure. Cis isomers are normally more sterically hindered than trans isomers. See Cis (Isomerism), Trans (Isomerism), (E), (Z).

Sterilize, Sterilization – Sterilization of a food is the application of sufficient heat or chemicals to result in the killing off of microorganisms.

Steven's Power Law – The mathematical equation stating the increase in perceived intensity is proportionate to the concentration of the material (I) to the nth power (S=In). See Fechner's Law, Weber Ratio (Fraction), Biedler Model.

Stevia – About 150 species (Including S. eupatoria, S. ovata, S. plummerae, S. rebaudiana Bertoni, S. salicifolia, S. serrata). This plant, commonly known simply as stevia is about 150 to 400 times sweeter than sucrose. Since the last publication, many stevia and stevia byproducts and extractives are approved for use in flavors. Care must be taken, however not to make sweetener claims because GRAS ingredients are not approved for use as sweeteners. In this case they must be used as flavor modifiers or FMP's. Included are; Stevioside (FEMA 4763), Rebaudoside C (FEMA 4720), Steviol Glycoside Extract (FEMA 4772, 4796, 4805 and 4806), Rebaudoside A (FEMA 4601), Steviol Glycoside Extract (FEMA 4771) and Glucosyl Steviol Glycosides (FEMA 4728). See Flavors With Modifying Properties, Chart 495 – Stevia and Stevia Derivatives, Sensory Evaluation, GRAS, Expert Panel, Non-Nutritive Sweeteners, Enhancers.

Stew – A mixture of vegetables, meat, fish seasonings, or other foodstuffs mixed together and boiled in a sauce. This system will not necessarily initiate much of the desirable browning reaction; therefore, often some of the individual ingredients are first sautéed, fried, browned, or otherwise treated. A pre-browned substance like a roux can be used for this effect.

St. John's Bread (Saint John's Bread) (Carob) – St. John's bread is also known as carob and locust bean. Obtained from the fruit of the locust tree growing in the Middle East and parts of southern Europe. The hard seeds inside yield the gum locust bean gum. Carob bean is another name for locust bean. St. John's bread is usually used for the solid extract. Further roasting of the solid extract during extraction yields a more flavorful product. St. John's bread is one of the most widely used solid extracts, used in many types of brown flavors including chocolates, vanillas, butterscotch, in combination with fenugreek in maples, and as a general overall contributor of ripe brown character in most fruits and other related products. Ground roasted carob powder can be used as an 'extender' to cocoa powder when cocoa is in short supply or when cost, caffeine, or other issues are at hand. See Extenders, Brown (Compounds), Roasting, Solid Extracts, Gums and Thickeners, Locust Bean, Chart 82 – Carob, Chicory Powder, Cocoa, Chocolate, Carob Bean.

St. John's Wort (Saint John's Wort) – See Chart 357 – St. John's Wort, Nutraceuticals, and Appendix 2.

Stigma – The sex organ of a flower are the pistil and the stamen. The stigma is the elongated structure of the crocus plant that yields the spice saffron. A stigma is a stamen plus a pistil. See Saffron.

Still – A still is an apparatus used for distillation. See Distillation, Packing, Theoretical Plate Count.

Still Beverage – A still beverage is one without added or formed gas. The latter is called a carbonated beverage. Examples are tea, coffee, and orange juice. See Carbonated Beverages, Carbonation.

Stimulate – To stimulate is to excite a sense. This stimulation produces a nerve signal or a response by a sensory system. See Stimulus.

Stimulus – The item, chemical, or condition that elicits a response.

Stimulus Error – When unrelated, stimuli bias the judgment at hand. Example – The same orange juice flavor is presented in different bases, one with cloud and the other without. Because most people expect orange juice to be cloudy, the cloudier sample will rate significantly better as an orange juice flavor than the clear counterpart. See Logical Errors, Halo Effect, Expectation Error, Order of Presentation Error, Mutual Suggestion Error, Motivational Error, Personality Errors (Capriciousness versus Timidity).

Stinging Nettle – See Nettle.

Stir Fry – A culinary technique used in the Asian cultures. Similar to sauté in the sense that small bite-sized cuts of naturally tender foods are used, and the sauce is developed in the pan. Stir fry enables an extremely high heat to be introduced via a jet fire beneath. The cooking is extremely fast. A stable oil like peanut oil is often used. Toasted sesame oil is used afterward as a flavoring. The items are sized for use by chopsticks. Ginger, wasabi, soy sauce, kombu, water chestnuts, beans, chicken, pork, and cabbage are some of the typical ingredients. See Ethnic Foods, Sauté, Frying Methods, Culinary Arts, and Appendix 2.

Stock – A somewhat flavorful base pre-sauce made from vegetables, fish, or meat. These stocks can be thickened to create a velouté using roux as a thickener. The choice of roux – white, pale/blonde, brown or dark – is dependent on the desired result.

The best preparation of a stock is to start with cold water and gently bring it to a simmer. This assures that the fats if present do not develop such small droplets as to cloud the resultant final stock. Also, if roux is added, the cold to hot/hot to cold rule applies. Stocks usually do not have salt or pepper added. This is done when converting a stock to a sauce later. Cooking times vary with the food being cooked. Veal or beef stocks take about 6–8 hours, poultry about 2–3 hours, fish and vegetables from 30 minutes to 1 hour. A stock can be the basis of many things including a consommé. Brown stocks are developed using browned bones, or by using an onion brulée for coloring, or by caramelized tomato (tomato pincage), or any combination of the browning and the latter two. Stocks can be thickened with various items to make a sauce including a slurry of cornstarch and water, reduction, concentrated or pureed foods, a liaison of cream and egg yolks, or roux. The shelf life in the refrigerator of the various stocks is as follows: Fish or vegetable stocks do not refrigerate well; chicken can last about 3 days in the refrigerator; and veal and other heavily cooked stock can last up to 7 days in the refrigerator. Mushrooms are often added to fish stocks to provide umami-type glutamic acid, which would normally not be present at the levels in meats. See Culinary Arts, Roux, Sauce, Consommé, Fond, Fumet, Slurry, Reduction, Liaison, Onion, Chinese Stock.

Stoke's Law – Stoke's Law states that the rate of sedimentation or coalescence of particles in an emulsion is proportional to the size of the particle, the thickness or viscosity of the liquid, the force of gravity and the difference between the specific gravities of the two fluids. A typical flavor emulsion has a micron range of 2–10 microns. An emulsion that has a median range of 1 micron will last 100 times that of one that has a median range of 10 microns.

The force of a sphere moving through a viscous liquid is proportional to the viscosity times the radius times the velocity (the constant is 6 times pi). This concept is useful in the determination of the viscosity of an unknown. Another variation of Stoke's Law states that the velocity of separation of an emulsion is equal to the following formula:

$$V = D2g(d - d1)/18n$$

Where D2 is the square of the diameter of the spherical particle in cm, d is the density of the particle, and d1 is the density of the whole emulsion. The physical constant, g, is the acceleration of gravity (981 cm/sec/sec) and n is the viscosity of the emulsion.

Stolon – A stolon is a horizontal runner. An example of this is found in a strawberry plant.

Stone Cells – The cellulose-based gritty particles in the pulp of a pear.

Storage Conditions – The environment in which a product is kept. By the very fact that a flavor is volatile, it is recommended that flavors be stored in relatively cool dry conditions. Careful avoidance of heat during the summer will help avoid adverse reactions. Extreme cold of the winter can contribute to solids precipitation out of solution, so extreme cold should be avoided as well. Solids like vanillin, ethyl vanillin, and other widely used solid volatile ingredients are prone to this effect. Gentle reheating of the material can be used to put the solids back in solution. See Volatility, Recommended Storage Conditions, Warehouse – Warehousing.

Storage Stability – The quality of product longevity over time. The nature of a material's ability to last and to maintain a profile acceptable for use. Quality includes all aspects of the flavor including organoleptic quality, microbiological quality, and physical quality, etc. A storage stability test indicates changes that occur in a product gauged over time. See Shelf-Life Stability, Accelerated Storage Stability Test.

Storax (Styrax) – Styrax contains styrene and therefore has a unique plastic-like top note. This character works well in contributing a sharp top note to fruits, honey, and many other flavors. The crude styrax gum resinoid contains a lot of water and is an inhomogeneous mass. It is usually extracted or dispersed in a solvent. For food grade use, care must be taken that DEP not be used. (Diethyl phthalate is a toxic substance.) The product contains cinnamates, cinnamyl esters, and other balsamic flavoring compounds. See Plastic, Honey, Top Note, and Chart 377 – Storax.

Stovetop Conditions – Stovetop conditions are the collection of environmental measurements like temperature, mixing conditions, etc., that would normally be found in a typical home kitchen. This definition has been expanded to include preserving, microwaving, canning, preserving, retorting, and pressure-cooking. See Processing Conditions, Processed Flavors.

Strawberry (Fragaria sp.) – Strawberries grow cultivated (larger with pointed ends) and wild (smaller). There are over 600 different species of strawberry. Strawberries however have been one of the foods that can commonly cause allergic reactions. The flavor of strawberry has been studied extensively. It is one flavor that has been difficult to replicate identically to nature. However, the classical approach to the flavor of strawberry is usually based on a combination of green, fruity, brown, and fermented

notes. Hexenyl compounds and lighter esters make the top note, diacetyl, fatty acids, and lactones, and middle esters make the fermented-type middle ground, and maltol-type compounds produce the jammy note so typical of the fruit. See Food Allergies, Fruity, Chart 378 – Strawberry, and Appendix 2.

Strawberry Aldehyde – Also known as Aldehyde C-16 (so-called). In reality, the compound is really a glycidate (ethyl methyl phenyl glycidate or also called ethyl epoxy phenyl butanoate). Although it has not been reportedly found in nature, it is a major characterizer in synthetic strawberry flavors. Because it has a nice, sweet berry note, it can be used in most other berries and can find its way into most of the other fruits as well. See Aldehydes (So-called), Berry (Like), Nature Identical.

Strawberry Furanone™ – See Furanones.

Strecker Degradation – The loss of an amino group and then the subsequent loss of the COO (carboxyl group) as carbon dioxide. A Strecker aldehyde formed from an amino acid, therefore, has one less carbon than the amino acid. Leucine, a C-6 amino acid Strecker degrades to C-5 (valeraldehyde).

Street Food – Street food is typically sold out in the public by a food van, cart, or booth. It is ready to eat or drink and often has an ethnic flavor. See Marketing, Culinary, Trends.

Strength –

1. The potency of a product. Flavor strength is the relative amount of material needed to achieve a perceptible degree of recognition.
2. The positive attribute that is associated with a good degree of flavor impact. Example: If a product has strength, it means it is not too weak and it is not necessary to use too much of it in order to achieve a desirable result.
3. In tea terminology, it implies a combination of positive attributes like briskness, pungency, and thickness. See Usage Level, Impact, Perception.

Streptococcus – See Pathogenic (Pathological) Organism.

Structural Character Predominance – The concept that certain chemical structures with characteristic odor types will predominate over other chemical structures. These compounds take over the defining characteristic in a compound with mixed ingredients. Example: Allyl thio propionate is an ester. An ester would normally be thought to be somewhat sweet and carry a typical fruity character. However, due to the thio moiety, the mercaptan structure contributes an overwhelming sulfury character that would lend itself more to pineapple and other tropical fruits. The following list is not all-inclusive, as the combinations and number of different chemical structures are too many to list, but it should include most of the most important flavor types. The order can vary somewhat depending on other ingredients in the mix, pH, etc.; therefore, Chart 318 – Structural Character Predominance lists those structures that are the most structurally predominant, generally down the line to those structures that are less structurally predominant.

Structure – See Chemical Structure.

Styrallyl Compounds – Styrallyl compounds typically have a weedy or canned-like character. See Chart 43 – Benzoates and Benzyl Esters.

Styrax – See Storax.

Subcritical Extraction – The process of isolating volatile ingredients. Fluid substances that would usually be gaseous at normal temperatures and pressures are converted to liquids at higher pressures and lower temperatures. The pressures or temperatures are then normalized and the extracting material is then vaporized leaving the extract. Extractant product can be recycled. See Supercritical Extraction, Critical Pressure, Critical Temperature.

Subjective Analysis – Testing that attempts to measure the otherwise unquantifiable. These tests would analyze likes, dislikes, and otherwise subjective intangibles. For this, a linear scale might be developed, and the testant might be asked to rate a subject product to general likes and dislikes (hedonic testing). See Hedonic Test, Discrimination Test, Sensory Analysis.

Subjectivity versus Objectivity – The analysis of reasoning that distinguishes between the felt and the calculated. 'I reason that one plus one equals two.' is an example of objective reasoning. It is the way a product is sold by price. 'I consider that I like that painting over there.' is an example of subjective reasoning. Today's salespeople are faced with more subjective selling challenges because of the complexity of today's products and flavor systems. Selling objectively is selling the sizzle not the steak. See Marketing, Sensory Analysis.

Subject Matter Expert – In the application of regulatory issues, a subject matter expert is one who is qualified to give guidance, Interpretation and manage personnel on a specific topic on which they are competent. See Regulations.

Sublimation – The change in state from solid directly to a gas and bypassing the normal liquid state. Carbon dioxide sublimates at atmospheric pressure from dry ice to CO_2 gas. However, at elevated pressures, the CO_2 is liquid. It is this principle that enables the process of critical extractions to take place. Menthol is an example of a flavor chemical that sublimates. See Supercritical Extraction, Subcritical Extraction, Critical Extraction.

Successful Flavor – Flavors are subjective. One person's likes may be another person's dislikes. Because of this, the one real measure of the quality or success of a flavor is 'How accurately does it meet the goals set by the customer?' Basically a good flavor is one that sells. See Marketing.

Succinamides – Although succinamides are used as seizure medications, (+/−)-N,N-dimethyl menthyl succinamide is approved for use as a flavoring agent. See Chart 480 – Succinamides Dimethyl Menthyl Succinamide.

Succinates – Succinates are esters of ethane dicarboxylate. They are not known for their extraordinary potency but as most of the esters can be generally used when a fruity non-characterizing nuance is desired. See Chart 319 – Succinates.

Sucralose – Approved for use in the United States as of April 1, 1998, the artificial sweetener has a sweetening power of about 600 times that of sucrose.

Sucrose – Also known as saccharose or table sugar. This sugar is a disaccharide and has a DE rating of approximately 120 because it is 1.2 times sweeter than dextrose.

Sugar(s) and Polyhydroxyl Compounds – A polyhydroxyl heterocyclic (oxygen) molecule. Pentoses are five-membered rings (four carbons plus oxygen). Hexoses are six-membered rings (five carbons plus oxygen). One ring is called a monosaccharide. Two connected rings are a disaccharide. Many rings linked into chains are a polysaccharide. At higher numbers of combined sugars, the general rule of thumb is the greater the amount of converted sugars, the less sweet the product. Beyond a set DE point, the molecule is then considered a maltodextrin (a DE rating of less than 15). A dextrin has a DE rating of 5 to 10. Starches are still larger polysaccharides and have higher molecular weights and lower DE ratings. Cellulose, a more complex polysaccharide, is larger still. Enzymes can be used to convert starches, dextrin, etc., into simpler sugars. Amylases are the class of enzymes used to convert starches in this manner. Cellulases are enzymes that break down cellulose. When simpler reducing sugars are formed, they can be used in a Maillard Reaction. Dextrins are produced by drum drying starches catalyzed by acid. The heat and acid breaks down the more complex starch molecule into the dextrin-size molecules. Corn syrup is made by applying enzymes to cornstarch to produce sugars. Polyhydroxyl compounds (polyhydric alcohols) are approved for use in non-standardized foods provided that they are used at good manufacturing practice levels necessary for intended use. See Invert Sugar, Enzymes, Corn Syrup, Dextrins, Starch Maltodextrins, Maillard Reaction, Dextrose Equivalence, Bone Black, Brown Sugar, Heterocyclic Compounds (Rings), Sugar Cane, Sugar Beet Extract Flavor Base, Disaccharides, Fructose, Monosaccharide, Lactose, Maltose, Molasses, (DE Rating), Sugar Refining, Digestion.

Sugar Beet Extract Flavor Base – Sugar beet extract is used in Europe as a flavor base. See Sweeteners (Nutritive); Sweeteners (Non-Nutritive); Sugar(s) and Polyhydroxyl Compounds; and Chart 379 – Sugar Beet Extract.

Sugar Cane (Saccharum officinarum) – Used to make table sugar, or fermented and distilled to make rum. See Rum.

Sugar Coating – See Pan Coating.

Sugar Esters – See Chart 321 – Sugar Esters.

Sugar Refining – Sugar beets or cane (cut into strips = cossettes) is cut and crushed. The juice called vesou is further refined. The chaff (bagasse) is used to fuel the process. The juice is then concentrated. Some chemical agents can then be added to the sugar, like lime, calcium carbonate, or carbon dioxide. Crystals are separated by centrifugation. At the point at which the crystals become 50% of the mass, the mother liquor or poor molasses is removed. A three-fold processing yields a darker molasses called blackstrap molasses. The raw sugar is still filled with impurities like dirt, insect parts, microorganisms, and waxes. This raw sugar is then refined or bleached in many ways. The bleaching process that was used for years uses microfine bone black, a carbonized version of the by-product of the slaughtering industry. The sugar is refined by flash oxidizing, yielding a white sugar. Partially raw or white sugar can have molasses, caramel, or artificial colors added, which is then called brown sugar. See DE (Rating) and Chart 133 – DE Rating.

Sugar States – See Hard Candy Manufacturing.

Sugary – Sugary means sweet and reminiscent of sugar.

Suggested Usage Level – The amount of flavor that is optimum. Although this sounds good in principle, flavor application rates vary significantly versus the different base systems. Unless the flavor has been tested in the same or equivalent base, the suggestion might be off. Because heat can be introduced during processing and this can greatly affect the flavor's profile, the base must also be put through similar processes in order to yield an accurate level in the lab. Finally, the usage level is often a subjective consideration. The optimum level can be dependent on many things. Oftentimes it is a very personal and subjective decision. We flavorists love the flavors we create. Perhaps this is why many people claim usage levels coming out of a flavor lab are often too high. Perhaps it's the level of odor in

the background environment. At the flavor house, flavor application specialists residing in a clean air environment should be the ones to determine usage levels.

Sulfites, Sulfates, Sulfur Dioxide and Sulfite Sensitivity – Although sulfites can occur naturally in foods such as wine (organic wine is not free from sulfites), sulfites are typically added to foods for preservation purposes. In wine it stops the yeast from further developing and inhibits the action of Acetobacter to turn that wine to vinegar. It is added to dried fruits and vegetables to prevent microbial growth. The potentially life-threatening allergy to sulfites is not an allergy but it is an IgE mitigated allergic response because it can show up in a skin test. Sulphites are made as a normal decomposition product of protein metabolism so they exist in the body naturally. Chemically sulfates however contain one more Oxygen SO_4^{-2} versus SO_3^{-2}. Sulfate does not contribute to an allergic response. Sulfur dioxide was used as an antimicrobial as far back as the fifteenth century burning sulfur candles in the wine barrels. Sulfite is also a bi-product of certain classes of caramels as sulfur is a crucial ingredient in some versions of the caramelization process. The accepted limit for sulfite presence is less than 10 ppm or 0.001%. (Other ways of defining it is; 1/100,000, or 0.01 g in a liter or 1 g of a 1% solution in a liter). The final usage rate as consumed is what is considered, so a flavor that has 100 ppm due to the presence of caramel color in it must declare the presence of sulfite allergens on the label, but if the customer uses It less than 10% In their final product It will appear at less than 10 ppm there and need not be declared. See Caramel, Sulfur, Allergens, Anaphylaxis.

Sulfur – Sulfur is an element or mineral that supports many functions in the body. Sulfur is necessary to produce vitamin B1 (thiamine), an essential vitamin, and certain essential amino acids like methionine, cysteine, and cystine, and is a crucial ingredient in the synthesis of collagen (for bones, tendons, and connective tissue) and keratin (for hair, nails, and skin). Sulfur comes into our diet via meats, nuts, eggs, and legumes. Sulfur compounds can sometimes react with metals from flavor containers or the insides of cans. This can even occur from foods that contain free sulfur containing amino acids. See Minerals.

Sulfur Compounds – Sulfur compounds are those chemicals that contain the element sulfur. Sulfur compounds are usually the flavor chemicals with character. At higher levels they remind one of rotting cabbage (methyl mercaptan), asparagus (dimethyl sulfide), mustard (allyl iso thio cyanate), boiled potatoes (methional/methyl thio propionaldehyde), and garlic (diallyl disulfide). In nature, sulfur compounds are formed through many different pathways. These pathways include enzyme derivation (alliase activity in onions) and the Maillard Reaction (formation of sulfur compounds through reaction of sulfur containing amino acids, i.e., cysteine, cystine, or methionine), etc. These compounds are present in natural flavor systems, albeit in small amounts. Therefore, to stimulate natural flavor systems, the addition of these chemicals is necessary. Sulfur compounds can be introduced into flavor systems through straight chemicals or through natural ingredients. Mercaptans or thiols are compounds that contain sulfur attached to a hydrogen atom. This group is known as a thio or thiol group. The terminology thiophenol is used in the GRAS list, for example GRAS# 3666. But this can be very confusing. One must be careful structurally when describing a thiophene and a thio phenol. A thiophene is a five-membered heterocyclic ring containing four carbons and one sulfur versus a thio phenol that is a mercaptan (or thiol group) and is simply sulfur connected to hydrogen. The counterpart to a mercaptan (or thiol) is an alcohol (hydroxyl group). Sulfides contain the element sulfur, disulfides are two connected sulfurs, trisulfides are three connected sulfurs and so on. Polysulfides indicate more than one sulfide in a particular molecule. Thiophenes are heterocyclic four carbons plus one sulfur containing molecules. Thiophenones therefore are thiophenes with a carbonyl group. Dithianes are six-membered heterocyclics with two sulfur atoms. Trithianes are compounds with a six-membered heterocyclic ring with three sulfurs. Dithiolanes are five-membered rings with two sulfurs. Trithiolanes are five-membered heterocyclic rings contain three sulfur atoms. We have included 5,7 dihydro 2 methyl thieno (3, 4 d) pyrimidine here as well, because, like the thiophenes, this compound contains a five membered sulfur containing a heterocyclic attached to a six-membered secondary di amino containing a heterocyclic. The dithiazines are six-membered heterocycles that have two sulfurs, one nitrogen, and three carbons (in this way they are listed in the pyrazine, etc. section and here). Trithianes are six-membered heterocyclic rings with three sulfurs and three carbons. Thienyl mercaptan and furfuryl mercaptan are interesting but powerful sulfur notes that are quite useful in brown flavors at trace levels, lending themselves to be useful to cocoa and chocolate flavors, coffee flavors, peanut butter and other nut flavors, and even tuna and other meat, fish, and poultry flavors. See Methional; Dimethyl Sulfide; Allyl Isothiocyanate;

Enzymes; Lachrymation; Enzymatic Derivation of Flavoring Ingredients; Maillard Reaction; Amino Acid; Sulfur Containing Esters; Sulfur Containing Furans, Furanones, and Other Related Chemicals; Heterocyclic (Compound) (Ring); and Chart 322 – Sulfur Containing Compounds.

Sulfur Containing Esters – Most of the sulfur containing esters have a unique blend of sweetness with a characteristic sulfur note. For this reason, they tend to be most useful in tropical flavors or in the more sophisticated fruit flavors. Sulfur containing esters are particularly useful in flavors like pineapple, tropical flavors, and more natural tasting juicy, jammy, or pulpy fruit flavors. See Chart 323 – Sulfur Containing Esters.

Sulfur Containing Furans, Furanones, and Other Related Chemicals – Furans and furanones with a sulfur group are an important category of flavoring compounds. These are responsible for a variety of flavor characteristics including roasted aromas for both meaty, nutty, chocolate, and coffee flavors. See Chart 324 – Sulfur Containing Furans.

Sulfur Containing Vitamins – Some vitamins contain atomic sulfur and can be used in reactions for their useful sulfur containing breakdown products. They also can be used in flavors to be heated so that they become precursors for sulfur containing aroma components. See Maillard Reaction, Non-Flavor GRAS Ingredients, Vitamins, Non-flavor, Precursors, Reaction Flavors, Processed Flavors, and Chart 325 – Sulfur Containing Vitamins.

Sulfurol™ – See Sulfur Compounds (Thiols).

Sulfuryl Acetate™ – See Sulfur Compounds, Sulfur Containing Esters.

Suma or Brazilian ginseng (mistaken identification) – See Appendix 2.

Sumac – The botanical herb grows wildly in the middle east, and produces berries that are used on fish (Lebanon), added to salads (Turkey), and in kebab seasonings (Iran and Soviet Georgia). American varieties are often poisonous. An example of this is poison sumac. Other poisonous trees and herbs are poison dogwood, poison ivy, and poison oak. These can cause severe irritation to exposed skin. If vapors are breathed in as when they are burned, the reaction can be fatal. See Food Allergy.

Summer Squash – See Squash.

Sun Choke – See Jerusalem Artichoke.

Sun Dried Tomatoes – Dehydrated tomatoes that have grown in popularity of late. Sun dried tomatoes have an interesting caramelized note along with a cooked tomato sauce-like background profile.

Sunflower –

1. Sunflower Seeds (Helianthus annuus) – The plant has an extremely large flower-like structure called a capitula with hundreds of florlets at the center. These flowers produce gray black seeds with white to yellowish white stripes. Inside the seed coating is an edible seed, which is somewhat like the flavor of pumpkin seeds, although more vegetable- and pistachio-like. Russian sunflowers are used to produce oil and the American type is usually consumed as such. Lower grade sunflower seeds are used for birdseed due to their nutritious nature. The purple outside coating is rich in anthocyanins. See Color (Colorants), Grape Skin Color.
2. Sunflower Oil – Sunflower oil is high in vitamin E and lower in saturated fat. High oleic sunflower oils have monounsaturated levels of 80% and above with newly developed hybrids having linoleic acid as well. See Fat, Saturated, Unsaturated, Fats and Oils, Polyunsaturated Fat, LDL, HDL, Cholesterol, and Appendix 2.

Sunset Yellow – See Colorings, Yellow No. 6.

Supercritical Carbon Dioxide Extraction – A special variety of supercritical Extraction which relies on the fact that under pressure CO_2 can solubilize many flavoring volatiles and then when the pressure is relieved the CO_2 evaporates leaving a very clean extract without the use of petro solvents. This system could be considered Organic Compliant if other NOP restrictions are maintained. See Extraction, NOP, Organic, USDA, Labeling, Supercritical Extraction.

Supercritical Extraction – Based on the use of gases at or above their critical temperature and pressure. The technique of supercritical extraction is used to isolate heat instable substances. The technique uses the ability of a gas to be pressurized into a liquid and then allowed to evaporate into a gas at much lower temperatures than with classical steam distillation. This technique therefore protects the delicate volatile aromas. A maceration of the extractant, with a subsequent removal, is called a static extraction. The continuous extraction of the macerate and addition to the original extract is called a dynamic extraction.

Super Fruits – Superfruits – The term Superfruit has no FDA approved definition as of the date of this book. Originally meaning fruits that have a high ORAC value and therefore great antioxidant characteristics, the term superfruits has seemingly been popularized to be a confusing mix of: 1. fruits that are healthy; 2. fruits that have a cool name; 3. fruits that have a high ORAC value; 4. fruits from an exotic location; and finally 5. fruits that someone produces so they tag on the name superfruit just to increase sales. One chemical group found in

superfruits which is responsible for the high ORQAC value is anthocyanins responsible for the red to blue natural coloring. See Superfruit List, Marketing, Exotic Fruit Names.

Superfruit List – This list is compiled from the internet having no other explanation than it is found in a search for superfruits in 2014. Açaí Berry, Achacha, Apples, Aronia (Chokeberry), Avocadoes, Babaco, Bananas, Blackberries, Black Currant, Blueberries, Cantaloupe, Cherimoya, Cherries, Chilliplum, Citrus Fruits, Coconut, Cranberries, Dragonfruit, Feijoa, Gac, Goji Berries, Grapes, Grapefruit, Guarana Berry, Guava, Jackfruit, Khaki, Kiwano, Kiwi, Koopopo, Lingonberries, Lychee, Mangosteen, Maqui Berry, Maquiberry, Maracuja, Mnuberry, Mulberry, Noni, Oranges, Papayas, Passionfruit, Pawpaw, Pineapple, Plums, Pomegranate, Pomelo, Pumpkin, Strawberries, Avocadoes, Raspberries, Sea Buckthorn, Schizandra, Soursop, Starfruit, Tomatoes, Toopopo, Watermelon, Yumberry, Yuzu. Some of these claim extraordinary abilities of antioxidant properties, mineral and nutritional health and nutraceutical properties. See Nutraceuticals, Nutrition, Marketing.

Supernatant – The liquid that is poured off the top of an extraction. The supernatant in a tea extract is the tea beverage itself. See Extraction, Solute, Solvent.

Superoxide – A free radical produced by the body to fight off invading microorganisms (O_2^{-1}). However, it can also be produced by mitochondrial respiration and can be a potent, toxic free radical in the body eliciting fat oxidation and perhaps cellular destruction. The body then develops SOD or superoxide dismutase to destroy this free radical. See Nutraceuticals.

Superoxide Dismutase – See Appendix 2.

Supertasters – Those who have an exceptionally high concentration of taste buds (>65 fungiform papillae/cm^2), and therefore, possess a very keen sense of taste. It seems to correlate with the ability to sense PROP at very low levels. See Moderate Tasters, Low Taster, Numb Tongues.

Supervision – Usually refers to a religious group and its overseeing the production of a food product. In accordance with Jewish law, a company must adhere to kosher rules to be kosher approved. With the Moslem faith, it is the rules of Halal that apply. See Kosher Supervision, Halal Supervision, Religious Restrictions, Regulations, Cultural Restrictions, Governmental Restrictions.

Suprème – A Velout– finished off with cream. A supreme sauce can also have mushrooms, added chicken or veal stock that is then further reduced as well.

Sureau – See Elder Flowers.

Surface Oil – Typically used in the discussion of spray dried materials the measure of surface oil describes how much of the internal product was not encapsulated. A high percentage of surface oils can yield a poorly flowing product, a weaker product and potentially an unstable product. See Spray Drying, Yield.

Surfactant – A surfactant is a film former, emulsifier, or wetting agent. Polysorbate 60 or Polysorbate 80 are two food-approved surfactants. Surfactants, however, often have soapy tastes and by virtue of this, minimize their use in food systems. The term surfactant comes from the phrase surface-active agent. See Emulsion.

Surimi – A man-made fish-based food product developed for replacement of higher costing crustacean meats like shrimp, crab, and lobster. Surimi can come in all colors and textures and is extruded in many shapes. Starting with textured proteins, extracted from fish meats, surimi is occasionally flavored and often texturized and bound with gums, gels, starches, whey protein concentrates, or other binding substances. See Fishy.

Susceptors – Varying shapes and sizes of metal pieces placed within the packaging of microwave dinners, positioned to increase temperatures and enhance Maillard Browning and caramelization in a microwave. See Microwave Oven.

Sushi – A number of different styles of fancy preparations using style, appearance, color, taste, and texture. Often raw or cooked fish or shellfish are covered, stuffed with or otherwise combined with fish, then mixed with seasonings like ginger, wasabi, or other flavorful substances, placed in layers, made into sandwich type combinations, wrapped in seaweed, diced, sliced or otherwise prepared.

Suspended Matter – Fine particles that are at least briefly suspended in a beverage, contributing a fullness and mouthfeel that usually is perceived as richness. This is the case in both tea and coffee. In coffee, a French press can be used to achieve this goal, rather than using more popular instant products. See Mouthfeel, Rich, Full, French Press.

Suspension – A two-phase mixture, whose insoluble phase (usually solids) is of sufficiently small size, weight, and structure to maintain a somewhat homogeneous state for a reasonable time. Example: A suspension of sodium carbonate in water is one where for a few minutes to a few hours, the insoluble solid particles of sodium carbonate remain homogeneously dispersed so that the resultant cloudy liquid will remain chalky white. Eventually most suspensions will separate and the solids will

settle to the bottom. Xanthan gum has a unique property of being able to suspend particles for a long time. This technique is used for suspending particulates in salad dressings, sauces, and syrups. See Solution, Xanthan Gum.

Sustainability – The ability of products and resources to be used without being used up. Sustainability issues involve crop characteristics, farmers and farm workers, environmental issues, demand, and production rates. See Crop to Crop Deviation, Natural, Organic.

Swallowing – Swallowing is the process of transporting chewed food or beverage down the esophagus to the stomach via a method of sequential muscular contractions in the esophagus called peristalsis. See Tongue.

Sweat(y) –

1. To perspire, a cooling mechanism of mammals through the sweat glands. Sweat contains mostly sodium chloride or salt and urea.
2. The aroma of sweat, caused by action of microorganisms on proteinaceous material within the sweat is characterized by caproic (hexanoic) acid. Also contained in sweat are the phenols 2 methyl phenol and 4 methyl phenol.
3. To heat food gently in oil until there is a translucent appearance and usually a softer consistency. Sweated vegetables are often used to provide flavors for stocks. See Culinary Arts, Fumet, Stock, Sauces.

Sweaty – Sweaty means reminiscent of sweat. This aroma characteristic is usually due to the presence of six carbon fatty acids like hexanoic acid. The derivation of these types of chemicals comes from by-products of bacterial growth upon nutrients found in secretions from sweat glands or other sources like yeasts or molds, which act upon a substrate as in cheese processes. Hexanoic acid is also known as caproic acid, the name and original derivation means goat acid. This reference is made due to the similarity of that aroma and the odor or sweat of goats. Therefore, another equivalent term for sweaty is goaty. See Cheese, Fatty Acids, Acids, and Chart 4 – Acids All Types.

Sweet –

1. An all too generalized descriptor for odor and taste. More correctly, sweet character should be further refined to indicate the source, such as ester sweet, citrus sweet, brown sweet, spicy sweet, and sugary sweet.
2. In tea terminology, a light extract or liquor.

The receptors responsible for the sweet sensation are the T1R2 and T1R3 taste receptors for sugar, saccharine and aspartame along with contributions from the sugar transporters and Katp metabolic sensors from the pancreas. The T1R3 receptor is stimulated by cyclamate and lactisole and is solely stimulated by non-nutritive types.

See Flavor Nomenclature Workshop, Descriptive Analysis, Tongue, Taste Buds.

Sweet Bay – See Laurel.

Sweet Cicely – This herb is also known as Spanish chervil, anise root, or European sweet chervil. When used in a food preparation where a sour fruit is used, the amount of sugar can be reduced, hence its name. The seeds taste like anise or licorice. Boiled roots were used at one time in salads, however, it is not used in the same manner as frequently today. See Salad.

Sweet Clover – See Melilotus and Appendix 2.

Sweet Dumpling Squash – Similar in shape and color to mammoth squash although smaller. See Vegetable, Vegetative; Sulfur.

Sweet Goods Industry – The large industrial segment that includes Confectionery, Desserts, Toppings, Bottled Syrups, Chewing Gum, Fillings, Cereals, and Flavored Sweeteners.

Sweet Potato (Ipomoea batatas) – Unlike its name, it is not a member of the potato family. It started in South America and has now spread worldwide. There is evidence that its consumption predates recorded history. Quite variable in color, the leaves can also be used like spinach. The flavor of the cooked product is more reminiscent of foods found in the pumpkin family than the potato family. Boniato is a Caribbean variety that has seen popularity in culinary applications. See Yam, Squash.

Sweeteners (Non-Nutritive) – Sodium saccharine has been provisionally listed for use with a specific disclaimer on the package that 'laboratory testing has shown that the product causes cancer in laboratory animals.' Thaumatin is a proteinaceous extract of Thaumatococcus daniellii. It has been reported that combinations of tartaric acid, peptides, and gluconates can mask the bitterness of these products. Some aldehydes like benzaldehyde and cinnamic aldehyde can react with Aspartame. Thaumatin, a newly approved GRAS sweetener, consists of two isomers each of over 200 amino acids. It is produced through purification from the fruit Thaumatococcus daniellii. Alitame should be approved in about 10 countries by the end of 1998. Sucralose is approved in Canada and Australia. Both are pending approval in the United States but are not yet approved here. See DE Rating; Sugar(s) and Polyhydroxyl Compounds; and Chart 373 – Non-Nutrative Sweeteners.

Sweeteners (Nutritive) – See Sugar(s) and Polyhydroxyl Compounds.

Sweet Myrrh – See Opopanax.

Sweetness Rating – The rating for sweetness is called the dextrose equivalency (DE). Sugar or sucrose is defined as 100, therefore dextrose is about 57 DE. Fructose is lower at higher temperatures but at low to moderate temperatures, fructose is about 118 DE. See Dextrose Equivalency.

Sweet Violet – See Violet.

Swimming Method – See Frying Methods.

Swiss Violet – See Violet.

Syneresis – The process of giving up bound water in a gelled system. Amylases in the saliva can degrade starch molecules, and bound water will weep if, for example, a pudding is 'double dipped.' Besides health and sanitary considerations, this behavior is very ill advised. Another way for the carbohydrate- or protein-type binding system to synerese or become unstable is to undergo multiple freeze thaw cycles. See Weeping, Gums and Thickeners, Gelation.

Synergism – When two or more ingredients combined equal a more intense perception than would be expected by that combination. In the medium range of intensity, one study clearly shows that sourness and saltiness are synergistic to the ration of 0.89. What this means is as sourness goes up, so does the impression of saltiness. See Masking.

Synesthesia – A mode of sense applied to a different mode. Example: When we smell cyclotene we think of it as a brown flavor. A list of synesthetic compounds might include: brown – vanillin, white – lactones, black – phenol, red fruit – benzaldehyde, purple – anthranilate, yellow – allyl caproate, green – cis 3 hexenol, light blue – mentol. See Brain.

Synthetic – Artificial – See Artificial.

Synthetic Biology – Another perhaps more palatable way of describing genetic modification. See GMO.

Syrup – (1) A thick rich liquid usually made from a sugar based ingredient providing sweetness as well as in some cases flavor color and acidity. (2) A gum thickened artificially sweetened system that simulates a sugar thickened syrup. See Non-Nutritive Sweeteners, Sugar.

Szechuan – A style of Chinese cookery from the Szechuan province of China characterized by hot and spicy flavors and the use of Szechuan Pepper. See Culinary.

Szechuan Pepper – Often confused with Chinese coriander (Persicaria odorata) but a different species altogether. Szechuan pepper is represented by the genus *Zanthoxylum*. The flavor is intensely hot. See Trigeminal, Taste, Hot, Heat, Culinary, Szechuan pepper Extract Chart 502 – Szechuan Pepper.

T

Table Browning – Table browning is the reaction of certain foods upon standing. Internal enzymes break down complex compounds into simpler sugars enhancing the nutritional store for the nutrition of the emerging seed embryo. This browning is usually observed in fruits, especially when a fruit is bruised. This effect is typically seen in bananas, apples, and pears. See Non-Enzymatic Browning, Brown (Compounds), Maillard Reaction, Enzymatic Browning, Enzymes.

Table Salt – Table salt is sodium chloride as it is normally sold and consumed by the public. Most table salt sold today has had potassium iodide added. This treatment is added to promote good thyroid function and inhibit goiter development. See Nutrition.

Tactile – The kinesthetic sensations of temperature, pressure, pain, irritation, and trigeminal stimuli like cooling, pepper heat, astringency and pungency. See Taste, Trigeminal, Kinesthesia.

Tagettes (Marigold) (Tagets patula L., T. erecta L., T. minuta L.) – Tagettes is a unique oil with characteristic powerful citrus sulfur-like odor. It is used in many products as an enhancer to the top note. The active ingredient is tagetone. However, tagetone is unstable and is prone to polymerization. See Sulfur, Citrus, Chart 380 – Tagettes, and Appendix 2.

Tailed Pepper – See Cubeb.

Taint – A taint usually describes an off character or odiferous malodor. A taint often comes from contamination via an external source or due to an internal change in chemical composition. See Off Odor, Disgust.

Tall Oil Phytosterols – Tall Oil Fatty Acids – Liquid Rosin or Tallol – Tall oil must be severely fractionated and purified for use as a nutraceutical. It first undergoes a distillation then with a further purification, less than 10% the phytosterols and fatty acids are enhanced. The name comes from the Swedish word 'tallolja' meaning pine oil. See Appendix 2.

Tallow – Beef fat. Tallow has been described as having a fatty, nutty, almost pyrazine-like background character. It is a by-product of the meat processing industry and can be used to adjust fat content or act as a flavor ingredient or reactant source. See Chicken Fat, Rendering, Lard.

Tamale –

1. The green liver of a lobster. Tamale is considered by some to be a delicacy and by others to be unpalatable.
2. Tamale is a traditional Latin American food. It consists of steam-cooked corn meal wrapped in corn husks, with or without a filling. Fillings can be cheese, meat, chilis, or other blends. See Seafood, Ethnic Food.

Tamanu Oil or Calophyllum tacamahaca – See Appendix 2.

Tamarillo – See Tree Tomato.

Tamarind (Tamarinda indica L.) – Also known as Indian date. Has a sour fruity flavor with a pleasant aroma. Yellow and red dyes can be obtained from the leaves. Tamarind grows in pods. The pod is long, brown, and sticky. Tamarind extract is used in many products including Worcestershire Sauce™. See Date, Worcestershire Sauce™, and Chart 381 – Tamarind.

Tamper Evident Packaging (Seals) – A variety of tamper-evident products have been developed since the Tylenol™ scare of October 1982, as well as other product tampering and security issues brought out by the advent of 9–11. See Food Safety.

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Tangelo – A fruit of the citrus family. See Citrus and Chart 382 – Tangelo.

Tangerine – The fruit whose origin can be traced to a variety of mandarin brought from China and cultivated in the Tangier region of Africa. It is flatter in appearance than the typical mandarin, and is sweeter in flavor profile than the orange. See Mandarin, Citrus, and Appendix 2.

Tannin – Also called tannic acid. Tannin is found in many foods including tea. Tannin is responsible for a trigeminal-type astringency producing an effect similar to that observed when water is removed from the mouth. The 'taste' of tannin is often accompanied by a metallic background character. See Trigeminal Nerves, Taste.

Tansy (Tanacetum vulgare L.) – The botanical is related to wormwood, the botanical used in absinthe drinks responsible for thujone-related toxicity. It is a spice with a typical herbaceous character. Dethujonized oils can be used in flavors. However, tansy is relatively unstable and is used less frequently, and could probably be substituted by sage, thyme, cedar leaf, or another aromatic spice. It can be used to prepare a tisane or herbal tea. Tansy is one of the bitter herbs in the Passover ritual. Tansy is also the name of a dessert made during Easter. The floral can also be used in salads, cakes, omelets, puddings, and stuffing mixes. See Wormwood, Absinthe, Trigeminal Nerves, Astringency, Tea, and Chart 383 – Tansy.

Tapioca – See Casava.

Tapioca Pudding – Tapioca pudding is a pudding often flavored with a vanilla. Tapioca as it is simply called is made from tapioca pearls. See Grains, Tapioca, Tapioca Starch.

Tapioca Starch – A clean-tasting starch obtained from the casava plant. Tapioca starch is used in a way similar to cornstarch. Tapioca starch can be either chemically or physically treated as specified by the FDA. The approved chemical agents impart novel or improved characters to the base starch. Some of these improvements include freeze thaw stability, enhanced physical attributes, unique gelation properties, or textural attributes. See Tapioca.

Target – The goal or optimum. This can either be a competitor's product to be duplicated, a gold standard, and optimum marketing ideal or any other definable conclusion. See Gold Standard, Duplication versus Replication, Marketing.

Tariff – Duty or customs fees. Shipping of products internationally must be associated with a tariff code. These can be found in the Harmonized Tariff Schedule of the United States. Flavor tariffs vary according to their components. One tariff group having to do with flavors but then subcategorized according to alcohol content is 3302.10. On the chart published by the United States International Trade Commission, the item is listed by description, unit of quantity and rates of duty. See Export, Shipping.

Tariff Code – See Tariff.

Tar-like, Tarry – Reminiscent of the odor of freshly applied tar or macadam. By the way, macadam is not found in it is Macadamia, it is a nut grown in Hawaii. A tarry descriptor describes a phenolic character similar to those odor compounds developed when proteins and sugars are burned or charred. See Burnt or Burned, Phenolic.

Taro (Colocasia esculenta) – In use in the Near East for over 4,000 years, taro root has also become a staple in tropical countries around the world. More than 100 different varieties have been identified. The vegetable has numerous concentric bands of skin coating the outside. Calcium oxalate found in the flesh and the leaves and an indigestible starch found in the flesh are neutralized when cooked. See Staple.

Tarragon (Estragon, Estragole) (Artemesia dracunculus L.) – The oil is reminiscent of basil and anise with a phthalide-like background, making it similar to lovage or celery. It is also known as dragon herb. The oil was believed to be an antidote to venomous bites, hence the name, which means little dragon. Its pairing with vinegar is legendary, such as in tarragon-flavored vinegar or vinegar-preserved tarragon. The aroma comes from oil glands underneath the leaves. However, when the fresh leaves are dried, they quickly lose flavor and taste more like hay. It is for that fact that extracts of dried tarragon can be used as a replacement for the prohibited flouve oil. See Basil, Anise, and Chart 384 – Tarragon.

Tarrazus – A coffee variety from Costa Rica with a full flavor and winey nuance. See Coffee.

Tart – Tart can also be described as sour or acidic. The perception of tartness is due to nerve impulses generated by the pH sensitive taste buds to acidic conditions in the saliva. See Acid, Acidulant(s).

Tartar Sauce – A dressing made from mayonnaise, chopped gherkins, shallots, capers, parsley, and tarragon. See Culinary Arts.

Tartrates – Esters of tartaric acid (dihydroxy ethane dicarboxylic acid), which tend to be fruity and berry like. They also can be used in grape and other fruit flavors. The acid form, tartaric acid, makes a good non-volatile acidulant companion to esters present in flavors. See Acidulant(s) and Chart 326 – Tartrates.

Tartrazine – See Colorings, Yellow No. 5.

Tastant – A chemical compound that elicits a response by the taste buds, a non-volatile. See Odorant, Volatiles, Non-Volatiles.

Taste – The sense that perceives non-volatiles. Organs that are sensitive to non-volatiles are called the taste buds. These structures are located on the surface of the tongue. These taste buds are as follows:

1. Sweet sensitive taste buds were thought previously to be located mostly at the tip of the tongue. These organs are sensitive to polyhydroxyl compounds like sugars and poly alcohols (mannitol, sorbitol, xylitol, maltitol).
2. Salt-sensitive taste buds that were thought previously to be located at the front of the tongue on either side. These organs are sensitive to sodium ions.
3. Sour-sensitive taste buds that were thought previously to be located mostly at the sides of the tongue. These organs are sensitive to lower pHs or acidity.
4. For the most part, bitterness is perceived at the rear of the tongue. Bitter taste buds are sensitive to complex molecules like alkaloids, glucosides, metallic complexes, proteinaceous substances, and other similar chemical structures. This positioning affects a potential gagging response that would protect the individual from the consumption of bitter poisons. Bitterness, unlike the other taste sensations transmitted through the facial nerve, is transmitted through the glossopharyngeal nerve. This is the same nerve that transmits the signals to the brain for numerous collections of stimuli that initiate the gag reflex (physical stimuli, stomach and intestinal disorders, toxic responses, even mental stimuli).
5. In recent years, umami or the fifth taste has been proven to be related to an actual taste, associated with electronic activity in the brain. The exact pathway is still unknown, and research is still ongoing. The previous theory was that these compounds trigger a sensitization in more than one type of taste bud, and therefore yield a more even or well-rounded enhancement of all taste signals. Recently data point to umami being an independent sensory signal.
6. Taste can be enhanced by aromas and vice versa. The presence of sugars makes a fruit flavor taste better, as does a slight acidity. Salt is needed for most meat flavors to taste right. A butter flavor without salt is much more difficult to discern. The right sugar/salt/acid balance makes all the difference in a snack seasoning.
7. Salt Replacement – The reason why the taste sensation of salt has been very difficult, if not impossible to replace if not to enhance, is actually quite simple. The sense of salt or perception of sodium ions is basic to our hard wiring. Because electronic stimuli are sent through the nerves via a potassium ion, the sodium ion interchange is crucial to all nerve impulses.
8. Trigeminal Stimuli – The Other Taste – The Chemical Sense – Sensations of coolness (mint), heat (capsicum pepper), and certain pungency types (the lachrymatory or tearing odor of mustard oil) are all examples of neither taste nor odor but trigeminal sensations. Trigeminal sensations are more associated with the sense of touch. Certain reptiles like snakes when they flick air to the backs of their throats to trigeminal sense organs, as they lack sophisticated olfactory (odor) and gustatory (taste) sense organs.
9. Our Subconscious Sense – The subconscious detection of chemical stimuli, known as pheromones (an example might be androstenone), is detected via a special and independent nerve site called a vomeronasal organ. The vomeronasal organ is found in the front of the nasal cavity. Some scientists maintain that the actual site of the human vomeronasal organ is inactive. They claim that it is currently vestigial like our appendix, and is reminiscent of older days when flight/fright/sexual mating rituals and other instinctual practices were much more important to our preservation. Still other scientists point out recent studies demonstrating our ability to perceive macromolecules such as androstenedione. Molecules with a significantly high molecular weight would produce very little vapor pressure. If the vomeronasal organ was inactive, then how could these molecules be identified?
10. The Structure of Taste Buds – Taste buds are arranged around pores in structures called papillae on the tongue. Papillae are structural protuberances, which are shaped like peaks (filiform papillae), mushrooms (fungiform papillae), larger bulbs (circumvallate or vallate papillae), or folds (foliate papillae). Taste buds are located mainly on the tongue; however, there are some taste buds located in the back of the throat and on the palate.
11. Other stimuli seem to affect the taste, but exact mechanisms are still unknown. One is beefy meaty peptide. See Salt; Sweet; Bitter; Sour; Taste Buds; Beefy Meaty Peptide; Capsicum; Heat; Mint (herb); Cool(ness), Cooling, or Mintyness; Olfaction; Gustation; Tongue; Nose; Androstenone; Pheromone; Vomeronasal Organ; Trigeminal Nerves; Stimulus; Lachrymator; Mustard; Mustard Oil; Supertasters.

Taste Bud Concentration – The amount of taste buds per square inch on the tongue. This has a direct correlation to the ability to taste. Low tasters have the least, moderate tasters have an average amount, and supertasters have an abundance of taste buds, and are therefore the most acute tasters. The ability to detect propyl thiouracil and the degree to which a testant responds to the bitterness of the chemical are felt to be directly related to the ability to taste. Therefore, PROP test strips can help determine tastes acuity. The second method of determining taste sensitivity is by doing a physical inventory of taste bud concentration. Here, a subject has a blue dye added to the tongue. The dye makes it easier to see the fungiform papillae, which contain the most taste buds. The actual number of buds are then counted within a visible square centimeter grid. Supertasters have greater than 65 fungiform papillae/cm^2. Low tasters have less than 35 fungiform papillae/cm^2. See Taste, Taste Buds, Low Taster, Supertasters, PROP, and Figure 30.

Taste Buds – Salt, Sweet, Bitter Sour, Umami, Calcium, Fat and Kukumi are the latest characteristics theorized to be perceived by the taste buds. Taste buds are found throughout the oral cavity, not only on formations on the tongue but in the roof of the mouth and at the back of the throat and recently taste buds have been found all the way to the large intestines according to studies at Monell Chemical Senses Center in Philadelphia, PA. Taste buds have even been found in the airways and even in the testicles where they seem to have an effect on sterility. Is it possible that we may see taste relating to diabetes and infertility in the future? Taste buds were thought to be located in concentrated areas on the tongue. The taste buds were thought to be distributed as follows: the sweet responsive buds are at the tip of the tongue, the sour receptors are at both of the front sides of the tongue, the salt-sensitive receptor sites are at the central sides of the tongue, and the bitter-sensitive taste buds are at the rear of the tongue. However, a study done by the author found out that indeed although there seems to be a concentrated locus of perception, the sensations are truly spread throughout the oral cavity. There seems to be an area in the center of the tongue that has less sensitivity. There are basic types of formations on the tongue called the papillae. The four types are the filiform papillae, foliate papillae, fungiform papillae, and the circumvallate papillae. The foliate papillae are a series of folded tissues or grooves in the rear surface of the tongue. The filiform papillae are triangular papillae with jagged edges. The circumvallate papillae are the larger circular structures in the chevron of the rear of the tongue. The circumvallate or vallate papillae are the larger nodes distributed throughout the tongue's surface. The fungiform papillae are the numerous structures located throughout the tongue whose cross sectional shape is mushroom-like. These have bundles of trigeminal nerves located at the base of the mushroom-like forms. Supertasters are those with higher concentration of fungiform amounts of papillae than others. These supertasters are able to perceive chemical tastes like capsicum heat, menthol cooling, piperine bite, and other non-taste/non-odor stimuli at a greater intensity than their moderate- to low-taster counterparts. PROP seems to be an indicator of taste bud density. Non-tasters of PROP seem to fit in the overall low tasting category having a mean density of taste buds of 48 taste buds per square centimeter. Medium tasters of PROP seem to correlate with medium overall tasters with a mean density of 40–65 taste buds per square centimeter, and super PROP tasters seem to correlate well with overall supertasters having a mean taste bud density of approximately 65–76 per square centimeter.The receptor for Umami, a G protein coupled T1R1/T1R3 protein seems to be in cats and possibly other

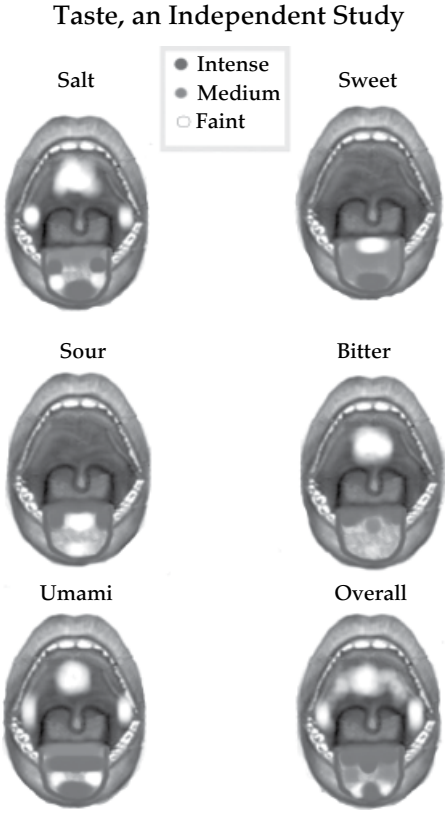


Figure 30

carnivores as well, as the desire for meats/amino acids is obvious. Cats apparently have no response for sweetness. See Taste, Supertasters, Taste Receptors, Stem Cells.

Taste Receptors – There are many taste receptors. The initial nerve impulses travel to the nucleus of the solitary tract (NST) in the brain where taste processing occurs. The sweet receptor is called the T1R2/T1R3, is responsible for appetite and blood sugar control (T1R) and the detection of sugar and amino acids generating production of the hunger hormone Ghrelin (T1R3). The sweet receptor is found in the intestine on the K and L type endocrine cells and as they secrete a class of hormones called incretins, and stimulate insulin production and in the duodenum L cell, secreting GLP-1 another incretin. The bitter receptor T2R receptor responds to bitterness; however, it seems the consumption of edible bitters actually increases the appetite. This is counterintuitive and more studies need to be performed to understand the mechanism fully. Bitter taste bud receptors in the colon (T2Rs) secret the stimulation of anions which, leading to water entering from the bloodstream into the colon causing diarrhea. When a pinch of salt is added to sugar it can be seen to enhance sweetness. This synergy has been explained the sensor SGLT1 that moves dextrose into the sweet taste cell when salt is present.

Tautomerization – A form of isomerization. Tautomerization can occur when a molecule can exist in either of two states. On one hand the tautomeric molecule can exist as a ketone, and on the other hand it can exist as an enol. The one form, enol (=CH – OH), has no charge, and the other form, the ketone (–CHO), has a strong dipole charge. This is the reason this type of isomerization is called a keto-enol isomer. See Isomer, Stereoisomers, Cis (Isomerism), Trans (Isomerism).

Taxonomy – The field of science that identifies and categorizes living things into categories based on structural elements. Previously there was considered only two kingdoms plant and animal. Recently, however it has been divided into five kingdoms. The kingdoms are relegated to two domains: 1. Eukaryotic and 2. Prokaryotic. These are further defined as (1) Eukaryotic (Plant, Fungi Animals and Protista) and (2) Prokaryotic (Monera). The branches are divided further into Phylum, Class, Order, Family, Genus and Species. Occasionally further refinement calls for Subspecies and even Races. The catalogue of Life which lists all known genus and species is published by Species 200 and Integrated Taxonomic Information System and updated periodically. The twelfth edition lists over 1.2 million species. See Biology, Fruit versus Vegetable.

TBA – Thiobarbituric acid, a measurement of fat stability and potential for oxidative rancidity. See Fat, Rancid (Rancidity), Stability, Oxidation.

TBHQ – Tertiary butyl hydroquinone is an antioxidant that has been used more in Europe than in the United States. Antioxidants such as this, BHA and BHT have been specifically banned by California Proposition. See Antioxidants.

TCA – See Trichloro Anisole, Corked Wine, Earthy, Musty, Wine.

TCD (Thermal Conductivity Detector) – Otherwise known as a Katharometer, a thermal conductivity detector is used in a gas chromatograph and senses an increase in heat conduction ability when a gas emerges from a column. It is accomplished by the use of a Wheatsone Bridge, an electronic configuration that detects changes in electrical resistence. A thermal conductivity (TC) detector is not as sensitive as a flame ionization detector, but it is capable of detecting some molecules, such as water, which give no signal in FID. Also a TCD does not ignite the gases so one sniffing at the exit port can identify the eluting aroma. See Gas Chromatography – GC, Flame Ionization Detector, SNIF NMR, Detectors.

TDT – Thermal death time. The amount of time it takes to destroy the microbial flora of a food product at lethal temperatures. See Sterilize, Sterilization; Pasteurization; Microbial Assay. See D Value, Z Value, Thermal Kill Step, Microbiological Assay, Food Safety.

Tea –

1. A beverage made from steeping the leaves of the tea plant (Camellia sinensis) in hot water. See Appendix 2.
2. A beverage made from steeping the leaves of any herbal preparation (usually described as an herbal tea). The plant known as the tea plant, is botanically known as Camellia sinensis. It probably originated in Tibet, China, or northern India. According to one story, a chain of events is described where a pot of boiling water, a strong breeze, and a tea plant were combined in a serendipitous combination. The first documented use of the drink made from tea leaves was in China over 4,500 years ago. The tea plant can produce leaves for over 100 years. The tiniest little tea leaves or end buds are called pekoe. Tea leaves can be fermented yielding black tea, semi-fermented yielding oolong tea, or it can be left unfermented, which is then called green tea. Green tea has raw tannins that are perceived as an astringent. It has seen use in ice cream and other food products,

especially in the Orient. However, its more recent claim to fame is as a systemic antioxidant implying such health benefits as cancer prevention and anti-aging. This assertion has not been totally substantiated. Teas can be flavored, smoked, instantized, spray dried, and decaffeinated. Many flavors have been typically associated with tea throughout the years. Originally, bergamot oil flavored tea called Earl Grey Tea and lemon flavored varieties were available. Now, orange and spice, cinnamon and other spices, fruit types, and other fruit blends and herbal combinations are popular. Today, many creative combinations are available. Spray dried tea or extracted tea is bottled, then flavored. This product category has grown significantly in popularity in the last decade. These beverages have been so successful to be at least one of the factors for the decrease in sales of the previously unshakable cola stronghold. Herbs, flowers, and other non-camellia type species are now lumped into the category 'herbal tea.' Some of the non-camellia species like chamomile and chrysanthemum have enjoyed a very long history. These date back as far as the camellia types. Tea has been recently explored for its nutraceutical advantages. Green tea is produced from freshly harvested tea and contains many of the polyphenols such as catechins believed to have positive health benefits. Other components in this category are quercitin, myricetin, and kaempferol. These chemicals in general have been shown to have cancer chemopreventive characteristics as well as antioxidant properties. The caffeine has actually been shown to have a synergistic effect in the cancer chemopreventive profile of green tea, so decaffeination would reduce this quality. Polyphenyloxidase is responsible for the macromolecular breakdown of substances that occurs when the tea is allowed to ferment. Fermented tea is known as black tea. The catechins are converted to the flavins and the arubugins. Oolong tea undergoes the same process but the leaves are shortly dried in hot air. Tea contains caffeine (also called theine). In fact, tea leaves contain more caffeine (2–1/2% to 4–1/2%) than coffee beans (1% to 2%). Non-camellia teas provide a tea alternative without the caffeine. Examples of herbs used in non-camellia blends are verbena, rosemary, violet, borage, thyme, sage, fennel, dill, and linden. See Green Tea, Black Tea, Steep, Herbal Tea, Pekoe, Chart 385 – Tea, and Appendix 2.

Tea Tree or Ti Tree – Tea tree is a popular name that has been applied to a number of different, unrelated plants. However, the true Tea Tree is Melaleuca alternifolia sp. from which tea tree oil is obtained. It is in the family Myrtaceae. The Ti plant, Cordyline fruticosa, is often confused with the Melaleuca, but it is a different botanical altogether. Manuka (Leptospermum scoparium) is another tea tree version that is used as a nutraceutical. See Meleleuca, Appendix 2, and Chart 465 – Tea Tree.

Temperature – The amount of heat contained in a substance can be measured by one of four scales: the Fahrenheit scale and the Celsius or Centigrade scales, Rankine and Kelvin. The Kelvin scale is the Centigrade scale using 0 degrees as absolute zero or –273.15 degrees Centigrade. The Rankine scale uses –459.67 degrees F as 0. In the Fahrenheit scale, water freezes at 32° and boils at 212°. In the Celsius scale, water boils at 100° and freezes at 0°. At the temperature of 40° below 0, both scales merge. The range of the Celsius scale is 5/9 of the Fahrenheit, therefore a conversion between Celsius to Fahrenheit would be: Temp C = (Temp F $-32 \times 5/9$). The four scales used today are: Freezing/Melting of Water (Celsius Scale = 0), (Kelvin Scale = 273.18), (Fahrenheit Scale = 32), (Rankine Scale = 491.69).

Temperature is:

1. One of the critical factors in a reaction.
2. Also an important influence in usually increasing solubility of solid ingredients.
3. Important in reducing harmful microbially contamination. High temperatures can kill or deduce the number of harmful organisms, and refrigeration or freezing is used to hold down their growth.
4. Is critical for volatile stability. Volatile chemicals will dissipate at higher temperatures. Introduction of excessive heat will send the flavor profile potentially out of balance. For this reason, flavors should be kept stored in a cool and dry area.
5. Important for integrity of the flavor. A flavor should not normally be kept at too high a temperature or too low. Number 4 is obvious but if a flavor is shipped during the winter and might get very cold, dissolved solids like vanillin or maltol are likely to come out of solution. Gentle heat will possibly resolubulize them, but that is dependent on the percentage. Of course the heat will affect the flavor as well, so it is a Catch-22. It is best to either develop flavors that are not suing chemicals near saturation or make sure the truck is either heated or even refrigerated if it must go through a very cold environment for an extended period of time and the flavor is potentially unstable at those temperatures. See Celsius, Fahrenheit, Law of Doubling Reaction Rates. See Chart 70 – Temperature Chart, Heat, Volatiles.

Tempering –

1. The process of slow cooling so fat crystallization can properly form smaller particles. Tempering allows for a smooth physical/visual finish and mouthfeel. The tempering of chocolate liquor (i.e., cocoa butter plus cocoa powder is called conching).
2. Metals can also be tempered. Both cast iron and Teflon®-coated pans need a sufficient amount of tempering before they can perform optimally.

See Fats and Oils, Cocoa, Chocolate, Melting Point Curve, Bloom.

Temporary Agustia – The non-permanent inability to taste. Oftentimes temporary agustia occurs from over-stimulation by a strong outside odor or taste. Examples of potentially agustic compounds are heat from capsicum, cooling from a mint candy, or the strong flavor profiles of a cup of coffee, a cigarette, alcoholic beverage, or other similar products. See Temporary Anosmia, Anosmia, Agustia, Specific Anosmia, Specific Agustia.

Temporary Anosmia – The non-permanent inability to smell. Oftentimes this occurs from a strong outside odor stimulus. Examples of potentially masking aromas are the cooling from a mint candy, or strong flavors like a cup of coffee, a cigarette, alcoholic beverages, or other similar products. See Temporary Agustia, Anosmia, Agustia, Specific Anosmia, Specific Agustia.

Tenacious – Possessing tenacity or having a long lasting effect in the mouth or nose. See Flavor Profile.

Tenacity – The lasting effect of a character or flavor nuance. One way of determining a flavor's tenacity is to use a perfume blotter. If a blotter is dipped into a flavor and put aside to evaporate, the aroma that is left after about an hour is called the dry down. A blotter can be sniffed the next day to see if any odor is left. If a character lasts that long, it could be considered tenacious. Tenacious materials tend to predominate the middle and background character of the overall flavor profile. Top notes by definition could not be tenacious. See Character.

Tendril – The clinging vines of a grape branch. See Botany.

Teosinte – *Zea Mays* ssp. *parviglumis* – The original ancestor of the corn we know today; teosinte is a grass of unimpressive stature. The corn of today is *Zea mays* ssp. *mays*. See Corn.

Teratogenic – A substance the can cause birth defects. It is thought that a chemical that can cause gene mutation (i.e., a mutagen can also act as a teratogen if it is ingested while a mother is pregnant, and causes the child to have mutated characteristics). See Food Safety.

Terpeneless – A description of an oil that indicates for all practical purposes, the terpenes have been removed. This is less clear oftentimes when dealing with citrus oils, because if the terpenes were truly all removed, the process could severely undermine the quality of the oil. For this reason, even though an orange oil is labeled as terpeneless, it is generally accepted that it could really be only a fiftyfold product. However, because there is no standard definition for terpeneless, what range of terpene reduction represents adequate for a terpeneless claim for each of the oils involved is often variable and hazy. Too many twentyfold to twenty-fivefold orange oils are considered 'terpeneless.' Tangerine, mandarin, grapefruit, lime, and lemon oils that are in the order of fifteenfold to twentyfold have been promoted as terpeneless. True removal of all terpenes without the total degradation of the fine flavor profile by heat seems more likely when using CO_2 extraction techniques and very sophisticated distillation techniques. These oils are of extremely high quality, but expensive. Cost of use is the deciding factor; See Sesquiterpeneless, Folding of Extracts and Essences, Folded Extracts and Essences, Essential Oil.

Terpenes – Terpenes are compounds found plentifully in nature. They are often at significant levels in spice oils, citrus oils, tree oils, and other and natural products. Isopentene is the building block of the terpenes. Two isopentene molecules make a terpene, three, a sesquiterpene, and four, a diterpene. Therefore, a typical empirical formula for a terpene would be C10H20…, a sesquiterpene C15H30…, and a diterpene C20H40, etc. Terpenes make up the bulk of many essential oils, especially the citrus oils. A Valencia orange oil can have up to 90 + % d-limonene in its volatile makeup. This poses a complex problem in that terpenes (especially limonene) are (1) insoluble in water; (2) relatively weak in strength; and (3) prone to development of unacceptable off notes due to oxidation (this is called a spoiled or oxidized oil). Therefore, terpenes are better off being removed. Thus, there have been a number of processes developed to remove them. The first is called folding. Folding is done typically through vacuum distillation or through a blow over still. Other processes include CO_2 extraction and washing (water + alcohol extraction). Compounds called oxygenated terpenes, sesquiterpenes, and diterpenes are oftentimes quite flavorful, so care must be taken not to remove useful compounds. Sometimes these are found in earlier fractions. They can be purified and added back to the original oil producing specialized oils. Because these came from the original oil, no change in labeling need

be done. These oxygenated terpenes are typically much more water soluble and to a greater degree more stable that are the terpenes. One example is citral, which is found in the essential oils of both lemon and expressed lime. It is found in lemon oil at an average of about 3–5%. This terpene aldehyde characterizes the oil. In fact, it is almost impossible to produce a lemon without some sort of citral-like character. In comparison, the limonene is present in lemon oil at about 67–85%. As we said before, as an aroma compound, it is much weaker, prone to oxidation, and is totally insoluble in water. Therefore, removal of the limonene while leaving the citral behind would produce a more soluble, stronger, and more stable oil. See Citrus; CO_2 Extraction; Distillation; Stability; Washing of Oils; Sesquiterpene; Diterpenes; Folding of Extracts and Essences; Oxidation; Rancidification; Terpenes, Oxygenated; Chart 327 – Terpenes and Related Compounds; Chart 328 – Terpenes Oxygenated etc; and Figure 31.

Terpenes, Oxygenated (Terpene Aldehydes, Terpene Alcohols) – The oxygenated terpenes are compounds that carry the strength and aroma in the citrus oils. At smaller quantities, they are the desirable components that are strengthened by extraction, folding, or washing. Citral is the characterizing component of lemon. It is responsible for the lemonyness of a furniture polish. Decanal (aldehyde C-10) gives the orange the rindy, peely odor. Alpha Terpineol, produced by distilling lime oil directly from fruit (a citric acid catalyzed reaction in the juice), gives the green lollypop flavor so characteristic of a distilled lime oil. The terpene ketone, carvone, is a unique compound because it exhibits one of the clearest examples of flavor differences due to optical isomerization. Unlike many optical isomers, the two optical isomers are extremely different in profile. The dextrorotatory (d) form of carvone exhibits a woody, caraway-dill flavor, and the laevorotatory (l) form exhibits a minty spearmint flavor. See Terpenes, Citral, Decanal, Lemon, Lime, Orange, Laevorotatory, Woody Dextrorotatory, Optical Isomers, Spearmint, Dill, Caraway, and Chart 328 – Terpenes Oxygenated etc.

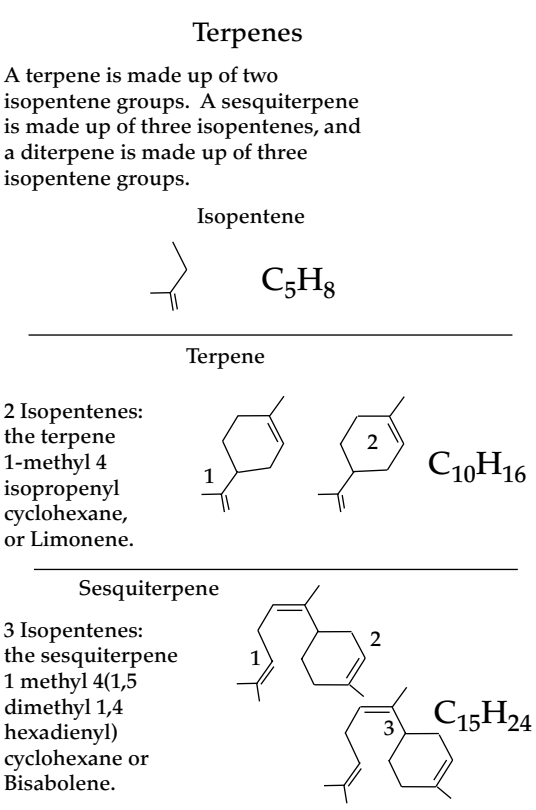


Figure 31

Terpenoid –
1. A chemical with a terpene-like structure.
2. Having a character reminiscent of a terpene.

See Terpenes.

Terpeny – Reminiscent in odor to the terpenes. See Flavor Descriptive Analysis.

Terrine – A mixture of meat, fish or vegetables cooked typically in a loaf and served cold or at room temperature. See Charcuterie, Culinary.

Terroir – Originally a French word whose translation is roughly 'sense of place.' It signifies the effect of climate and geography, expanded to soil conditions, weather patterns, and other local factors that contribute to a special character of a local food crop. This is most obvious in wines, coffees, and heirloom foods, but can also be expanded to cheeses. It was, for example, the unique mold growing in the caves of Roqueforte that lent itself to the special flavor of its named cheese. See Heirloom Foods, Wine, Coffee, Cheese.

Tert(iary) – Signifying a carbon linked to three other groups. See Chemical Structure.

Tertiary Amine – A nitrogen attached to three carbon-based groups, represented as (R1-N-R2(R3). See Chemical Structure, Primary Amine, Secondary Amine.

Tertiary Butyl Hydroxy Quinone – See TBHQ.

Test Design – The structure of a sensory evaluation procedure. Test design is based on the objective of the project, the test objective, the product type, availability of subjects, and the assessment of risk. See Alpha Risk, Beta Risk.

Tetrad Test – An alternative to Duo trio, Triangle and 3-AFC tests used in smaller group settings. The tetrad test pits two groups of two samples randomly ordered, and the panelist is asked to group the four items into two sets of two. This has a more powerful

accuracy than either the triangle or duo-trio but not as good as the 3-AFC, however to achieve a significance level of 0.05 or 95% accuracy, and a power of 90%, you would need 87 people for a duo-trio, 78 for a triangle but only 25 for a tetrad. The one thing that reduces the accuracy of this test is the evaluation of strongly flavored products due to fatigue. The set-up of the test is as follows: The two samples to be tested A and B are randomly presented to the testers in two groups of two namely AABB, ABAB, ABBA, BBAA, BAAB and BABA. The tester is to accurately group the two different Items into two different groups. Statistical analysis is applied to determine the accuracy of the test as usual. See Sensory Evaluation, 2-AFC, Duo-Trio, Triangle Test, Statistical Analysis

Texture – The characteristic of feel or touch. The group of attributes that describes the mouthfeel of a food product. Texture can be described as slimy, thick, gritty, sandy, rubbery, spongy, soft, hard, grainy, dry, tacky, slippery, creamy, or fatty just to name a few. Sensory attributes of texture are typically detected and transmitted by both trigeminal nerves and touch sensors in the mouth. See Flavor, Odor, Sensory Analysis.

Textured Vegetable Protein (TVP) – Proteins that have been isolated (usually from soy) and have been extruded or otherwise texturized to form useful replacements for meats, seafood, or as other ingredients. Historically, TVPs had off tastes attributed to the oxidation of trace oils. Recently they have been greatly improved flavorwise, by the removal of trace unsaturated oils. See Soybean, Cardboard, Oxidation, Fats and Oils, Rancid (Rancidity).

Texture Profile Analysis™ – A spin-off from Flavor Profile Analysis™, first developed by A.D. Little, which assigns to a subject material descriptor for textural attributes. See Flavor Profile Analysis™ and Descriptive Analysis.

Thalamus – The structure deep within the brain, consisting of two egg-shaped, walnut-sized structures, the function of which is to first receive, then to relay to the brain, certain sensory information such as vision, hearing, touch, and taste. Bitter taste sensations are transmitted through the glossopharyngeal nerve from the rear of the tongue. Other tastes are sent through the facial nerve from the front two-thirds of the tongue. In either case, the signal is then relayed to the base of the brain through the medulla oblongata, then up to the thalamus then finally to the cerebral cortex. Each sense, taste, odor, textural cue, and trigeminal stimulus goes through different pathways to the final flavor memory centers in the cerebral cortex. See Endocrine System, Exocrine System, Hormones, Brain, Physiology, Odor, Flavor, Aroma(s), Volatiles, Flavor Profile.

Theaspirane Related Compounds – All but the acetoxy variety is found in tea, blackberries, or other woody-type products. See Woody and Chart 338 – Theaspirane and Related Compounds.

Theobromine – An alkaloid found in many natural products, including cocoa. See Alkaloids, Bitter.

Theoretical Plate Count – The concept was first applied in the fractionation/distillation process of refining crude oil. The concept is defined as follows: Each of the hundreds of components that make up an oil has its own boiling point. In a theoretical column, at a given temperature, these ingredients will rise (reflux) to a certain height where a level or collection plate might be placed for removal of the individual components as in the fractional distillation of petroleum. In the column the removal system will collect each of the separated ingredients in roughly a purified form. The actual degree of this separation in the real world has much to do with many factors including co-distillation, azeotroping, surface tensions to column walls, packing materials, etc. Therefore, the degree of separation of any column or its distillation efficiency is reflected and measured by a formula that theoretically imagines these plates to be present, ergo the theoretical plate count. See Separation, Distillation.

Thermal Conductivity Detector – See TCD, Detectors, Gas Chromatography (GC), Flame Ionization Detector.

Thermal Kill Step – The point in a process where sufficient heat is introduced throughout a product to insure adequate pasteurization, reduction of pathogenic organisms, and to produce a safe food product. See Pasteurization, Pathogens, HACCP, Food Safety, D Value, Z Value.

Thiamine Hydrochloride – Vitamin B1. Besides its use as a vitamin supplement, thiamine HCl has flavor uses. Thiamine HCl has been used as a precursor source for meaty components in Maillard systems, particularly those using hydrolyzed vegetable proteins as a source of amino acids. Thiamine hydrochloride also has an aroma to it. This is obvious in vitamin supplements containing the ingredient, each of which have a distinctive sulfurous odor. Due to this fact, thiamine can be used as a source of sulfury character in flavors. However, care must be taken as to labeling. The question of intended use fits well in this example (vitamin versus precursor). The question is simply put. Is the thiamine there as a vitamin or as a flavor precursor or flavorant itself? If the answer is as a vitamin, then it must be labeled as a nutritive supplement. If it used as a flavorant, then most sources are artificial and it cannot be used

in a natural flavor unless it is either from a natural source, or it is declared to be an artificial flavor. See Intended Use.

Thiazoles, Thiazolines, Thiazyl Compounds – These compounds included in this group represent interesting combinations of nutty, roasted, and meaty flavors. Thiazoles are double heterocyclic compounds with both atomic nitrogen and sulfur in a five-membered ring. Thiazoles contain two double bonds, while thiazoline only has one double bond. See Nutty, Meaty, and Chart 329 – Thiazoles.

Thick, Thickness –

1. A fullness of mouthfeel, usually associated with umami-type tastants and/or high solids content (soluble or suspended).
2. A description for a high viscosity product.
3. In tea terminology, a highly concentrated product with bright color and good flavor strength.

See Thin, Mouthfeel, Umami Taste, Viscosity, Suspended Matter.

Thin – Having a low flavor profile, subtle, yet watery, apparent, yet lifeless. See Thick.

Third Party Audits – Third Party Auditors – Not the supplier or the customer but an independent representative who assesses the system used at a food company. Third party audits can follow many accepted protocols. See Food Safety Audit (s), BRC, SQF, Iso 9001, AIB.

Thistle, Blessed – Cnicus Benedictus – See Nutraceuticals and Chart 386 – Thistle, Blessed.

Thousand Island Dressing – A dressing made from ketchup or tomato products, chili sauce, green peppers, pimientos, and chives. See Culinary Arts, Food Technology, Product Development.

Three Alternate Forced Choice Comparison Test (3-AFC) – A sensory test that asks the question: 'Out of these three items which has more…' The items are usually identified with random labels (such as non-bias numbers or letters) and presented in the following serving sets: AAB, ABA, BAA, ABB, BAB, and BBA. See Sensory Evaluation, Three Stimuli Tests.

Three Stimuli Tests – Sensory evaluation methods that include Triangle Test, Duo-Trio Tests, and Direction Comparison Tests (3-AFC). See Triangle Test, Duo-Trio Tests, and Direction Comparison Tests (3-AFC).

Threshold Determination – A technique used to calculate the threshold value of a given aromatic or taste substance. One in 10 serial dilutions are prepared. These are then rated and continued until the testor comes up with the dilution that has virtually no odor or aroma. Then the tester will go upward in concentration until the odor or taste is just perceived. This point is defined as the threshold. Threshold can vary according to the base, the health of the individual, and a variety of other factors. Due to these potential errors, the experiment should be repeated until enough data can be safely averaged. See Discrimination Test, Sensitivity.

Threshold Value – See Minimum Perceptible Concentration.

Throw – The dilution factor of a syrup to carbonated or still water. A typical bottler's syrup dilution or flavor application rate is a fraction to 1 ounce of flavor to 1 gallon of syrup at a 1 plus 5 throw. This means that for every gallon of flavored syrup, it will be diluted with 5 more gallons of carbonated water, or a final dilution of 1 in 6. See Bottler's Syrup.

Thujone (Free) – Thujone, a terpene ketone, is considered to be a skin irritant and is also mildly toxic. It is found in many essential oils and extracts of natural origin. Because of this, safety regulations apply and food-grade oils often are necessarily made thujone free. Cedarwood oil is a prime example. The product able to be used in foods is cedarwood oil alcohols, which is thujone free. See Cedar White.

Thyme (Common Mugwort) – Thymus Vulgaris – Thyme is an herb that seems to aid in the digestion of fatty foods and therefore makes a good seasoning for duck, pork, mutton, or goose. The oil contains thymol and carvacrol and therefore has an intense aromatic and pungent flavor. Thyme oils are often confused with origanum oils. However, thyme oils differentiate themselves from origanum with the amount and nature of the phenols present. Thyme oils have over 40% phenol content of which 90% of those phenols are thymol. White thyme oil is really redistilled red thyme oil. Thymus heimalis is not approved for food use, but is a thyme species usually referred to as Spanish verbena oil. Thymus citriodorus is a lemon-scented thyme. Thymus serphyllum is also called serpolet and flavors much of the cooking in Provence, France. Some other varieties of thyme are variegated thyme, garden thyme, silver posie thyme, Doone valley thyme, and lemon thyme. See Phenol, Thymol, Chart 387 – Thyme, and Appendix 2.

Tiglates – Esters of 3 methyl 2 butenoic acid are generally sweet. Tiglates are described by some as having a mint character as well. See Esters and Chart 330 – Tiglates.

Time Intensity Curve – A plot of time versus flavor intensity with notations when the profile has changed. This is a simple, yet effective way to describe the profile of many flavor systems, observing important time-related issues of changes in flavor intensity and type. See Dynamic Flavor Profile Method.

Time Intensity Profile – See Time Intensity Curve, Figure 32, and Figure 33.

Time Management – See Priority.

Time of Flight – A very rapid mass analyzer (Mass Spectroscope) using the technique of time measurement for determining an Ion's mass to charge ratio. Originally developed as early as 1946, it was used extensively for the purpose of drug residue determinations and toxic screening for forensics and is now used in the areas of DNA, peptides and protein sequencing, and analyses of intact viruses. See Gas Chromatography, Mass Spectrometer.

Tincture – A dilution or extraction in alcohol. See Extract, Infusion.

Tisane – French word for infusion, used often when describing teas that are made of herbal, non-Camellia Sinensis blends. See Tea, Green Tea, Black Tea, Herbal Tea.

Titanium Dioxide – A white pigment ground very fine. See Colorings, Titanium Dioxide.

Title 9 – See CFR Title 9.

Title 21 – See CFR Title 21.

Title 27 – See CFR Title 27.

Title 49 – See CFR Title 49.

TIME / INTENSITY CURVES AND FLAVOR PROFILE

One of the useful techniques to describe flavors is the application of the flavor profile to a time/intensity graph. The time usually involved in the experience we call "tasting" is typically very short, averaging in the range of 7–15 seconds per experience. The volatilization of aromas and their then "fading away" from the experience in a very short period of time, only recognize the next aroma type in the sequence results in what some call an "illusory elution" similar to that found in the elution of volatiles in a gas chromatograph. This illusory elution is dependent on many factors, such as polarity or water solubility. Vapor pressure in the mouth has much to do with retention in the saliva versus evaporation retronasally. However, the most important factor is molecular weight. Light compounds will be perceived first and heavy compounds last. The light molecular weight substances such as dimethbeyl sulfide, ethyl acetate, and taste components such as acid and salt appear in the beginning. Heavier compounds such as cinnamic aldehyde, resinous substances such as phenyl ethyl esters, di and tri terpenes, and other higher molecular weight components will be perceived at the end of the taste experience. The overall effect of this is for a flavor to be able to be defined as having a topnote, a middle ground and a background or back note. Much about this is discussed in the text of this book.

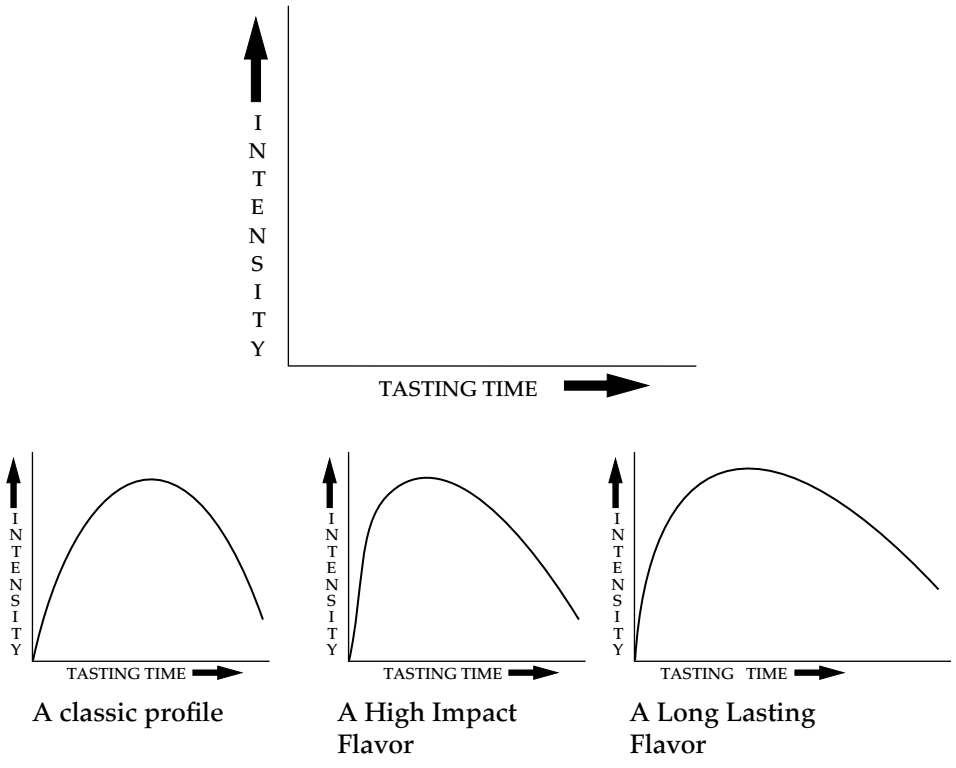
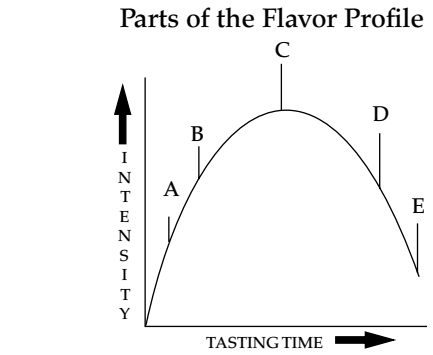


Figure 32



Notations can be made in the curve indicating the flavor type. A = Diacetyl, B = Butyric Acid, C = Non Fat Dry Milk, D = Gamma Decalactone, E = Bitterness from EMC.

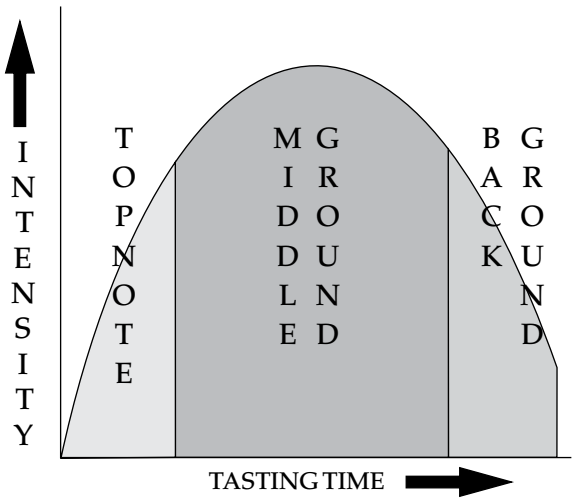


Figure 33

Titration – The technique often used with a graduated cylinder where an unknown liquid compound is used to react with a known quantity and concentration to determine the concentration of a particular substance in the unknown. This is often used with an indicator such as phenolphthalein, methylene blue, where there is a visible color change to see the point at which the indicator just turns. This is the equilibrium point where the unknown is equivalent to the known. The molar concentrations are determined and with knowledge of the ion ratios, and volumes, the unknown is calculated. See Quality Control, Wet Chemistry, Instrumental Analysis.

Toadstool – A poisonous umbrella-shaped mushroom. It is unclear where the word derived from. One source indicates it translates roughly from the word 'tot' in German, which means dead and while another indicates it is derived from the fear that toads are poisonous. Both imply that the umbrella-shaped fungus can be sat upon by this diminutive animal. See Fungus.

Toasted, Toasting – A complex Maillard browning reaction represented by furanones and other furyl compounds, pyrazines, and other toasted notes, etc. See Maillard Reaction.

Tobacco – The leaf whose active ingredient is nicotine and is used to make cigarettes, pipe tobacco, cigars, and non-smoking-type products like snuff, chewing tobacco, etc. One method of flavoring tobacco is by adding flavor to a viscous liquid called a casing, distributing this flavor on the surface of the leaf, and then drying the coated leaves in a tall chimney-like structure called a flue. This procedure is called flue curing. The aroma of burning tobacco is aromatic and somewhat pungent. Many tobacco flavor ingredients have been test-smoked to ascertain their flavor characteristics in the final smoking stage. One of the accepted lists for aromatic materials to be used in tobaccos is called the Hunter list. Some aromas like acetaldehyde have had reported enhancing effects to the biological potency of the nicotine, and therefore it, like other chemicals, are used not only for their aroma value but their physiochemical effects as well. Much testing has been done as to the nature of GRAS chemicals in their ignited state. See Regulations, Cigarettes, E-Cigarettes, Safety.

Tocopherol, Alpha – See Vitamins.

Tolu Balsam (Myroxylon nalsamum (L.) Harms.) – Tolu balsam is a natural oleo balsam resin. It has a character that can be described as sweet and balsamic with a cinnamic/vanillic character. It is used as a fortifier to many brown notes including vanilla, rum, butterscotch, chocolate, etc. Tolu contains cinnamic acid, benzoic acid, and alkoxy phenols. It is those alkoxy phenols, which are related to vanillin in structure and which give tolu the vanillic character and contribute to its characteristic enhancement properties. See Vanilla, Peru Balsam, and Chart 388 – Tolu Balsam.

Tolyl Esters – Based on tolyl alcohol (methyl benzyl alcohol). These compounds are similar to the benzyl esters in profile. Some tolyl compounds do have unpleasant aftertastes, and their usefulness in flavors is varied. See Benzyl Esters and Chart 331 – Tolyl Esters.

Tomatillo (Physalis isocarpa) – Also known as the Mexican husk tomato. Botanically, the tomatillo is closer to the gooseberry than it is related to the tomato, despite the similarity in flavor profile to tomato. See Tomato.

Tomato (Lycospersicon esculentum) – Originally grown in Mexico and Central America, the tomato made its way into Italian cooking as pomodoro or golden apple during the 'Age of Exploration.' The green fruit does contain a toxic alkaloid, giving

some credence to early reports as to the fruit being toxic. There are many varieties of tomato including plum tomato, which is elongated and has a more rounded and fuller flavor; the cherry tomato, a small tomato similar to the original variety with a more green character and higher acid level; the yellow tomato with a high sweetness level; the pear tomato, shaped like a pear (smaller on top and larger on bottom) with a flavor similar to the plum tomato; the beefsteak tomato, a large sweeter tomato; currant tomatoes, with a tart almost bitter flavor similar to cherry tomatoes; and the common tomato. From a flavor standpoint, tomatoes are quite complex owing much of their flavor profile to green compounds (saturated and unsaturated aldehydes), trace sulfur components, and esters. An example of heat-generated isomerization, the more unstable cis unsaturated alcohols and aldehydes lessen as the tomato juice or the puree is cooked. The cis isomer transfigures into the more stable trans configured isomers as the tomato sauce develops through the cooking process. See Aldehydes (Unsaturated Alkenals, Alkadienals, Alkynals, and Cyclic Non-Aromatic Aldehydes) and Chart 389 – Tomato.

Tomato Lycopene – See Appendix 2 and Chart 471 – Tomato Lycopene.

Toners – Additives that are used to soften or mellow out an unwanted characteristic. This is often used in vinegar where the toner can also add a wanted flavor such as apple cider, balsamic vinegar, or tarragon (used in Bernaise sauce). See Blenders, Vinegar.

Tongkat Ali or eurycoma – Longifolia jack. See Appendix 2.

Tongue – The organ upon which the taste buds are found. Taste buds are the minor organs that sense salt, sweet, bitter, and sour. See Taste, Taste Buds, Agustia, Nose.

Tonquin (Tonkin) Musk – See Musk Tonquin.

Toothpaste Flavors – To cover up the active ingredients in the toothpaste, which include emulsifiers, abrasives, and other ingredients, mint-type flavors are often used. Mints like spearmint and peppermint or menthol from re-crystallized cornmint are usually the most effective. The mint oils are often combined with methyl salicylate, cinnamic aldehyde, anethole, and other ingredients. See Health Care Flavors.

Top Note – The top note of a flavor profile is the first character perceived. Top notes are comprised of chemicals having smaller molecular weights. Top note compounds therefore, tend to be heat instable due to their greater volatility. See Background, Middle Ground, Time Intensity Profile, Dynamic Flavor Profile Method, Flavor Profile.

Topped and Rectified – Topped and rectified is a terminology used in distillation meaning the distillation of some of the lighter components and the removal of the heaviest components as well. First, a simple vacuum distillation is done removing a few percent of material. Then, this is followed by the addition of a non-volatile substrate to the distillate. A subsequent distillation of the rest of the oil removes some of the extremely heavy compounds as well as the lighter fractions. However, some heavy terpenoids can act as oxygen scavengers, which act as the oil's natural antioxidants, so their removal is not always advantageous, and these useful properties might then be lost. For this reason, the technique is not used often with citrus products, but it is used with mint oils. See Distillation.

Topping –

1. The process of distilling off the first fractions of an essential oil.
2. A sugary-based product used on a cake or confection.See Distillation.

Total Quality Management – A policy that strives to ensure the involvement of everyone to assure the quality of products produced. The principles are as follows: (1) Ensure that customers drive quality. (2) Treat everything as a process (or part of one). (3) Improve continuously. (4) Build in quality from the start. (5) Solve problems using facts and data. (6) Involve everyone. A TQM driven company is contrary to the classical way companies have operated. Profits are merely an indicator of past performance, and should not drive the company. Quality and long-term vision should drive the company. Defects are a result of faulty systems and not faulty employees. The quality process is never ending; improvements can always be made. See Quality Assurance.

Touch – The fifth sense. The ability to experience light touch, pain, heat, cold, pressure, irritation, etc. The touch receptors are located throughout the body. The sense of touch is received as electrical signals and interpreted in the cerebral cortex of the brain. Different parts of the body have greater amounts of these nerve endings. The face, tongue and lips, fingers, hands, and the genitals have the greatest amount of touch receptors. They are therefore the most sensitive to tactile stimulation, pain, etc. The actual receptors vary in structure. Pressure nerve sensors send stimuli upon compression, and so on. Individual sites do not seem to be associated with singular sensation types, but have many nerve ending types in the same area. See Trigeminal Nerves.

Tourner – See Knife Cuts.

Toxicological Threshold of Concern – The Threshold of Toxicological Concern (TTC) approach has been developed to qualitatively assess the risk of low-level substances in the diet. This can be employed to

establish a de minimus effect, that level below which a substance has no adverse effect. See De Minimus, Toxicology.

Toxicology – The study of poisonous chemicals and their effects on our body. Paracelsus the Greek scientist is quoted as saying 'Poison is in everything and no thing is without poison'. The dosage makes it either a poison or a remedy. There are many publications on Toxicology. Examples are; 'Food and Chemical Toxicology', 'International Journal of Toxicology', and 'European Journal of Food and Food Safety'. See FEMA, Select Panel, LD20, Food Safety, Feeding Studies, GRAS.

Toxic Release Inventory (TRI) – A list of substances prepared by a company that itemizes what hazardous substances of a significant hazard level are on a company's premises. This list is prepared and modified annually by the EPA in cooperation with OSHA and other governmental agencies. The purpose of the list is to alert the authorities so they may be prepared in the event of an accidental release into the environment. See Environment, EPA, Regulations, OSHA.

Toxic Substances Control Act (TSCA) – The legislation that governs the handling, storage, sale, purchase, and release of toxic substances in the United States. See Toxic Release Inventory, Environment, EPA, Regulations.

Toxin – A poison produced by an organism. Bacterial toxins are divided into three classes: (1) endotoxins – released from the inside of dead bacteria; (2) exotoxins – released from the surface of live bacteria; and (3) enterotoxins – toxins that enflame the intestinal lining. See Toxicology, Hazardous Substances, Feeding Studies, Poison.

Toxoid – An inactivated toxin capable of stimulating the body's production of antibodies by the immune system. Inoculations of toxoids can enable the body to build up antibodies and be immunized against certain diseases. Once the immune system comes in contact with these weakened offenders, it can then learn how to combat them in the future. See Toxins.

TQM – See Total Quality Management.

Trace (Components) – Some chemicals can be found at extremely low concentrations and still be flavor effective. Some examples are isobutyl methoxy pyrazine (green bell pepper), ionones (raspberry), some mercaptans (furfuryl mercaptan, i.e., coffee). The components can be detected at parts per billion in liquid media and far lower than that in the atmosphere. These trace components while still flavor-significant via the human sensory mechanism, might not be recognizable by current instrumental detector systems. For this reason the flavorist's sensory input is still vital when doing flavor-based gas chromatographic analysis/mass spectroscopic duplication.

Trace (Gas Chromatograph) – Another name for the graph that is produced when a gas chromatographic unit is running.

Trace Elements – A group of minerals that are necessary at very small amounts in order for the body to maintain good health. They include chromium (Cr), copper (Cu), selenium (Se), sulfur (S), and zinc (Zn).

Trade Secret/Trade Secret Act – In 1979 and again as amended in 1985, the Uniform Trade Secrets Act published by the Uniform Law Commission was passed to protect the owners of trade secrets and companies that operated in multiple states. As of May 2013 only 47 of the 50 states have enacted the act into state law. See Legislation, Secrecy Agreements/Confidentiality Agreements, Public Domain, Intellectual Property.

Tragacanth Gum – See Gums and Thickeners.

Traif – Non-Kosher. See Kosher Supervision.

Transesterification – A chemical interaction that occurs in flavors upon standing. Transesterification is the swapping of ester moieties over time. Example: If there is amyl acetate and butyl formate in solution, over time there will be an observable amount of amyl formate and butyl acetate.

Trans Fats – Trans fats are formed when vegetable oils go through partial hydrogenation. Consumption of trans fats has been shown to raise LDL or bad cholesterol and to lower HDL or good cholesterol. As of January 2006, the Food and Drug Administration requires the labeling of trans fats on the nutritional panel according to the NLEA. See Trans (Isomerism), Fat.

Transglutamase – See Enzymes.

Trans (Isomerism) – Designated by the symbol (E), trans isomers are a non-sterically hindered configuration of a double bond. When there is a double bond between two carbon atoms, two hydrogen atoms are attached to opposite carbons on opposite sides and two non-hydrogen atoms are attached on to the other sides. See Cis (Isomerism), (E), (Z), and Figure 34.

Translucent, Translucency – The physical characteristic wherein light can pass only partially through a material. In a liquid, the resultant product would appear cloudy. See Transparent, Transparency; Opacity, Opaque; Flocculation; Cloudiness; Cloud; Emulsion.

Transmittable Spongiform Encephalopathy – See BSE.

Transparent, Transparency – The physical characteristic in which light can pass through a material. The resultant material appears clear. See Light; Translucent, Translucency; Opacity, Opaque.

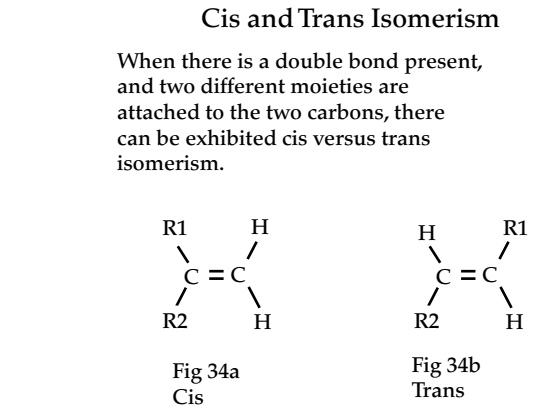


Figure 34

Trasi – A firm paste made from fermented shrimp. See Shrimp.

Tray Drying – A dehydration method that may or may not include evaporation. A fairly thin layer of product is spread out on a tray and usually heated. The particles can then be ground and sized. Tray drying yields particles that are usually amorphous and much larger than with spray drying. See Spray Drying, Drying Methods, Agglomeration, HVP.

Treacle – Sugar is produced and purified using bone black. The resultant mass yields brown sugar and treacle. Treacle has been used in earlier times as a medicinal treatment more specifically to treat poisons, but in modern times it is used as a condiment. It is also made by blending molasses corn syrup and invert sugar. Some say it is synonymous to molasses or golden syrup. See Sugar.

Tree Tomato (Cyphomandra betacea) – Also called tamarillo. The fruit comes in two varieties; one is orange with yellow pulp and the other is purple with orange pulp. See Tomato.

Tres Rios – A coffee varietal of Costa Rica having a light flavor profile. See Coffee.

TRI – See Toxic Release Inventory.

Triangle Test – A sensory-based analysis where three randomized unknown samples are tested. In a triangle test, two of the products are the same and one is different. The respondent is requested to pick out the odd sample. The setup is crucial. Labels and placement, and also the order (which is the two, which is the one) of these products should be randomized. The combinations of the three would be AAB, ABA, BAA, BBA, BAB, ABB, or six different sets. Sufficient subjects should be involved to make the results accurate. Some believe the minimum to be 24, or four randomized samplings. These rules must be followed to assure accurate statistical results. Duplication of results to achieve a minimum just increases the resultant errors. Example: Doubling the score of the 17th to the 20th panelist to achieve a 24 minimum sampling will just double the errors that might be inherent in those scores. See Sensory Evaluation, Attribute Tests, Discrimination Test, tetrad Test.

Tribulus terrestris – See Appendix 2.

Trichloro Anisole (2,4,6 Trichloroanisole, TCA) – This is the chemical that is responsible for the 'corked' character in wine. It comes from a mold growth in the cork wood. It also can come from the barrels although this is much rarer. It is said that about 5–7% of wine produced has this taint. Many wineries are now switching to screw caps and synthetic rubber corks. See Wine, Fermentation, Yeast and Mold.

Trigeminal Nerves – One of the 12 cranial nerves that divides into three main branches: (1) the ophthalmic nerve; (2) the maxillary nerve; and (3) the mandibular nerve. The ophthalmic nerve respond to sensations in the scalp, upper eyelid, tear duct, and cornea. The maxillary nerve transmits impulses from the upper jaw. And the mandibular nerve provides a conduit for impulses sensed by the lower jaw, jaw muscles, and non-taste impulses from the tongue. It is the trigeminal nerve that responds to chemical irritation. Examples of these stimuli are lachrymation (effect of producing tears), the coolness of mint, the heat of capsicum, the drying effect of tannins, the taste of metals, etc. The trigeminal nerve also transmits textural cues. These textural cues are sensed by the many touch receptors located in and around the olfactory and gustatory organs. Among these textural cues would be non-taste sensations including pains, pressure, actual coolness, actual heat, irritation, mouthfeel, dryness, fattiness, etc. Trigeminal nerve fibers surround the structure of each papillae, especially the fungiform papillae. Because trigeminal fibers are associated with taste buds, it goes hand in hand with the subject's degree of taste ability. Supertasters who have a greater concentration of taste buds, therefore have a greater concentration of trigeminal tongue fibers as well. Studies by Dr. Beverly Tepper of Rutgers University indicate that trigeminal and taste responses are indeed linked. Olfactory abilities are independent of taste bud concentration. Certain reptiles lack the more sophisticated olfactory (odor) and gustatory (taste) sense organs. For example, snakes sense through a trigeminal type system. The animal will flick air to the back of their throat to rush chemicals toward trigeminal sense organs. Trigeminal receptors are also located in the lateral lower sides of the catfish. It is due to the placement of these sites that

scientists now believe that trigeminal sensors are powerful locators of chemicals formed through the process of decomposition as well. See Olfaction, Gustation, Taste Bud Concentration, Low Taster, Moderate Tasters, Supertasters, PROP.

Triglyceride – Correctly stated by accepted IUPAC terminology, a triglyceride is really a triacyl glycerol. A triglyceride is a fatty compound made up of a glycerine molecule attached to three fatty acids. See Monoglycerides, Diglycerides, Fat.

Trihydroxy Benzoic Acid Derivatives – See Benzoates and Benzyl Esters.

Triphala – See Appendix 2.

Triple Bond – A covalent chemical linkage whereupon one atom is attached to another by sharing three pairs of electrons. Using the accepted UIPAC system, this class of compounds would belong to the alkyne group. The other hydrocarbons in this group are the alkanes (single bond) and the alkenes (double bond). Example: A triple-bonded propenyl group would be called a propynyl group. See Alcohols – Unsaturated – Non-Aromatic, Aldehydes (Unsaturated Alkenals, Alkadienals, Alkynals, and Cyclic Non-Aromatic Aldehydes), Unsaturated Esters, Green, Watermelon, Rindy.

Triple Distilled – A terminology used in the mint industry, which by accepted practice means a 3% cut by distillation. See Topping, Rectification, Distillation, Purification, Folding of Extracts and Essences, Vacuum Distillation.

Triticale (Triticum Scale = a cross between wheat and rye) – Triticale has the crop resilience of rye and contains a good amount of gluten as does wheat. Therefore, triticale makes high quality bread. See Bread, Wheat.

Triticum – See Dog Grass.

Tropical Fruits – Fruits that are grown in the tropical climates. Examples are mango, passion fruit, guava, guarana, guanabana, star fruit, kiwi, li hing mui, longan, lychee, papaya, and many others. Often tropical flavors are associated with a sulfury fruity and often with floral subtleties. Thio esters and thio terpenes, buchu, tagettes, and other similar sulfur containing components are helpful in capturing those nuances. See Mango, Fruity, Guava, Passion Fruit, Star Fruit, Papaya, Pineapple, Coconut, Banana, Guanabana, Guarana, Sulfur Compounds.

Tropical Oils – Certain vegetable oils that are high in saturated fatty acids. These include coconut, palm kernel oil, etc. Recent demands for polyunsaturated oils due to health concerns have limited the use of tropical oils. See Fat, Fatty Acids, Saturated (Satiated).

True Fruit (Flavor or Extract) – This is a designation that is not used nearly as much as it has been in the past. Legally a true fruit or true flavor means that all of the flavoring in the product comes from the named fruit only. Another terminology is FTNF, meaning 'from the named fruit.' Often, a true fruit flavor does not have the flavor strength of the corresponding WONF. The designation and prevalence of WONF or 'with other natural flavorings' is far greater than the true fruit types. See Flavor Labeling, WONF, From the Named Fruit.

Truffles – See Mushrooms (food).

Tsai Shim – See Chinese Cabbage.

TSCA – See Toxic Substances Control Act.

TSE (Transmittable Spongiform Encephalopathy) – A variety of spongiform encephalopathies that attack various organisms as follows:

In humans:

- CJD or Creutzfeldt–Jakob Disease (and new variant CJD – nvCJD or vCJD). See Creutzfeldt–Jakob Disease.
- GSS or Gerstmann Sträussler Scheinker syndrome. See Gerstmann Sträussler Scheinker Syndrome.
- FFI or Fatal Familial Insomnia. See Fatal Familial Insomnia.
- Kuru. See Kuru.
- Alpers syndrome (hypothesized). A similar degenerative disease that is only postulated to be a TSE.

In other vertebrate animals:

- Scrapie in sheep.
- See Bovine Spongiform Encephalopathy (BSE) in cows.
- See Bovine Spongiform Encephalopathy Chronic Wasting Disease (CWD) in American elk and deer.
- See Chronic Wasting Disease.
- Transmissible Mink Encephalopathy (TME) in mink. A TSE that affects adult minks.
- Feline Spongiform Encephalopathy (FSE) in cats. A TSE that affects felines. It will be interesting as data become more available if this is a potential hazard in cultures that consume cats and other similar animals. See BSE.

TTB – Formerly part of the BATF, the Taxation and Tobacco Bureau regulates alcoholic beverages, alcohol, drawback, and other alcohol related issues. Recently the Bureau developed 'Formulas Online' to help greatly expedite the registration of flavor formulas for use in Alcoholic Beverages. There are a number of chemicals that make a flavor non-potable. There are also a few flavoring Ingredients which have restricted usage (Vanillin, ethyl vanillin, synthetic maltol, ethyl maltol). Natural flavors for Alcoholic Beverages can have 0.1% artificial topnote added. See Potable, Non-Potable, Alcoholic Beverages.

T-test – A single sample base, purely hedonic type test or one that test only two groups of data. A paired T-Test describes typical changes in before and after systems. See Hedonic Test, Discrimination Test.

Tuber – A starchy root structure. These structures are found in potatoes, yams, sweet potatoes, or casava.

Tuberose (Polyanthes tuberosa L.) – The flavor profile is floral and very sweet. Tuberose concrete is really a pomade (a fat extraction based off an enfleurage-like process similar to the one used to produce jasmine extracts). As is true with jasmine, the tuberose flower keeps on producing volatiles even after it is cut. The fact that the absolute made via enfleurage ex pomade is 15 times the strength of the absolute made from extraction by petroleum solvent is a good example of the effectiveness of the older procedure, even though it is thought to be somewhat outdated. However, world production is tiny and most of the oil available might be suspect (adulterated). See Pomade, Absolute, Concrete, Floral, and Chart 390 – Tuberose.

Tulsi or (Holy Basil) or Ocimum sanctum – See Appendix 2.

Turbidity – The degree of cloudiness of a liquid.

Turkey – A larger fowl that has a flavor vaguely reminiscent of chicken, although the meat tends to be more savory and even a bit gamier (substituted fatty acids). Turkey is the traditional staple for the Thanksgiving holiday in the United States and other fall and winter occasions (Christmas, etc.). Tryptophan, an amino acid found in turkey, has been identified as the ingredient responsible for making people tired after heavy turkey consumption as during the Thanksgiving holiday. An interesting anecdote about the usage of the slang 'turkey' meaning stupid describes the domesticated variety. It is said that turkey pens have no corners, because a turkey is so dumb, it will not be able to turn around and will stay in the corner unless prodded. Also, turkey pens have to be covered, because when it rains, turkeys lift up their heads to see where the rain is coming from and drown. Also, pebbles and shot have to be mixed with turkey grain to give the turkey a feeling of satiation, or the turkey will eat itself to death. See Animal Husbandry, Meat, and Chart 391 – Turkey.

Tumeric – See Turmeric.

Turmeric (Tumeric, Curcuma) (Curcuma longa L.) – The spice contains curcumin, a potent yellow colorant. This is not to be confused with Indian Turmeric (Note: Native American Indian), which is the species Hydrastis canadensis, otherwise known as American yellowroot. It is one of the main ingredients in Indian curry powder, contributing the intense yellow coloring. Turmeric is also called Indian saffron. (Note: In this case, it is Asian Indian.) See Color (Colorants), Chart 392 – Turmeric, and Appendix 2.

Turnip (Brassica rapa) – The flavor of turnip is somewhat bitter, vegetable like, and sulfury having a typical yellow vegetable character. Dehydrated turnip powder resembles the flavor profile of some dehydrated ginseng powders. See Ginseng.

Turpentine (Pinus palustris Mill.) – The physiological or pathological exudates from conifers. Usually turpentine is derived from the Abies or Pinus species. Other turpentine-related flavoring materials are Canada balsam and gum elemi. Canada balsam is a true exudate (i.e., a resinous or gummy substance that becomes a solid or semisolid upon expression). Elemi is an exuded gum with properties and composition similar to turpentines. The essential oil derived from turpentine is called turpentine oil, and the resinous by-product is called wood rosin. Abietic acid is one of the important constituents of wood rosin. Abietic acid can be further chemically treated to develop some perfume fixatives like Abitol (mixed dihydro and tetra hydro abietic alcohol), methyl abietate, and methyl dihydro abietate. Turpentine is 25–35% beta pinene and approximately 50% alpha pinene. However, pinene oxidizes to peroxides and can polymerize, therefore, most turpentine products are too unstable for flavor use. See Citrus, Pine, Exudate, and Chart 393 – Turpentine.

Tutti-Fruity – A fantasy flavor used in chewing gum. The flavor character of tutti-fruity is based on a combination of orange and other citrus oils, esters, and vanillin. Different brands are composed of different blends of modifying flavoring substances. See Modifying, Characterizing, and Differential Flavoring Substances.

T-Test – T-Value – The Analysis of the average of data when compared against a known value. As an example; if data on Specific Gravity shows results as an average of 1.000+/–0.15 and the target is 1.000+/–0.05 Is this a reasonable deviation? The t-test would show that it is very significant, however the flavorist would indicate that for a natural product the specific gravity is well within expected natural occurrences. See Sensory Evaluation, Statistics – Statistical Analysis.

TVP – Textured vegetable protein. TVPs are used to replace meat products and can be extruded in a host of ways. Extrusion methods, dyes and ingredient combinations result in differences in the textural attribute of the final products. Some combinations simulate fibrous meats like poultry while other combinations simulate non-fibrous meats like beef. In the past, most of the TVPs were made out of soy. These soy products had trace amounts of oil. This

oil is unsaturated. Oxidation of these fats produced dienals in trace quantities. Dienals are often perceived as cardboard-like off flavors when in trace amounts. For this reason, the use of TVPs took a while to be established in the marketplace. Recently, textured vegetable proteins are thoroughly washed or extracted, and clear of these oils. Hence, clean tasting products are now available. See Hydrolyzed Vegetable Proteins.

Two-out-of-five Test – A randomized sensory method using five unknowns. In this test, two samples are of one type and three are of another type. This method is more sensitive to differences in the samples than is the triangle test because the chances of being right are 1 in 10. However, to assure total randomization, many samples are needed, and therefore a large number of minimum test subjects are required. Furthermore, because there are five unknowns, satiation and fatigue are very likely. For these reasons, analysis for fragrances and cosmetics are more appropriate, and flavor analysts favor the triangle test. See Compared or Comparison Tests, Simple Difference Test, Attribute Tests, Discrimination Test, Triangle Test, Errors of Analysis.

Two Stimulus Tests – These include Paired Difference Test, A-Not-A Test, Directional Paired Comparison Test (2-AFC). See Directional Paired Comparison Test, A-Not-A Test, Paired Difference Test, Three Stimulus Tests.

Tyndall Cone – A Tyndall cone is a conical structure, which is observed macroscopically when a beam of light is shown through an emulsion in a transparent container. See Emulsion, Tyndall Effect.

Tyndall Effect – The observation that particles in an emulsion vibrate. This effect can be seen in homogenized milk when viewed under a microscope. This was first described by the nineteenth century Irish scientist John Tyndall. The Tyndall effect is demonstrated by shining a light source through an emulsion. The light spreads out and forms a conical structure called the Tyndall cone through the emulsion liquid. See Emulsion.

Type Flavor – An industry common usage that really does not have a specific definition in the CFR but that has been used in labeling practice for some time. If a natural flavor is made up of all natural ingredients but none from the named flavor the terminology of. 'Flavor Type' is used. An example is the use of orange terpenes and lemongrass to make a natural lemon-type flavor. See True Fruit (Flavor or Extract), WONF, Natural Flavor, Labeling.

U

UDS Testing – See Up and Down the Street Testing.

Ultra High Temperature – UHT – 138 degrees C (280 Degrees F) for 2.0 seconds. See Pasteurization, Thermal Kill Step, Food Safety, Vat Pasteurization, Ultra pasteurization, Aseptic Processing, Canning, Sterilization, Microbiological Assay.

Umami – The Japanese word for savory, meaning a perception of overall fullness. This savory character typifies tastants like MSG or nucleotides like I+G™. Monosodium glutamate has fallen into disfavor in the last decade or so as its use has been alleged to bring on the Chinese restaurant syndrome. The National Institute of Health did one study on CRS and concluded that it did exist, although to a relatively small degree in the overall population. Furthermore, the symptoms themselves seem to represent a minimal risk to health. The FDA then asserted the requirement to list the substance, but made no other rulings to limit its use. Subsequently, other findings refute the initial NIH results, and the controversy continues. Chemically it has been determined that one typically required structure is a cyclpropyl group linked to a terpene aldehyde. See Enhancers, I+G™, MSG, Amino Acid.

UN – See United Nations.

Unbalanced – When a flavor profile is disjointed or out of whack. An unbalanced flavor can occur when one nuance seems to predominate over the others, or when there is an unnatural change in flavor profile or character. A formerly balanced flavor profile can become unbalanced by the change of just one parameter (i.e., the solvent system, the processing conditions, or the usage level). Therefore, the greatest flavor in the world can fall flat on its face if subtleties of process, etc., are not understood or known. See Disjointed, Balanced (Flavor Profile).

Unfit For Beverage Use – Non-potable, acceptable by the TTB for drawback considerations. See TTB, Potable, Potability, Alcohol, Fit.

United Nations – In 1961, the Codex Alimentarius Commission was developed under the Food and Agricultural Organization of the UN. In June 1962 the World Health Organization joined with them in the Codex effort. The World Trade Organization often resolves international disputes and it is the Codex that is used as a reference point when appropriate. See Codex Alimentarius, World Trade Organization, World Health Organization.

United States Pharmacopoeia (USP) – A compendium of monographs, which apply to chemicals and ingredients used in pharmaceutical preparations. The USP states and defines the analytical testing procedures and reagent formulations needed to perform those tests. Some of these products are also used in foods. The designation 'Menthol Crystals, USP' means that this grade of menthol has been tested and is in compliance with USP guidelines. Some of the information and specifications cited in the USP have been used in both the GRAS list and the Food Chemicals Codex. See FCC, NF, GRAS List.

Units of Measurement – Whether it's Centigrade (Celsius) versus Fahrenheit, Pounds versus Kilos, or Yards versus Meters, units of measurements and the conversion between them are critical. One mistake is the direct conversion of kilograms and pounds. Kilograms is a measure of mass and pounds are a measurement of weight. Weight is the mass of a

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body multiplied by the attraction or force of gravity. Therefore the mass in the English System is the pound/mass and that is 1/32 feet per second squared of the weight. The weight in the metric system is the Newton which is 9.807 meters/second squared (the acceleration of gravity in the Metric System) times the mass. On the moon, for example a person would weigh much less but have the same mass. On Jupiter, that person would weigh far greater but still have the same mass. See Weight, Mass.

UN Number – Assigned by the United Nations Committee on Dangerous Goods, the UN Numbers list products versus hazard class. Under this designation, flavors is listed as Hazard Class 3 (Flammable Substances) and is typically defined as number 1197. Some flavors also fall into the corrosive class, however under the new HAZMAT 2012 protocol danger supersedes warning, so it's the flammability which most likely Is referred to over the corrosiveness. See HAZMAT 2012, OSHA, UN.

Unsaturated (Bond) – Any chemical bond that shares more than one pair of electrons. A double bond shares two pairs of electrons, a triple bond shares three pairs of electrons. See (E), (Z), Cis (Isomerism), Trans (Isomerism), Double Bond, Triple Bond.

Unsaturated Alcohol – See Alcohols (Unsaturated, Non-Aromatic).

Unsaturated Aldehyde – See Aldehydes – Unsaturated Alkenals, Alkadienals, Alkynals, and Cyclic Non-Aromatic Aldehydes).

Unsaturated Esters – Esters that have one or more sites of unsaturation (i.e., double bonds, triple bonds) will have their corresponding overall profile modified by a dominant green or fatty note. Lighter molecular weight products (C-9 or less) will be more like green leaves or like green apples or would have a spicy pungent green character. Heavier molecular weight unsaturated esters (C-10 or more) will tend to get fatty green-like fried oil, potato chips, violet leaves, lard, sour cream, cream cheese, tallow, etc. Elsewhere in this book, it is mentioned that there is a maximum molecular weight above which potential odorants do not exist. This is due to a diminishing vapor pressure. With unsaturated esters, carbon 20 molecules are still odiferous while their saturated carbon 18 counterparts are not. See Fried (Oil) Flavor, Potato Chip, Violet, Sour Cream, Tallow, Spicy, Chart 333 – Unsaturated Esters Aliphatic, and Chart 334 – Unsaturated Esters Aromatic.

Unstable Emulsion – An emulsion system that will fall out, coalesce, or ring. See Emulsion, Fall Out, Ringing, Coalesce.

Up and Down the Street Testing – Similar to Bubba Testing in that it refers to comments from people around a certain vicinity. However, a consumer test of this sort can also include urban as well as rural data. See Bubba Testing, Consumer Testing, Hedonic Testing. See UDS, Sensory Evaluation.

Usage (Level) – Different flavorings components have different threshold levels and different vapor pressure characteristics. Therefore, finding the appropriate level of use for a flavor is critical. Furthermore, due to effects of the base on flavor perception, changes in the base can greatly affect a formulation's overall balance. This is why it is important to either obtain the food base or be able to simulate the base effectively to assure the flavor created will work in that system. Also, in order for the flavor to be evaluated properly, it must be subjected to as close to the conditions as it will be subjected to in the processing plant. Storage and shipping conditions should also be considered. See Marketing, Product Development, Food Technology, Culinary Arts.

USDA – United States Department of Agriculture. This agency regulates agricultural food crops, those flavors that are added to meat products (greater than 2% meat) Organic Foods. Until recently, the Proprietary Mix Committee (PMC) of the Meat and Poultry Inspection Division (MPID) of the USDA would directly regulate flavor usage in USDA-regulated products. The PMC would write letters of approval and dictate labeling guidelines for each and every flavor. Recently, the FEMA and USDA have jointly developed a format and a system to streamline this procedure. See Proprietary Mix Committee, Regulations, Organic Labeling.

USDC – United States Department of Commerce. The Department of Commerce regulates pricing, advertising, and other related areas. Certain labeling claims would be covered both under the FDA regulations as well as under the USDC truth in labeling/truth in advertising acts. See Flavor Labeling.

Usnea or Usnea barbata or Old Man's Beard or Oak Moss – Evernia prunastri. See Oak Moss, and Appendix 2.

USP – See United States Pharmacopoeia.

UV Spectroscopy – An instrumental scanning method that analyzes the absorption of light within the UV spectrum. Many flavor chemicals absorb UV light at different wavelengths. Absorptivity is the function of the absorbance (signal strength) and the concentration of the sample in moles/liter. (Cell size is usually 1 cm) Visible spectroscopy uses the visible color spectrum (ROY G BIV) or red orange yellow green blue indigo and violet. On the other side of red is infrared, and on the other side of violet is UV or ultraviolet. UV analysis is useful in identifying some flavor aroma compounds because they absorb In the UV spectrum. See Moles, Visible Spectroscopy.

V

Vacuum – The absence of anything. A partial vacuum is more achievable, and is used for lowering boiling points, increasing vapor pressure, and drying techniques.

Vacuum Distillation – The process of distillation with the aid of lower pressures thus enabling lower pot temperatures. Thus, the destruction to sensitive organic molecules and excess volatilization is therefore minimized. See Distillation.

Vacuum Tumbling – A process used to introduce a marinade into a whole meat tissue. A meat is enclosed with a liquid marinade in a cylinder with baffles. The cylinder is then revolved horizontally. From the tumbling action and the lower air pressure, the meat sucks up the marinade more efficiently into its tissue structure. It is by far the most efficient means of introducing a marinade into a meat product. See Marinades, Injection, Meat and Savory Industry.

Valence – The potential ionizing charge. Example: The valence of an atom that can easily give up two or three electrons, like iron, would be +2 and +3. In this instance, the names for these ions would be ferrous (Fe II) and ferric (Fe III) ions. This could also be written Fe+2 and Fe+3. The valence of iron would therefore be +2 or +3, respectively. In the case of chlorine, in sodium chloride, the corresponding atom has a valence of −1, meaning it has gained an electron from the chlorine atom, and the sodium atom has a valence of +1. See Chemistry.

Valencene – A sesquiterpene with FEMA GRAS# of 3443 whose characteristic woody-terpene note is an important aroma contributor in the flavor profile of valencia orange oil. See Chart 327 – Terpenes and Related Compounds.

Valeraldehyde – An important aldehyde that is considered brown and nutty. It can be used at low levels in rum, vanilla, butterscotch, maple, chocolate, rum, jammy fruits, etc. See Strecker Degradation, Aldehydes (Aliphatic, Keto Aldehydes, and Cyclic Aldehydes).

Valerian Root (Valeriana officinalis L.) – Valerian root oil contains a significant amount of valeric acid and can therefore be used in flavors where a warm acidic note is appreciated. These include flavors like vanilla, butterscotch, chocolate, maple, cheese, and dairy. See Acids, Chart 394 – Valerian Root, and Appendix 2.

Valeric Acid – Valeric acid has a cheesy flavor profile, and is in part, responsible for the 'dirty sneaker' note of Italian cheeses. See Cheesey, Acid.

Valeryl – See Amyl.

Valeryl Esters – See Chart 146 – Alkyl Esters Grouped by Alcohol Moiety.

Validation versus Verification – These two terms are often confused. Validation of food hygiene control measures is different from verification and routine monitoring. Validation reviews the Scientific Background. Validation is typically conducted prior to the initiation of a new food safety system to assure that it is capable of achieving the desired food safety outcome. Verification is conducted to prove that the validated concepts are working. See Food Safety, HACCP.

Validation Studies – According to HACCP principles, the validation of the systems, procedures or control points to be applied should be based on reasonable scientific study, documentation, or data to insure the adequacy that all food safety hazards are under control. See HACCP, Food Safety.

Vanilla (Vanilla planifola Andr., V. tahitensis J.W. Moor [F and B], V. pompona Schiede [F.]) – Vanilla is an orchid with a very narrow flower. When cultivation was attempted away from the original

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habitat, no one could understand why the flower wouldn't form the bean. The secret was the shape and size of the bee indigenous to the area that could fit down the long flower structure for pollination. Today, the cultivated orchids are hand pollinated. On the island of Reunion and in Madagascar, where the flowers grow, thus current hand pollination production yields the highest quality of beans. The name Bourbon beans and subsequently Bourbon vanilla is named after the Reunion island of Bourbon. Today, Madagascar provides approximately 80% of the world's supply of vanilla beans. Tahitian beans are a different variety and yield a different flavor profile. They are recognizable in physical structure by being shorter than the Bourbon beans. The vanilla beans (pods) are toxic at first, but later through an enzymatic breakdown of glucovanillin by glucovanillinase, glucose and vanillin are formed. Then glucose undergoes a browning reaction with amino acids and proteins and provides a substrate for fermentation. The Guadeloupe vanilla is typically represented by a different species. The Guadeloupe flavor is called vanillone. This extract is considered to be inferior to the others. Vanilla extract is the only FDA defined flavor. See Vanilla (Extract). The chemistry of vanilla extract is complex. Flavoring materials include zingerone, propenyl guaethol, anisyl alcohol, anisyl formate, anisaldehyde, veratraldehyde, ethyl vanillin, isosafrole, cyclotene, maltol, heliotropine, diacetyl, and other fermented characters, and other brown notes. Some of these components derived from natural sources can be used to enhance the original vanilla and produce effectively strengthened WONFs. The synthetic forms are used to blend and modify artificial vanilla compounds as well. In wholly synthetic vanillas, phenolic products and sugar browning compounds are also used to replicate the beany character imparted by the natural extract. Therefore, this approach can be useful in supported background character possibly lost when avoiding the use of vanilla extract and using vanillin and or other similar artificial components. Vanilla extract is the only true flavor that is standardized by the FDA. See Code of Federal Regulations, Chart 395 – Vanilla, and Appendix 2.

Vanilla (Extract) – The only flavor standardized by the FDA. The following edited excerpts are from the CFR. See Extract. Vanilla extract CFR Title 21 Paragraph 169.175: (a) Vanilla extract is the solution in aqueous ethyl alcohol of the sapid and odorous principles extractable from vanilla beans. In vanilla extract, the content of ethyl alcohol is not less than 35% by volume and the content of vanilla constituent, as defined in Paragraph 169.3(c), is not less than one unit per gallon. The vanilla constituent may be extracted directly from vanilla beans or it may be added in the form of concentrated vanilla extract or concentrated vanilla flavoring or vanilla flavoring concentrated to the semisolid form called vanilla oleoresin. Vanilla extract may contain one or more of the following optional ingredients: (1) glycerin; (2) propylene glycol; (3) sugar (including invert sugar); (4) dextrose; and (5) corn syrup (including dried corn syrup). Other citations of note: Concentrated Vanilla Extract, CFR Title 21 Paragraph 169.176; Concentrated Vanilla Flavoring, CFR Title 21 Paragraph 169.178; Vanilla Powder, CFR Title 21 Paragraph 169.179; Vanilla – Vanillin Extract, CFR Title 21 Paragraph 169.180. See Code of Federal Regulations, FDA, Standard of Identity, Extract.

Vanillin – The active ingredient found in vanilla beans and is the main characterizer in vanilla extract. It was originally identified within vanilla extract and then first synthesized by Reimer Company in 1876. Due to dramatic competitive pressures in the vanilla extract industry, unscrupulous vanilla extract producers had used synthetic vanillin in their vanilla extracts. The FEMA vanilla committee was organized to develop standards by which scrupulous extractors could monitor the others. The two heavier isotopes of carbon, carbon 13 and carbon 14, can be assayed with today's instruments. The ratio of heavier isotopes to carbon 12 helps determine an extract's authenticity. One source of synthetic vanillin is through the oxidation of lignin. This method is not the only method of production used today, but it does provide a clean source of vanillin through the efficient use of a by-product. Lignin is developed in the sulfite stream of the wood pulp used in the paper industry. As any waste stream poses a potential waste issue, using the stream to develop a saleable product is the best of both worlds. The process takes the lignin and then oxidizes it directly to vanillin through a chemical reaction. An interesting side note about the relationship of vanillin and wood is an observation made in a flavor lab when vanillin is used. If vanillin had been used, and another person walks in the room, often the comment is made 'I smell wood burning.' This is an illustration of the acuity of our sense of odor recognition, because the oxidation of the lignin in wood would naturally produce an amount of vanillin, and odor memory would remind us of that. Because natural sources for commonly used ingredients have grown in importance, natural vanillin would be an obvious candidate. Natural vanillin can be developed from a number of other sources. One natural starting

material is eugenol derived from clove-type oils and other oils. Synthetic vanillin is mostly produced through the guaiacol today. Vanillin is used in flavors as an overall modifier and typically rounds out a flavor profile. Vanillin is used ubiquitously throughout the flavor world, much as hydroxycitronellal is used by the perfumers, and is probably the most widely used flavor odor chemical. The CAS# for vanillin is 121-33-5, and the FEMA GRAS number is 3107. It is a unique type of aroma compound in that it is an aromatic with an aldehydic, ether, and a hydroxyl group (methoxy hydroxy benzaldehyde). Therefore, it is listed under each of those categories. See separate listings for further chemical details. See Carbon 13, Carbon 14, Natural Certification, Isotopic Analysis (Isotopic Ratio).

Vanillyl Esters and Related Vanillyl Compounds – Esters of vanillyl alcohol (4 hydroxy 3 methoxy benzene methanol) retain a sweet vanillic character from the aldehyde (vanillin). See Aromatic Aldehydes, Vanillin, Vanilla, Brown (Compounds), Chart 335 – Vanillyl Compounds.

Van't Hoff's Law – The law that states that chemical reaction rates double for every 10 degrees of rise in degrees Celsius (Centrigrade). See Flavor Reactions, Shelf Life, Accelerated Shelf-Life Testing, Temperature, Heat.

Vapid – A flavor that is flat, insipid, or devoid of character. See Sapid.

Vaping – Using an e-cigarette. See E-Cigarettes, Safety, GRAS, Tobacco, Cigarettes, Hunter List.

Vapor Pressure – The evaporative potential energy of a volatile. This pressure is measured as a force whose units are pounds per square inch or grams per square centimeter. How vapor pressure affects flavor perception is complex. Flavor aromas have a tendency toward oil solubility, and food systems often contain both water and oil phases. Furthermore, the sensory environments through which we perceive these volatiles, that is, the tongue and nasal mucosa, are aqueous systems. Therefore, the way flavoring substances act in the food systems and how they are eventually perceived in the mucosa and saliva differ for each chemical. See Vapor Pressure Versus Strength Anomaly.

Vapor Pressure versus Strength Anomaly – If vapor pressure were the sole factor affecting perception, then as the molecular weight increases, the strength of the aroma chemical would decrease linearly due to increasing molecular weight. However, this is not the case. The reason is that each chemical has its own perceived strength, and this effect is often unrelated to molecular weight. For instance, in water, ethyl propionate C-5 might have roughly the same strength as an equal amount of ethyl pelargonate C-11, accounting for solubility differences. However, both of them might have a lesser strength in water at an equivalent amount when compared to ethyl hexanoate C-8.

Variance – The degree of spread between the distribution of count values in a statistical array. The standard deviation is the square root of the variance. See Statistics, Statistical Analysis; Analysis of Variance.

Vat Pasteurization – 63 degrees C (145 Degrees F) for 30 minutes. See Pasteurization, Thermal Kill Step, Food Safety, High Temperature Short Time, Higher Temperature Shorter Time, Ultra pasteurization, Aseptic Processing, Canning.

vCJD – Variant Creutzfeldt–Jacob Disease. See Mad Cow Disease, Kuru Disease.

Vegetable, Vegetative – A descriptive terminology that denotes a sulfurous flavor reminiscent of vegetables, either cooked or raw. See Sulfur, Vegetable Oils.

Vegetable Juice Concentrate – See Juice Concentrate.

Vegetable Oil – Fixed oils (Rather than essential oils) in Seeds, Nuts, and other plants. Vegetable oils are composed of triglycerides, often with mixed levels of chain length and unsaturation. It is these characteristics which define the properties of the Individual oils. Refined vegetable oils have been treated to the point where most countries acknowledge allergenic proteins are no longer present at significant levels to cause harm. Palm and Soybean oil comprise the largest factors in worldwide sales, while Canola (Rapeseed), Sunflower, Peanut, Cottonseed, Palm Kernel, Coconut and Olive make up the rest. See Fats and Oils.

Vegetable Protein – Proteins that are derived from any plant source. See HVP, Yeasts, AYE, Autolysis, Hydrolysis, Enzymes, and Chart 397 – Vegetable Protein.

Vegetables –

1. See under separate listings in botanicals.
2. One of a member of the plant kingdom as in animal, mineral, or vegetable.
3. The food category that includes many varieties of garden plants used as food. They include bulb vegetables, root vegetables, fruit vegetables, leaf vegetables, stalk vegetables, tuber vegetables, and inflorescent vegetables. Grains and legumes are considered different categories than vegetables. The categories are:
   a. Bulb vegetables: garlic, onion, scallion, chives, shallot, and leek.
   b. Leaf vegetables: chicory, cabbage, watercress, spinach, lettuce nettle, sorrel, dandelion, and radicchio.
   c. Inflorescent vegetables: artichoke, broccoli, broccoli rape, and cauliflower.

d. Fruit vegetables: eggplant, avocado, chayote, cucumber, squash, okra, olive, and peppers.
e. Root vegetables: beet, burdock, carrot, celeriac, malanga, turnip, parsnip, radish, rutabaga, and salsify.
f. Stalk vegetables: asparagus, bamboo, chard, cardoon, celery, kohlrabi, fiddlehead, fern, and fennel.
g. Tuber vegetables: crosne, yam, jicama, manioc, sweet potato, potato, taro, and Jerusalem artichoke.See Separate Listings, Grains, Legumes.

Vegetable Oils – The fixed non-essential fatty substances that are derived from products in the plant family. There are many vegetable oils, each with their own characteristic aromas, stability, oxidative potentials, etc. Examples listed below have the following designations listed in parentheses, respectively: (saturated fat – monounsaturated fat – polyunsaturated fat): canola oil (7 – 56 – 33), coconut oil (90 – 6 – 2), corn oil (12 – 24 – 60), grape seed oil (10 – 16 – 70), palm oil (50 – 37 – 10), peanut oil (17 – 46 – 32), safflower oil (9 – 12 – 75), sesame oil (14 – 40 – 42), soybean oil (14 – 23 – 58), sunflower oil (10 – 45 – 40), walnut oil (9 – 23 – 63). See Oleophilic, Fats and Oils, Nut and Seed Oils, Vegetable Shortening, and Chart 396 – Vegetable Oils.

Vegetable Shortening – See Fats and Oils.

Vegetarian – A person who eliminates meat from his/her diet. There are four subcategories of vegetarianism:

1. Semivegetarians include milk, eggs, and occasionally poultry, ham, and fish but no beef.
2. Lacto-ovo vegetarians allow milk and eggs but excludes fish and all meats.
3. Lactovegetarians allow milk only, excludes eggs, fish, and all meats.
4. Vegans allow nourishment only from plant sources.

One of the main problems with vegetarianism is obtaining the continuous source of adequate proteins. Certain necessary proteins and essential amino acids found common in meats are lacking in many vegetables. This is true of many sulfur containing amino acids. For this reason, all vegetarians, especially vegans, must consume mixed vegetable products and among them should be sources of essential amino acids from legumes (peanuts, beans), grains, and seeds. Vitamin-fortified soy milks and vitamin supplements help assist the body in obtaining nutrients generated by eating a normal balanced diet. See Vegetables, Meat.

Vegetative – The character typical of Cabernet Sauvignon and Sauvignon Blanc wines, which has recently been attributed to the bell pepper pyrazine 2 methoxy 3 isobutyl pyrazine. See Vegetable, Vegetative.

Veined Cheese – See Cheese, Bleu (Blue) Cheese.

Veloute Sauce – A fish-based sauce thickened with flour and butter. See Culinary Arts.

Velveting – Process in Chinese cooking. Velveting a chicken for example is a stepwise procedure that includes coating the meat in a mixture of egg white, cornstarch, and often rice wine (or dry sherry). The meat is then simmered in hot water or oil on the stovetop. The mixture is stirred until it turns an opaque white and then strained. This procedure protects the meat from the harsh temperatures of the wok. The name comes from the resultant velvety texture given to the meat and gives some items in Chinese cooking a unique texture. See Culinary Arts.

Venn Diagram – In cluster analysis, data points are organized by drawing a circle or oval shape around like or related values. They could intersect or stand alone. These circles/ovals are also called Venn Diagrams. See Multivariate Analysis, Cluster Analysis, Sensory Analysis.

Verification – See Validation versus Verification, HACCP, Food Safety.

Verjuice – The juice of unripened grapes that is used in the preparation of Dijon mustard. See Mustard.

Vermouth – An originally Italian aperitif using angelica root, anise seed, marjoram herb, wormwood herb, and other bittering agents. See Artemesia.

Veronica (Speedwell) (Veronica officinalis L.) – See Bitter and Chart 398 – Veronica.

Vervain – Verbena officinalis, L. – An herb with flavor characteristic similar to lemon with a brown background character. See Chart 399 – Vervain and Appendix 2.

Vetiver (Vetiver zizanoides) – Vetiver is a grass. The flavor profile is slightly lemony. The terpenes contain a fair amount of natural dimethyl sulfide. One report has it being used in asparagus flavors. The essential oil contains many compounds typically found only in vetiver, such as vetiveraldehyde, vetiverol, vetiver acetate, and vetiverone. See Warm, Herbaceous, Lemony, Resinous, Chart 400 – Vetiver, and Appendix 2.

Vibrational Theory – Luca Turin, who posed the theory in a theoretical paper, is a physiologist by training and a recognized expert on perfumes. The theory expands on the fact that both visual stimuli and sound stimuli are related to vibrations or frequencies. These frequencies pertain to intramolecular vibrations that occur across the molecule's chemical bonds. Some recent experimentation cast a shadow of doubt on the theory. His theory was first

proposed in a BBC TV documentary and then referred to in a book written about Mr. Turin by Chandler Burr, *The Emperor of Scent*. See Amoore's Theory.

Vibriosis – Vibriosis is a disease caused by an infection by bacteria of the Vibrio genus. The symptoms are diarrhea, skin infections, and/or blood infections. The diarrhea-causing Vibrio parahemolyticus is a relatively harmless infection, but Vibrio vulnificus infection, though rare, can lead to blood poisoning and death. The Vibrio genus includes the organisms that produces cholera. See Pathogenic (Pathological) Organism.

Vichyssoise – A potato-based soup often seasoned with shallots, chives, or similar condiments. See Culinary Arts.

Vietnamese Coriander – *Persicaria odorata* Much used in Southeast Asian cooking this variety of coriander has a subtler flavor than the one used in European/Western Hemisphere styles. Also known as Chinese coriander. See Coriander.

Vignette – An illustrative design on a package. According to regulations, the vignette is a representation of the makeup of the product inside. Example: If the vignette on the package indicates that there are lemons, oranges, and cherries, then characteristics of each of those three ingredients should be contained in the profile of the flavor. If the product is natural, then natural components must be present. This is cited in CFR Title 21. If the product is an artificial product, the company must be able to show that it is using either (1) a flavor mixture with each of the attributable notes or (2) each of the individual flavors that have some aromatics that characterize the pictured foods. See Food, Regulations.

Vinaigrette – A sauce made with vinegar as a base mixed with salt, oil, spices, and other food materials. This sauce is then used as a topping for vegetables, meats, or other food preparations, but mainly used as salad toppings. See Culinary Arts.

Vinca Minor or Lesser Periwinkle – See Periwinkle and Appendix 2.

Vinegar – Vinegar can be developed, flavored, and modified in many different ways. Artificial vinegar is made by dissolving acetic acid in water. The classic way of making vinegar is through a bacterial inoculation of alcohol, wine, or apple cider. Vinegar can also be made from cane sugar, malt, dates, oranges, bananas, rice, or coconut milk. Vinegar is easy to make. To produce common vinegar, two steps are required. The first stage in making vinegar is the development of alcohol and is accomplished by the fermentation of sugars by yeasts like Saccharomyces ellipsoideus. The growth of the yeast is retarded by the development of the acetic acid; therefore the two stages cannot occur simultaneously. Alcohol-containing products, exposed to the air come in contact with microorganisms in the air such as Acetobacter spp. This can happen naturally, or the system can take the next step by inoculation. The system can be inoculated with a culture of microorganisms like Acetobacter acetii, A. pasteurianum, or A. kutzingianum. The inoculate forms a sludge on the top of the vinegar. This sludge eventually falls to the bottom of the liquid, where it forms a mass called mother of vinegar or vinegar mother. This substance, vinegar mother, can then be added to stored or vatted vinegar to produce more vinegar. This is called the traditional Orleans method. See Acetic Acid, Balsamic Vinegar, Vinegar Toners, Apple Cider Vinegar, Wine Vinegar, and Appendix 2.

Vinegar Toner – A flavor whose effect or use is to tone down the harshness of the acetic acid in vinegar. See Masking Agent, Round.

Viney – Reminiscent of the vine or stem of certain fruits or vegetables. These characters are usually associated with the presence of harsh saturated and unsaturated aldehydes. See Green.

Vintage – The crop date. This is important in wines. Also, with chemicals, essential oils, or other flavoring materials, the date of production, distillation, or synthesis must be known so product shelf life can be gauged. See Shelf Life, Aging, Oxidation, Spoilage.

Violet or Viola odorata – See Appendix 2.

Violet Leaf Absolute – A flower extract known for its vegetable green character. The absolute contains the aldehyde found also in the rind of watermelons and cucumbers, namely (E) 2 (Z) 6 nonadienal. Violet is also used to flavor some chewing gums and breath drops. The absolute of the leaves is the most commonly used. It has a unique characteristic and contains a rich amount of dien alcohol and aldehydes found in other natural products at much lower levels. Therefore, the botanical is a natural source of these dienals and dienols for use in many WONFs. The most characteristic component is trans 2 cis 6 nonadienol that has a very obvious and characteristic violet leaf-/cucumber-type flavor. The flavors that could use this note would include any that had a leafy, almost fatty green profile including cucumber, watermelon, tomato, kiwi, fruit flavors, meat flavors, and many more. Violet flowers are used occasionally in confections like violet-flavored chewing gum. See Chart 401 – Violet.

Virginia Snakeroot – See Snakeroot, Snake Root Serpentaria.

Virology – The study of viruses. See Bacteriology.

Viscid – The property of being glutenous, sticky, or ropy. See Texture.

Viscosity – The characteristic of the thickness of a liquid. Time-oriented viscosity curves are developed by an instrument called a Brabender viscometer™. Another viscometer has a collection of different spindles used to measure different viscosity ranges. Measurement of the viscosity of a substance is done in poise, but typical viscosities encountered are reported in 1/100 of a poise or a centipoise. See Thickness, Newtonian Flow, Non-Newtonian Flow, Bostwick Consistometer, Flow Rate, Centipoise.

Visible Spectroscopy – The scanning instrumental analysis that uses visible spectrum and charts absorbance of visible light within a certain frequency. See UV Spectroscopy, IR Spectroscopy.

Vitamin Deficiency Diseases – See Vitamins.

Vitamins – Vitamins are necessary ingredients for overall health. Without vitamins a person would contract a vitamin-deficiency disease. Vitamins are categorized into two groups: fat soluble vitamins and water soluble vitamins. The fat soluble vitamins include vitamins A, D, E, and K, and the water soluble vitamins include C, B12, B complex, and U. Deficiencies of water soluble vitamins are more likely to occur, as these vitamins are more readily eliminated from the body. Fat soluble vitamins collect in the adipose tissues and are therefore stored. But it is for this reason that overuse of fat soluble vitamins can cause long-term toxicity. The various vitamins follow:

1. Fat Soluble Vitamins
   a. Vitamin A promotes strong bones and teeth, normal vision, healthy skin, and protection in the linings of the lungs (retinol, retinoids) made through conversion of carotene. Sources include yellow-colored vegetables, egg yolks, dairy products, peaches, apricots. Deficiency disease is night blindness.
   b. Vitamin D (calciferol [D1], ergocalciferol [D2], and cholecalciferol [D3]) regulates absorption of cal-cium and phosphorus for good bones and teeth. Measured in International Units (IU). Sources include vitamin D enriched milk, sunlight.
      Deficiency disease is rickets in children and osteomalacia in adults.
   c. Vitamin E is a collective group in which alpha tocopherol is the main constituent and regulates normal cell structure and enzyme formation, red blood cell development, and protection of the lungs against damage by pollutants. Vitamin E is suspected to be able to slow down the aging of cells. Sources include oils, nuts, vegetables, cereals, wheat germ, egg yolks. Deficiency disease is anemia.
   d. Vitamin K is essential to the formation of substances that can clot blood that are produced by the liver. Sources include a balanced diet plus the activity of microorganisms in the intestines. Prolonged use of antibiotics can destroy this flora and therefore the main source of vitamin K production. Deficiency disease is slow clotting of blood.
2. Water Soluble Vitamins
   a. Vitamin B complex.
   b. Thiamine (B1) plays an important role in enzyme development for the breakdown of carbohydrates and the function of nerves, muscles, and particularly the heart. Deficiencies can come about with hyperthyroidism, severe alcoholism, and other diseases. Sources are present in most unrefined foods, cereals, breads, pastas, meats, nuts, and eggs. Deficiency diseases are beri (with symptoms of abdominal pain, depression, memory impairment) and if coupled with severe alcohol dependence, Wernicke–Korsakoff syndrome.
   c. Riboflavin (B2) also plays a role in enzyme production for utilization of carbohydrates, but also enzymes that use fats and proteins, regulate other B vitamins, and produce hormones by the adrenal glands. Sources are liver, milk, cheese, eggs, green leafy vegetables, whole grains, breads, cereals, and brewer's yeast. Deficiency diseases are amblyopia (poor visual acuity) and photophobia (abnormal sensitivity to light).
   d. Niacin (nicotinic acid) (B3) also plays a role in enzyme production for utilization of carbohydrates and fats, the functioning of the nervous and digestive systems, manufacture of the sex hormones, and maintenance of healthy skin. Sources are liver, nuts, poultry, grains, fish, and beans. Deficiency diseases are pellagra (soreness and cracking of the skin, inflammation of mouth and tongue, and mental disorders.
   e. Pantothenic acid (B5) also plays a role in enzyme production and for utilization of carbohydrates and fats, the functioning of the nervous system, manufacture of the sex hormones, corticosteroids, the utili-zation of other vitamins, function of the adrenal glands, and normal growth and development. Deficiency might occur from severe alcohol dependency or after surgery. Sources are liver, heart, kidney, fish, brewer's yeast, and wheat germ.

Deficiency diseases are fatigue, headache, nausea, abdominal pain, numbness or tingling.

f. Pyroxidine (B6) plays a role in enzyme production for utilization of carbohydrates, proteins, and fats, the functioning of the nervous and digestive systems, the manufacture of red blood cells, and maintenance of healthy skin. Sources include liver, chicken, pork, fish, whole grains, wheat germ, and dried beans. Pyroxidine is also produced in small amounts by bacteria in the intestine. Deficiency diseases are weakness, irritability, depression, skin disorders, inflammation of mouth and tongue, cracked lips, and anemia, and in infants, seizures.
g. Biotin plays a role in enzyme utilization of carbohydrates and fatty acids, and the excretion of protein waste products. Sources include liver, peanuts, beans, egg yolks, mushrooms, bananas, grapefruit, and watermelons. Deficiency diseases are weakness, hair loss, depression, skin disorders, and inflammation of the tongue.
h. Folic acid plays a role with the enzymes that produce nucleic acids, and therefore growth and reproduction, healthy red blood cells, and proper functioning of the nervous system. Certain prescription medications or alcohol dependence might generate a deficiency. Sources include green leafy vegetables, broccoli, spinach, mushrooms, liver, nuts, beans, peas, egg yolks, and whole wheat bread. Deficiency diseases are anemia, sores around the mouth and tongue, and poor growth in children.
i. Cyanocobalamin (B12) plays a vital role in the activity of several enzymes in the body. It has an important role in the development of genetic material in the body, and a crucial role in growth and development, production of red blood cells, functioning of the nervous system, and utilization of folic acid. Sources include liver, kidney, chicken, pork, beef, fish, eggs, and dairy products. Deficiency diseases are megaloblastic anemia, sore mouth and tongue, damage to the spinal chord such as numbness, tingling in the limbs, and loss of memory.
j. Ascorbic Acid (Vitamin C) is an antioxidant and preventer of the deficiency disease scurvy. Sailors who went long times without Vitamin C in their diet developed scurvy. 'You are a scurvy nave' is a quote based on this observation of a sailor who spent too long at sea without citrus. They began bringing limes and other citrus products abroad ship, thereby giving rise to the nickname 'limeys.' Vitamin C is an antioxidant, sequestrant, and coenzyme activator in many bodily functions. Linus Pauling theorized that mega doses of the vitamin would help people prevent getting colds and boost their immune system. This has yet to be fully proven. Vitamin C is used in foods for a number of reasons for its chelating and antioxidant properties. Sources include fruits and meats. Deficiency disease is scurvy. The French explorer Jacques Cartier (1500s) gained the knowledge of scurvy prevention from local American Natives using an extract made from the Eastern White Cedar tree. Later, James Lind (1700s) determined that citrus fruit could treat scurvy and published it in a medical journal.
k. Choline is a compound found in lecithin, which is important in the transmission of nerve impulses.
l. Inositol is an active factor in the B complex vitamins that aids in the conversion of food to energy. With choline, inositol is active in fat metabolism.
m. PABA (Para Amino Benzoic Acid) is an important factor in the development of red blood cells. It also aids in the conversion of protein-based compounds into energy and has been shown to be effective in healthy hair and skin. See Minerals, See Nutrition, DSHEA.

See Chart 336 – Vitamins.

Vitrification – The cooling of a viscous liquid to a glass transition. See Spray Drying, Glass Transition, Sugar, Hard Candy.

Volatile Oil – A volatile oil is the aroma essence of a food, spice, herb, bark, root, or floral. The volatile oil content is a measurement determined by distilling the oil using a Clevenger Trap. FCC monographs on volatile oils for oleoresins are listed in the first supplement to the third edition of the Food Chemicals Codex. See Analytical Chemistry, FCC.

Volatiles – Volatiles are aroma chemicals. It is a fundamental factor that flavors contain aroma chemicals whose characteristic vapor pressure vary from system to system. Furthermore, the saliva is aqueous, and most flavor chemicals tend toward oil solubility. Many foods contain both water and fats. Due to this fact, it becomes obvious that minor changes in a given food system such as changes in polarity, processing conditions, and solids content can greatly affect the flavor's performance. See Vapor Pressure, Saliva, Aqueous, Fat, Polarity, Processing Conditions, Solid, Illusory Elution, Heat, Temperature.

Volatility – The degree of evaporation or vapor pressure. See Vapor Pressure, Vapor Pressure Versus Strength Anomaly.

Volatile Sink – A condition and system whereby ingredients, processes, or techniques are used to hold down the volatility of aroma compounds. Example: Vegetable oil can be used as a volatile sink in flavors to hold down the steam distillation of volatiles occurring during the microwave process.

Vomeronasal Organ – The organ that detects pheromones. Many, if not most, of the higher organisms have been shown to have a similar structure, and these structures detect pheromones. It is also noted that pheromones can have a powerful control over an animal's reactions. Some scientists still argue that the actual purpose of the human vomeronasal organ has not been determined, although it is recently felt by some to be located in humans at the front of the nose. Scientists have proven that a demonstrable percentage of our population can perceive macromolecules such as androstenone. They go on to point out that this molecule would be very difficult to detect by our normal olfactory system due its high molecular weight and therefore tiny presence in the air due to diminished vapor pressure. This example is seen by some as proof positive of the function of the human vomeronasal organ. Recent studies have confirmed that this does not exist in humans, despite the fact that we still can detect huge molecules that could have little to no vapor pressure due to their molecular weight. Therefore, it is concluded that despite the absence of the vomeronasal organ per se, the receptors are probably in the olfactory nasal cavity. See Pheromones, Volatiles.

W

Walnut Hull, English (Juglans regia L. and other Juglans species) – The walnut has a number of varieties including the black walnut (J. nigra), white walnut (or butternut = J. crinerea), the noix de Grenoble, the highest quality of walnut, which is grown in France, and the J. regia, known as the English walnut or royal walnut. The flavor is creamy and fatty. The membrane separation between the halves of the kernel contains a high amount of tannins. See Astringent, Bitter, Nut(s), Chart 402 – Walnut, and Appendix 2.

Warehouse – Warehousing – The use of third party storage often near the destination. When developing costs for flavors warehousing costs must be factored in. Under the FSMA (Food Safety Modernization Act) facilities that store finished packaged flavors are not under the scrutiny of the HARPC (Hazard Analysis and Risk Based Preventative Controls).

It is important that the environment of the warehouse be known. If the warehouse exceeds 80°F for a significant length of time it could affect the flavor character by causing volatiles to evaporate. See HACCP, FSMA, Volatiles, Sensory Evaluation.

Warm – A sensory effect in which there is a perceived rise in temperature on the mucosa, tongue, nasal passage, or mouth lining whether real or perceived. See Mucosa, Tongue, Nasal Passage, Mouth Lining.

Wasabi, Wasabe – Wasabia japonica – Japanese horseradish. Wasabe or wasabi is known as Chinese horseradish. Wasabi is a common condiment in Far Eastern cooking. It is used in the Japanese fish dish called sashimi. Wasabe is a relative of horseradish, and like its cousin contains allyl isothiocyanate and related compounds. See Horseradish and Appendix 2.

Washed Extract – The extract or water, alcohol, oil portion of a washing. See Washing, Washed Oil.

Washed Oils – The by-product oils of a washing. See Washing, Terpeneless, Citrus, Essential Oil, Folding of Extracts and Essences.

Washed Rind Cheese – Cheese that is soaked in a brine solution after forming. The cheese can be washed with brine inoculated with brevibacterium linens, the culture that gives washed rind cheeses their distinctive 'aroma.' Epoises is a famous stinky washed rind cheese. See Cheese.

Washing – Washing is a special process of purifying an essential oil. The washing process is as follows: First an essential oil is added to a mixture of alcohol and water. The mixture is then agitated and after a specified amount of time, the oil is removed by a separatory funnel or removed by using another separation method. The volatiles that have a partial solubility in the water alcohol mixture contribute the flavor. The mixture of the oil that is left is the washed oil, and is a by-product of the procedure. The water, alcohol, partial oil mixture is called a washed extract or a washing. See Extraction, Terpenes, Oxidation.

Water Activity – The water or moisture activity (Aw) of a product is the free or non-bound water within the product. This measurement of water activity is made by calculating the ratio of the existing vapor pressure (the moisture in the product) divided by the vapor pressure of pure water at that temperature. Water activity is essential in predicting product textural attributes, quality, and microbiological stability. See Shelf Life, Microbiology, FDA, FDA – Food Code 2013, pH, Solids, Brix.

Water Chestnuts (Elocharis dulcis and Trapa spp.) – The flavor of water chestnuts is subtle, with a slight

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nutty flavor. Water chestnuts mostly introduce a crisp, chewy, watery textural profile that is found often in Oriental cuisines. See Mouthfeel, Nutty.

Watercress, Water Cress – See Cress and Appendix 2.

Water Hardness – See Hard Water.

Watermelon (Citrullus lanatus) – The fruit is named as such because of its high water content (above 90%). The thick rind contains an appreciable amount of unsaturated aldehydes. Typically, these are trans aldehydes and dienals of the 2(E) 6(Z) variety. The flavor is also estery and juicy with a floral reminiscence. Usually the pulp is red, but can also come in white, yellow, or pinkish hues. See Fruity.

Water Solubility versus Oil Solubility – Most flavoring systems are water soluble. Although there are exceptions due to the nature of the food base. Often as with salad dressing, many sauces and dairy products, either water or fat based flavors can be used. There is a transition period where flavor volatiles can migrate into the fat and/or water phases. This takes a few days and is known as flavor transitioning or partitioning. The degree of separation is characterized as the Partition Coefficient. See Polarity, Hydrophilic, Oleophobic, Lipophobic, Oil Solubility, Partition Coefficient.

Wax Gourd (Benincasa hispida) – See Vegetable, Vegetative.

Waxy Maize Starch – A strain of corn whose kernels are larger and have a waxy-looking coating on them are grown for their high branched chained starches (amylopectin). See Corn, Modified Food Starch, Amylopectin, Amylose, Carbohydrates.

Weber Fraction (Weber Ratio) – Also known as the Weber Ratio. This concept states that each of the sensory perceptions has a consistent sensitivity to change. The change of a sensory stimulus must exceed a certain minimum in order to be first perceived. With aromas it is approximately 15–20%. Therefore, a flavor must be increased or decreased by 15–20% before a change is perceived. This is also known by many to be the concept of least noticeable difference. Delta Psi/Psi = Constant where Delta Psi is the change in intensity of the stimulus, and Psi is the stimulus. See Least Noticeable Difference, Fencher's Law.

Weeping – Weeping occurs when a product gives up previously bound water. See Syneresis, Gelation, Water Activity.

Weighing Agent – See Weighting Agents.

Weight – The force of gravity on a mass. The weight of a substance will be less in different gravities. Therefore, a mass of 1 kilo will weigh less on the moon than on the earth. The U.S. system uses pounds, which is a weight measurement. The European or metric system uses mass, based on the gram mass. See Mass, Units of Measure.

Weighting Agents – An improved and more stable emulsion can be made by adjusting the specific gravity of the dispersed phase (for example, the oil of a cloud) to as close as possible to the specific gravity of the continuous phase (same example, the water). For this purpose, a heavy molecular weight substance called a weighting agent may be used. The two common weighting agents used in the United States are brominated vegetable oil (BVO, the maximum allowable usage to yield no more than 15 ppm in final product) and glycerate esters of wood rosin (ester gum is the maximum allowable usage to yield no more than 100 ppm in the final product). However, most flavorists feel brominated vegetable oil is not effective at its approved level of use. SAIB or sucrose acetate isobutyrate also has recently been approved. See Cloud, Dispersed Phase, Continuous Phase, Emulsifying Agent, Specific Gravity, Ester Gum, Brominated Vegetable Oil, SAIB (Sucrose Acetate Isobutyrate).

Weisenberg Effect – The observation that over-aged sweetened condensed milk will travel up a rotated glass rod due to uncoiling of globular protein molecules. See Protein.

West Indian Sandalwood Oil (Amyris) (Amyris balsamifera L.) – See Woody, East Indian Sandalwood Oil, Sandalwood, White (East Indian Sandalwood), and Chart 403 – West Indian Sandalwood Oil.

Wet Analysis – As opposed to instrumental and physical analysis. Wet analysis is accomplished mostly using titration methods. Although most analyses of this type are now used by electrode methods; some wet methods are still used. Some examples are Kejdahl determination of nitrogen, Karl Fischer determination of water, iodine number, and saponification value. See Analytical Chemistry.

Wet Milling – A process whereby water and sulfur dioxide are used to separate corn into its component parts. See Modified Food Starch, Steepwater.

Wetting Agent – A substance that either eliminates or minimizes the surface tension of a liquid. Products that act in this manner are called surfactants. See Emulsifying Agent, Vapor Pressure.

Weymouth Pine – See Pine.

Wheat (Triticum spp.) – There are many varieties of wheat. The earliest variety was found in Mesopotamia (wild einkorn wheat – Triticum monococcum). Turkey red wheat, brought to the United States by European immigrants, is the variety typically used in cereals. Triticum vulgare is commonly called bread wheat, and T. durum (Durum wheat) is an important ingredient in pasta. Spelt wheat

(Triticum speltum) is a variety grown in Europe, which has a hard husk, and when de-husked can be prepared like rice. Wheat germ oil is derived from the germ of the wheat that is high in fat, proteins, minerals, and vitamins. The germ is extracted with the use of solvents. The grass develops structures called ears or spikes. Wheatears can have three to five flowers. These flowers are called spikelets. The central stem or rachis has two sterile bracts called glumes and two fertile bracts called glumellas. The kernel is called a caryopsis. The term semolina is often misused. Semolina sometimes refers to the ground form of wheat, rice, corn, or other grains. However, to be more accurate, it should only refer accurately to ground hard durum wheat. Semolina is used to make couscous. Bulgar is made from whole-wheat grains without the bran (outside coating); mostly endosperm and germ, which is partially cooked then toasted. A dish from Lebanon called Tabbouleh, is made from bulgur, parsley, mint, and lemon juice. Seitan is a spongy food made from gluten derived from durum wheat flour. Bulgar wheat is developed by a process first developed in the near east. This process first starts off with a steaming of the grain, then a subsequent drying. The resultant flavor profile developed by this process is nutty and almost reminiscent of a hazelnut. See Germ, Grains.

Wheat Germ or Triticum vulgare (Vill), Triticum sativum (Lam.) – See Appendix 2.

Wheels – A general term for pie-sliced circles that are used to represent a vernacular. The author developed a flavor wheel many years ago representing the categories of aromas and tastes analogous to the groups discussed in the Dynamics Flavor Profiling Method. There are also wine wheels, fragrance wheels, coffee wheels (developed jointly by Ted Lingle and the author for the Specialty Coffee Association of America), and beer wheels.

Whey – The liquid portion of the 'curds and whey' produced by coagulation of milk used to produce cheese. See Curds and Whey, Cheese.

Whip – To beat air into a product so it is lighter and fluffier. Ice cream is produced by whipping air into the system while it is cooled. This technique produces a volume-added factor called overrun. Overrun is the amount of whipped volume over the initial volume. Aeration of food systems effects the flavor release. See Overrun.

Whipping Agent – A substance that helps form a rigid and stable foam. A whipping agent helps to entrap air into the system, while maintaining the body of the foam or the head. Sometimes whipping agents can contribute adverse off flavors that must be covered up by masking flavors. See Emulsion, Aerosol, Aeration.

White Kidney Bean or Phaseolus vulgaris – See Beans and Appendix 2.

White Origanum – See Thyme.

White Saunders – See Sandalwood, White.

White Willow Bark or Hyssopus officinalis – See Appendix 2.

Whole Yeast – A yeast cell, which remains intact and has not gone through the process of lysis (autolysis, enzyme hydrolysis, or acid hydrolysis). See Animal Feed, Primary (Grown) Yeast, Secondary Yeast, Baker's Yeast.

Whortleberry (Vaccinium myrtillus L.) – A European species of blueberry, used in marmalades, jellies, or even eaten directly. See Blueberry.

Wild Bergamot – See Horsemint.

Wild Cherry or Prunus serotina – See Cherry and Appendix 2.

Wild Chicory – See Chicory.

Wild Marjoram (Thymus masticina, Origanum vulgare) – See Aromatic.

Wild Origanum – See Thyme.

Wild Rice – Fritallaria camschatcensis – Also Called Canada Rice, Indian Rice or Water Oats. This rice type is actually a different genus than Oryza – classical rice. It grows in wet swampy areas, is dark brown in color and nutty in flavor. See Rice, Cereals and Grains.

Wild Thyme – Also known as Feldthymian Oil, Thymus Serpylum or Serpolet. See Thyme.

Wild Yam or Dioscorea villosa – See Yam and Appendix 2.

Willow, white or Salix alba (LINN.) – See Appendix 2.

Wine – The flavor of wine is complex. Terpenes and terpenoids contribute to the floral aromas of the muscat and alexandria grapes. These chemicals include such compounds as geraniol, linalool, and nerol, and lower quantities of citronellol, nerol oxide, alpha terpineol, linalool oxide, and dienols. Bell pepper pyrazine has been named as the contributor to the vegetative character in Sauvignon Blanc and Cabernet Sauvignon. Saccharomyces cerevisiae converts sugars to alcohol, carbon dioxide, and many chemical by-products. Ethyl esters, fusel oil, and phenyl ethyl alcohol are some of these components, just to name a few. Yeasts also can develop a number of other ingredients. One terpene, farnesol, has been directly attributed to S. cerevisiae. Secondary fermentation by lactobacillus or leuconostoc bacteria can produce a buttery, diacetylic, or acid aroma. The aging of the wine in oak caskets contributes to phenolic or smoky character. Included in these types of leached aroma compounds could be vanillin, eugenol, and other

phenolic substances. See Fermentation, Grape, and Chart 483 – Wine Varieties.

Wine Fusel Oil – See Fusel Oil.

Wine Vinegar – Vinegar made from wine with a good degree of acetic acid character along with a winey background profile. See Vinegar.

Winey – Reminiscent of the flavor of wine. This is a character found often and is usually indicative of a slight fermentation. From a chemical standpoint, a winey character usually means there is the presence of ethanol, esters, acids, and larger molecular weight alcohols found at lower levels. Two examples of these would be amyl and hexyl alcohols. See Wine, Fermentation, Fermented, Descriptive Terminology.

Witch Hazel or Hamamelis virginiana – See Appendix 2.

Witchetty Grubs – A larva of an indigenous Australian moth that is purported to have a very fine nutty flavor. It was made popular on TV when survivalist shows had the stars eating these grubs. The Australian government put a subsequent ban on eating the grubs after a shortage occurred due to weather conditions. See Insects – Edible.

Withdrawal – This is different than a recall. It is when product has possibly been produced but none has been distributed to the public and the items may just be returned, destroyed or handled in another safe manner. See Mock Recall, HACCP, Pathogens, Food Safety, Recall.

Winnowing – In the process of cocoa production, which includes the processes of first cracking of the nib shell, and the subsequent separation of the shell from the roasted nib by pressurized air. See Processes, Cocoa, Chocolate.

Wintergreen (Gaultheria procumbens L.) – The product contains gualtherin glucoside, which through distillation produces methyl salicylate and glucose. See Salicylates, Root Beer, and Chart 404 – Wintergreen.

Winter Squash – See Squash.

Wok – A cooking utensil used in Asian cooking. The wok is a wide, broadly curved, shallow circular pan using high heat. It is a low moisture cooking technique where the sauce is developed right in the wok pan. The heat is turned first on high then it is lowered. The oil is added to the top and let drain to the bottom. The meat is introduced, and aromatic items like ginger, garlic, and scallions are then added. The items are cooked until fragrant. The oil used is typically peanut oil or canola oil. The sauce is made by the introduction of soy sauce, teriyaki, rice wine, and other fragrant liquids. See Culinary Arts.

Wok Hay – Wok hay is the description of the typical aromatic flavor introduced by the wok over its course of use. The flavor is developed by the high temperatures that the foods reach and build up a coating over a long period of time. In Chinese the term for wok hay is heung mei. See Culinary Arts, Wok, Ethnic Cooking Techniques.

Wolfberry – Lycium barbaratum L. – Part of the nightshade family, which includes tomato, eggplant, chilli, and potato. Wolfberry or goji has been grown wild in China and used in medicines and recipes for about 2000 years. It is an extremely nutritious plant having an equivalent macronutrient content to soy, with omega 3 and 6 fatty oils, and a high concentration of micronutrients as well. See Nutraceuticals and Appendix 2.

WONF – An acronym that stands for 'with other natural flavors.' It was an industry fallacy that the named product had to be at least 50% of the flavoring portion in order to legitimately call a product a WONF. In CFR Title 21, it states that sufficient enough material must be present to characterize the entire product, and no mention of percentage is made. A WONF indicates that a characterizing amount of flavor type is present, and the remainder of the flavor portion is made from contributing products from the non-named product blended to enhance or modify the original and must be entirely from natural sources. Notice that non-flavoring materials are not considered in this determination. When a company wishes to claim 'this product is made from all natural ingredients,' even the non-flavoring ingredients must be considered. This practice is not a regulatory claim, but a corporate policy. However, once this claim is made, the FTC truth in labeling acts kick in and strict adherence to those regulations come into play. See True Fruit, Type Flavor, Artificial Flavor, Natural Flavor.

Woodruff, Sweet (Asperula odorata L.) – Sweet woodruff has a tobacco, almost honey-like odor. See Tobacco, Brown (Compounds), and Chart 405 – Woodruff.

Woody –

1. Reminiscent of wood. A dry resinous character that is made up of terpenoid products of the terpene to sesquiterpene and diterpene types. Illustrative by the essential oils of vetivert and sandalwood.
2. In wine, the particular flavor obtained from aging in oak or other wood casks. See Resinous, Terpenes, Terpenoid, Sesquiterpene, Diterpene, Isopentene.

Worcestershire Sauce™ – A flavorful sauce that uses asafoetida. The original product was derived from an ingredient made in Japan. It is typically a combination of vegetable and fruit juices, syrups, amino acids, spices, salt, and vinegar. See Culinary Arts, Sauces.

Worker's Right to Know Act – See Right To Know Act.

World Health Organization – WHO – The division of the United Nations that states they 'identify global health matters, shape health research agenda, set norms and standards, articulate evidence-based policy options, provide technical support to countries and monitor and assess health trends'. As an example they are involved with Codex Alimentarius, and set forth the Global Harmonized System of Food Safety. See GHS, Third Party audits, SQF, BRC.

World Trade Organization – WTO – The division of the United Nations that settles international disputes. It convenes a judicial body that will refer to the Codex Alimentarius in Its decisions. See Codex Alimentarius.

Wormwood – See Artemisia and Appendix 2.

Wort – The liquid fermentable that is separated from the mash after the mash digestion has been completed. See Alcoholic Beverages.

Wraps – A general non-edible or edible surround to keep in flavor, temperature, or just to provide a unit for cooking. Some wraps include corn leaves (tamales), olive leaves, breads such as pita bread, paninis, greens such as lettuce in Korean barbecue, etc.

Wright Stain – Developed by James Homer Wright, it is a buffered stain using combinations of Eosin Y, Azure B, and Methylene Blue used to accentuate structures in white blood cells. See Pathogenic (Pathological) Organism, Gram (Stain) Test, Gram Negative Bacteria, Gram Positive Bacteria.

X

Xanthan Gum – See Gums and Thickeners.
X-Bar – Average. See Statistics, Statistical Analysis.
Xylenol – See Chart 11 – Alcohols Aromatic and Unsaturated.

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Y

Yacon or Polymnia edulis – See Appendix 2.

Yam (Dioscorea spp.) – A tuber similar in shape and flavor to sweet potato. Yams have a variably colored flesh (white, yellow, ivory, pink, or brownish pink). The flesh contains a mucilaginous coating, which gives the raw vegetable a slippery texture. The flavor of a yam is not as sweet as the sweet potato and is somewhat earthier. A candied or caramelized yam is a popular mode of treatment. The starch derived from yams is called Guyanese arrowroot. Most varieties of yams are grown in the tropical or subtropical climates, although the variety called D. batata or Chinese yam can be grown in more temperate climates. See Sweet Potato.

Yarrow Herb (Milfoil, Achillea) (Achillea millefolium L.) – Yarrow herb is a relative of Iva (A. moschata). The essential oil of A. millefolium had been used to adulterate German chamomile oil as it is also dark blue and/or greenish blue in coloring. However, if this occurred, it was often discovered because yarrow herb oil is bitter, piney, and camphoric, and does not have the same organoleptic characteristics, as does chamomile. In some instances, examples of adulterated yarrow herb has been seen. In these cases, the adulterating substances are typically cedar leaf oil, Siberian pine needle oil, camphene, and bornyl acetate. Therefore, it is important to obtain authentic oils, and to know and trust your supplier. Although the original CFR designated the product for use in alcoholic beverages only, the subsequent recommendation by the FEMA GRAS list deems it safe for general use. See Iva, Chart 406 – Yarrow, and Appendix 2.

Yautia (Puerto Rican Terminology) – See Malanga.

Yeast and Mold (Assay) – The microbial analysis that reports the number of yeast and mold colonies in counts per gram. This report shows active yeasts and not whole pasteurized or autolyzed yeast products. Yeast and molds is one of the typical cleanliness tests determining a foods potential for spoilage. See Standard Plate Count, Spoilage, Fermentation, Microbiology, E. coli.

Yeast Autolysate – See Autolyzed Yeast Extract.

Yeast Extract – See Autolyzed Yeast Extract.

Yeasts – Microorganisms of the plant family that are members of the class called fungi. Yeasts can be both beneficial or harmful. Beneficial yeasts are used both in fermentation or as nutritive sources. Harmful yeast can be responsible for unwanted fermentation and other types of food spoilage. Saccharomyces cerevisiae is used to ferment beer and wine and is also used in baking. In a fermentation process, there can be an abundance of yeast cells generated as a by-product as in a brewery. Therefore, instead of costly effluent controls, the yeast can be a useful material. The by-product mass is separated, collected, and treated in a number of ways to make it commercially viable. First, if the yeast is brought to a high enough temperature, thus destroying the cells, they are no longer viable. This can then be used as an inexpensive source of nutrients and can be used in animal feeds or pet foods. If the initial yeast is a result of brewery by-product, the flavor of the yeast is heavy and fermented with a characteristic beer-like flavor taking on aromatics from the hops used in the brew. Because this yeast is a by-product, and not grown on purpose, it is called a secondary yeast. Another process used to transform potential by-product yeast into a useful product is called yeast autolysis. In this

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case, if the yeast is subjected to temperatures close to incubation temperatures (i.e., 110–120°F), but not high enough kill the cells immediately, the cells still die eventually, but something else beneficial takes place. Endogenous enzymes (i.e., proteases and cellulases) begin breaking down the proteins in the cytoplasm and some of the cellulosics in the cell wall. This process of auto-solubilization is called autolysis, and the end product is called an autolyzed yeast. This autolyzed yeast can be dehydrated resulting in a dry autolyzed yeast. Because the process of autolysis forms free amino acids and sugars, the resultant yeast becomes a good nutritional source, a good source of flavor enhancers, and an excellent source of starting materials for a Maillard Reaction. The insoluble materials can also be eliminated by centrifugation or by other means yielding a liquid that is clear. This liquid can also be dried. The resultant powder is called a dry autolyzed yeast extract. Depending on the length of time the autolyzed yeast mass is kept at the elevated temperatures, the color of the final yeast grows darker. Maillard browning can occur at elevated extended temperatures yielding a more savory profile. On top of this, pure or mixed amino acids, sugars, vitamins, and other precursors can be added to enhance the potential reaction process. During the gasohol trend, Candida sp. strains were used to convert excess oil to alcohol. This alcohol was then blended with gasoline to produce an environmentally friendlier fuel. Candida utilis (Torulopsis utilis) is also used to clean up the sulfite liquor produced as a by-product in the production of paper. This product known generically as Torula yeast™ has a typically nutty flavor. Torula yeast™ has a significant place in the snack food industry. The dried Torula powder is often combined with smoke and used as a substrate in snack seasonings for use on items such as peanuts. Roasted peanut seasoning uses a smoked Torula yeast™ as its base. Kluveromyces (formerly saccharomyces) fragilis is a strain of yeast that ferments lactose. As a good source of lactose is whey, the growing of K. fragilis offers a useful substrate upon which to grow product. In the Midwest, where whey streams are significant, produced as a by-product for making cheese, yeast can be used to convert this whey into alcohol and other useful by-products. One of the by-products of this fermentation is of course alcohol. The yeast resulting from a whey fermentation would have an acid, dairy-like flavor and is useful in enhancing cheese flavors. Osmophilic yeasts grow the best under high concentrations of sugar. See Hydrolyzed Plant Protein, Yeast and Mold, Baker's Yeast, Yeast Autolysate, and Chart 41 – Yeast Products and Chart 407 – Yeast.

Yellow Dock or Rumex crispus – See Appendix 2.

Yellow Melilot – See Melilotus.

Yellow Sandalwood – See Sandalwood, White.

Yellow Saunders – See Sandalwood, White.

Yerba Maté – A tea-type product that is very popular in South America. See Maté, Tea, and Appendix 2.

Yerba Santa (Bear's Weed, Mountain Balm, Eriodictyon) – A popular tea product similar to yerba maté. See Yerba Maté, Chart 408 – Yerba Santa, and Appendix 2.

Ylang-Ylang (Cananga odorata Hook f. and Thoms. Forma Genuina) – This oil resembles cananga oil, and was long thought to be a better quality version of the same species. It is now accepted that cananga is another species of the same genus. The oil is a good source of benzyl esters, particularly benzyl acetate, eugenol, cresol, and other alcohols, and floral notes like linalool and geraniol. For this reason, ylang-ylang oil is used to give a fruity, slightly floral lift to fruit WONFs. It has been called the poor man's jasmine due to its similarity of at least some of its components. See Jasmine, Chart 409 – Ylang Ylang, and Appendix 2.

Yohimbe or Corynanthe yohimbe – See Appendix 2.

Yuca (not Yucca) – See Casava.

Yucca (Joshua Tree) (Yucca brevifolia Engelm) – Yucca filamentosa (Y. smalliana) – See Astringent, Chart 410 – Yucca, and Appendix 2.

Yuzu – *Citrus ichangensis and Citrus reticulata.* It is believed to be a hybrid of a sour mandarin and an Ichang papeda. It resembles a cross between a grapefruit and an orange and has a flavor profile similar to that combination, although with a muskiness coming from the presence of yuzu lactone a macrocyclic musk (dodeceneolide).

Z

(Z) – The designation for cis type structural isomerism. See Cis (Isomerism).

Zdravetz Oil (Geranium macrorrhizum) – Although a different species than geranium, the production of this oil is virtually non-existent, and therefore most zdravetz oil is probably an enhanced geranium oil. See Geranium.

Zeaxanthin – See Nutraceuticals and Appendix 2.

Zest – The colorful outer peel of the citrus fruit that contains the flavedo, or aroma producing cells. The other part of the peel, the pith, or albedo is the spongy whitish coating on the inside of the peel. The pith often contains bitter alkaloids like naringin, which is found in the pith of grapefruits. See Citrus, Pith, Flavedo, Albedo, Rind, Pulp Sacs, Peel.

Zeta Potential – The degree of repulsion between two charged micellular particles within an emulsion. The greater the zeta potential, the lesser the chance two or more particles can overcome this repulsive force and coalesce. See Emulsion Stability, Emulsions.

Zingerone – The active ingredient in ginger. See Ginger and Chart 337 – Zingerone.

Zizyphus or Zizyphus vulgaris or Zizyphus spinosa – Jujube Berries – See Nutraceuticals and Appendix 2.

Z Value – The range of temperature in Fahrenheit necessary for the D-value to change by a factor of 10 or one logarithmic unit in a specified growth population of microorganisms. See Microbiology; Pasteurization; Sterilize, Sterilization.

Zwaardemaker – The Zwaardemaker smell system was a method for classifying smells developed by the Dutch physiologist Hendrick Zwaardemaker. He published this work in 1895. In this work the following nine groups were identified: Ethereal, Aromatic, Fragrant, Ambrosiac, Alliaceous, Empyreumatic, Hiccine, and Foul. See Henning.

Zwitterion – A molecule existing in its ionic state that carries opposite electronic charges. This ion has a dipole moment but is neutral in its overall charge. An example of this would be an amino acid. By definition, an amino acid has an alkaline (basic) amino group and an acid (carboxyl type) group in the same molecule. See Ampholyte.

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Flavor Ingredient and Miscellaneous Charts

We have modified the chart numbering system in this edition so there may be gaps in the chart numbers.

Chart 2 Acetals

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
2,4-Dimethyl-1,3-dioxolane	C5H10O2	4099	—	—	3390-12-3
3 oxobutanal dimethyl acetal	C6H12O3	3381	—	—	54336-21-5
acetal (acetaldehyde diethyl acetal)	C6H14O2	2002	172.515	—	105-57-7
Z- and E-isobutyraldehyde propylene glycol acetal or cis- and trans-2-Isopropyl-4-methyl-1,3-dioxolane	C7H14O2S	4287	—	—	67879-60-1
acetoin propylene glycol ketal	C7H14O3	4532	—	—	94089-23-3
dl acetaldhyde ethyl isopropyl acetal	C7H16O2	4432	—	—	25334-93-4
(+/−)-acetaldehyde ethyl isopropyl acetal	C7H16O2	4432	—	—	25334-93-4
furfural propylene glycol acetal	C8H10O3	4537	—	—	4359-54-0
furfural propyleneglycol acetal	C8H10O3	4537	—	—	4359-54-0
ethyl aceto acetate ethylene glycol ketal	C8H14O4	4476	—	—	6413-10-1
cis- and trans-2-Isobutyl-4-methyl-1,3-dioxolane or Z- and E-3-methylbutyraldehyde propylene glycol acetal	C8H16O2	4286	—	—	18433-93-7
Valeraldehyde propyleneglycol acetal	C8H16O2	4372	—	—	74094-60-3
Isovaleraldehyde glyceryl acetal	C8H16O3	4380	—	—	54355-74-7
acetaldehdye ethyl isobutyl acetal	C8H18O2	4528	—	—	6986-51-2
acetaldehyde ethyl isobutyl acetal	C8H18O2	4528	—	—	6986-51-2
methional diethyl acetal	C8H18O2S	4590	—	—	16630-61-8
benzaldehyde dimethyl acetal	C9H12O2	2128	172.515	—	1125-88-8
(+/−)-E- and Z-2-Hexenal propylene glycol acetal or (+/−)-trans- and cis-2-Hexenal propylene glycol acetal	C9H16O2	4272	—	—	94089-21-1

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Chart 2 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
(+/−)-E- and Z-2-Hexenal glyceryl acetal or (+/−)-trans- and cis-2-Hexenal glyceryl acetal	C9H16O3	4273	—	—	214220-85-6
Z- and E-Ethyl 2,4-dimethyl-1,3-dioxolane-2-acetate or cis- and trans-Ethyl 2,4-dimethyl-1,3-dioxolane-2-acetate	C9H16O4	4294	—	—	6290-17-1
heptanal dimethyl acetal	C9H20O2	2541	172.515	—	10032-05-0
Isovaleraldehyde diethyl acetal	C9H20O2	4371	—	—	3842-03-3
benzaldehyde propylene glycol acetal	C10H12O2	2130	172.515	—	2568-25-4
benzaldehyde glyceryl acetal	C10H12O3	21219	172.515	—	1319-88-6
phenyl acetaldehyde dimethyl acetal	C10H14O2	2876	172.515	—	101-48-4
ethyl levulinate propylene glycol ketal	C10H18O4	4479	—	—	57197-36-1
acetaldehyde ethyl cis 3 hexenyl acetal	C10H20O2	3775	—	—	60763-40-8
(E)-2-Hexenal diethyl acetal	C10H20O2	4047	—	—	67746-30-9
Heptanal propyleneglycol acetal	C10H20O2	4368	—	—	4351-10-4
Acetaldehyde 1,3-octanediol acetal	C10H20O2	4376	—	—	202188-43-0
Hexanal butane-2,3-diol acetal	C10H20O2	4384	—	—	155639-75-1
cyclohexanone diethyl ketal	C10H20O2	4516	—	—	1670-47-9
heptanal glyceryl acetal	C10H20O3	2542	172.515	—	1708-35-6
octanal dimethyl acetal	C10H22O2	2798	172.515	—	10022-28-3
acetaldehyde diisobutyl acetal	C10H22O2	4527	—	—	5669-09-0
acetaldehyde di-isobutylacetal	C10H22O2	4527	—	—	5669-09-0
cinnamic aldehyde ethylene glycol acetal	C11H12O2	2287	172.515	—	5660-60-6
piperonal propylene glycol acetal	C11H12O4	4622	—	—	61683-99-6
piperonal propyleneglycol acetal	C11H12O4	4622	—	—	61683-99-6
4 methyl benzaldehyde propylene glycol acetal (tolualdehyde pg acetal)	C11H14O2	4628	—	—	58244-29-4
phenyl acetaldehyde propylene glycol acetal	C11H14O2	4629	—	—	5468-05-3
4-methylbenzaldehyde propyleneglycol acetal	C11H14O2	4628	—	—	58244-29-4
phenylacetaldehyde propyleneglycol acetal	C11H14O2	4629	—	—	5468-05-3
phenyl acetaldehyde glyceryl acetal	C11H14O3	2877	172.515	—	29895-73-6
tolylaldehyde glyceryl acetal	C11H14O3	3067	172.515	—	1333-09-1
anisaldehyde propylene glycol acetal	C11H14O3	4627	—	—	6414-32-0
anisaldehyde propyleneglycol acetal	C11H14O3	4627	—	—	6414-32-0
Vanillin propylene glycol acetal	C11H14O4	3905	—	—	68527-74-2
phenyl propionaldehyde dimethyl acetal	C11H16O2	2888	172.515	—	90-87-9
2-Hexyl-4,5-dimethyl-1,3-dioxolane	C11H21O2	4048	—	—	6454-22-4
4-heptenal diethyl acetal	C11H22O2	3349	—	—	18492-65-4
Octanal propyleneglycol acetal	C11H22O2	4383	—	—	74094-61-4

Chart 2 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
6-Methyl-5-hepten-2-one propyleneglycol acetal o 6-Methyl-5-hepten-2-one propylene glycol ketal	C11H23O2	4400	—	—	68258-95-7
nonanal dimethyl acetal	C11H24O2	4367	—	—	18824-63-0
cinnamic aldehyde propylene glycol acetal	C12H14O2	4569	—	—	4353-01-9
cinnamaldehyde propyleneglycol acetal	C12H14O2	4596	—	—	4353-01-9
Vanillin *erythro* and *threo*-butan-2,3-diol acetal	C12H1604	4023	—	—	63253-24-7
phenyl acetaldehyde 2,3 butylene glycol acetal	C12H16O2	2875	172.515	—	5468-6-4
2 phenylpropanal propylene glycol acetal	C12H16O2	4595	—	—	67634-23-5
2-phenylpropanal propyleneglycol acetal	C12H16O2	4595	—	—	67634-23-5
Ethyl vanillin propylene glycol acetal	C12H16O4	3838	—	—	68527-76-4
phenylacetaldeyde diethyl acetal	C12H18O2	4625	—	—	6314-97-2
phenylacetaldehyde diethyl acetal	C12H18O2	4625	—	—	6314-97-2
benzyl methoxy ethyl acetal	C12H18O3	2148	172.515	—	7492-39-9
citral dimethyl acetal	C12H22O2	2305	172.515	—	7549-37-3
2,6-Dimethyl-5-heptenal propyleneglycol acetal	C12H22O2	4382	—	—	74094-63-6
Nonanal propyleneglycol acetal	C12H24O2	4373	—	—	68391-39-9
decanal dimethyl acetal	C12H26O2	2363	172.515	—	7779-41-1
Acetaldehyde diisoamyl acetal	C12H26O2	4024	—	—	13002-09-0
hydroxy citronellal dimethyl acetal	C12H26O3	2585	172.515	—	141-92-4
2-Nonanone propyleneglycol acetal or 2-Nonanone propyleneglycol ketal	C12H27O2	4399	—	—	CAS Pending
acetaldehyde phenyl ethyl propyl acetal	C13H20O2	2004	172.515	—	7493-57-4
perillaldeehyde propylene glycol acetal	C13H20O2	4530	—	—	121199-28-8
perillaldehyde propyleneglycol acetal	C13H20O2	4530	—	—	121199-28-8
citral propylene glycol acetal	C13H22O2	—	172.515	7626	10444-50-5
citral glyceryl acetal	C13H22O3	4486	—	—	5694-82-6
citral glyceryl acetal	C13H22O3	4486	—	—	5694-82-6
2,6 nonadienal diethyl acetal	C13H24O2	3378	—	—	67674-36-6
Decanal propyleneglycol acetal	C13H26O2	4364	—	—	5421-12-5
hydroxycitronellal propylene glycol acetal	C13H26O3	4485	—	—	93804-64-9
hydroxycitronellal propyleneglycol acetal	C13H26O3	4485	—	—	93804-64-9
Acetaldehyde hexyl isoamyl acetal	C13H28O2	4365	—	—	233665-90-2
Valeraldehyde dibutyl acetal	C13H28O2	4375	—	—	13112-65-7
acetaldehyde butyl phenyl ethyl propyl acetal	C14H22O2	3125	—	—	64577-91-9
citral diethyl acetal	C14H26O2	2304	172.515	—	7492-66-2

Chart 2 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
Acetaldehyde di-cis-3-hexenyl acetal	C14H26O2	4381	—	—	63449-64-9
Undecanal propyleneglycol acetal	C14H28O2	4374	—	—	74094-62-5
Hexanal octane-1,3-diol acetal	C14H28O2	4377	—	—	202188-46-3
Dodecanal dimethyl acetal	C14H30O2	4366	—	—	14620-52-1
hydroxy citronellal diethyl acetal	C14H30O3	2484	172.515	—	7779-94-4
alpha amyl cinnamic aldehyde dimethyl acetal	C16H24O2	2062	172.515	—	91-87-2
phenyl acetaldehyde di isobutyl acetal	C16H26O2	3384	—	—	68345-22-2
Hexanal hexyl isoamyl acetal	C17H36O2	4369	—	—	896447-13-5
butanal dibenzyl thioacetal	C18H22S2	4589	—	—	101780-73-8
Hexanal dihexyl acetal	C18H38O2	4370	—	—	33673-65-3
Vanillin 3-(l -menthoxy)propane-1,2-diol acetal	C20H30O5	3904	—	—	180964-47-0

Chart 3 Acetoacetates

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
ethyl acetoacetate	C6H10O3	2415	172.515	—	141-97-9
butyl acetoacetate	C8H14O3	2176	172.515	—	591-60-6
cis-3-hexenyl acetoacetate	C10H16O3	4489	—	—	84434-20-8
isoamyl acetoacetate	C9H16O3	3351	—	—	2308-18-1
ethyl acetoacetate ethyleneglycol ketal	C8H14O4	4477	—	—	6413-10-1
benzyl acetoacetate	C11H12O3	2136	172.515	—	5396-89-4
geranyl acetoacetate	C14H22O3	2510	172.515	—	10032-00-5
l-Menthyl acetoacetate	C14H24O	4327	—	—	59557-05-0

Chart 4 Acids All Types

Note: Some adjuvant usages are listed under the CFR Citations for Acids as well as the typical GRAS type listings.

Aliphatic Acids and Cyclic Acids

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
formic acid	CH2O2	2487	172.515, 186.1316, 573.480	—	64-18-6
acetic acid	C2H4O2	2006	101.100, 131.111, 131.136, 131.144, 133.123, 133.124, 133.169, 133.173, 133.178, 133.179, 169.115, 169.140, 169.150, 184.1005, 184.1754, 184.1848 (as a component in starter distillate), 582.1005	—	64-19-7
pyruvic acid or (alpha keto propionic acid)	C3H4O3	2970	172.515, 172.695	—	127-17-3

Chart 4 *Continued*

Aliphatic Acids and Cyclic Acids

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS #	CAS #
3-Hydroxy-2-oxopropionic acid	C3H4O4	3843	—	—	1113-60-6
propionic acid	C3H6O2	2924	133.149, 133.195, 184.1081, 184.1221, 184.1784, 582.3081	—	79-09-4
dl lactic acid	C3H6O3	2611	CFR Citations: 131.111, 131.112, 131.136, 131.138, 131.144, 131.146, 131.160, 131.160, 131.162, 131.185, 131.187, 131.200, 131.203, 131.206, 133.102, 133.106, 133.108, 133.111, 133.113, 133.118, 133.123, 133.124, 133.127, 133.129, 133.133, 133.136, 133.138, 133.140, 133.141, 133.144, 133.148, 133.149, 133.150, 133.152. 133.153, 133.155, 133.156, 133.160, 133.162, 133.164, 133.165, 133.169, 133.173, 133.178, 133.179, 133.181, 133.182, 133.183, 133.184, 133.185, 133.187, 133.188, 133.189, 133.190, 133.195, 135.110, 135.140, 136.110, 150.141, 150.161, 172.515, 184.1061, 582.1061	—	598-82-3
l lactic acid	C3H6O3	2611	see above list	—	79-33-4
d lactic acid	C3H6O3	2611	see above list	—	10326-41-7
fumaric acid (trans butene dioic acid)	C4H4O4	2488	150.141, 172.350, 146.113, 150.161, 131.44	—	110-17-8
2 oxo butyric acid	C4H6O3	3723-	—	—	600-18-0
malic acid	C4H6O5	2655	131.111, 131.136, 131.144, 150.141, 150.161, 169.115, 169.140, 169.150, 184.1069, 582.60, 582.1069	—	97-67-6
dl malic acid	C4H6O5	2655	see above list	—	617-48-1
succinic acid (amber acid, 1,4 butanedioic acid)	C4H6O4	3044	131.111, 131.136, 131.144, 172.230, 172.275, 184.1094, 582.1091	—	110-15-6
succinic acid	C4H6O4	4719	—	—	110-15-6
tartaric acid	C4H6O6		73.170, 131.111, 131.136, 131.144, 136.110, 150.141, 150.161, 162.110, 163.111, 163.112, 176.170, 184.1077, 184.1099, 582.1099, 582.6099	—	87-69-4
butyric acid	C4H8O2	2221	182.60, 582.60, 172.515, 178.2010, 184.1784	—	107-92-6

Chart 4 *Continued*

Aliphatic Acids and Cyclic Acids

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
isobutyric acid	C4H8O2	2222	172.515, 573.914	—	79-31-2
2-Oxopentanedioic acid	C5H6O5	3891	—	—	328-50-7
3-Methyl-2-oxobutanoic acid	C5H903	3869	—	—	759-05-7
valeric acid	C5H10O2	3101	172.515, 173.315, 573.914	—	109-31-2
isovaleric acid	C5H10O2	3102	172.515, 573.914	—	503-74-2
2 methyl butyric acid	C5H10O2	2695	172.515	—	116-53-0
aconitic acid or (1,2,3, propene tricarboxylic acid, or equisetic acid, or citridic acid, or achelleic acid)	C6H6O6	2010	184.1007, 582.60	—	499-12-7
citric acid	C6H7O7	2306	73.85 (used in the manufacture of caramel), 101.30 (present in and representative of the % of juices), 131.111, 131.112, 131.136, 131.138, 131.144, 131.146, 133.123, 133.124, 133.129, 133.169, 133.173, 133.178, 133.179, 145.145, 145.180, 146.114, 146.120, 146.121, 146.132, 146.140, 146.141, 146.148, 146.185, 146.187, 150.141, 155.130, 161.110, 163.110, 163.111, 163.112, 169.115, 169.140, 169.150, (173.160 fermentation produced by candida guillermondii, 173.165 .. and candida lipolytica), 173.280 (extraction process in the manufacture of), 184.1033 (present in starter distillate), 582.1033, 582.6033	—	77-92-9
sorbic acid	C6H8O2	211	—	—	110-44-1
			133.118, 133.123, 133.124, 133.169, 133.173, 133.179, 133.187, 133.188, 150.141, 150.161, 166.110, 181.23, 182.3089, 582.3089	—	
cis-3-hexenoic acid	C6H10O2	4493	—	—	1775-43-5
3-Methyl-2-oxopentanoic acid	C6H10O3	3870	—	—	1460-34-0
4-Methyl-2-oxopentanoic acid	C6H10O3	3871	—	—	816-66-0
adipic acid or (1,4 butanedicarboxylic acid)	C6H10O4	2011	131.111, 131.136, 131.144, 184.1009, 582.1009	—	00124-04-9
hexanoic acid (caprylic acid)	C6H12O2	2559	184.1025	—	142-62-1

Chart 4 *Continued*

Aliphatic Acids and Cyclic Acids

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
2 ethyl butyric acid	C6H12O2	2429	172.515	—	88-09-5
2 methyl valeric acid	C6H12O2	2754	172.515	—	97-61-0
3 methyl pentanoic acid	C6H12O2	3437	—	—	105-43-1
4 methyl pentanoic acid	C6H12O2	3463	—	—	646-07-1
2,4 dimethyl 2 pentenoic acid	C7H1202	3143	—	—	66634-97-7
heptanoic acid	C7H14O2	3348	172.515	—	111-14-8
2 methyl hexanoic acid	C7H14O2	3191	—	—	4536-23-6
5 methyl hexanoic acid	C7H14O2	3572	—	—	628-46-6
5-oxooctanoic acid	C8H14O3	4455	—	—	3637-14-7
cyclohexane acetic acid	C8H16O2	2347	172.515	—	5292-21-7
2 methyl heptanoic acid	C8H16O2	2706	172.515	—	1188-02-9
octanoic acid	C8H16O2	2799	172.210, 172.860, 173.340, 184.1025, 186.1025	—	124-07-2
nonanoic acid	C9H18O2	2784	172.515	—	112-05-0
4 methyl octanoic acid	C9H18O2	3575-	—	—	54947-74-9
1,2,5,6 tetrahydro cuminic acid	C10H16O2	3731-	—	—	71298-42-5
3-isopropenyl-6-oxoheptanoic acid	C10H16O3	4461	—	—	4436-82-2
cyclohexane carboxylic acid	C10H18O2	2348	172.515	—	98-89-5
9 decenoic acid	C10H18O2	3660-	—	—	14436-32-9
5-oxodecanoic acid	C10H18O3	4456	—	—	624-01-1
4 methyl nonanoic acid	C10H20O2	3574-	—	—	45019-28-1
decanoic acid	C10H20O2	2364	172.515	—	334-48-5
cis-and *trans*-2-Heptylcyclopropanecarboxylic acid	C11H20O2	4130	—	—	697290-77-0 (trans) 697290-76-9 (cis)
undecanoic acid	C11H22O2	3245-	—	—	112-37-8
4-(2,2,3-trimethylcyclopentyl) butanoic acid	C12H22O2	4529	—	—	957136-80-0
5-oxododecanoic acid	C12H22O3	4458	—	—	3637-16-9
lauric acid	C12H24O2	2614	172.21	—	143-07-7
n-Tridecanoic acid	C13H26O	4336	—	—	638-53-9
myristic acid	C14H28O2	2764	1731.340, 172.210, 172.860	—	544-63-8
palmitic acid	C16H36O2	2832	173.840, 172.860, 172.210	—	57-10-3
stearic acid	C18H36O2	3035	173.340, 184.1090, 172.860, 172.210, 172.615	—	57-11-4
oleic acid or (9 octadecenoic acid)	C18H34O2	2815	182.90, 173.315(a3), 172.860, 182.70, 173.315, 172.210	—	112-80-1
linoleic acid	C19H32O2	—	106.25, 106.30, 107.1, 107.100, 175.100, 181.5065, 182.1065, 184.1065, 573.640, 582.5065	—	60-33-3
arachidonic acid enriched oil	C20H32O2	4679	—	—	301851-64-9
6-[5(6)-decenoyloxy]decanoic acid	C20H36O4	4442	—	—	85392-05-8

Chart 4 *Continued*

Aliphatic Acids and Cyclic Acids					
Compound	**Empirical Formula**	**FEMA GRAS #**	**CFR**	**NAS#**	**CAS#**
mixture of ricinoleic acid, linoleic acid, and oleic acid	Mixture	4804	—	—	pending
Aromatic Acids					
Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
3,4-dihydroxybenzoic acid	C7H5O4	4430	—	—	99-50-3
benzoic acid	C7H6O2	2131	184.1021, 150.61, 150.141, 166.110, 166.40	—	65-85-0
4-Hydroxybenzoic acid	C7H603	3986	—	—	99-96-7
2-Hydroxybenzoic acid	C7H603	3985	—	—	69-72-7
3-hydroxybenzoic acid	C7H6O3	4431	—	—	99-06-9
2-Methoxybenzoic acid	C8H7O3	3943	—	—	579-75-9
4-Methoxybenzoic acid	C8H803	3945	—	—	100-09-4
phenyl acetic acid	C8H8O2	2878	172.515	—	103-82-2
phenoxy acetic acid	C8H8O3	2872	172.515	—	122-59-8
3-Methoxybenzoic acid	C8H8O3	3944	—	—	586-38-9
4-Hydroxy-3-methoxybenzoic acid	C8H8O3	3988	—	—	121-34-6
3 phenyl propionic acid	C9H10O	2889	172.515	—	501-52-0
hydroxy(4-hydroxy-3-methoxyphenyl)acetic acid	C9H10O5	4660	—	—	55-10-7
2-Oxo-3-phenylpropionic acid	C9H8O3	3892	—	—	156-06-9
o-trans-coumaric acid	C9H8O3	4700	—	—	614-60-8
N-Benzoylanthranilic acid	C15H10NO3	4078	—	—	579-93-1
4-amino-5-(3-(isopropylamino)-2,2-dimethyl-3-oxopropoxy)-2-methylquinoline-3-carboxylic acid	C19H25N3O4	4774	—	—	1359963-68-0

Chart 5 Acids – Unsaturated Aliphatic

Compound	**Empirical Formula**	**FEMA GRAS #**	**CFR**	**NAS#**	**CAS#**
2-Butenoic acid	C4H6O2	3908	—	—	3724-65-0
2-Pentenoic acid	C5H8O2	4193	—	—	13991-37-2
4 pentenoic acid	C5H8O2	2843	172.515	—	591-80-0
methyl crotonic acid or (3 methyl 2 butenoic acid)	C5H8O2	3187-	—	—	541-47-9
2 methyl trans butenoic acid	C5H8O2	3599	172.515	—	80-59-1
trans 2 hexenoic acid	C6H10O2	3169-	—	—	13419-69-7
3 hexenoic acid	C6H10O2	3170-	—	—	4219-24-3
2 methyl 2 pentenoic acid	C6H10O2	3195-	—	—	16957-70-3
2 methyl 3 pentenoic acid	C6H10O2	3464-	—	—	37674-63-8
2 methyl 4 pentenoic acid	C6H10O2	3511-	—	—	1575-74-2

Chart 5 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
4-Methylpent-2-enoic acid	C6H10O2	4180	—	—	10321-71-8
cis-3-hexenoic acid	C6H10O2	4493	—	—	1775-43-5
2,4-Hexadienoic acid, (E,E)-	C6H8O2	3921	—	—	110-44-1
2,4 dimethyl 2 pentenoic acid	C7H12O2	3143-	—	—	66634-97-7
(E)-2-Heptenoic acid	C7H12O2	3920	—	—	18999-28-5
9,12 octadecadienoic acid (48%) PLUS 9,12,15 octa deca trienoic acid (51%)	C8H12O2	3380-	—	—	999999-08-0
Geranic acid or (E2),6-Octadienoic acid, 3,7-dimethyl-	C8H12O2	4121	—	—	459-80-3
3-Isopropenylpentanedioic acid	C8H12O4	4352			6839-75-4
(E)-2-Octenoic acid	C8H14O2	3957	—	—	1871-67-6
cis-5-Octenoic acid	C8H14O2	4350	—	—	41653-97-8
trans-4-Octenoic acid	C8H14O2	4357	—	—	18776-92-6
3-Octenoic acid	C8H14O2	4362	—	—	1577-19-1
3 phenyl propenoic acid or (cinnamic acid)	C9H16O2	2288	172.515	—	621-82-0
(E)-2-Nonenoic acid	C9H16O2	3954	—	—	3760-11-0
2-Decenoic acid	C10H10O2	3913	—	—	3913-85-7
tetra hydro cuminic acid or (4 (1 methyl ethyl) 3 cyclohexene 1 carboxylic acid)	C10H16O2	3731-	—	—	71298-42-5
3-isopropenyl-6-oxoheptanoic acid	C10H16O3	4461	—	—	4436-82-2
3,7 dimethyl 6 octenoic acid or (citronellic acid)	C10H18O2	3142-	—	—	502-47-6
9 decenoic acid	C10H18O2	3660-	—	—	14436-32-9
5 + 6 decenoic acid	C10H18O2	3742-	—	—	72881-27-7
4-Decenoic acid	C10H18O2	3914	—	—	26303-90-2
10 undecenoic acid	C11H20O2	3247-	—	—	112-38-9
11-Dodecenoic acid	C12H22O2	4355	—	—	65423-25-8
arachidonic acid enriched oil	C20H32O2	4679	—	—	301851-64-9
6-[5(6)-decenoyloxy]decanoic acid	C20H36O4	4442	—	—	85392-05-8

Chart 6 Acidulants

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
pyruvic acid (acetyl formic acid)	C3H4O3	2970	172.515	—	127-17-3
lactic acid or (hydroxy propanoic acid)	C3H6O3	2611	150.61, 131 all, 133 all, 150.141, 150.161, 172.515, 184.1061	—	598-82-3
fumaric acid or (trans butene dioic acid)	C4H4O4	2488	150.141, 172.350, 146.113, 150.161, 131.44	—	110-17-8
succinic acid	C4H6O4	4719	131.111, 131.136, 131.144, 172.230, 172.275, 184.1091, 582.1091	—	110-15-6
dl malic acid	C4H6O5	—	131.111, 131.136, 131.144, 150.141, 150.161, 169.115, 169.140, 169.150, 184.1069, 582.60, 582.1069	118	617-48-1
l malic acid (apple acid)	C4H6O5	2655	131.111, 131.136, 131.144, 150.141, 150.161, 169.115, 169.140, 169.150, 180.1069, 582.60, 582.1069	—	617-48-1

Chart 6 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
tartaric acid or (l–2,3 dihydroxy butane dioic acid)	C4H6O6	3044	73.170, 131.111, 131.136, 131.144, 136.110, 150.141, 150.161, 162.110, 163.111, 163.112, 176.170, 184.1077, 184.1009, 582.1099, 582.6099	—	133-37-9
levulinic acid or (oxo pentanoic acid)	C5H8O3	2627	172.515	—	123-76-2
adipic acid or (butane dicarboxylic acid)	C6H10O4	2011	184.1009, 131.144	—	124-04-9
aconitic acid or (achilleic acid, citridic acid, equisetic acid, 1 propene 1,2,3 tricarboxylic acid)	C6H6O6	2010	184.201	—	499-12-7
sorbic acid	C6H8O2	—	133.118, 133.123, 133.124, 133.169, 133.173, 133.179, 133.187, 133.188, 150.141, 150.161, 166.110, 181.23, 182.3089, 582.3089	211	110-44-1
ascorbic acid (vitamin C)	C6H8O6	2109	137.105, 137.200, 145.110, 145.115, 145.135, 145.170, 150.141, 150.161, 155.200, 155.201, 161.175, 182.3013, 182.5013, 182.8013, 582.3013, 582.5013	—	50-81-7
erythorbic acid (iso vitamin C)	C6H8O6	2410	182.3041, 145.11	—	89-65-6
citric acid or (hydroxy 1,2,3 propane tricarboxylic acid)	C6H8O7	2306	73.85 (used in the manufacture of caramel), 101.30 (present in and representative of the % of juices), 131.111, 131.112, 131.136, 131.138, 131.144, 131.146, 133.123, 133.124, 133.129, 133.169, 133.173, 133.178, 133.179, 145.145, 145.180, 146.114, 146.120, 146.121, 146.132, 146.140, 146.141, 146.148, 146.185, 146.187, 150.141, 155.130, 161.110, 163.110, 163.111, 163.112, 169.115, 169.140, 169.150, (173.160 fermentation produced by Candida guillermondii, 173.165 and Candida lipolytica), 173.280 (extraction process in the manufacture of), 184.1033 (present in starter distillate), 582.1033, 582.6033	—	77-92-9
benzoic acid	C7H6O2	2131	150.141, 150.161, 166.40, 166.110, 184.1021	—	65-85-0
phosphoric acid	H3PO4	2900	182.1073	—	7664-38-2
Hydrochloric Acid	HCl	—	114.90, 131.111, 131.136, 131.144, 133.149, 137.350, 155.191, 155.194, 160.105, 160.185, 172.892, 182.1057, 582.1057	97	7647-01-0
tannic acid (tannin)	n/a	3042	173.310, 184.1097	—	1401-55-4

Chart 7 Alcohols – Aliphatic Alcohols

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
ethanol	C2H6O	2419	169.3, 169.175, 169.176, 169.177, 169.178, 169.180, 169.181, 172.340, 172.560, 184.1293	—	64-17-5
isopropyl alcohol	C3H8O	2929	73.1, 172.515, 172.560, 172.712, 173.240, 173.340	—	67-63-0
propanol	C3H8O	2928	172.515, 573.880	—	71-23-8
propylene glycol	C3H8O2	2940	169.175, 169.176, 169.177, 169.178, 169.180, 169.181, 184.1666, 582.4666	—	57-55-6
1,3-propanediol	C3H8O2	4753	—	—	504-63-2
glycerine (glycerol)	C3H8O3	2525	169.175, 169.176, 169.177, 169.178, 169.180, 169.181, 182.90, 182.1320	—	56-81-5
isobutanol	C4H10O	2179	172.515	—	78-83-1
butanol	C4H10O	2178	172.515, 172.56	—	71-36-3
1,3 butylene glycol	C4H10O2	—	173.22	8796	107-88-0
amyl alcohol (pentanol)	C5H12O	2056	172.515	—	71-41-0
isoamyl alcohol or (synthetic fusel oil, synthetic fusel alcohol)	C5H12O	2057	172.515	—	123-51-3
2 pentanol	C5H12O	3316	—	—	6032-29-7
3 methyl 2 butanol	C5H12O	3703	—	—	598-75-4
(/–) 2-Methyl-1-butanol	C5H12O	3998	—	—	137-32-6
3 hydroxy 2 pentanone	C5H12O2	3550	—	—	312-66-3
1 hexanol	C6H14O	2567	172.515	—	111-27-3
3 hexanol	C6H14O	3351	—	—	623-37-0
3 methyl 1 pentanol	C6H14O	3762	—	—	589-35-5
1 heptyl alcohol	C7H16O	2548	172.515	—	111-70-6
2 heptanol	C7H16O	3288	—	—	543-49-7
3 heptanol	C7H16O	3547	172.515	—	589-82-2
octanol	C8H18O	2800	172.515, 172.23	—	111-87-5
2 ethyl 1 hexanol	C8H18O	3151	—	—	104-76-7
2 octanol	C8H18O	2801	172.515	—	123-96-6
3 octanol	C8H18O	3581	—	—	589-98-0
2,3,4-Trimethyl-3-pentanol	C8H18O	3903	—	—	3054-92-0
3 octanone 1 ol	C8H18O2	2804	172.515	—	65405-68-7
5 octanol 4 one or (butyroin, or 5 hydroxy 4 octanone)	C8H18O2	2587	172.515	—	496-77-5
nonyl alcohol or 3,5,5 trimethyl hexanol	C9H20O	2789	172.515	—	143-08-8
2 nonanol	C9H20O	3315	—	—	628-99-9
2,6 dimethyl 4 heptanol	C9H20O	3140	—	—	108-82-7
l decanol	C10H22O	2365	172.515, 172.864	—	112-30-1
3,7 dimethyl octanol	C10H22O	2391	172.515	—	106-21-8
3 decanol	C10H22O	3605	—	—	1565-81-7
l mentholv or (1 methyl 4 isopropyl cyclo hexan 3 ol)	C10H20O	2665	172.515, 182.2	—	89-78-1

Chart 7 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
tetra hydro linalool	C10H22O	2060	172.515	—	78-69-3
undecyl alcohol	C11H24O	3097	172.515	—	112-42-5
2 undecanol	C11H24O	3246	3246	—	1653-30-1
2,4-Dimethyl-4-nonanol	C11H24O	4407	—	—	74356-31-3
lauryl alcohol	C12H26O	2617	172.515, 172.864	—	112-53-8
3-(l-Menthoxy)-2-methylpropane-1,2-diol	C14H28O3	3849	—	—	195863-84-4
(/−)-Dihydrofarnesol	C15H26O	4031	—	—	51411-24-6
hexadecanoic alcohol (cetyl alcohol)	C16H34O	2554	172.515, 172.864	—	36653-82-4

Chart 8 Alcohols – Aliphatic Cyclic Alcohols

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
(±)-1-cyclohexylethanol	C8H16O	4794	—	—	1193-8-1
3,5,5-Trimethylcyclohexanol	C9H14O	3962	—	—	116-02-9
l-Piperitone or p-Menth-1-en-3-one	C10H16O	4200	—	—	4573-50-6
myrtenol	C10H16O	3439	—	—	515-00-4
2 (10) pinene 3-ol	C10H16O	3587	—	—	5947-36-4
fenchyl alcohol	C10H18O	2480	172.515	—	1632-73-1
dihydro carveol	C10H18O	2379	172.515	—	619-01-2
isopulegol	C10H18O	2962	172.515	—	89-79-2
borneol	C10H18O	2157	172.515	—	507-70-0
iso borneol	C10H18O	2158	172.515	—	124-76-5
thujan 4-ol	C10H18O	3239	—	—	546-79-2
para mentha 8 thiol 3 one	C10H18OS	3177	—	—	38462-22-5
p-Menthane-3,8-diol	C10H19O2	4053	—	—	42822-86-6
para menthan 2 ol or (carvomenthol)	C10H20O	3562	—	—	499-69-4
l menthol or (1 methyl 4 isopropyl cyclohexan 3 ol)	C10H20O	2665	172.515	—	2216-51-5
trans-4-tert-butylcyclohexanol	C10H20O	4724	—	—	21862-63-5
trans-4-tert-butylcyclohexanol	C10H20O	4724	—	—	21862-63-5
1-Menthyl methylether	C11H22O2	4054	—	—	1565-76-0
cis- and trans-p-1(7),8-Menthadien-2-yl acetate	C12H18O2	3848	—	—	71660-03-2
2-ethyl 1,2,3, trimethyl 2-norbornanol or (2-ethyl fenchyl alcohol)	C12H22O	3491	—	—	18368-91-7
2,2,6,7-tetramethylbicyclo[4.3.0] nona-4,9(1)-dien-8-ol	C13H20O	4521	—	—	97866-86-9
2,2,6,7-tetramethylbicyclo[4.3.0] nona-4,9(1)-dien-8-one	C13H20O	4522	—	—	97844-16-1
2,2,6,7-tetramethylbicyclo[4.3.0] nona-4,9(1)-dien-8-ol	C13H20O	4521	—	—	97866-86-9
2,2,6,7-tetramethylbicyclo[4.3.0] nona-4,9(1)-dien-8-one	C13H20O	4522	—	—	97844-16-1

Chart 8 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
3 (1 menthoxy) propane 1,2 diol	C13H26O3	3784	—	—	87061-04-9
Menthyl pyrrolidone carboxylate or Frescolat™	C14H16O2	4155	—	—	68127-22-0
3-methyl-5-(2,2,3-trimethylcyclopent-3-en-1-yl)pent-4-en-2-ol	C14H24O	4775	—	—	67801-20-1
3-methyl-5-(2,2,3-trimethylcyclopent-3-en-1-yl)pent-4-en-2-ol	C14H24O	4775	—	—	67801-20-1
santalol	C15H24O	3006	172.515	—	11031-45-1
(1-methyl-2-(1,2,2-trimethylbicyclo[3.1.0]hex-3-ylmethyl)cyclopropyl)methanol	C15H26O	4776	—	—	198404-98-7
caryophyllene alcohol	C15H26O	3741	172.515	—	4586-22-5
L-Monomenthyl glutarate	C15H26O5	4006	—	—	220621-22-7
Menthyl valerate	C15H30O2	4156	—	—	89-47-4
(+/−)-*N*,*N*-Dimethyl menthyl succinamide	C16H30N2O2	4230	—	—	544714-08-1
note: isopulegol, 2(10) pinene 3 ol, santalol and dihydrocarveol is both a saturated cyclic compound with also an unsaturated isopropenyl group.					

Chart 9 Alcohols – Aromatic Alcohols

Compound	Empirical Formula	FEMA GRAS #		NAS#	CAS#
phenol	C6H6O	3223	175.105, 175.300, 175.380, 175.390, 176.170, 177.1210, 177.2410	—	108-95-2
resorcinol (1,3 benzene diol)	C6H6O2	3589	—	—	108-46-3
salicylaldehyde or (2-hydroxy benzaldehyde)	C7H6O2	3004	172.515	—	90-02-8
3 Hydroxy Benzoic Acid (m-Salicylic Acid)	C7H6O3	4431	—	—	99-06-9
3,4 Dihydroxy Benzoic Acid (Protocatchuic acid)	C7H6O4	4430	—	—	99-50-3
benzyl alcohol	C7H8O	2137	172.515	—	100-51-6
ortho cresol (ortho methoxy phenol)	C7H8O	3480	—	—	95-48-7
meta cresol (meta methoxy phenol)	C7H8O	3530	—	—	108-39-4
para cresol (para methoxy phenol)	C7H8O	2337	172.515	—	106-44-5
guaiacol (ortho hydroxy anisole)	C7H8O2	2532	172.515	—	90-05-1
2-methyl thio phenol	C7H8OS	3240	—	—	137-06-4
ortho (methyl thio) phenol	C7H8OS	3210	—	—	1073-29-6
4 methyl 2,6 dimethoxy phenol	C7H12O3	3704	—	—	6638-05-7
4 ethyl phenol	C8H8O	3156	—	—	123-07-9

Chart 9 *Continued*

Compound	Empirical Formula	FEMA GRAS #		NAS#	CAS#
para vinyl phenol	C8H8O	3739	—	—	2628-17-3
ortho hydroxy acetophenone	C8H8O2	3548	—	—	118-93-4
vanillin or (4 hydroxy 3 methoxy benzaldehyde)	C8H8O2	3107	135.110, 163.111, 163.112, 163.113, 163.114, 163.117, 163.123, 163.130, 163.135, 163.140, 163.145, 163.150, 163.155, 182.60, 182.90, 582.60	—	121-33-5
4-hydroxy benzoic acid	C8H8O3	2710	150.141, 150.161, 172.515, 184.1490	—	
4-methylbenzyl alcohol	C8H10O	4624	—	—	589-18-4
alpha methyl benzyl alcohol or (1 phenyl ethyl alcohol, styrallyl alcohol)	C8H10O	2685	172.515	—	98-85-1
methoxy benzyl alcohol or (anisyl alcohol)	C8H10O	2099	172.515	—	105-13-5
2 phenyl ethyl alcohol or (benzyl carbinol)	C8H10O	2858	172.515	—	60-12-8
2,5 xylenol (2,5 dimethyl phenol)	C8H10O	3595	—	—	95-87-4
2,6 xylenol (2,6 dimethyl phenol)	C8H10O	3249	—	—	576-26-1
3,4 xylenol (3,4 dimethyl phenol)	C8H10O	3596	—	—	95-65-8
2 methoxy 4 methyl phenol (creosol)	C8H10O2	2671	172.515	—	93-51-6
2-phenoxyethanol	C8H10O2	4620	—	—	122-99-6
2,6 dimethoxy phenol or (pyrogallol 1,3 dimethyl ether)	C8H10O2	3137	—	—	91-10-1
vanillyl alcohol	C8H10O3	3737	—	—	498-00-0
2 methoxy 4 vinyl phenol or (vinyl guaiacol)	C9H10O2	2675	172.515	—	7786-61-0
3 ethoxy 4 hydroxy benzaldehyde or (ethyl vanillin)	C9H10O3		2464/163.53, 163.111, 163.112, 163.113, 163.114, 163.117, 163.123, 163.130, 163.135, 163.145, 163.150, 164.155, 182.60, 582.60	—	121-32-4
beta methyl phenyl ethyl alcohol	C9H12O	2732	172.515	—	1123-85-9
ortho propyl phenol	C9H12O	3522	—	—	644-35-9

Chart 9 *Continued*

Compound	Empirical Formula	FEMA GRAS #		NAS#	CAS#
para propyl phenol	C9H12O	3649	—	—	645-56-7
2 iso propyl phenol	C9H12O	3461	—	—	88-69-7
1 phenyl 1 propanol	C9H12O	2884	172.515	—	93-54-9
3 phenyl 1 propanol	C9H12O	2885	172.515	—	122-97-4
mesitol or 2,4,6-trimethylphenol	C9H12O	4329	—	—	527-60-6
ortho ethoxy methyl phenol	C9H12O2	3485	—	—	20920-83-6
4 ethyl guaiacol	C9H12O2	2436	172.515	—	2785-89-9
para alpha dimethyl benzyl alcohol	C9H14O	3139	—	—	536-50-5
propyl gallate or (3,4,5, trihydroxy benzoic acid propyl ester or Tenox P.G.TM)	C10H12O5	2947	166.110, 172.615, 173.380, 175.125, 175.300, 175.390, 176.170, 177.1010, 177.1210, 177.1350, 184.1660	—	121-79-9
iso eugenol or (2 methoxy 1 hydroxy 4 propenyl benzene)	C10H12O2	2468	172.515	—	97-54-1
4 (para hydroxy phenyl) 2 butanone	C10H12O2	2588	172.515	—	5471-51-2
propyl para hydroxy benzoate or para alpha, alpha trimethyl benzyl alcohol	C10H12O3	2951	150.161, 150.141, 172.515, 184.1670	—	94-13-3
(para cymene 8 ol)	C10H14O	3242	—	—	1197-01-9
alpha, alpha dimethyl phenyl ethanol	C10H14O	2393	172.515	—	100-86-7
para iso propyl benzyl alcohol or (cuminic alcohol)	C10H14O	2933	172.515	—	536-60-7
thymol or (3-para cymenol, or 3 hydroxy para cymene, or para isopropyl meta cresol)	C10H14O	3066	172.515	—	89-83-8
4 phenyl 2 butanol	C10H14O	2879	172.515	—	2344-70-9
2 methoxy 4 propyl phenol or (dihydro eugenol)	C10H14O2	3598	—	—	2785-87-7
4 ethyl 2,6 dimethoxy phenol	C10H14O3	3671	—	—	14059-92-8
propenyl guaethol or (1-ethoxy 2-hydroxy 5-propenyl benzene)	C11H14O	2922	172.515	—	94-86-0
4 propenyl 2,6 dimethoxy phenol	C11H14O3	3728	—	—	20675-95-0

Chart 9 *Continued*

Compound	Empirical Formula	FEMA GRAS #		NAS#	CAS#
allyl 2,6 dimethoxy phenol	C11H14O3	3655	—	—	6627-88-9
isobutyl salicylate or (isobutyl ortho hydroxy benzoate)	C11H14O3	2213	172.515	—	87-19-4
zingerone or (4-hydroxy 3-methoxy benzyl acetone)	C11H14O3	3124	172.515	—	122-48-5
5 phenyl pentanol	C11H16O	3618	—	—	10521-91-2
alpha propyl phenyl ethyl alcohol	C11H16O	2953	172.515	—	705-73-7
2 methyl 4 phenyl 2 butanol	C11H16O	3629	—	—	103-05-9
4 propyl 2,6 dimethoxy phenol	C11H16O3	3729	—	—	6766-82-1
1 phenyl 3 methyl 3 pentanol	C12H18O	2883	172.515	—	10415-87-9
alpha isobutyl phenyl ethyl alcohol	C12H18O	2208	172.515	—	7779-78-4
raspbilene or alpha-ionene or 4,4,7-trimethyl-2,3-dihydro-1H-naphthalene	C13H18	4264	—	—	475-03-6
Phloretin or 3-(4-Hydroxy-phenyl)-1-(2,4,6-trihydroxy-phenyl)-propan-1-one	C15H14O5	4390	—	—	60-82-2
4-(2-propenyl)phenyl-beta-d-glucopyranoside	C15H20O6	4548	—	—	64703-98-6
(2r)-3′,5-dihydroxy-4′-methoxyflavanone	C16H12O5	4799	—	—	1449417-52-0
(+/−)-Hesperetin or 5,7-Dihydroxy-2-(3-hydroxy-4-methoxy-phenyl)-chroman-4-one	C16H14O6	4313	—	—	69097-99-0
3′,7-dihydroxy-4′-methoxyflavan	C16H16O4	4708	—	—	76426-35-2
magnolol	C18H18O2	4559	—	—	528-43-8
(–)-matairesinol	C20H22O6	4762	—	—	580-72-3
myricitrin	C21H20O12	4491	—	—	17912-87-7

Chart 10 Alcohols – Unsaturated Non-Aromatic

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
1 penten 3 ol	C5H10O	3382	172.515	—	616-25-1
3 methyl buten 1 ol (Prenol)	C5H10O	3647	—	—	556-82-1
cis-2-Pentenol	C5H10O	4305	—	—	20273-24-9
furfuryl alcohol or (2-furyl carbinol)	C5H6O2	2491	175.105	—	98-00-0
2-Methylbut-2-en-1-ol	C5H8O	4178	—	—	4675-87-0
5-Hexenol	C6H12O	4351	—	—	821-41-0
trans-3-Hexenol	C6H12O	4356	—	—	928-97-2
2 hexen 1 ol	C6H12O	2562	172.515	—	2305-21-7
3 hexen 1 ol	C6H12O	2563	172.515	—	928-96-1
4 hexen 1 ol	C6H12O	3430	—	—	6126-50-7
hexen 3 ol	C6H12O	3608	—	—	4798-44-1
3-mercaptohexanal	C6H12OS	4585	—	—	51755-72-7
maltol	C6H6O3	2656	172.515	—	118-71-8
(Z)-2-Hexen-1-ol	C6H8O	3924	—	—	928-94-9
2,4-Hexadien-1-ol	C6H8O	3922	—	—	111-28-4
2-hydroxy 2-cyclo hexen 1-one	C6H8O2	3458	—	—	10316-66-2
methyl cyclopentenolone	C6H8O2	2700	172.515	—	80-71-7
trans-2-*trans*-4-Heptadien-1-ol	C7H10O	4127	—	—	33467-79-7
3,5 dimethyl 1,2 cyclopentanedione	C7H10O2	3269	—	—	13494-07-0
5-ethyl 2-hydroxy 3-methyl cyclopent 2-en 1-one	C7H10O2	3454	—	—	53263-58-4
2-ethyl 4-hydroxy 5-methyl 3(2H) furanone	C7H10O3	3623	—	—	27538-09-6
5-ethyl 3-hydroxy 4-methyl 2(5H) furanone	C7H10O3	3153	—	—	698-10-2
(+/−)-1-Hepten-3-ol	C7H12O	4129	—	—	4938-52-7
(Z)-4-Hepten-1-ol	C7H12O	3841	—	—	6191-71-5
4-methyl 2,6 dimethoxy phenol	C7H12O3	3704	—	—	6638-05-7
ethyl maltol (3-hydroxy 3-ethyl 4-pyrone)	C7H8O2	3487	—	—	8114-94-0
(E,E)-2,4-Octadien-1-ol	C8H12O	3956	—	—	18409-20-6
3-ethyl 2-hydroxy 4-methyl cyclopent 2-en 1-one	C8H12O2	3452	—	—	21835-01-8
1,5-octadien-3-ol	C8H14O	4732	—	—	83861-74-9
(E)-2-Octen-1-ol	C8H14O	3887	—	—	18409-17-1
(E)-2-Octen-4-ol	C8H14O	3888	—	—	20125-81-9
2-ethyl-2-hexenal	C8H14O	4612	—	—	645-62-5
trans-6-octenal	C8H14O	4787	—	—	63196-63-4
1 octen 3 ol	C8H16O	2805	172.515	—	3391-86-4
cis 3 octen 1 ol	C8H16O	3467	—	—	20125-84-2
3 octen 2 ol	C8H16O	3602	—	—	76649-14-4
cis 5 octen 1 ol	C8H16O	3722	—	—	64275-73-6
(r)-(-)-1-octen-3-ol	C8H16O	4492	—	—	3687-48-7

Chart 10 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
cis-2-octenol	C8H16O	4615	—	—	26001-58-1
cis-4-Octenol	C8H16O	4354	—	—	54393-36-1
(E)-3-(Z)-6-Nonadien-1-ol	C9H14O	3884	—	—	56805-23-3
(Z)(Z)-3,6-Nonadien-1-ol	C9H14O	3885	—	—	53046-97-2
2,4-Nonadien-1-ol	C9H14O	3951	—	—	62488-56-6
2,6 nonadien 1 ol	C9H16O	2780	172.515	—	7786-44-9
2,6 dimethyl 6 hepten 1 ol or (alpha melonol)	C9H18O	3663	—	—	36806-46-9
cis 2 nonen 1 ol	C9H18O	3720	—	—	41453-56-9
cis 6 nonen 1 ol	C9H18O	3465	—	—	35854-86-5
trans 2 nonen 1 ol	C9H18O	3379	—	—	31502-14-4
cis-3-Nonen-1-ol	C9H18O	4412	—	—	10340-23-5
trans-3-nonen-1-ol	C9H18O	4605	—	—	10339-61-4
2,6-dimethyl-5-heptenol	C9H18O	4789	—	—	4234-93-9
1,3-p-menthadien-7-al	C10H14O	4506	—	—	1197-15-5
verbenol or (bicyclo [3.1.1] hept 2-en 2-ol)	C10H16O	3594	—	—	473-67-6
2 (10) pinene 3 ol	C10H16O	3587	—	—	5947-36-4
myrtenol (2 pinene 10 ol)	C10H16O	3439	—	—	515-00-4
carveol	C10H16O	2247	172.515	—	99-48-9
para mentha 1,8 dien 7 ol	C10H16O	2664	172.515	—	536-59-4
verbenol	C10H16O	3594	—	—	473-67-6
2,4-decadien-1-ol	C10H16O	3911	—	—	18409-21-7
d-2,8-p-menthadien-1-ol	C10H16O	4411	—	—	22771-44-4
isopulegol	C10H18O	2962	172.515	—	89-79-2
linalool (coriandrol)	C10H18O	2635	182.60,582.6	—	78-70-6
alpha terpineol	C10H18O	3045	172.515	—	98-55-5
beta terpineol or (para menth 8 en 1 ol)	C10H18O	3564	172.515	—	138-87-4
dihydro carveol or (8 para menthen 2 ol)	C10H18O	2377	172.515	—	619-01-2
para menth 1 en 3 ol	C10H18O	3179	—	—	491-04-3
para menth 3 en 1 ol	C10H18O	3563	172.515	—	586-82-3
nerol	C10H18O	2770	172.515	—	106-25-2
4 carvomenthenol	C10H18O	2248	172.515	—	562-74-3
dihydrocarveol	C10H18O	2379	172.515	—	619-01-2
geraniol or (2 trans 3,7 dimethyl 2,6 octadien 1-ol)	C10H18O	2507	182.60,582.6	—	106-24-1
fenchol (1,3,3 trimethyl 2-norbornanol)	C10H18O	2480	172.515	—	1632-73-1
1-Decen-3-ol	C10H18O	3824	—	—	51100-54-0
8-p-menthene-1,2-diol	C10H18O2	4409	—	—	1946-00-5
linalool oxide or (5 ethenyl tetrahydro alpha, alpha 5 trimethyl 2 furan methanol)	C10H18O2	3746	172.515	—	1365-19-1
(±)-2,5-undecadien-1-ol	C11H20O	4747	—	—	91212-78-1
trans-2-Decenol	C10H20O	4304	—	—	22104-80-9
cis-4-Decenol	C10H20O	4349	—	—	57074-37-0
citronellol (dl form)	C10H20O	2309	172.515	—	106-22-9

Chart 10 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
(+/−)-*trans*- and *cis*-4,8-Dimethyl-3,7-nonadien-2-ol	C11H18O	4102	—	—	67845-50-5
(E,R)-3,7-Dimethyl-1,5,7-octatrien-3-ol	C11H18O	3830	—	—	20053-88-7
2-Undecen-1-ol	C11H20O	4068	—	—	37617-03-1
undecen 1-ol	C11H22O	CFR1	172.515	—	112-43-6
trans- and *cis*-2,4,8-Trimethyl-3,7-nonadien-2-ol	C12H20O	4211	—	—	479547-57-4
(+/−)-2,4,8-Trimethyl-7-nonen-2-ol	C12H22O	4212	—	—	437770-28-0
2,2,6,7-tetramethylbicyclo[4.3.0] nona-4,9(1)-dien-8-ol	C13H20O	4521	—	—	97866-86-9
2,2,6,7-tetramethylbicyclo[4.3.0] nona-4,9(1)-dien-8-one	C13H20O	4522	—	—	97844-16-1
dehydro dihydro ionol or (alpha, 2, 6, 6 tetramethyl 1,3 cyclohexadiene 1 propanol)	C13H22O	3446	—	—	57069-86-0
alpha ionol	C13H22O	3624	—	—	25312-34-9
beta ionol	C13H22O	3625	—	—	22029-76-1
(4z,7z)-trideca-4,7-dienal	C13H22O3	4735	—	—	13552-95-9
dihydro beta ionol or (alpha 2,6,6, tetramethyl beta 1 cyclohexene 1 propanol)	C13H24O	3627	—	—	3293-47-8
trans-2-tridecenol	C13H26O	4617	—	—	74962-98-4
3-methyl-5-(2,2,3-trimethylcyclopent-3-en-1-yl) pent-4-en-2-ol	C14H24O	4775	—	—	67801-20-1
2,6,10-trimethyl-9-undecenal	C14H26O	4768	—	—	141-13-9
santalol (alpha & beta)OR (ArgeolTM, or ArheolTM)	C15H24O	3006	172.515	—	77-42-9
nerolidol	C15H26O	2772	172.515	—	7212-44-4
farnesol or (2,6,10 trimethyl 2,6,10 dodecatrien 12-ol)	C15H26O	2478	172.515	—	4602-84-0
Caryophyllene alcohol	C15H26O	4410	—	—	56747-96-7
2-hexyl-2-decenal	C16H30O	4786	—	—	13893-39-5
cis-9-Octadecenol	C18H36O	4363	—	—	143-28-2
2-octyl-2-dodecenal	C20H38O	4785	—	—	25234-33-7
trilobatin	C25H24O13	4674	—	—	4192-90-9

Chart 11 Alcohols – Aromatic and Unsaturated

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
4-Hydroxybenzyl alcohol	C7H8O2	3987	—	—	623-05-2
para vinyl phenol	C8H8O	3793	—	—	2628-17-3
4-methylbenzyl alcohol	C8H10O	4624	—	—	589-18-4
2-phenoxyethanol	C8H10O2	4620	—	—	122-99-6
cinnamyl alcohol	C9H10O	2294	172.515	—	104-54-1
4-Propenylphenol	C9H10O	4062	—	—	539-12-8
2 methoxy 4 vinyl phenol OR (vinyl guaiacol)	C9H10O2	2675	172.515	—	7786-61-0
2,3,6-Trimethylphenol	C9H12O	3963	—	—	2416-94-6
2 phenyl 3 butenol OR (methyl styrallyl carbinol)	C10H12O	2880	172.515	—	17488-65-2
p-tert-Butylphenol	C10H15O	3918	—	—	98-54-4
propenyl guaethol OR (1-ethoxy 2-hydroxy 5-propenyl benzene)	C11H14O	2922	172.515	—	94-86-0
2-Phenylphenol	C12H11O	3959	—	—	90-43-7

Chart 12 So-called Aldehydes

So-called	Really	Known As
Aldehyde C-14	Gamma Undecalactone	Peach Aldehyde
Aldehyde C-16	Ethyl Methyl Phenyl Glycidate	Strawberry Aldehyde
Aldehyde C-18	Gamma Nonylactone	Coconut Aldehyde

Chart 13 Aldehydes Aliphatic & Keto Aldehydes & Cyclic Ald

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
acetaldehyde	C2H4O	2003	182.60	—	75-07-0
pyruvic aldehyde OR (acetyl formaldehyde)	C3H4O2	2969	172.515	—	78-98-8
propanal	C3H6O	2923	172.515	—	123-38-6
butanal	C4H8O	2219	172.515	—	123-72-8
isobutyraldehyde	C4H8O	2220	172.515	—	78-84-2
valeraldehyde (pentanal)	C5H10O	3098	172.515	—	110-62-3
2 methyl butanal	C5H10O	2691	172.515	—	96-17-3
3 methyl butanal	C5H10O	2692	172.515	—	590-86-3
2-thienylmethanol	C5H6OS	4642	—	—	636-72-6
hexanal	C6H12O	2557	172.515	—	66-25-1

Chart 13 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
2 ethyl butanal	C6H12O	2426	172.515	—	97-96-1
2 methyl pentanal	C6H12O	3413	—	—	123-15-9
2,3 epoxy heptanal	C7H12O2	4658	—	—	58936-30-4
2,3-epoxyheptanal	C7H12O2	4658	—	—	58936-30-4
heptanal	C7H14O	2540	172.515	—	111-71-7
3-Methylhexanal	C7H14O	4261	—	—	19269-28-4
2,3 epoxy octanal	C8H14O2	4657	—	—	42134-50-9
2,3-epoxyoctanal	C8H14O2	4657	—	—	42134-50-9
4-methyl-2-(methylthiomethyl)-2-pentanal	C8H14OS	4568	—	—	40878-73-7
octanal	C8H16O	2797	172.515	—	124-13-0
6-methylheptanal	C8H16O	4498	—	—	63885-09-6
piperonal (heliotropine)	C8H6O	2911	182.60, 582.60	—	120-57-0
(2,4)- and (3,5)- and (3,6)-dimethyl-3-cyclohexenylcarbaldehyde	C9H14O	4505	—	—	27939-60-2
nonanal	C9H18O	2782	172.515	—	124-19-6
2 methyl octanal	C9H18O	2727	172.515	—	7786-29-0
3,5,5 trimethyl hexanal	C9H18O	3524	—	—	5435-64-3
dl 6 metyl octanal	C9H18O	4433	—	—	30689-75-9
(+/−)-6-methyloctanal	C9H18O	4433	—	—	30689-75-9
2,3 epoxy decanal	C10H18O2	4659	—	—	102369-06-2
2,3-epoxydecanal	C10H18O2	4659	—	—	102369-06-2
3,7-dimethyl-1-octanal or 3,7-dimethyloctanal	C10H19O	4348	—	—	5988-91-0
decanal	C10H20O	2362	182.60, 582.60	—	111-31-2
(+/−)-4-Ethyloctanal	C10H20O	4117	—	—	58475-04-0
2,6 dimethyl octanal	C10H20O	2390	172.515	—	7/9/7779
8-methylnonanal	C10H20O	4803	—	—	3085-26-5
(±)-6-methoxy-2,6-dimethylheptanal	C10H20O2	4745	—	—	62439-41-2
3-(3,4-methylenedioxyphenyl)-2-methylpropanal	C11H12O3	4599	—	—	1205-17-0
(e)-4-undecenal	C11H20O	4672	—	—	68820-35-9
undecanal	C11H22O	3092	172.515	—	112-44-7
(±)-8-methyldecanal	C11H22O	4795	—	—	127793-88-8
2-hexylidenehexanal	C12H22O	4616	—	—	13019-16-4
dodecanal (lauric aldehyde)	C12H24O	2615	172.515	—	112-54-9
2 methyl undecanal	C12H24O	2749	172.515	—	110-41-8
Tridecanal	C13H25O	4335	—	—	10486-19-8
myristaldehyde	C14H28O	2763	172.515	—	124-25-4
12-Methyltridecanal	C14H28O	4005	—	—	75853-49-5

Chart 14 Aldehydes – Unsaturated

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
2,4 pentadienal	C5H6O	3217	—	—	764-40-9
Pent-4-en-1-al	C5H8O	4262	—	—	2100-17-6
2 pentenal	C5H8O	3218	—	—	764-39-6
2 methyl 2 butenal	C5H8O	3407	—	—	497-03-0
3 methyl 2 butenal	C5H8O	3646	—	—	107-86-8
trans 2 trans 4 hexadienal	C6H8O	3429	—	—	142-83-6
3-Hexenal	C6H10O	3923	—	—	4440-65-7
trans-4-hexenal	C6H10O	4046	—	—	25166-87-4
2 methyl 2 pentenal	C6H10O	3194	—	—	623-36-9
4 methyl 2 pentenal	C6H10O	3510	—	—	5362-56-1
hexen 2 al	C6H10O	2560	172.515	—	6728-26-3
cis 3 hexenal	C6H10O	2561	—	—	6789-80-6
cis 4 hexenal	C6H10O	3496	—	—	4634-89-3
2,4 heptadienal	C7H10O	3164	—	—	3/5/4313
4 heptenal (cis and trans)	C7H12O	3289	172.515	—	6728-31-0
trans 2 heptenal	C7H12O	3165	—	—	18829-55-5
3-(5-Methyl-2-furyl)prop-2-enal	C8H8O2	4175	—	—	5555-90-8
trans 2 trans 6 octadienal	C8H12O	3466	—	—	56767-18-1
trans 2 trans 4 octadienal	C8H12O	3721	—	—	30361-28-5
(+/−)-*trans*- and *cis*-5-(2,2-dimethylcyclopropyl)-3-methyl-2-pentenal	C8H12O	4105	—	—	877-60-1
2 butyl 2 butenal	C8H14O	3392	—	—	25409-08-9
2 octen 1 al	C8H14O	3215	—	—	2363-89-5
cis 5 octenal	C8H14O	3749	—	—	41547-22-2
2,4 nonadienal	C9H12O	3212	—	—	3/4/6750
trans 2 cis 6 nonadienal	C9H12O	3377	—	—	557-48-2
trans 2 trans 6 nonadienal	C9H12O	3766	—	—	17587-33-6
Nona-2,4,6-trienal	C9H12O	4187	—	—	57018-53-8
mixture of 1-vinyl-3-cyclohexenecarbaldehyde and 4-vinyl-1-cyclohexenecarbaldehyde	C9H12O	4783	—	—	1049017-63-1; 1049017-68-6
2 methyl 2 octenal	C9H14O	3711	—	—	49576-57-0
2 ethyl 2 heptenal	C9H14O	2438	172.515	—	10031-88-6
2 nonenal	C9H14O	3213	—	—	2463-53-8
cis 6 nonenal	C9H14O	3580	—	—	2277-19-2
2 iso propyl 5 methyl 2 hexenal	C9H14O	3406	—	—	35158-25-9
(+–)-cis- and trans-2-Methyl-2-(4-methyl-3-pentenyl) cyclopropanecarbaldehyde – tastant	C9H14O	4393	—	—	97231-35-1
(E)-4-Nonenal or trans-4-Nonenal	C9H16O	4302	—	—	2277-16-9
2,6 dimethyl 5 heptenal OR (melonal)	C9H18O	2389	172.515	—	106-72-9
2,6,6 trimethyl cyclohexa 1,3 dienyl methanal (dehydro beta cyclo citral, safranal)	C10H14O	3389	—	—	116-26-7
trans 2 trans 4 decadienal	C10H14O	3135	—	—	25152-84-5
2-t*rans*-4-*trans*-7-*cis*-Decatrienal	C10H14O	4089	—	—	66642-86-2
2 decenal	C10H16O	2366	172.515	—	3913-71-1

Chart 14 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
4 decenal	C10H16O	3264	—	—	30390-50-2
cis 5 isopropenyl cis 2 methyl cyclopentan 1 carboxaldehyde (photocitral)	C10H16O	3645	—	—	55253-28-6
2,6,6 trimethyl 1,2, cyclohexene 1 carboxaldehyde (cyclo citral)	C10H16O	3639	—	—	432-25-7
4,5-Epoxy-(E)-2-decenal	C10H1602	4037	—	—	188590-62-7
9-Decenal	C10H18O	3912	—	—	39770-05-3
2,6,6 trimethyl 1 cyclohexene 1 acetaldehyde (beta homocitral)	C11H18O	3474	—	—	472-66-2
2,4 undecadienal	C11H18O	3422	—	—	13162-46-4
2 undecenal	C11H18O	3423	—	—	2463-77-6
9 undecenal	C11H20O	3094	172.515	—	143-14-6
10 undecenal	C11H20O	3095	172.515	—	112-45-8
(Z)-4-Dodecenal OR Tangerinal	C12H22O	4036	—	—	21944-98-9
3,7,11-Trimethyl-2,6,10-dodecatrienal	C12H18O	4019	—	—	19317-11-4
trans 2 trans 6 dodecadienal	C12H22O	3637	—	—	21662-16-8
trans 2 trans 4 dodecadienal	C12H22O	3670	—	—	21662-96-0 2
dodecenal	C12H24O	2402	172.515	—	4826-62-4
(Z)-8-Tetradecenal	C14H26O	4066	—	—	169054-69-7
trans 2 cis 4 cis 7 trideca trienal	C13H20O	3638	—	—	13552-96-0
2 tridecenal	C13H26O	3082	172.515	—	7774-82-5
Tetradec-2-enal	C14H26O	4209	—	—	51534-36-2
9-Octadecenal	C18H34O	4059	—	—	5090-41-5

Chart 15 Aromatic Aldehydes

Compound	Empirical Formula	FEMA	CFR	NAS#	CAS#
benzaldehyde	C7H6O	2127	182.60, 582.60	—	100-52-7
4-Hydroxybenzaldehyde	C7H6O2	3984	—	—	123-08-0
salicylic aldehyde OR (hydroxy benzaldehyde)	C7H6O2	3004	172.515	—	90-02-8
2 hydroxy 4 methyl benzaldehyde	C8H8O	3697	172.515	—	698-27-1
tolualdehydes (mixed ortho, meta & para)	C8H8O	3068	172.515	—	1334-78-7
phenyl acetaldehyde	C8H8O	2874	172.515	—	122-78-1
ortho methoxy benzaldehyde or (ortho anisaldehyde)	C8H8O2	7627	172.515	7627	135-02-4
para methoxy benzaldehyde or (para anisaldehyde)	C8H8O2	2670	172.515	—	123-11-5
o-Anisaldehyde	C8H8O2	4077	—	—	135-02-4
vanillin or (4 hydroxy 3 methoxy benzaldehyde)	C8H8O3	3107	135.110, 163.111, 163.112, 163.113, 163.114, 163.117, 163.123, 163.130, 163.135, 163.140, 163.145, 163.150, 163.155, 182.60, 182.90, 582.60	—	121-33-5

Chart 15 *Continued*

Compound	Empirical Formula	FEMA	CFR	NAS#	CAS#
2 hydroxy 4 methoxy benzaldehyde	C8H8O3	4435	—	—	673-22-3
tolyl acetaldehyde or (syringaldehyde)	C9H10O	3071	172.515	—	104-09-6
2,4 dimethyl benzaldehyde or (2,4 xylyl aldehyde)	C9H10O	3427	—	—	15764-16-6
4 ethyl benzaldehyde	C9H10O	3756	—	—	4748-78-1
2 phenyl propionaldehyde	C9H10O	2886	172.515	—	93-53-8
3 phenyl propionaldehyde	C9H10O	2887	172.515	—	104-53-0
para ethoxy benzaldehyde	C9H10O2	2413	172.515	—	10031-82-0
veratraldehyde or (vanillin methyl ether)	C9H10O3	3109	172.515	—	120-14-9
4-Hydroxy-3,5,-dimethoxy benzaldehyde	C9H10O3	4049	—	—	134-96-3
3 ethoxy 4 hydroxy benzaldehyde or (ethyl vanillin)	C9H10O3	2464	163.53, 163.111, 163.112, 163.113, 13.114, 163.117, 163.123, 163.130, 163.135, 163.145, 163.150, 164.155, 182.60, 582.60	—	121-32-4
2 phenyl butenal	C10H10O	3224	—	—	4411-89-6
2 (para tolyl) propionaldehyde	C10H12O	3078	172.515	—	99-72-9
cumin aldehyde or (para isopropyl benzaldehyde)	C10H12O	2341	172.515	—	122-03-2
2 phenyl 4 pentenal	C11H12O	3519	—	—	24401-36-3
3 phenyl 4 pentenal	C11H12O	3318	—	—	939-21-9
vanillidine acetone	C11H12O3	3738	—	—	1080-12-2
isopropyl phenyl acetaldehyde	C11H14O	2954	172.515	—	4395-92-0
2 methyl 3 tolyl propionaldehyde (Mixed ortho, meta, para)	C11H14O	2748	172.515	—	41496-43-9
3 methyl 2 phenyl butanal	C11H14O	2378	172.515	—	2439-44-3
2 methyl 4 phenyl butanal	C11H14O	2737	—	—	40654-82-8
4 methyl 2 phenyl 2 pentenal	C12H14O	3200	—	—	26643-91-4
cuminaldehyde (3 (para isopropyl phenyl) propionaldehyde)	C12H16O	2957	172.515	—	7775-00-0
vanillyl butyl ether or (4-(butoxy methyl) 2 methoxy phenol)	C12H18O3	3796	—	—	82654-98-6
2 phenyl 3 (2 furyl) pro 2 enal	C13H10O2	3586	—	—	65545-81-5
butyl cinnamic aldehyde	C13H16O	2191	172.515	—	7492-44-6
(+/−)-2-Phenyl-4-methyl-2-hexenal	C13H16O	4194	—	—	26643-92-5
2 methyl 3 (p isopropyl phenyl) propanal	C13H18O	2743	172.515	—	103-95-7
5 methyl 2 phenyl 2 hexenal	C14H18O	3199	—	—	21834-92-4

Chart 16 Alfalfa

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
food	2013	182.2	—	84083-36-0	green
extract	—	582.2	—	—	nutty
powder	—		6622	—	brown
herb & seed	—	182.10, 582.10	6170	—	vegetable

Chart 17 Alkaloids

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
Caffeine Related Compounds					
caffeine	C8H10N4O2	2224	182.1180	—	58-08-2
theobromine OR (methyl caffeine)	C7H8N4O2	3591	—	—	83-67-0
Quinine Related Compounds				—	
quinine sulfate	(C20H24N2O2)2-H2SO4 + 7 H2O	2977	172.575	—	6119-70-6
quinine bisulfate	C20H24N2O2-H2SO4 + 7 H2O	2975	172.575	—	549-56-4
quinine hydrochloride	C20H24N2O2-HCl+2 H2O	2976	172.575	—	130-89-2

Chart 18 Hydrocarbons – Alkyl Non Aromatic

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
4-methyl-cis-2-pentene	C6H12	4650	—	—	691-38-3
2 methyl 1,3, cyclohexadiene	C7H10	—	172.515	7800	30640-46-1
(E,E)-2,4-Nonadiene or trans-2-trans-4-Nonadiene	C7H14O	4292	—	—	56700-78-8
alpha-Octene or 1 octene	C9H16	4293	—	—	111-66-0
1-nonene	C9H18O	4651	—	—	124-11-8
1-cyclopropanemethyl-4-methoxybenzene	C11H14O	4759	—	—	16510-27-3
1,3,5,7-undecatetraene	C11H16	4652	—	—	116963-97-4
1,3,5 undecatriene	C11H18	3795	—	—	16356-11-9

Chart 19 Allergens

Tree Nuts ***
Peanuts ***
Soy and other Legumes
Crustaceans (Shellfish) ***
Eggs and Egg Products
Dairy and Dairy Products
Grain Products (containing Gluten)
Mollusks
Fish
Soy and other Legumes
Sulfites *** (Not a true protein allergen, but potentially a life threatening hypersentive)

*** Represent the most dangerous allergens and sensitizers
Peanuts is listed separately from other legumes due to the intensity of the potential response.

Chart 20 Allyl Compounds

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
allyl mercaptan	C3H6S	2035	172.515	—	870-23-5
allyl iso thio cyanate	C4H5NS	2034	172.515	—	57-06-7
allyl methyl disulfide	C4H8S2	3127	—	—	2179-58-0
allyl methyl trisulfide	C4H8S3	3253	—	—	34135-85-8
allyl thio propionate	C6H10OS	3329	—	—	41820-22-8
allyl propionate	C6H10O2	2040	172.515	—	2408-20-0
allyl sulfide	C6H10S	2042	172.515	—	592-88-1
allyl disulfide	C6H10S2	2028	172.515	—	2179-57-9
diallyl trisulfide	C6H10S3	3265	—	—	2050-87-5
allyl butyrate	C7H12O2	2021	172.515	—	2051-78-7
allyl 2 furoate	C8H8O3	2030	—	—	4208-49-5
allyl tiglate	C8H12O2	2043	172.515	—	7493-71-2
allyl isovalerate	C8H14O2	2045	172.515	—	2835-39-4
allyl sorbate	C9H12O2	2041	172.515	—	30895-79-5
allyl 2 ethyl butyrate	C9H16O2	2029	172.515	—	7493-69-8
allyl hexanoate	C9H16O2	2023	172.515	—	142-19-8
allyl anthranilate	C10H11NO2	2020	172.515	—	7493-63-2
allyl heptanoate	C10H18O2	2031	—	—	123-68-2
allyl cyclo hexane acetate	C11H12O2	2032	172.515	—	4728-82-9
allyl phenyl acetate	C11H12O2	2039	172.515	—	1797-74-6
allyl phenoxy acetate	C11H12O3	2038	172.515	—	7493-74-5
allyl dimethoxy phenol	C11H14O3	3655	—	—	6627-88-9
allyl cinnamate	C11H18O2	2022	172.515	—	1866-31-5
allyl octanoate	C11H20O2	2037	172.515	—	4230-97-1
allyl cyclo hexane propionate	C12H20O2	2026	172.515	—	2705-87-5
allyl nonanoate	C12H22O2	2036	172.515	—	7493-72-3
allyl cyclo hexane butyrate	C13H22O2	2024	172.515	—	7493-65-4
allyl cyclo hexane pentanoate	C14H24O2	2027	172.515	—	7493-68-7
allyl 10 undecenoate	C14H24O2	2044	172.515	—	7493-76-7
allyl cyclohexane hexanoate	C15H26O2	2025	172.515	—	7493-66-5
allyl alpha ionone	C16H24O	2033	172.515	—	79-78-7
diallyl polysulfides where x=2,3,4 or 5	C6H10Sx,	3533	—	—	72869-75-1

Chart 21 Bitter Almond

Form	FEMA GRAS #	CFR	CAS #	NAS #	Descriptor
Oil	2046	582.20 (FFPA), 182.2	8013-76-1	—	brown nut types

Chart 22 Aloe

Form	FEMA GRAS #	CFR	NAS #	CAS #	Descriptor
Aloe	2047	172.51	—	8001-76-1	bittering agent

Chart 23 Althea Root

Form	FEMA GRAS #	CFR	NAS #	CAS #	Descriptor
Althea Root (Althea officinalis L.)					
roots	2048	—	—	—	brown
roots & flowers	—	172.510	—	999999-19-7	gums & thickeners

Chart 24 Ambergris

Form	FEMA GRAS #	CFR	NAS #	CAS #	Descriptor
Ambergris	2049	582.5, 182.50	—	88038-65-1	resinous

Chart 25 Ambrette Seed

Form	FEMA GRAS #	CFR	NAS #	CAS #	Descriptor
absolute oil	2050	182.20	—	8015-62-1	musk type
absolute	2051	182.10, 582.20	—	8015-62-1	floral type
tincture	2052	182.10, 582.20	—	999999-19-8	floral type

Chart 26 Amides

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
n-(1h-pyrazol-5-yl)-n-(thiophen-2-ylmethyl)-2-(p-tolyloxy)acetamide	C11H14O4	4809			1374760-95-8
(+/−)-n-lactoyl tyramine	C11H15NO3	4550	—	—	781674-18-8
n-(2-hydroxyethyl)-2,3-dimethyl-2-isopropylbutanamide	C11H23NO2	4602			883215-02-9
N-Cyclopropyl-*trans*-2-*cis*-6-nonadienamide	C12H19NO	4087	—	—	608514-55-2
N-Ethyl *trans*-2-*cis*-6-nonadienamide	C12H19NO	4113	—	—	608514-56-3
n-ethyl-2,2-diisopropylbutanamide	C12H25NO	4557			51115-70-9
n-(1,1-dimethyl-2-hydroxyethyl)-2,2-diethylbutanamide	C12H25NO2	4603			51115-77-6
n-ethyl-5-methyl-2-(1-methylethenyl) cyclohexanecarboxamide	C13H23NO	4808			1426229-32-4
n-(2-methylcyclohexyl)-2,3,4,5,6-pentafluorobenzamide	C14H14F5NO	4678			1003050-32-5
(3r,3s)-3-[[(4-amino-2,2-dioxido-1h-2,1,3-benzothiadiazin-5-yl)oxy]methyl]-n-cyclopentyl-2-oxo-3-piperidinecarboxamide	C14H21N5O5S	4793			1446687-20-2
(2e,6e/z,8e)-n-(2-methylpropyl)-2,6,8-decatrienamide	C14H23NO	4668			504-48-3
N-Isobutyldeca-*trans*-2-*trans*-4-dienamide	C14H25NO	4148	—	—	18836-52-7
cyclopropanecarboxylic acid (2-isopropyl-5-methylcyclohexyl)amide	C14H25NO	4558			958660-02-1; 958660-04-3
n-cyclopropyl-5-methyl-2-isopropylcyclohexanecarboxamide	C14H25NO	4693			73435-61-7
N-3,7-Dimethyl-2,6-octadienylcyclopropylcarboxamide	C14N23NO	4267	—	—	744251-93-2
3-[(4-amino-2,2-dioxido-1h-2,1,3-benzothiadiazin-5-yl)oxy]-2,2-dimethyl-n-propylpropanamide	C15H22N4O4S	4701			1093200-92-0

Chart 26 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
[1R-(1.alpha.,2.beta.,5.alpha)]-N-[[5-Methyl-2-(1-methylethyl)cyclohexyl]carbonyl glycine ethyl ester or N-[(Ethoxycarbonyl) methyl)-p-menthane-3-carboxamide	C15H27NO3	4309	—	—	68489-14-5
(r)-n-(1-methoxy-4-methylpentan-2-yl)-3,4-dimethylbenzamide	C16H25NO2	4751			851669-60-8
N-(Heptan-4-yl)benzo[d][1,3]dioxole-5-carboxamide	C16H25NO4	4232	—	—	745047-51-2
N1-(2-methoxy-4-methylbenzyl)-N2-(2-(pyridin-2-yl)ethyl)oxalamide	C16H30N2O2	4231	—	—	745047-97-6
N1-(2,4-Dimethoxybenzyl)-N2-(2-(pyridin-2-yl)ethyl)oxalamide	C16H30N2O3	4233	—	—	745047-53-4
2-(4-methylphenoxy)-n-(1h-pyrazol-3-yl)-n-(thiophen-2-ylmethyl)acetamide	C17H19N3O	4809			1374760-95-8
nonanoyl 4 hydroxy 3 methoxy benzylamide	C17H27NO3	2787	172.515	—	2444-46-4
N1-(2-Methoxy-4-methylbenzyl)-N2-(2-(5-methylpyridin-2-yl)ethyl)oxalamide	C17H33N2O2	4234	—	—	745047-94-3
n1-(2,3-dimethoxybenzyl)-n2-(2-(pyridin-2-yl) ethyl) oxalamide	C18H21N3O4	4741			851670-40-1
(1r,2s,5r)-n-(4-methoxyphenyl)-5-methyl-2-(1-methylethyl)cyclohexanecarboxamide	C18H27NO2	4681			68489-09-8
n-(2-(pyridin-2-yl)ethyl)-3-p-menthanecarboxamide	C18H28N2O	4549			847565-09-7
n-p-benzeneacetonitrilementhanecarboxamide	C19H26N2O	4496			852379-28-3
(2s,5r)-n-[4-(2-amino-2-oxoethyl)phenyl]-5-methyl-2-(propan-2-yl) cyclohexanecarboxamide	C19H28N2O2	4684			1119711-29-3
(e)-n-[2-(1,3-benzodioxol-5-yl)ethyl]-3-(3,4-dimethoxyphenyl)prop-2-enamide	C20H21NO5	4773			125187-30-6
3-(3,4-Dimethoxyphenyl)-N-[2-(3,4-dimethoxyphenyl)ethyl]-2-propenamide or N-[2-(3,4-Dimethoxyphenyl)ethyl]-3,4-dimethoxycinnamic acid amide	C21H25NO2	4310	—	—	69444-90-2
(e)-3-benzo[1,3]dioxol-5-yl-n,n-diphenyl-2-propenamide	C21H25O5	4788			1309389
Acetamide, Methanecarboxamide	C2H5NO	4251	—	—	60-35-5
Butyramide	C4H9NO	4252	—	—	541-35-5

Chart 27 Amines

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
ammonium sulfide	H8N2S	2053	172.515	—	12124-99-1
Ethylamine	C2H7N	4236	—	—	75-04-7
trimethyl amine	C3H9N	3241	173.20	—	75-50-3
Isopropylamine, 1-Methylethylamine	C3H9N	4238	—	—	75-31-0
Propylamine	C3H9N	4237	—	—	107-10-8
Triethylamine	C3H9N	4246	—	—	121-44-8
Trimethylamine oxide	C3H9NO	4245	—	—	1184-78-7
Trimethylamine oxide	C3H9NO	4245	—	—	1184-78-7
1-Amino-2-propanol	C3H9N0	3965	—	—	78-96-6
Piperazine	C4H10N	4250	—	—	110-85-0
3-(methylthio)propylamine	C4H11NS	4649	—	—	4104-45-4

Chart 27 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
butylamine	C4H11N	3130	—	—	109-73-9
Isobutylamine, 1-Amino-2-methylpropane	C4H11N	4239	—	—	78-81-9
sec-Butylamine, (±)-2-Aminobutane	C4H11N	4240	—	—	13952-84-6
isopentylamine	C5H13N	3219	—	—	107-85-7
2-Methylbutylamine	C5H13N	4241	—	—	96-15-1
Isopentylidene isopentylamine	C5H13N	3990	—	—	35448-31-8
Pentylamine	C5H13N	4242	—	—	110-58-7
Hexylamine	C6H15N	4243	—	—	111-26-2
ammonium isovalerate	C5H13O2N	2054	172.515	—	7563-33-9
1,6-Hexalactam, 2-Oxohexamethylenimine, amino hexanoic acid cyclic lactam, 2 aza cycloheptanone	C6H11NO	4235	—	—	105-60-2
S-ethyl 2-acetylamino ethanethioate	C6H14NO	4039	—	—	4396-62-7
2-Aminoacetophenone	C8H9NO	3906	—	—	551-93-9
phenyl ethyl amine	C8H111N	3220	—	—	64-04-0
Tyramine, 2-(4-Hydroxyphenyl) ethylamine	C8H11NO	4215	—	—	51-67-2
N,*N*-Dimethylphenethylamine	C9H13N	4248	—	—	19342-01-9
Tripropylamine	C9H21N	4247	—	—	102-69-2
n ethyl isopropyl 5 methyl cyclohexyl carboxamide	C13H254NO	3455	—	—	39711-79-0

Chart 28 Amino Acids – Groups

Aromatic Amino Acids	
	Phenylalanine
	Tyrosine
	Tryptophan
Sulfur Containing Amino Acids	
	Methionine
	Cysteine
	Cystine
Alcohols (These react with phosphates)	
	Serine
	Threonine
Polar Groups – Acids	
	Apartate
	Glutamate
Polar Groups – Bases	
	Histidine
	Lysine
	Arginine
Polar Groups – Amides	
	Asparginine
	Glutamine
Non Polar Groups – Aliphatic Amino Acids	
	Glycine
	Valine
	Alanine
	Leucine
	IsoLeucine
	Proline

Chart 29 Amino Acids

Compound	Empirical Formula	FEMA GRAS #		NAS#	CAS#
glycine OR (amino acetic acid	C2H5NO2	3287	172.320, 172.812	—	56-40-6
taurine	C2H7NO3S	3813-	—	—	107-35-7
l alanine OR ((S) 2 amino propionic acid)	C3H7NO2	—	172.320	6	56-41-7
dl-alanine	C3H7NO2	3818	172.540	7600	302-72-7
d-alanine	C3H7NO2	—	not approved as such	—	338-69-2
beta alanine	C3H7NO2	3252-		—	107-95-9
l cysteine mono hydrochloride-anhydrous	C3H7NO2-HCl	—	172.320, 184.1271	1000	52-89-1
s-carboxy methyl l cysteine OR l cysteine mono hydrochloride-monohydrate	C3H7NO2-HCl-H20	—	not approved as such	—	638-23-3
dl cysteine mono hydrochloride-monohydrate	C3H7NO2-HCl-H20	—	not approved as such	—	96998-61-7
l cysteine OR((R) 2 amino 3 mercapto propionic acid)	C3H7NO2S	3263	172.320, 184.1271	—	52-90-4
dl cysteine OR ((R) 2 amino 3 mercapto propionic acid)	C3H7NO2S	—	not approved as such	72	3374-22-9
d cysteine OR ((R) 2 amino 3 mercapto propionic acid)	C3H7NO2S	—	not approved as such	—	32443-99-5
dl cystine	C3H7NO2S	—	not approved as such	72	923-32-0
l serine ((S) 2 amino 3 hydroxy propionic acid)	C3H7NO3	—	172.320	173	56-45-1
dl serine ((S) 2 amino 3 hydroxy propionic acid)	C3H7NO3	—	172.320	172	308-84-1
l-cysteine methyl ester hydrochloride	C4H10ClNO2S	4781	—	—	18598-63-5
mono potassium l aspartate	C4H6KNO4	—	not approved as such	—	1115-63-5
monosodium l aspartate	C4H6NNaO	—	not approved as such	—	3792-50-5
monosodium l aspartate monohydrate	C4H6NNaO4-H2O	—	not approved as such	—	—
l aspartic acid OR ((S) 2 amino succinic acid)	C4H7NO4	3656	172.320	—	56-84-8
l aspargine OR ((S) 2 amino succinamic acid)	C4H8N2O3	—	172.320	—	2058-58-4
l aspargine monohydrate	C4H8N2O3-H2O	—	not approved as such	—	5794-13-8
gamma amino butyric acid	C4H9NO2	—	not approved as such	—	56-12-2
epsilon amino caproic acid	C4H9NO2	—	not approved as such	—	60-32-2

Chart 29 *Continued*

Compound	Empirical Formula	FEMA GRAS #		NAS#	CAS#
gamma-Aminobutanoic acid or 4-Aminobutyric acid	C4H9NO2	4288	—	—	56-12-2
l cysteine methyl ester mono hydrochloride	C4H9NO2S-HCl	—	not approved as such	—	18598-63-5
l threonine	C4H9NO3	—	172.320	—	72-19-5
dl threonine	C4H9NO3	—	172.320	—	80-68-2
l-threonine	C4H9NO3	4710	—	—	72-19-5
l glutamine OR ((S) 2 amino glutaramic acid)	C5H10N2O3	3684	172.320	—	56-85-9
l valine ((S) 2 amino 3 methyl butyric acid)	C5H11NO2	—	172.320	—	72-18-4
d valine	C5H11NO2	3444	—	—	516-06-3
dl valine	C5H11NO2	3444	—	—	516-06-3
l methionine ((S) 2 amino 4 (methyl thio) butyric acid)	C5H11NO2S	3301	172.320	—	59-51-8
dl methionine	C5H11NO2S	—	172.320	360	63-68-3
l cysteine ethyl ester mono hydrochloride	C5H11NO2S-HCl	—	not approved as such	—	868-59-7
N-Lactoyl ethanolamine	C5H11NO3	4256	—	—	5422-34-4
l ornithine acetate monohydrate ((S) 2,5 diamino valeric acid acetate monohydrate)	C5H12N2O2-C2H4O2-H2O	—	not approved as such	—	60259-81-6
l ornithine mono hydrochloride ((S) 2,5 diamino valeric acid mono hydrochloride)	C5H12N2O2-HCl	4190	—	—	3184-13-2
L-Ornithine monochlorohydrate/ Ornithine	C5H12N4O2 / NH2(CH2)3CH(CO2H)(NH2) · HCl	4190	—	—	3184-13-2
N-Lactoyl ethanolamine phosphate	C5H12NO6P	4257	—	—	782498-03-7
mono potassium l glutamate	C5H3NO4K	—	172.320	—	
mono sodium glutamate	C5H8NO4Na	2756	—	—	142-47-2
monosodium glutamate monohydrate	C5H8NO4Na-H20	—	not approved as such	—	6106-04-3
l proline ((S) 2 pyrollidine carboxylic acid)	C5H9NO2	3319	172.320	—	147-85-3
dl proline ((S) 2 pyrollidine carboxylic acid)	C5H9NO2	—	not approved as such	161	609-36-9
hydroxy proline	C5H9NO3	—	not approved as such	—	51-35-4
n acetyl l cysteine	C5H9NO3S	—	not approved as such	—	616-91-1
glutamic acid	C5H9NO4	3285	180.1045, 172.320	—	56-86-0
l glutamic acid OR ((S) 2 amino glutaric acid)	C5H9NO4	3285	172.320	—	56-86-0

Chart 29 *Continued*

Compound	Empirical Formula	FEMA GRAS #		NAS#	CAS#
glutamic acid hydrochloride	C5H9NO4-HCl	—	172.320	88	138-15-8
1,6-Hexalactam	C6H11NO	4235	—	—	105-60-2
3-(allylthio)-alanine or S-allyl-L-cysteine	C6H11NO2S	4322	—	—	21593-77-1
l cystine ((R) 2, 2′ diamino 3, 3′ dithio bis (propionic acid)	C6H12N2O4S2	—	172.320	73	923-32-0 or 56-89-3
l citruline OR ((S) 2 amino 5 isovaleric acid)	C6H13N3O3	—	not approved as such	—	372-75-8
l isoleucine ((2S, 3S 2 amino 3 methyl valeric acid)	C6H13NO2	—	172.320	102	73-32-5
dl isoleucine OR l leucine ((S) 2 amino 4 methyl valeric acid)	C6H13NO2	3295	172.320	—	443-79-8
l leucine ((S) 2 amino 4 methyl valeric acid)	C6H13NO2	3297	172.320, 172.812	—	61-90-5
l-isoleucine	C6H13NO2	4675	—	—	73-32-5
l lysine ((S) 2,6 diamino hexanoic acid) (anhydrous)	C6H14N2O2	—	172.320, 3847	109	56-87-1
dl lysine ((S) 2,6 diamino hexanoic acid) (anhydrous)	C6H14N2O2	—	172.320	108	70-54-2
l lysine acetate	C6H14N2O2-C2H4O2	—	not approved as such	—	57282-49-2
l lysine mono hydrochloride	C6H14N2O2-HCl	—	172.320	—	657-27-2
l arginine OR ((S) 2 amino 5 guanido valeric acid)	C6H14N4O2	—	172.320	—	74-79-3
dl arginine	C6H14N4O2	3819	—	20	74-79-3
L-Arginine	C6H14N4O2	3819	—	—	74-79-3
L-Lysine	C6H14N4O2	3847	—	—	56-87-1
l arginine acetate	C6H14N4O2-C2H4O2	—	not approved as such	—	71173-62-1
l arginine mono hydrochloride	C6H14N4O2-HCl	—	172.320	—	1119-34-2
l histidine ((S) 2 amino 1H imidazole 4 propionic acid)	C6H9N3O2	3694-	—	—	71-00-1
dl histidine ((S) 2 amino 1H imidazole 4 propionic acid)	C6H9N3O2	—	not approved as such	95	
l histidine mono chloride monohydrate	C6H9N3O2-HCl-H2O	—	not approved as such	—	5934-29-2
n-acetyl glutamate	C7H11NO5	4752	—	—	1188-37-0
n acetyl l glutamic acid	C7H11NO5	—	not approved as such	—	1188-37-0
n acetyl l glutamine	C7H12N2O4	—	not approved as such	—	35305-74-9

Chart 29 *Continued*

Compound	Empirical Formula	FEMA GRAS #		NAS#	CAS#
n acetyl l methionine	C7H13NO3S	—	not approved as such	—	65-82-7
n acetyl dl methionine	C7H13NO3S	—	not approved as such	—	1115-47-5
l-methionylglycine	C7H14N2O3S	4692	—	—	14486-03-4
l carnotine	C7H15NO3	—	not approved as such	—	461-06-3
dl carnotine hydrochloride	C7H15NO3-HCl	—	not approved as such	—	461-05-2
glycyl glycine	C7H15NO3-HCl	—	not approved as such	—	566-50-3
acetyl l methionine	C7H16NO2S	—	172.372	—	1115-47-5
l-alanyl-l-glutamine	C8H15N3O4	4712	—	—	39537-23-0
N-Gluconyl ethanolamine	C8H17NO7	4254	—	—	686298-93-1
N-Gluconyl ethanolamine phosphate	C8H18NO10P	4255	—	—	791807-20-0
l phenyl alanine ((S) 2 amino 3 phenyl propionic acid,or 1-alpha amino hydro cinnamic acid)	C9H11NO2	3585	172.320	—	63-91-2
dl phenyl alanine	C9H11NO2	3726	172.320	—	150-30-1
d phenyl alanine	C9H11NO2	—	not approved as such	—	673-06-3
l-tyrosine ((S) 2 amino 3 (4 hydroxy phenyl) propionic acid	C9H11NO3	3736	172.320	—	60-18-4
levodopa OR ((S) (3, 4 dihydroxy phenyl) alanine)	C9H11NO4	—	not approved as such	—	59-92-7
levodopa ((S) (3, 4 dihydroxy phenyl) alanine)	C9H11NO4	—	not approved as such	—	59-92-7
l carnosine	C9H14N4O3	—	not approved as such	—	305-84-0
glutamyl-2-aminobutyric acid	C9H16N2O5	4738	—	—	16869-42-4
l ornithine l aspartate	C9H19N3O6	—	not approved as such	—	3230-94-2
glutamyl-norvaline	C10H18N2O5	4740	—	—	71133-09-0
glutamyl-norvaline	C10H18N2O5	4740	—	—	71133-09-0
l lysine l aspartate	C10H21N3O6	—	not approved as such	—	27348-32-9
l lysine l aspartate	C10H21N3O6	—	not approved as such	—	27348-32-9
l arginine l aspartate	C10H21N5O6	—	not approved as such	—	7675-83-4
l arginine l aspartate	C10H21N5O6	—	not approved as such	—	7675-83-4
l tryptophan(e) ((S) 2 amino 3 (3 indoyl) propionic acid)	C11H12N2O2	—	172.320	—	73-22-3

Chart 29 *Continued*

Compound	Empirical Formula	FEMA GRAS #		NAS#	CAS#
dl tryptophan(e) ((S) 2 amino 3 (3 indoyl) propionic acid)	C11H12N2O2	—	172.320	—	54-12-6
l tryptophan(e) ((S) 2 amino 3 (3 indoyl) propionic acid)	C11H12N2O2	—	172.320	—	73-22-3
dl tryptophan(e) ((S) 2 amino 3 (3 indoyl) propionic acid)	C11H12N2O2	—	172.320	—	54-12-6
n acetyl l tyrosine	C11H13NO4	—	not approved as such	—	537-55-3
n acetyl l tyrosine	C11H13NO4	—	not approved as such	—	537-55-3
l arginine glutamate	C11H23N5O5	—	not approved as such	—	4320-30-3
l arginine glutamate	C11H23N5O5	—	not approved as such	—	4320-30-3
glutamyl valyl glycine	C12H21N3O6	4709	—	—	38837-70-6
glutamyl-norvalyl-glycine	C12H21N3O6	4739	—	—	38837-71-7
glutamyl valyl glycine	C12H21N3O6	4709	—	—	38837-70-6
glutamyl-norvalyl-glycine	C12H21N3O6	4739	—	—	38837-71-7
n acetyl l tryptophan	C13H14N2O3	—	not approved as such	—	1218-34-4
n acetyl dl tryptophan	C13H14N2O3	—	not approved as such	—	87-32-1
n acetyl l tryptophan	C13H14N2O3	—	not approved as such	—	1218-34-4
n acetyl dl tryptophan	C13H14N2O3	—	not approved as such	—	87-32-1
l lysine l glutamate (anhydrous)	C22H23N3O6	—	not approved as such	—	5408-52-6
l lysine l glutamate (anhydrous)	C22H23N3O6	—	not approved as such	—	5408-52-6
l lysine l glutamate dihydrate	C22H23N3O6-2H20	—	not approved as such	—	5408-52-6
l lysine l glutamate dihydrate	C22H23N3O6-2H20	—	not approved as such	—	5408-52-6
n-[n-[3-(3-hydroxy-4-methoxyphenyl) propyl]-l-alpha-aspartyl]-l-phenylalanine 1-methylester, monohydrate	C24H32N2O8	4716	—	—	714229-20-6
n-[n-[3-(3-hydroxy-4-methoxyphenyl) propyl]-l-alpha-aspartyl]-l-phenylalanine 1-methylester, monohydrate	C24H32N2O8	4716	—	—	714229-20-6

Chart 30 Amyl Cinnamyl Compounds

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
alpha amyl cinnamic aldehyde	C14H18O	2061	172.515	—	122-40-7
alpha amyl cinnamic aldehyde dimethyl acetal	C16H24O2	2062	172.515	—	91-87-2
alpha amyl cinnamic alcohol	C14H20O	2065	172.515	—	101-85-9
alpha amyl cinnamyl formate	C15H20O	2066	172.515	—	7493-79-0
alpha amyl cinnamic acetate	C16H22O	2064	172.515	—	7493-78-9
alpha amyl cinnamic isovalerate	C19H28O	2067	172.515	—	7493-80-3

Chart 31 Anise – Aniseed

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descripter
botanical	2093	182.10, 582.10	—	84775-42-8	sweet spice
oil	2094	182.20, 582.20	—	8007-70-3	sweet spice

Chart 32 Angelica

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
botanical	—	6172	6172	8015-64-3	musk type
seed	—	6173	6173	8015-64-3	musk type
extract	2087	—	—	8015-64-3	floral type
oil	2088	—	—	8015-64-3	bitter type
seed extract	2089	—	—	8015-64-3	musk type
seed oil	2090	—	—	8015-64-3	musk type
stem oil	2091	—	—	8015-64-3	musk type

Chart 33 Angostura

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
extract	2092	182.10, 182.20, 582.20	6174	91697-93-7	bittering agent

Chart 34 Anisyl Esters and Anisates

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
anisyl formate	C9H10O3	2101	172.515	—	122-91-8
methyl anisate	C9H10O3	2679	172.515	—	121-98-2
anisyl acetate	C10H12O3	2098	172.515	—	104-21-2
anisyl propionate	C11H14O3	2102	172.515	—	7549-33-9
anisyl butyrate	C12H16O3	2100	172.515	—	963-56-0
anisyl phenyl acetate	C16H16O3	3740	172.515	—	102-17-0

Chart 35 Anthranilates

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
methyl anthranilate	C8H9NO2	2682	182.60, 582.60	—	134-20-3
Methyl *N*-formylanthranilate	C9H9NO3	4171	—	—	41270-80-8
ethyl anthranilate	C9H11NO2	2421	172.515	—	87-25-2
methyl n methyl anthranilate	C9H11NO2	2718	172.515	—	85-91-6
allyl anthranilate	C10H11NO2	2020	172.515	—	7493-63-2
Methyl *N*-acetylanthranilate	C10H11NO3	4170	—	—	2719-08-6
Methyl *N,N*-dimethylanthranilate	C10H13NO2	4169	—	—	10072-05-6
Ethyl *N*-methylanthranilate	C10H13NO2	4116	—	—	35472-56-1
N-Benzoylanthranilic acid	C11H14NO3	4078	—	—	579-93-1
butyl anthranilate	C11H15NO2	2181	172.515	—	7756-96-9
isobutyl anthranilate	C11H15NO2	2182	172.515	—	7779-77-3
Ethyl *N*-ethylanthranilate	C11H15NO2	4115	—	—	38446-21-8
Isobutyl *N*-methylanthranilate	C12H17NO2	4149	—	—	65505-24-0
cyclohexyl anthranilate	C13H17NO2	2350	172.515	—	7779-16-0
cis-3-Hexenyl anthranilate	C13H17NO2	3925	—	—	65405-76-7
phenyl ethyl anthranilate	C15H15NO2	2859	172.515	—	133-18-6
beta naphthyl anthranilate	C17H13NO2	2767	—	—	63449-8-3
linalyl anthranilate	C17H23NO2	2637	172.515	—	7149-26-0
Citronellyl anthranilate	C17H25NO2	4086	—	—	68555-57-7

Chart 36 Anticaking Agents

Compound	CFR	Notes and Limitations	FEMA GRAS #
aluminum calcium silicate	170.3, 182.2122,582.2122	anticaking agent <2%	
calcium chloride	184.1193	GRAS GMP usage	
calcium silicate	182.2227, 73.260, 172.410, 573.2160	anticaking agent <2%, (<5% in baking powder)	
calcium sulfate	184.123	GRAS GMP usage	
diatomaceous earth	573.34	anticaking agent <2%	
feed grade calcium stearate	573.28	anticaking agent <2%	
carnauba wax	184.1978	GRAS GMP usage	
iron ammonium citrate	172.430, 573.560	anticaking agent <25 p.p.m.	
magnesium carbonate	184.1425	GRAS GMP usage	
magnesium oxide	184.1431	GRAS GMP usage	
magnesium silicate	182.2437	anticaking agent <2%	
mannitol (More than 20 g daily may cause a laxative effect.)	180.25	varied usage with statement	
methylated silica	—	GRAS GMP usage	3185
mineral oil, white	172.878, 178.3620	varying amounts from 0.095% to 0.3 depending on usage.	
polyethylene glycol	172.82	<0.2% in food tablets	
potassium acid tartrate	184.1077	GRAS GMP usage	
propylene glycol	184.1666	GRAS GMP usage	
pyrophyllite	573.9	anticaking agent <2%	
salts of fatty acids	172.863	GRAS GMP usage	

Chart 36 *Continued*

Compound	CFR	Notes and Limitations	FEMA GRAS #
silicon dioxide	172.480, 573.940	anticaking agent <2%	
sodium aluminum silicate	182.2727	anticaking agent <2%	
sodium calcium alumino silicate hydrated	182.2799	anticaking agent <2%	
sodium mono and dimethyl naphthalene	172.824	anticaking agent <0.1%	
sorbitol (More than 20 g daily may cause a laxative effect.)	184.1835	varied usage with statement	
tricalcium silicate	182.2906	anticaking agent <2%	
verxite (a magnesium aluminum iron silicate)	573.1	dog feed <1.5%, animal feed <5%	
yellow prussate of soda	172.490, 573.1020	anticaking agent <13 p.p.m.	

Chart 37 Antifoaming Agents

Compound	CFR	NAS#	CAS#
alpha hydro omega poly (oxy ethylene) poly (oxy propylene) block copolymer)	172.808(a)(3), 173.340	—	9003-11-6
dimethyl poly siloxane	173.340	1065	9006-65-9
formaldehyde (CH2O)(preservative in defoamers not to exceed 1.0%)	173.340	—	50-00-0
polyacrylic acid, sodium salt	173.340	—	9003-04-7 or 25549-84-2
polyethylene glycol	173.340, 172.820	—	25322-68-3
polyoxy ethylene (40) monostearate	U.S.P. XVI	—	9004-99-3
Polysorbate 60 (polyoxy ethylene (20) sorbitan monostearate)	172.838, 173.340	—	9005-67-8
Polysorbate 65 (polyoxy ethylene (20) sorbitan tristearate)	172.838, 173.340	—	9005-71-4
propylene glycol alginate	172.858, 173.340	—	9005-37-2
silicon dioxide (SiO2)	172.480, 173.340	—	7631-86-9
sorbitan monostearate	172.842, 173.340	—	1338-41-6
white mineral oil	172.878, 173.340	—	8012-95-1

Chart 38 Antioxidants

Compound	Empirical Formula	FEMA GRAS #	NAS#	CFR	CAS#
ascorbic acid	C6H8O6	—	—	101.9, 101.36, 107.10, 107.100, 37.105, 137.200, 145.110, 145.115, 145.135, 145.170, 150.141, 150.161, 155.200, 155.201, 161.175, 182.3013, 182.5013, 182.8013, 184.1307a, 582.3013, 582.5013	50-81-7
ascorbyl palmitate	C12H38O7	—	—	166.110, 182.3149, 582.3149	137-66-6

Chart 38 *Continued*

Compound	Empirical Formula	FEMA GRAS #	NAS#	CFR	CAS#
butylated hydroxy anisole+++	C11H16O2	2183	—	166.110, 172.110, 172.515	25013-16-5
butylated hydroxy toluene+++	C15H243O	2184	—	166.110, 172.115, 173.340	128-37-0
dilauryl thio propionate (DLTP)+++	C30H58O4S	—	—	181.24	123-28-4
distearyl thio dipropionate (DSTP)+++	C42H82O4S	—	—	181.24	693-36-7
erythorbic acid	C6H8O6	—	—	101.33, 145.110, 155.200, 182.3041, 582.3041	85-65-6
gum guaiac	—-	—	—	175.300, 181.24, 582.3336	8052-39-9
nordihydroguaiaretic acid (NDGA)+++	C18H22O4	—	—	189.165	27686-84-6
propyl gallate (PG)+++	C10H12O5	—	—	172.615, 175.125, 175.300, 181.24, 184.1660, 582.3660	121-79-9
tertiary butyl hydro quinone	C10H14O2	—	1023	172.185, 177.242	1948-33-0
thiodipropionic acid (TDPA)+++	C6H10O4S	—	—	181.24	11/17/2001
tocopherols	C29H50O2	—	—	172.867, 182.5892, 182.8892, 184.1890, 582.5892	59-02-9
trihydroxy butyrophenone	C10H17O4	—	—	175.105, 181.24	1421-63-2

+++ note: total content of antioxidants are not to exceed 0.02% of fat content.

Chart 39 Aromatic

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
para alpha dimethyl styrene	C10H12	3144	—	—	1195-32-0
biphenyl (phenyl benzene)	C12H10	3129	—	—	92-52-4

Note: These purely aromatic compounds are devoid of any other elements but carbon and hydrogen. Many other hetero aromatic compounds are listed throughout the book.

Chart 40 Aryl Compounds

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
styrene (vinyl benzene)	C8H8	3233	172.515, 172.615	—	100-42-5
1 methyl naphthalene	C11H10	3193	—	—	90-12-0
p methyl diphenyl (1 benzyl 4 methyl benzene)	C13H12	3186	—	—	644-08-6

Chart 41 Yeast Products

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
Yeast, Active	—	—	101.4, 101.22, 102.22, 136.110, 137.235, 137.260, 137.305, 139.115, 139.122, 139.155, 160.105, 160.145, 160.185, 170.3, 172.896	—	68876-77-7
Yeast, Cell Wall	—	—	172.898, 137.235, 137.260, 137.305, 139.115, 139.122, 139.155, 172.325, 172.896, 184.1983, 501.22	—	8013-1-2
Yeast Extract	—	—	481+'101.4, 101.22, 102.22,	—	8013-1-2
Yeast Extract, Autolyzed	—	—	101.4, 101.22, 102.22, 137.235, 137.260, 137.305, 139.115, 139.122, 139.155, 155.120 (AYE), 155.130, 155.170, 155.200, 155.210, 172.325, 172.896, 184.1983, 501.22	1500	8013-1-2
Yeast Malt Sprout Extract	—	—	172.590	1187	8013-1-2
Yeast, Pischia Pastoris (use in Chicken feed only)	—	—	573.750	—	68876-77-7
Yeast, Whole Inactive Dry Brewers	—	—	101.4, 101.22, 102.22, 137.235, 137.260, 137.305, 139.115, 139.122, 139.155, 172.325, 172.896, 501.22	460	68876-77-7

Chart 42 TTB Restrictions Chart

Item	Allowable %
acacia gum	1%
acetic acid	0.15%
aconitic acid	0.00%
adipic acid	0.02%
agar	0.25%
ammonium alginate	0.10%
artemesia (wormwood)	thujone free
bakers yeast extract	5%
beeswax yellow and white	0.00%
benzoic acid	0.10%
BHA	0.02% of edible fats & oils
bitter almond oil	(free from prussic acid)
brominated vegetable oil	15 ppm
calcium acetate	0.00%
calcium alginate	0.30%
calcium chloride	0.05%
calcium phosphate dibasic	0.50%
calcium phosphate monobasic	0.02%
calcium phosphate tribasic	0.50%
calcium phosphate pyrophosphate	0.20%
calcium sulfate	0.07%

Chart 42 *Continued*

Item	Allowable %
camphor tree	safrole free
caprylic acid	0.00%
cedar white (arborvitae) leaves & twigs	thujone free
cherry pits	25 ppm HCN
cherry laurel leaves	25 ppm HCN
cinchona red & yellow bark total alkaloids	83 ppm
corn silk & corn silk extract	4 ppm
dithiols	1 ppm
E.D.T.A.	25 ppm
elder tree leaves **alcoholic beverages only**	25 ppm HCN
ester gum	100 ppm
ethyl formate	0.01%
gelatin	0.80%
guar gum	0.50%
gum ghatti	0.10%
gum tragacanth	0.10%
isopropyl citrate	0.02%
karaya gum	0.00%
licorice & derivatives	0.10%
locust bean gum	0.50%
malic acid	0.70%
mannitol	2.50%
methyl cellulose	0.00%
methyl paraben	0.10%
mustard (allyl isothiocyanate)	0.02%
mustard (brown, black or oriental)	1.00%
mustard (yellow/white)	1.70%
oak moss finished product	thujone free
oil of rue	4 ppm
peach leaves	25 ppm HCN
potassium alginate	0.01%
potassium metabisulfite	0.06%
potassium sorbate	0.10%
propylene glycol	5%
propyl paraben	0.10%
quinine	83 ppm
quinine bisulfate (as quinine)	83 ppm
quinine hydrochloride (as quinine)	83 ppm
quinine sulfate (as quinine)	83 ppm
rue	2 ppm
sassafras leaves	(safrole free)
silicone	10 ppm
sodium acid pyrophosphate	0.30%
sodium alginate	1.00%
sodium alumino silicate	2.00%
sodium benzoate	0.10%
sodium calcium aluminosilicate (hydrated)	2.00%
sodium carboxy methyl cellulose	0.80%
sodium hexametaphosphate	0.05%
sodium phosphate, dibasic	0.50%

Chart 42 *Continued*

Item	Allowable %
sodium phosphate, monobasic	0.08%
sodium thio phosphate	0.00005% in flavor
sorbic acid	0.20%
sorbitol	12%
St. Johnswort leaves, flowers and caulis	(Hypericin free)
stannous chloride	0.00%
stearyl citrate	0.15%
sulfur dioxide	10 ppm
tagettes	(As Oil Only)
tannic acid	0.02%
tansy	finished product (thujone free)
woodruff, sweet	5 ppm coumarin
yarrow	finished product (thujone free)

Chart 43 Benzoates and Benzyl Esters

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
methyl benzoate (Niobe oil)	C8H8O2	2683	CFR172.515	—	1916-07-0
benzyl formate	C8H8O2	2145	CFR172.515	—	104-57-4
ethyl benzoate	C9H10O2	2422	CFR172.515	—	93-89-0
benzyl acetate	C9H10O2	2135	CFR172.515	—	140-11-4
alpha methyl benzyl formate (styrallyl formate)	C9H10O2	2688	CFR172.515	—	7775-38-4
methyl ortho methoxy benzoate	C9H10O3	2717	CFR172.515	—	606-45-1
propyl benzoate	C10H12O2	2931	CFR172.515	—	2315-68-6
isopropyl benzoate	C10H12O2	2932	CFR172.515	—	939-48-0
methyl benzyl acetate (mixed ortho, meta & para)	C10H12O2	3702	CFR172.515	—	2216-45-7
alpha methyl benzyl acetate (styrallyl acetate)	C10H12O2	2684	CFR172.515	—	93-92-5
benzyl propionate	C10H12O2	2150	CFR172.515	—	122-63-4
phenyl butyrate	C10H12O2	4621	—	—	4346-18-3
Sodium 4-Methoxybenzoyloxyacetate	C10H12O2Na	4016	—	—	17114-82-8
ethyl para anisate	C10H12O3	2420	CFR172.515	—	94-30-4
propyl p-hydroxy benzoate	C10H12O3	2951	CFR150.141, 150.161, 172.515, 184.1670	—	94-13-3
benzyl aceto acetate	C11H12O3	2136	CFR172.515	—	5396-89-4
ethyl benzoyl acetate	C11H12O3	2423	CFR172.515	—	94-02-0
benzyl butyrate	C11H14O2	2140	CFR172.515	—	103-37-7
isobutyl benzoate	C11H14O2	2185	CFR172.515	—	120-50-3
benzyl isobutyrate	C11H14O2	2141	CFR172.515	—	103-28-6
alpha methyl benzyl propionate (styrallyl propionate)	C11H14O2	2689	CFR172.515	—	120-45-6
butyl para hydroxy benzoate	C11H14O3	2203	CFR172.515	—	94-26-8
2-phenoxyethyl propionate	C11H14O3	4618	—	—	23495-12-7
benzyl tiglate, (benzyl trans 2 methyl 2 butenoate)	C12H14O2	3330-	—	—	37526-88-8
benzyl levulinate	C12H14O3	4623	—	—	6939-75-9

Chart 43 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
alpha methyl benzyl butyrate (styrallyl butyrate)	C12H16O2	2686	CFR172.515	—	3460-44-4
benzyl isovalerate	C12H16O2	2152	CFR172.515	—	103-38-8
isoamyl benzoate	C12H16O2	2058	CFR172.515	—	94-46-2
alpha methyl benzyl isobutyrate	C12H16O2	2687	CFR172.515	—	7775-39-5
Benzyl hexanoate	C12H18O2	4026	—	—	6938-45-0.
benzyl 2,3 dimethyl crotonate	C13H16O2	2143	CFR172.515	—	7492-69-5
alpha, alpha dimethyl benzyl isobutyrate (styrallyl isobutyrate)	C13H18O2	2388	CFR172.515	—	7774-60-9
alpha ethyl benzyl butyrate	C13H18O2	2424	CFR172.515	—	10031-86-4
hexyl benzoate	C13H18O2	3691-	—	—	6789-88-4
benzyl benzoate	C14H12O2	2138	CFR172.515	—	120-51-4
benzyl salicylate	C14H12O3	2151	CFR172.515	—	118-58-1
phenyl ethyl benzoate	C14H14O2	2860	CFR172.515	—	94-47-3
dimethylbenzyl carbinyl crotonate	C14H18O2	4403	—	—	93762-34-6
benzyl phenyl acetate	C15H14O2	2149	CFR172.515	—	102-16-9
2-ethylhexyl benzoate	C15H22O2	4630	—	—	5444-75-7
cinnamyl benzoate	C16H14O2	4703	—	—	5320-75-2
benzyl cinnamate	C16H14O2	2142	CFR172.515	—	103-41-3
dimethylbenzyl carbinyl hexanoate	C16H20O2	4404		CAS Pending	
benzyl nonanoate	C16H24O2	4626	—	—	6471-66-5
eugenyl benzoate	C17H16O3	2471	CFR172.515	—	531-26-0
geranyl benzoate	C17H22O2	2511	CFR172.515	—	94-48-4

Chart 44 BHA and BHT

Compound	Empirical Formula	FEMA GRAS #	CFR	CAS#
BHA[+++]	C11H16O2	2183	CFR172.110, 172.115, 172. 515, 172.1185	25013-16-5
BHT[+++]	C15H24O	2184	CFR172.110, 172.115, 172.515, 172.1185	128-37-0

[+++]Note: total content of antioxidants are not to exceed 0.02% of fat content.

Chart 45 Bornyl Esters

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
bornyl formate	C11H18O2	2161	—	—	7492-41-3
iso bornyl formate	C11H18O2	2162	172.515	—	1200-67-5
bornyl acetate	C12H20O2	2159	172.515	—	76-49-3
iso bornyl acetate	C12H20O2	2160	172.515	—	125-12-3
iso bornyl propionate	C13H22O2	2163	172.515	—	2756-56-1
bornyl butyrate	C14H23O2	3907	—	—	13109-70-1
bornyl iso valerate	C15H26O2	2165	172.515	—	76-50-6
iso bornyl iso valerate	C15H26O2	2166	172.515	—	7779-73-9
bornyl valerate	C15H26O2	2164	172.515	—	7549-41-9

Chart 46 Anise – Star

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
botanical	2095	182.10	—	8007-70-3	sweet spice
oil	2096	—	—	8007-70-3	sweet spice

Chart 47 Apricot Kernel Oil

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Oil	2105	182.40, 582.40	—	72869-69-3	Vegetable Oil

Chart 48 Arnica

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Arnica	172.510	—	—	—	Resinous, floral, vegetable

Chart 49 Artemesia

Botanical or Food Name	FEMA GRAS	CFR	CAS#	Type
botanical thujone free	3114	172.51	8008-93-3	bittering agent
extract thujone free	3115	172.51	8008-93-3	bittering agent
oil thujone free	3116	172.51	8008-93-3	bittering agent

Chart 50 Artichoke

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
food	—	—	—	—	sulfur
leaves (alcoholic beverages only)	—	172.510	—	—	bittering agent

Chart 51 Colloids

Colloids		Dispersed Phase		
		Gas	Liquid	Solid
Continuous Phase	Gas	None-All gases are dispersible with each other	Liquid Aerosol-Fog, Mist	Solid Aerosol-Smoke, Air Particulates
	Liquid	Foam-Meringue, Whipped Cream	Emulsion-Oil in Water:Milk, Water in Oil:Butter, Mayonnaise	Sol-Paint, Blood, Grease
	Solid	Solid Foam-Styrofoam	Gel-Gelatin, Cheese, Opal	Solid Sol-Colored Glass

Chart 52 Asafoetida

Botanical or Food Name	FEMA GRAS	CFR	CAS#	Type
extract (Garlicky in flavor)	2106	182.20, 582.20	9000-4-8	sulfur type
gum	2107	—	9000-4-8	sulfur type
oil	2108	182.20, 582.20	9000-4-8	sulfur type

Chart 53 Ash Bark

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Ash Bark (Xanthoxylum spp. also called Prickly Ash Bark)					
extract	2110	182.20, 582.20	—	999999-19-9	bittering agent
oil	—	182.20, 582.20	—	999999-19-9	

Chart 54 Balm

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
botanical	2111	182.10, 582.10	—	8014-71-9	terpene type
leaves	2113	182.20, 582.20	—	8014-71-9	bittering agent
leaves extract	2112	182.20, 582.20	—	8014-71-9	bittering agent

Chart 55 Basil

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
botanical	2118	182.10, 582.10	6175	8015-73-4	sweet spice
oil	2119	182.20, 582.20	—	8015-73-4	sweet spice
oleoresin	2120	182.20, 582.20	—	8015-73-4	sweet spice

Chart 56 Bay

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Bay Leaf, West Indian (Pimenta racemosa Mill) See Spices.					
extract	2121	—	—	91721-75-4	sweet phenolic spice
oil	2122	182.20, 582.20	—	91721-75-4	sweet phenolic spice
oleoresin	2123	—	—	99999-20-0	sweet phenolic spice
botanical	—	—	6177	—	sweet phenolic spice
Bay, Sweet (Bay Laurel) (Laurel nobilis L.)					
botanical	2124	182.10, 582.10	—	8006-48-5	sweet spice
oil	2125	182.20, 582.20	—	8007-48-5	sweet spice
berries	2612	182.20, 582.20	—	8007-48-5	sweet spice
extract	2613	182.20, 582.20	6176	8006-78-8	sweet spice
oleoresin	—	—	6178	—	sweet spice

Chart 57 Beechnut and Beech Creosote

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Beech Nut (Fagus spp.)					fruit
beechwood creosote	—	172.515	—	—	smoky

Chart 58 Beeswax

Botanical or Food Name	FEMA GRAS #	CFR	NAS#	CAS#	Type
Beeswax (Apis mellifera L.)					
beeswax and bleached	2126	184.1973	—	8012-89-3	floral
absolute	—	—	6312+	8012-89-3	floral

Chart 59 Beet

Botanical or Food Name	FEMA GRAS #	CFR	NAS#	CAS#	Type
Beets (Beta vulgaris)					
food	—	—	—	—	earthy
powdered	—	—	6402	—	earthy, coloring

Chart 60 Benzoin

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Benzoin (Styrax benzoin Dry and Other Species)	2132	2172.515	—	119-53-9	resinous type
resin	2133	172.510	—	9000-5-9	resinous type

Chart 61 Bergamot

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Bergamot (Citrus bergamia Risso and C. aurantium L. subspecies Bergamia Wright & Arn)					
food	—	—	—	—	fruit
oil	2153	182.20, 582.20	—	8007-75-8	terpenoid, floral, linalool type

Chart 62 Birch – Sweet Birch

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Birch, Sweet (Betula lenta L., B. alba L.)					
oil	2154	—	—	68917-50-0	sweet spice
tar oil	—	172.515	—	68917-50-0	Phenolic

Chart 63 Blackberry

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Blackberry Bark (Rubus spp.)					
extract	2155	172.510	—	84787-69-9	woody type
food	—	—	—	—	fruit
sweet blackberry leaves extract	4717	—	—	1268518-76-8	fruity

Chart 64 Bois De Rose

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Bois De Rose (Aniba rosaeodora Ducke)	2156	182.20, 582.20	—	8015-77-8	woody, linalool type

Chart 65 Boldo Leaves

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Boldo Leaves (Boldus Leaves) (Peumus boldus Mol.)					
(in alcoholic beverage only)	—	172.510, 182.10, 582.10	6350	—	sweet spice

Chart 66 Boronia

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Boronia (Boronia megastigma Nees.)					
flowers	—	172.51	—	—	floral
absolute	2167	—	—	91771-36-7	floral

Chart 67 Bryonia

Botanical or Food Name	NAS#	CFR	Type
Bryonia (Bryonia alba L. or B. doica Jacq.) (in alcoholic beverage only)	6016+	172.51	bitter principle

Chart 68 Buchu

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Buchu (Barosma betulina Bartl. & Wendl and Other Species)					
oil	2169	—	—	68650-46-4	sulfur type
leaves	—	172.51	—	—	sulfur type

Chart 69 Buck Bean

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Buck Bean (Manyanthes trifolia L.)					
leaves	—	172.51	6017	—	bitter principle
extract	—	172.515	6018	—	bitter principle

Chart 70 Temperature Chart

	Freezing Point of Water	Boiling Point of Water
Fahrenheit	32	212
Celcius	0	100
Kelvin	273.18	373.18

Chart 71 Cocoa

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Cacao (Cocoa) (Theobroma cacao L.)					
extract, essence	—	101.22, 163.113, 182.20, 582.20	—	8002-31-1	brown type

Chart 72 Cajeput

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Cajeput (cajuput) (Melaleuca leucadendron L. and other Melaleuca sp.)					
oil	—	2225	—	8008-98-8	camphor type
botanical	172.510	—	—	—	camphor type

Chart 73 Calumba

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Calumba (Jateorhiza palmita (Lam.) Miers)	—	172.510 (in alcoholic beverages only)	6620	—	bitter principle

Chart 74 Camomile

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
flower (Hungarian)	—	182.10, 582.10	6184	8015-92-7	vegetable
flower oil (Hungarian)	2273	182.20, 582.20	—	8002-66-2	floral
flower (Roman)	—	182.10, 582.10	6183	8015-92-7	floral
oil (English)	2272	182.20, 582.20	—	8015-92-7	vegetable
flower extract (Roman)	2274	182.20, 582.20	—	8015-92-7	vegetable
oil (Roman)	2275	182.10, 582.20	—	8015-92-7	floral

Chart 75 Camphor

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Camphor (Cinnamomum camphora L.) Nees & Ebermeir					
oil, Japanese White Camphor (safrole free)	2231	172.51	—	8008-51-3	camphor type

Chart 76 Cananga

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Cananga (Cananga iterate Hook & Thoms.)					
oil	2232	182.20, 582.20	—	68606-83-7	floral ester type

Chart 77 Capers

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Capers (Capparis spinosa L.)					
bark	—	182.10, 582.10	—	—	acid type
food	—	—	6179	—	spice

Chart 78 Capsicum

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Capsicum (Paprika Oleoresin) Capsicum annum L. Botanical	—	73.340, 182.20, 582.2	—	84625-29-6	aromatic spice, color
Capsicum annum L. var. Longum Sendt (Cayenne)	2266	—	—	8023-77-6	aromatic spice
Capsicum annum L. var. Sendt (Paprika)	2833	73.340, 182.10, 582.1	—	84625-29-6	aromatic spice, color
Capsicum annum or C. frutescens Extract	2233	182.20, 582.20	—	8023-77-6	heat principle
Capsicum annum or C. frutescens Oleoresin	2234	73.345, 182.20, 582.20, 182.10, 582.10	—	84625-29-6	heat principle
Capsicum frutescens & C. annum	—	—	6707	—	aromatic spice
Capsicum minimum Mill. & Other Species	—	73.340, 182.20, 582.2	—	8023-77-6	heat principle
Capsicum Pepper (red Bell pepper)	2849	182.10, 582.10,	6180	85940-30-3	aromatic spice, color
Capsicum Pepper (red Bell pepper)	—	73.34	—	—	food

Chart 79 Caraway

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Caraway (Carum carvi L.) botanical	2236	182.10, 582.10	—	85940-31-4	aromatic spice
Caraway (Carum carvi L.) oil	2238	182.20, 582.20	—	8000-42-8	aromatic spice
Caraway, Black (Nigella sativa L.)	2237	182.10, 582.10	—	8000-42-8	aromatic spice
Caraway, Black (Nigella sativa L.) botanical	2342	182.10, 582.10	—	84775-51-9	aromatic spice

Chart 80 Cardamom

Botanical or Food Name	NAS #	FEMA GRAS	CFR	CAS#	Type
Cardamom (Elattaria cardamomum Maton)					
botanical	—	2240	182.10, 582.10	8000-66-6	aromatic spice
oleoresin	6366+	—	182.20, 582.20	8000-66-6	aromatic spice
oil	—	2241	182.20, 582.20	8000-66-6	aromatic spice

Chart 81 Carnuba

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Carnuba Wax (Carnauba Wax)	—	—	61	8015-86-9	wax

Chart 82 Carob

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Carob Bean (Ceratonia siliqua L.)					
bean	—	—	6203	84961-45-5	brown flavor
extract	2243	182.20, 582.20		—	brown flavor
dark roasted powder	—	—	6634	—	brown flavor
extract (generic)	—	—	—	—	brown flavor

Chart 83 Carrot

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Carrot (Daucus carota L.)					
oil	2244	73.300, 182.20, 582.2	—	8015-88-1	aromatic spice

Chart 84 Cascara

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Cascara (Sagrada) (Rhamnus purshiana DC.)					
2253	172.51	—	—	8007-6-5	bitter principle

Chart 85 Cascarilla

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Cascarilla (Croton eluteria Benn.)					
bark extract	2254	182.20, 582.20	—	8007-6-5	terpene type
bark oil	2255	182.20, 582.20	—	8007-6-5	aromatic spice

Chart 86 Carvyl Esters

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
carvyl acetate	C12H18O2	2250	CFR172.515	—	97-42-7
carvyl propionate	C13H20O2	2251	CFR172.515	—	97-45-0
dihydrocarvyl acetate	C13H20O2	2380	CFR172.515	—	20777-49-5

Chart 87 Cassie

Form	FEMA GRAS #	CFR	NAS #	CAS #	Descriptor
Cassie (Acacia farnesianna L. Willd)					
absolute	2260	172.51	—	89958-31-6	balsamic floral type

Chart 88 Castor Oil

Form	FEMA GRAS #	CFR	NAS #	CAS #	Descriptor
Castor Oil (Ricinus communis L.)					
	2263	172.510, 172.876, 178.3280 (hydrogenated), 182.50, 582.50	—	8001-79-4	oil

Chart 89 Castoreum

Form	FEMA GRAS #	CFR	NAS #	CAS #	Descriptor
Castoreum (Castor fiber L. and C. canadensis Kubl.)					
extract	2261	182.50, 582.50	—	8023-83-4	aromatic
liquid	2262	182.50, 582.50	—	8023-83-4	fetid, musky

Chart 90 Catechu

Form	FEMA GRAS #	CFR	NAS #	CAS #	Descriptor
Catechu (Acacia catch Wild.)					
bark extract	2264	172.51	—	8001-76-1	bitter principle
bark powder	2265	172.51	—	8001-76-1	bitter principle

Chart 91 Cedar

Form	FEMA GRAS #	CFR	NAS #	CAS #	Descriptor
Cedar, White (Thuja occidentalis L.)					
leaf and twig oil	2267	172.51	—	8007-20-3	aromatic spice
leaves and twigs		—	6304	—	terpene type
cedarwood oil (dethujonized)	8813+	—	—	8000-27-9	woody
cedarwood oil alcohols	—	—	7726	68603-22-5	woody
cedarwood oil terpenes	—	—	6028	68608-32-2	woody
cedarwood oil alcohols and terpenes	—	—	6373	68603-22-5	woody

Chart 92 Celery

Form	FEMA GRAS #	CFR	NAS #	CAS #	Descriptor
Celery (Apium graveolens L.)					
food	—	—	—	8015-90-5	green
seeds	2268	182.10, 582.10	—	8015-90-5	aromatic spice
seed extract	2269	182.20, 582.20	—	8015-90-5	vegetable type
seed solid extract	2270	182.20, 582.20	—	8015-90-5	aromatic spice
seed oil	2271	182.20, 582.20	—	8015-90-5	aromatic spice
seed oleoresin	—	182.20, 582.20	6422	8015-90-5	aromatic spice
ground celery	—	—	6680	—	green
celery juice	—	—	6701	—	green
celery leaf oil	—	—	6635	8015-90-5	green
celery leaf – botanical	—	—	6636	—	green
dried celery powder	—	—	6523	—	green

Chart 93 Centaur

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Centaur, Minor (Centaurium umbellatum Gilib.) See Bitter.					
	—	172.510 (alcoholic beverages only)	6029	—	bitter principle

Chart 94 Cherry Bark

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Cherry Bark (Wild Cherry Bark) (Prunus serotina Ehrh. & P. canadensis Poiret)					
	2276	182.20, 582.20	—	84604-07-9	brown type

Chart 95 Cherry Laurel

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Cherry Laurel (Prunus laurocerasus L.)					
oil	2277	172.510	—	8000-44-0	nut type
water	—	172.510	6031	—	—
leaves	—	172.510	6030	—	—

Chart 96 Cherry Pits

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Cherry Pits (Orunus avium L. & P. cerasus L.)					
	2278	172.51	—	8000-44-0	nut type

Chart 97 Chervil

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Chervil (Anthriscus cerefolium L. Hoffm.)					
botanical	2279	182.10, 582.10	—	1338-80-3	bitter principle
extract	—	182.20, 582.20	6185	—	bitter principle

Chart 98 Chestnut

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Chestnut (Castanea dentata (Marsh.) Brokh.)					
food	—	—	—	—	fruit
botanical, leaves	—	172.51	6032	—	bitter principle
solid extract	—	172.51	6034	—	nutty
liquid extract	—	172.51	6033	—	nutty

Chart 99 Chicory

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Chicory (Cichorium intybus L.)					
	2280	180.20, 582.20	—	6850-43-1	bitter principle
food, roasted	—	—	—	—	brown flavor
food	—	—	—	—	vegetable

Chart 100 Chili Pepper

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Chili Pepper (Capsicum spp.)					
food	—	—	6423	—	heat principle
oleoresin	—	—	6340	—	heat principle
sweet chili	—	—	6394	—	heat principle
ground chili	—	—	6424	—	heat principle
ground chili	—	—	6405	—	heat principle

Chart 101 Chinchona Bark

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Chinchona (*Cinchona succirubra* Pav. and Related Species)					
red bark	2281	172.51	—	6890-12-5	bitter principle
red bark extract	2282	172.51	—	6890-12-5	bitter principle
yellow bark extract	2283	172.51	—	6890-12-5	bitter principle
yellow extract	2284	172.51	—	6890-12-5	bitter principle
extract	2285	172.51	—	6890-12-5	bitter principle

Chart 102 Chirata

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Chirata (*Swertia chirata* (Roxb.) Buch.-Ham.)					
botanical	—	—	172.510 (alcoholic beverages only)	6035	Bitter
extract	—	—	172.510 (alcoholic beverages only)	6036	Bitter

Chart 103 Chives

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Chives (Allium schoenoprasum L)	—	182.10, 582.10	—	—	sulfury spice
A. tuberosum = Chinese Chive					
food	—	182.10, 582.10	6186	—	sulfury spice
chopped and dried	—	182.10, 582.10	8521	—	sulfury spice

Chart 104 Cinnamon

Form	FEMA GRAS#	CFR	NAS#	CAS #	Descriptor
Cinnamon					
Major Varieties	2256	182.10, 182.20, 582.10, 582.20	—	80007-80-5	aromatic spice
Ceylon Cinnamon = Cinnamomum zeylanicum Nees	2256	182.10, 182.20, 582.10	—	80007-80-5	aromatic spice
Saigon Cinnamon = Cinnamomum loureirii Nees (Saigon Cassia)	2256	182.10, 182.20, 582.10	—	80007-80-5	aromatic spice
Chinese Cinnamon = Cinnamomum cassia Nees (Chinese Cassia)	2256	182.10, 182.20, 582.10, 582.20	—	80007-80-5	aromatic spice
Padang or Batavia Cinnamon = Cinnamomum burmanni Blume (Padang or Batavia Cassia)	2256	182.10, 182.20, 582.10, 582.20	—	80007-80-5	aromatic spice
cassia bark extract	2257	—	—	80007-80-5	aromatic spice
cassia bark oil	2258	—	—	80007-80-5	aromatic spice
cassia bud flowers	2259	182.20, 582.20	—	80007-80-5	aromatic spice
cinnamon botanical	2289		—	80007-80-5	aromatic spice
bark extract	2290	182.20, 582.20	—	80007-80-5	aromatic spice
cinnamon bark oil	2291	145.140, 145.135, 145.145, 145.181, 182.20, 582.20, 145.1818	—	80007-80-5	aromatic spice
cinnamon bark oleoresin	—	182.20, 582.20	—	80007-80-5	aromatic spice
leaf oil	2292	182.20, 582.20	—	80007-80-5	aromatic spice
cinnamon bark	—	—	6314	80007-80-5	aromatic spice
cinnamon oleoresin	—	—	6425	80007-80-5	aromatic spice
Padang or Batavia cinnamon	—	—	6305	80007-80-5	aromatic spice
oleoresin of Padang or Batavia cinnamon	—	—	6576	80007-80-5	aromatic spice

Chart 105 Citronella

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Citronella (Cymbopogon winterianus & Rel. Species)					
oil (C. nardus Rendle)	2308	182.20, 582.20	—	8000-29-1	aromatic spice
terpenes	2318	182.20, 582.20	6350	8000-29-1	Terpenoid

Chart 106 Citrus Peel

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Citrus Peel (Citrus sp.)	2318	182.20, 582.20	—	94266-47-4	terpene type

Chart 107 Civet

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Civet Absolute (Civet cats Viverra Civetta Schreber & V. zibetha Schreber)					
absolute	2319	182.50, 582.20	—	68916-26-7	musky

Chart 108 Clary Sage

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Clary (Clary Sage) (Salvia sclarea L.)					
botanical	2320	182.10, 582.10	—	8016-63-5	floral
oil	2321	182.20, 582.20	—	8016-63-5	terpene type

Chart 109 Cloves

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Clove (Eugenia caryophyllata Thunb.)					
bud extract	2322	184.1257	—	8000-34-8	spice
bud oil	2323	184.1257	—	8000-34-8	spice
bud oleoresin	2324	184.1257	—	8000-34-8	spice
leaf oil (non-Madagascar)	—	184.1257	—	8000-34-8	spice
clove leaf oil (Madagascar)	2325	—	—	8000-34-8	spice
cloves botanical	2327	145.140, 145.180, 184.1257	—	8000-34-8	spice
clove stem oil	2328	184.1257	—	8000-34-8	spice
clove stem oleoresin	—	—	6309	8000-34-8	spice

Chart 110 Clover

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Clover Tops (Trifolium Species)					
botanical	2326	182.10, 582.10	—	85085-25-2	aromatic spice
solid extract	2326	—	—	85085-25-2	aromatic spice
extract	—	—	6188	85085-25-2	aromatic spice
oil	—	—	6189	85085-25-2	aromatic spice
Red Clover Tops	—	182.20, 582.20	—	85085-25-2	aromatic spice
Red Clover Tops Extract	—	182.20, 582.20	—	85085-25-2	aromatic spice
Red Clover Tops Oil	—	182.20, 582.20	—	85085-25-2	aromatic spice
clover herb distillate	4727	—	—	84082-81-5	green

Chart 111 Cocoa Leaf

Botanical or Food Name	FEMA GRAS	NAS#	CFR	CAS#	Type
Cocoa Leaf (*Erythroxylon coca* Lam. and Other Species)	2329		182.20, 582.20, 163.113	84775-48-4	*bitter principle*
cocoa bean distillate		6638+			
cocoa bean concentrate		6531+			

Chart 112 Coffee

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Coffee (Coffea arabica L. and Other Coffea Species)					
concentrate	—	182.20, 582.20	—	—	bitter principle
extract	—	182.20, 582.20	—	—	brown flavor
solid extract	—	182.2	—	—	brown flavor
coffee distillate	—	—	6538	—	brown flavor
coffee oil	—	—	6639	—	brown flavor

Chart 113 Cinnamates and Cinnamyl Compounds

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
cinnamic aldehyde	C9H8O	2286	182.60, 582.60	—	104-55-2
alpha methyl cinnamic aldehyde	C10H10O	2697	172.515	—	101-39-3
ortho methoxy cinnamic aldehyde	C10H10O2	3181	172.515	—	1504-74-1
para methoxy cinnamic aldehyde	C10H10O2	3567	—	—	1963-36-6
methyl cinnamate	C10H10O2	2698	172.515	—	103-26-4
ethyl cinnamate	C11H12O2	2430	172.515	—	103-36-6
para methoxy alpha methyl cinnamic aldehyde	C11H12O2	3182	—	—	65405-67-5
allyl cinnamate	C11H18O2	2022	172.515	—	1866-31-5
iso propyl cinnamate	C12H14O2	2939	172.515	—	6/5/7780
alpha butyl cinnamic aldehyde	C13H16O	2191	172.515	—	7492-44-6
butyl cinnamate	C13H16O2	2192	172.515	—	538-65-8
isobutyl cinnamate	C13H16O2	2193	172.515	—	122-67-8
alpha amyl cinnamic aldehyde	C14H18O	2061	172.515	—	122-40-7
isoamyl cinnamate	C14H18O2	2063	172.515	—	7779-65-9
tetrahydro furfuryl cinnamate	C14H16O3	3320	—	—	65505-25-1
cyclohexyl cinnamate	C15H18O2	2352	172.515	—	7779-17-1
alpha hexyl cinnamic aldehyde	C15H20O	2569	172.515	—	101-86-0
benzyl cinnamate	C16H14O2	2142	172.515	—	103-41-3
heptyl cinnamate	C16H22O2	2551	172.515	—	10032-08-3
cinnamyl cinnamate	C18H16O2	2298	172.515	—	122-69-0

**Cinnamyl Anthranilate A delisted substance no longer approved for use in foods. See Delisting, FEMA, Food Safety, Cinnamyl Esters and Cinnamyl Alcohol

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
cinnamyl alcohol	C9H10O	2294	172.515	—	104-54-1
cinnamyl formate	C10H10O2	2299	172.515	—	104-65-4
p methyl cinnamic aldehyde	C10H10O	3640	172.515	—	1504-75-2
cinnamyl acetate	C11H12O2	2293	172.515	—	103-54-8
cinnamyl propionate	C12H14O2	2301	172.515	—	103-56-0
propyl cinnamate	C12H14O2	2938	172.515	—	7778-83-8
ethyl alpha-acetylcinnamate	C13H14O2	4597	—	—	620-80-4
cinnamyl butyrate	C13H16O2	2296	172.515	—	103-61-7
cinnamyl isobutyrate	C13H16O2	2297	172.515	—	103--59-3
cinnamyl isovalerate	C14H18O2	2302	172.515	—	140-27-2
cinnamyl benzoate	C16H14O2	—	172.515	—	5320-75-2
cinnamyl phenyl acetate	C17H16O2	2300	172.515	—	7492-65-1
cinnamyl cinnamate	C18H16O2	2298	172.515	—	122-69-0

Chart 114 Coffee Varieties

Variety	Source	Character
Arabica		
AA Kibo		
AA Snow Top		
AA Top Quality		
Altura		
Antigua	Guatemala	Chocolatey
AP-1 Special		
Atitlan	Guatemala	Acidic, with slight winy character
Armenia Excelso		
Bahia		
Barhona Arabica		
Blue Mountain No. 1	Jamaica	Distinctively nutty and slightly acidic. The country carefully controls the quality.
Blue Mountain Peaberry	Jamaica	
Bourbon		
Café Bonita		
Café na Sombra		
Central Standard		
Chanchamayo		
Coatapec	Mexico	Mild, slightly acidic
Conillon		
Crystal Mountain		
Djimah G-5		
Extra Prime Washed		
Extra Tarquino		
Harrar	Sumatra	Earthy, grapey
Harrar Bold Grane		
Harrar Longberry	Ethiopia	Used in Turkish blends
Yemen		Chocolaty
		Harrar Star
		High Grown Central
		High Mountain Supreme
Highland Harrar		
Huila	Columbian	A regional variety
Java Arabica Grade1		
Kenya AA	Kenya	Winy, slightly floral (jasmine, apricot)
Kilamanjaro	Tanzanian	Well balanced, not as acid as East African,
stronger than Central American		
Kona Extra Fancy		
Kona Kai	Hawaii	Rich, earthy, full bodied, good acidity
Kona No. 1		
Lavado Fino		
Lekempti		
Libana Excelso	Columbian	Strong flavored
Limu		
Mandheling Kalossi		

Chart 114 *Continued*

Variety	Source	Character
Mandheling Grade 1 Special		
Maragogype	Mexico	A variety originally from Brazil
Medellin Excelso	Columbian	Nutty
Medellin Excelso		
Mocha	Ethiopia	Gamy or winy
Mocha Mattari		
Monsooned Malabar		
Mysore	India	Smooth with little or no acidity
Mysore Mocha	India+Ethiopia	A blend of the two varieties
Nicaragua		Mild
Narino	Columbia	A regional variety
No. 1		
Papayan Supremo		
Peaberry	Kenya et al.	A single, smaller bean per fruit with a distinctive flavor
Patroc		
Plantation A		
Prioma Lavado		
Prime Washed		
Robusta		
Robusta Cherry		
Robusta Grade-1		
Robusta No. 1		
Robusta Screen 18		
Robusta Standard		
Santos	Brazilian	Soft and mellow
Sao Jose		
Sidamo Washed		
Strictly High Grown		
Sulawesi	Indonesia	Lemon
Tarrazu	Costa Rican	Delicate acidity, rich
Washed		
Washed Robusta		
WIB-1		

Chart 115 Colorings

Coloring Status	FEMA GRAS	CFR Status **	NAS#	CAS#	Natural vs.Synthetic	Hue
Angola weed	—	172.510	—	—	natural extract	blue, red, violet
Annatto The active ingredient in annatto is the carotenoid bixin.						
Annato	2103	73.30, 73.2030, 73.1050	—	8015-67-6	natural extract	brick red
Annato seed	2104	—	—	—	—	—
Astaxanthin (3,3′ dihydroxy-beta beta-carotene-4,4′ dione) Animal feed for fish only. Used to enhance pink color of salmon. (Not to exceed 80mg/k of feed.)						
	—	73.35, 501.4, 101.22(k)(2), 101.100 (a)(2)	—	—	natural extract	pinkish
Capsicum (paprika) (*Capsicum annum* L.) Natural by-product from capsicum peppers and extraction of capsicum						
botanical	2833	73.340, 182.20, 582.20	—	84625-29-6	natural extract	reddish orange
oleoresin	2834	182.20, 582.20, 73.345		—	natural extract	reddish orange
Caramel color Acid catalyzed caramelization of sugar. Caramel is approved for use in a cocoa butter substitute made from coconut (CFR 172.861).						
	2235	73.85, 73.1085, 73.2085, 182.1235, 582.1235	—	8028-89-5	natural extract	brown
Carmine Derived from shells of cochineal beetle coccus cacti.						
	2234	73.100, 73.1100, 73.2087	—	8023-72-6 or 1260-17-9	natural from beetles	red
Carmine Aluminum Lake	2242	73.100	—	1260-17-9	Aluminum lake of carminic acid	red
Beta Apo 8′ Carotenal		73.90	1299	1107-26-2	Synthetic	red orange
Carotene It is approved for use in margarine						
	—	166.11, 73.95, 73.1095, 73.2095, 182.5345, 184.1245	63	7235-40-7	Synthetic, although found naturally in many foods	red orange

Carotenoids. See Astaxanthin, or Apo 8′ Carotenal, or Canthaxanthin, Annato (Bixin).						
Canthaxanthin (Xanthophyll) Used in broiler chickens to enhance the color of the skin. Not to exceed 4.41 mg/k of complete feed.						
		73.75, 70.25	—	—	synthetic	yellow
Cochineal (*Coccus cacti* L.) Derived from shells of cochineal.						
	2330	73.100, 73.11	—	1390-65-4	cochineal beetle; coccus cacti	red
	—	73.100, 73.11	1309	1260-17-9	extract	red
Dragon's Blood (daemonorops draco Blume) Resin from Malaysian rattan palm. Main ingredient in color is dracorubin.						
	2404	172.510	—	9000-19-5	natural extract	red
Enocianina Enoncianina is made up of anthocyanins and is derived from grape skins. Extracted from the deseeded marc after the grapes have been pressed. See Grape Skin Extract, Grape Color Extract.						
	—	73.170	1310	11029-12-2	Natural Extract	turning purplish red at lower pH purplish blue at higher pH
Gambia or Gambir (Gambia Catechu, Pale Catechu). See Real Catechu-Botanicals-Acacia species).						
Uncaria Gambia (Huner) Roxb.	—	172.510	—	—	Extracted from the leaves and branches of tree and vine.	yellow to reddish coloring
extract	2264	172.510	—	8001-48-7 or	Extracted from the leaves and branches of tree and vine.	yellow to reddish coloring
powder	2265	172.510	—	8001-76-1	Extracted from the leaves and branches of tree and vine.	yellow to reddish coloring
gum	2265	172.515	—	—	Extracted from the leaves and branches of tree and vine.	yellow to reddish coloring
Titanium Dioxide Titanium Dioxide is micro-fine powder that is added as a whitener.						
	—	73.575, 73.1575, 73.2575, 73.3126	—	13463-67-7	Synthetic	white
Turmeric Contains the active ingredient, curcumin. For use in mayonnaise (169.140), salad dressings (169.150), and Animal Feeds (501.22).						
oleoresin	3087	73.615, 182.20, 582.20	—	8024-37-1	Natural Extract	yellowish green
botanical	3085	73.600, 182.10, 582.10	—	—	Natural Extract	yellowish green
extract	3086	182.20, 582.20	—	—	Natural Extract	yellowish green
FD&C Dyes						
Blue No. 1: Brilliant Blue (ethyl 4-[para-[ethyl (meta sulfo benzyl) amino]-(ortho sulfo phenyl) benzylidene] 2,5 cyclohexadien 1-ylidene] meta sulfo benzyl) ammonium hydroxide).						
	—	74.101, 82.101	1272	3844-45-9	artificial color	greenish blue
	—	—	1279	—	aluminum lake	greenish blue
	—	—	1280	—	calcium lake	greenish blue

Chart 115 *Continued*

Coloring Status	FEMA GRAS	CFR Status **	NAS#	CAS#	Natural vs.Synthetic	Hue
Blue No. 2: (2-(1,3 dihydro 3- oxo 5-sulfo 2H indol 2-ylidene) 2,3 dihydro 3-oxo 1H indole 5-sulfonic acid)						
	—	74.102, 82.102	1278	860-22-0	artificial color	deep blue
	—		1291	—	aluminum lake	deep blue
	—		1292	—	calcium lake	deep blue
Cheese coloring Some specifications and standards of identity for cheese allow the addition of harmless green or blue coloring to the cheese to counteract the natural yellow color of the curd. See FD&C Blue #1, Blue #2, Green #1. CFR Citations: 133.102 (Asiago), 133.106 (Bleu), 133.111 (Cacciovallo). 133.141 (Gorgonzola), 133.155 (Mozzarella and Samorza Cheese), 133.156 (Low Moisture Mozzarella and Samorza Cheese), 133.164 (Nuworld), 133.181 (Provolone), 133.183 (Romano), 133.184 (Roquefort), 133.186 (Sap Sago).						
Green No. 3: Fast Green FCF (n-ethyl n-[4-[[4-[ethyl[(3-sulfo phenyl) methyl] amino] phenyl] (4-hydroxy 2-sulfophenyl) methylene] 2,5 cyclohexadien 1-ylidene] sulfo benzene methan aminium hydroxide).						
	—	74.203	1276	2353-45-9	artificial color	bluish green
	—	—	1287	—	alumina lake	bluish green
	—	—	1288	—	calcium lake	bluish green
Red No. 40: Allura Red (6-hydroxy 5-[(2-methoxy 5-methyl 4-sulpho phenyl) azo] 2-naphthalene sulfonic acid).						
	—	74.340, 74.1340, 73.2340	1274	25956-17-6	Artificial Color	yellowish red
	—	—	1283	—	alumina lake	yellowish red
	—	—	1284	—	calcium lake	yellowish red
Yellow No. 5: Tartrazine (4,5-dihydro 5-oxo 1-sulfo phenyl 4-(sulfo phenyl azo) 1H pyrazo 3-carboxylic acid).						
	—	74.705, 74.1705, 74.2705, 82.705	1275	1934-21-0	artificial color	lemon yellow
	—	—	1285	12225-21-7	aluminum lake	lemon yellow
	—	—	1286	—	calcium lake	lemon yellow
Yellow No. 6: Sunset Yellow (3-hydroxy 5-[(4-sulfo phenyl) azo] 2-naphthalene sulfonic acid)						
	—	74.706, 74.1706, 74.2706, 82.706	1277	2783-94-0	artificial color	orange yellow
	—	—	1289	15790-07-5	aluminum lake	orange yellow
	—	—	1290	—	calcium lake	orange yellow
Ultramarine Blue (Na7Al6Si6O24S3 a sodium aluminum sulfo-silicate. May be combined with sodium sulfate or silica to alter the shade). Only for use in coloring the salt added to animal feeds, not to exceed 0.5% of the salt by weight.						
	—	CFR73.50	—	—	artificial color	blue

Chart 116 Comparative Chemical Groups

Groups are:	**Groups are:**
Acidulants	Sebacates
Acids (Fatty)	Sorbate Esters
Acids (Unsaturated Fatty)	Succinates
Aldehydes (Aromatic)	Sulfur Containing Esters
Aldehydes (Saturated Alkanals)	Tartrate Esters
Aldehydes (Unsaturated Alkenals, Alkadienals, Alkynals)	Tiglate Esters
Amines (Primary), Ammonium Compounds	Tolyl Esters
Amyl Cinnamyl Compounds	Unsaturated Esters
Anthranilates	Vanillyl Esters (And Related Vanillyl Compounds)
Botanicals (Herbs, Barks, Roots, Florals, Etc.), Extracts and Essential Oils	Furyl Compounds (Furans, Furfurals, Furanones)** Furyl Esters above
Coumarin Derivatives	Inorganic Salts. See Also Phosphates
Esters ** Note: See listings of these esters within the group Alkyl Esters.	Ionones, Methyl/Ionones, Irones, Psuedo-ionones, Ionols
Aceto Acetates	Jasmones, Jasmonates
Allyl Esters	Ketones (Aliphatic)
Amyl Esters **	Ketone (Aromatic)
Anisyl Esters	Lactones
Benzoates & Benzyl Esters	Musks
Bornyl & Isobornyl Esters	Naphthyl Compounds
Butyl/Isobutyl Esters **	Non-flavor Ingredients (Adjuvants) (Appearing on the GRAS List)
Carvyl Esters	Phosphates
Caryophyllene Esters	Phthalides
Cinnamyl Esters/Cinnamates	Secondary Amines
Citronellyl Esters. See Floral Esters	Pyrazines
Cyclohexyl Esters	Pyridines, Pyrazoles, Pyrollidines, Pyrroles, Quinolines, Oxazolines, Oxazoles,
Decyl Esters **	Quinoxilines
Dodecyl Esters **	Pyrimidines, Dithiazines
Ethyl Esters **	Sulfur Compounds
Eugenyl and Iso Eugenyl Esters	Esters. See Sulfur Containing Esters
Furyl Esters	Furans, Furanones. See Sulfur Containing Furans, Furanones, Etc.
Geranyl Esters. See Floral Esters	Iso Thio Cyanates
Heptyl Esters **	Mercaptans (Thiols)
Hexenyl Esters	Sulfides, Disulfides, Trisulfides, Polysulfides
Hexyl Esters **	Thiazoles, Thiazolines
Keto, Hydroxy & Oxo Esters	Thiophenes, Dithianes, Trithiolanes, Thieno Pyrimidines, Dithiazines
Lactate Esters	Sulfur Containing Furans, Furanones, Etc.
Levulinates	Sulfur Containing Vitamins
Linalyl Esters. See Floral Esters	Terpenes (Oxygenated)
Malonates, Malates	Terpene Alcohols & Ethers, Terpene Aldehydes, Terpene Ketones, Sulfur Containing Terpenes
Methyl Esters **	Terpenes, Sesquiterpenes, etc.
Phenyl Acetates & Phenyl Ethyl Esters	Unsaturated Alcohols
Phenyl Propyl Esters/Phenyl Propionates	Vitamins
Propyl & Isopropyl Esters	
Pulegyl Esters	
Pyruvates	
Rhodinyl Esters	
Salicylates	
Santalyl Esters	

Chart 117 Coumarin Derivatives

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
6 methyl coumarin	C10H8O2	2699	—	—	92-48-8
dihydrocoumarin (benzodihydropyrone)	C9H8O2	2381	—	—	119-84-6
octahydro coumarin	C9H14O2	3791	—	—	4430-31-3
1a,7b-dihydrocyclopropa[c]chromen-2(1H)-one or 2-(2-Hydroxyphenyl) cyclopropanecarboxylic acid delta lactone or Cyclopropyl coumarin	C10H6O2	4270	—	—	5617-64-1

Chart 118 Coumarin Replacers

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
7 methyl 4, 4a, 5,6 tetrahydro 2-(3H) naphthalenone	C11H14O	3715	—	—	34545-88-5
4 (3,4 methylene dioxy phenyl) 2 butanone (piperonyl acetone)	C11H12O3	2701	—	—	55418-52-5

Chart 119 Cyclohexyl Compounds

Compound	Empirical Formula	FEMA GRAS #	NAS#	CFR	CAS#
Cyclopentanone	C5H8O	3910	—	—	120-92-3
Cyclohexanone	C6H10O	3909	—	—	108-94-1
1,6-Hexalactam, or 2-Oxohexamethylenimine, amino hexanoic acid cyclic lactam, 2 aza cycloheptanone	C6H11NO	4235	—	—	105-60-2
Mixture of methyl cyclohexadiene and methylene cyclohexene	C6H12 and C6H10	4311	—	—	30640-46-1 and 1888-90-0
Paraldehyde, or 2,4,6-Trimethyl-1,3,5-trioxacyclohexane	C6H12O3	4010	—	—	123-63-7
2-Methylcyclohexanone	C7H12O	3946	—	—	583-60-8
3-Methylcyclohexanone	C7H12O	3947	—	—	591-24-2
4-Methylcyclohexanone	C7H12O	3948	—	—	589-92-4
cyclohexyl formate	C7H12O2	2353	—	172.515	4351-54-6
Epoxyoxophorone, or 3,5,5-Trimethyl-2, 3-epoxycyclohexane-1,4-dione	C8H12O3	4109	—	—	38284-11-6
cyclohexyl acetate	C8H14O2	2349	—	172.515	622-45-7
methyl cyclohexane carboxylate	C8H14O2	3568	—	—	4630-82-4
4-Isopropyl-2-cyclohexenone	C9H14O	3939	—	—	500-02-7
cyclohexyl propionate	C9H16O2	2354	—	172.515	6222-35-1
ethyl cyclohexane carboxylate	C9H16O2	3544	—	—	3289-28-9
3,5,5-Trimethylcyclohexanol	C9H18O	3962	—	—	116-02-9
4-Isopropenylcyclohexanecarboxaldehyde or (+/−)-cis- and trans-1,2-Dihydroperillaldehyde	C10H16O	4312	—	—	22451-50-9 and 22451-49-6
cyclohexyl butyrate	C10H18O2	2351	—	172.515	1551-44-6
cyclohexane ethyl acetate	C10H18O2	2348	—	172.515	5452-75-5
allyl cyclohexane acetate*	C11H12O2	2023	—	172.515	4728-82-9

Chart 119 *Continued*

Compound	Empirical Formula	FEMA GRAS #	NAS#	CFR	CAS#
ethyl cyclohexane propionate	C11H20O2	2431	—	172.515	10094-36-7
cyclohexyl isovalerate	C11H20O2	2355	—	172.515	7774-44-9
3,3,5-trimethylcyclohexyl acetate	C11H20O2	4512	—	—	67859-96-5
allyl cyclohexane propionate*	C12H20O2	2026	—	172.515	2705-87-5
cyclohexyl anthranilate*	C13H17NO2	2350	—	172.515	7779-16-0
Cycloionone, or 6,6,7,8,8a-Tetrahydro-2,5,5,8a-tetramethyl-5H-1-benzopyran	C13H20O	3822	—	—	5552-30-7
(E)-2-(2-Octenyl)cyclopentanone	C13H22O	3889	—	—	65737-52-2
allyl cyclohexane butyrate*	C13H22O2	2024	—	172.515	7493-65-4
allyl cyclohexane valerate	C14H24O2	2027	—	172.515	7493-68-7
cyclohexyl cinnamate*	C15H18O2	2352	—	172.515	7779-17-1
2-(3,7-Dimethyl-2,6-octadienyl)cyclopentanone	C15H24O	3829	—	—	68133-79-9
allyl cyclohexane hexanoate*	C15H26O2	2025	—	172.515	7493-66-5
3-[3-(2-isopropyl-5-methyl-cyclohexyl)ureido] butyric acid ethyl ester	C17H32N2O3	4766	—	—	1160112-20-8

Chart 120 Cognac Oil

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Cognac Wine (Lees or Dregs)					
green	2331	182.50, 582.50	—	8016-21-5	ester
white	2332	182.50, 582.50	—	8016-21-5	ester

Chart 121 Copaiba

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Copaiba (Copaifera sp.)					
botanical	—	172.510	6040	8013-97-6	balsam
oil	—	172.510	6041	8001-61-4	balsam

Chart 122 Coriander

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Coriander (Coriandrum sativum L)					
botanical	2333	182.10, 582.10	—	8008-52-4	linalool type
oil	2334	182.20, 582.20	6338	8008-52-4	linalool type
flakes	—	—	6467	8008-52-4	linalool type

Chart 123 Corn Silk

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Corn Silk					
botanical	2335	—	—	999999-21-7	Nutraceutical
extract	—	184.1262	6190	999999-21-7	Nutraceutical
oil	—	184.1262	6191	999999-21-7	Nutraceutical

Chart 124 Costmary

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Costmary (Chrysanthemum balsamita L.)					
(alcoholic beverages only)	—	172.510	6043	—	minty, linalool type

Chart 125 Costus

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Costus (Saussurea lappa Clark)					
root oil	2336	172.510	—	8023-88-9	resinous, floral

Chart 126 Cottonseed Oil

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Cottonseed Oil	—	—	376	8001-29-4	vegetable oil

Chart 127 Cubeb

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Cubeb (Piper cubeba L. f.)					
botanical	2338	—	172.510	8007-87-2	terpene
oil	2339	—	172.510	8007-87-2	woody

Chart 128 Cumin

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Cumin (Cuminum cyminum L.)					
botanical	2340	182.10, 582.10	—	8014-13-9	spicy aromatic
oil	2343	182.2	—	8014-13-9	spicy aromatic
oleoresin	—	—	6571	—	spicy aromatic

Chart 129 Curacao

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Curacao (Peel) (Citrus aurantium L.)					
peel extract	2344	—	—	94266-47-4	Citrus
peel oil	2345	—	—	94266-47-4	Citrus

Chart 130 Currants

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Currant, Black Buds (Ribees Nigrum L.) (Cassis)					
food					fruit
currant buds absolute	2346	—	—	172.510	floral
juice (cassis)	—	6702	—	172.510	fruit
leaves	—	6044	—	172.510	green floral

Chart 131 Deli Meats

Name	Made from
Ham	Pork that is salted smoked and cooked. Sodium nitrite is added to the curing to inhibit pathogenic microorganisms like Clostridium botulinum to grow. This develops a pink coloration.
Prosciutto	A heavy smoked Italian ham.
Bacon	Made from the belly (sliced bacon) or loins (back bacon) of the pork. Bacon is often smoked, seasoned and salted.
Canadian bacon	More like a heavy smoked ham.
Sausage	Sausage is prepared by stuffing animal intestines called casings with chopped, seasoned, nitrited meat. Some sausages are very hot and spicy (chorizo, kielbasa, pepperoni), or fatty and spicy (salami). Synthetic or alternative animal casings are used for kosher considerations. (as with Frankfurters). Synthetic casings can be made from edible collagen or inedible cellulose.
Wurst	Means the process was done in Germany.
Liverwurst	A type of wurst made from pureed liver, and spices like black pepper, etc.
Frankfurters	American style sausages (wieners, Hot Dogs), which are usually based off of a savory base blend with added garlic, pepper, onion, salt and other spices.
Andoville	A special veal sausage made from chitterlings and other offals.
Rilletes	Mixed meats cooked in lard.
Foie Gras	Duck or Goose liver that is enlarged by force-feeding the animals.
Blood Sausage	Made from seasoned pig's blood and fat. See **Chitterlings.**

Chart 132 Delisted Items

Name	CFR Listing
2-hexyl 4-acetoxy tetra hydro furan	was CFR172.515 and FEMA GRAS# 2566
2-methyl 5-vinyl pyrazine	was FEMA GRAS# 3211
3-nonanon 1-yl 1-acetate	was FEMA GRAS# 2786
Acetamide	was FEMA # 4251 - delisted in preamble GRAS 24
Calamus and its derivatives	CFR 189.110
Cinnamyl Anthranilate	CFR 189.113
Citrus Red #2 (1-(2,5 dimethoxy phenyl azo) 2-naphthol)	was CFR74.302 Terminated CFR81.10, 81.30
Coumarin	CFR 189.130
Cyclamate	CFR 189.135
Ethyl Acrylate	was FEMA # 2418 delisted in preamble GRAS 21
Gentian Violet #1	was CFR172.510, 500.29, 500.30 Terminated CFR589.1000
Gentian Violet (Violet #1)	CFR 500.29, 529.1000
Green No. 1	Terminated CFR81.10, 81.30
ortho vinyl anisole	was FEMA GRAS# 3248
Quinoline	was FEMA # 3470 - delisted in preamble GRAS 27
Red No. 3 Erythosine (9-(ortho carboxy phenyl 6-hydroxy 2,4,5,7, tetra iodo 3(H) xanthen 3 one)	was CFR Title 21 Section 74.303 Terminated CFR81.10, 81.30
Safrole, Isosafrole and Dihydrosafrole	CFR 189.180

Chart 133 DE Rating

Sweetener	DE (Rating)	Regulatory Status
Maltodextrin	10 DE 11	CFR184.1444
Maltodextrin	15 DE 15	CFR184.1444
Lactose	16	CFR73.85 (Caramel), 101.9, 131.111, 131.112, 131.136, 131.138, 131.144, 131.144, 131.146, 131.147, 131.170, 131.200, 131.203, 131.206, 133.124, 133.178, 133.179, 135.110, 135.140, 166.110, 168.122, 169.179, 173.357
Maltodextrin	18 DE 21	CFR184.1444
Raffinose	25	Not approved
Maltose	32	CFR131.111, 131.112, 131.136, 131.138, 131.144, 131.146, 131.170, 131.200, 131.203, 131.206, 133.214, 133.178, 133.179
Malt Syrup	30	170.3, 184.1445
Honey	35	CFR131.111, 131.136, 131.138, 131.144, 131.146, 131.170, 131.200, 131.206, 133.127, 145.115, 145.125, 145.130, 145.135, 145.170, 145.175, 145.185, 145.190, 146.187, 168.180
Xylose	35	3606
Lactitol (A dimeric sugar produced by catalytic hydrogenation of lactose)	35	GRAS
Erythritol	35	GRAS
Maple Syrup (Pure)	40	CFR168.140, 168.180, 170.3
Corn Syrup	36 DE 42	CFR168.120, 168.210, 170.3, 173.37, 182.1866, 184.1865, 573.530 (Hydrogenated)
Isomalt™ (Mixture of 1-ortho alpha d-gluco pyranosyl mannitol (1,1 GPM dihydrate) and 6 ortho alpha d-gluco pyranosyl d-sorbitol (1,6 GPS)	45	GRAS
Mannitol	50	CFR100.130, 101.9, 180.25, 582.547
Inositol	50	Not GRAS
Dulcitol	50	Not GRAS
Corn Syrup	42 DE 50	CFR168.120, 168.210, 170.3, 173.37, 182.1866, 184.1865, 573.530 (Hydrogenated)
Corn Syrup	58 DE 58	CFR168.120, 168.210, 170.3, 173.37, 182.1866, 184.1865, 573.530 (Hydrogenated)
Sorbitol	60	CFR100.130, 101.9, 184.1835, 582.5835
Corn Syrup	68 DE 68	CFR168.120, 168.210, 170.3, 173.37, 182.1866, 184.1865, 573.530 (Hydrogenated)
Hydrogenated Starch Hydrolysates (low maltitol)	70	GRAS
Glucose (Dextrose) Syrup	74	CFR168.120, 168.121, 173.357, 182.1866, 184.1865
Hydrolyzed Lactose(Glucose & Galactose)	80	CFR133.124, 133.178, 133.179, 135.11
Maltitol	90	GRAS
Iditol	90	Not GRAS

Chart 133 *Continued*

Sweetener	DE (Rating)	Regulatory Status
Dextrose	100	CFR73.85, 133.124, 133.178, 145.3, 145.134, 145.180, 145.180, 146.3, 146.140, 146.145, 146.146, 155.200, 168.110, 168.111, 168.120, 168.122, 169.175, 169.179
High Fructose Corn Syrup-42	100 (Variable Perception)	CFR173.357, 182.1866
Xylitol (Naturally occurring sugar alcohol which is produced by catalytic hydrogenation of d-xylose)	120	CFR172.395, 101.9
Sucrose	120	CFR73.85, 101.9, 131.111, 131.112, 131.136, 131.138, 131.144, 131.146, 131.170, 131.200, 131.203, 145.3, 145.110, 145.115, 145.120, 145.125, 145.130, 145.135, 145.140, 145.145, 145.170, 145.175, 145.180, 145.185, 145.190, 146.3, 146.114, 146.132, 146.185, 155.3, 155.200, 156.3, 170.3, 184.1854
Xylose	120	3606-
High Fructose Corn Syrup-55	120 (Variable Perception)	CFR173.357, 182.1866
High Fructose Corn Syrup Pure Crystalline	170 (Variable Perception)	CFR173.357, 182.1866
Glycyrrhizin	4000	GRAS as a flavoring not a sweetener.
Tagatose	9000	Bulk sweetener, flavor enhancing properties
Aspartame™ (l-aspartyl l-phenyl alanine) or (Nutrasweet™)	18000	CFR172.804
Acesulfame K (Sunett)™	20000	CFR172.800
Saccharin	30000	CFR101.11
Saccharin, Ammonium	30000	CFR101.11, 180.37
Saccharin, Sodium	30000	CFR101.11, 145.116, 145.126, 145.131, 145.136, 145.171, 145.176, 145.181, 150.141, 150.161
Sucralose™ (1,6-dichloro 1,6-dihydroxy beta d-fructo furanoyl 4-chloro 4-deoxy alpha d-galacto pyranoside 4,1′,6′-trichloro galactosucrose)	60000	Approved for use in the U.S., Apr 1 1998
Alitame™ (not approved in U.S.) or (l-alpha aspartyl n (2,2,4,4, tetramethyl 3 thienyl) d-alanine hydrate)	290000	Petition for approval in U.S. has been withdrawn.
Thaumatin	300000	GRAS as a flavor enhancer not a sweetener.
Neotame	1000000	Approved for beverages, dairy and bakery and as a flavor enhancer in chewing gum

Chart 134 Distillates

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Banana Distillate	—	—	6537	—	Banana
Butter Starter Distillate	2173	—	—	91745-88-9	Butter
Cherry Bark, Wild, Distillate	—	—	6536	—	Cherry
Cocoa Distillate	—	—	6638	—	Cocoa
Coffee Distillate	—	—	6538	—	Coffee
Lemon Distillate	—	—	6653	—	Lemon

Chart 135 Dodecyl Esters

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
dodecyl isobutyrate	C16H32O2	3452	—	—	6624-71-1

Chart 136 Damiana

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Damiana (Tumera diffusa Willd var. aphrodisiaca (Desvaux) Ward.)					
	—	172.510	6351	—	bitter principle

Chart 137 Dandelion

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Dandelion (Taraxaum officinale Weber & T. laevigatum DC					
food				68990-74-9	bitter principle
fluid extract	2357	182.20, 582.20	—	68990-74-9	bitter principle
root oil solid extract	2358	182.20, 582.20	—	68990-74-9	bitter principle

Chart 138 Davana

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Davana (Artemisia pallens Wall.)					
	2359	182.20, 582.20	—	8016-3-3	floral vegetable, woody

Chart 139 Dill

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Dill (Anethum graveolens L.)					
botanical	2382	182.1282	—	8006-75-5	vegetable
weed and seed oil	2383	184.1282	—	8006-75-5	woody
weed oil	—	—	6307	8006-75-5	vegetable
Dill, Indian Seed (Anethum sowa Roxb.)					
seed oil	2384	172.510, 184.1282	—	8006-75-5	woody
weed oil	—	172.510, 184.1282	—	8006-75-5	woody

Chart 140 Dittany and Dittany of Crete

Name	FEMA GRAS #	CFR	NAS#	CAS #	Type
(Dittany Fraxinella) Tonic (alcoholic beverages only)	—	172.510	6052	—	aromatic spice
Dittany of Crete (Origanum dictamnus L.) See Bitter.	2399	172.510	—	899998-27-6	bitter principle

Chart 141 Doggrass

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Doggrass (Agropyron repens L. Beauv.)					
extract	2403	182.20, 582.20	—	84649-79-6	bitter principle

Chart 142 Dragon's Blood

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Dragon's Blood (Daemonorops draco Blume) See Also Colorants.					
extract	2404	172.510	—	9000-19-5	astringent, colorant

Chart 143 Emulsifying Agents

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
beeswax	—	2126	184.1973	—	8012-89-3
candelilla wax	—	3479	184.1976	—	8006-44-8
carnauba wax	—	—	184.1978, 582.1978	—	8015-86-9
castor oil	—	2263	172.876	—	8001-79-4
castor oil, hydrogenated	—	—	178.328	—	8001-78-3
Citric acid esters of mono- and di-glycerides or Citric and fatty acid esters of glycerol	not available	4307	—	—	97593-31-2
cocoa butter substitute	—	—	184.1259, 172.861	—	—
diacetyl tartaric acid esters of mono & diglycerides	—	—	184.1101, 582.4101 (In bread 136.110	—	—
Diacetyl tartaric acid esters of mono- and diglycerides (Panodan 0165 Datem)	—	4092	—	—	100085-39-0 308068-42-0
dioctyl sodium sulfo succinate	—	—	172.81	—	20727-33-7
edible oils	—	—	(Allowed as food components, therefore not subject to regulation by the FDA)	—	—
ethoxylated mono and diglycerides	—	—	172.834	—	6896-98-9 or 67784-88-7
fatty acids	—	—	172.860, 172.210, 101.9, 101.62, 101.7-, 101.75, 101.77, 101.78, 184.1025 (caprylic)	—	67254-79-9
glyceryl monooleate	—	2526	184.1323, 172.515	—	111-03-5
glyceryl monostearate	—	2527	184.1324, 582.1324, 172.515	—	12-94-4
glyceryl tristearate	—	—	172.811	—	555-43-1
Glyceryl-lacto esters of fatty acids	—	4124	—	—	98084-79-8
hydroxylated lecithin	—	—	172.814	—	8029-76-3
lactylated esters of fatty acids	—	—	172.848, 172.850	—	—
Lactylated fatty acid esters of glycerol and propylene glycol	—	4153	—	—	444004-59-5 444004-60-8
lecithin	—	—	184.1400, 582.1400, 172.814	—	8002-43-5
methyl and ethyl esters of fatty acids	—	—	172.225, 573.640	—	—
mineral oil, white	—	—	172.878, 178.3620, 573.680, 573.72	—	—
mono and diglycerides	—	—	184.1505, 582.4505	—	67784-87-6
Mono- and diglycerides of fatty acids	—	4186	—	—	67701-32-0 67701-33-1 68990-53-4

oleic acid	—	2815	172.210, 172.862	—	112-80-1
petrolatum	—	—	172.880, 178.3700, 573.720	—	8009-8-3
petroleum hydrocarbons, odorless, light	—	—	172.884	—	—
petroleum wax	—	—	172.886, 173.3710, 178.3720	—	8002-74-2
petroleum wax, synthetic	—	—	172.888	—	
polyethylene glycol	—	—	172.210, 172.820, 172.888, 178.3750, 178.3760, 178.3910, 573.800	—	27496-68-9
Polyglycerol esters of fatty acids	—	4201	—	—	79665-93-3
Polysorbate 20 (poly oxy ethylene (20) sorbitan monolaurate)	—	2915	172.515, 173.340, 178.3400	—	9005-64-5
Polysorbate 60 (poly oxy ethylene (20) sorbitan monostearate)	—	2916	172.836, 573.840, 172.515, 73.340, 178.3400	—	9005-67-8
Polysorbate 65 (poly oxy ethylene (20) sorbitan tristearate)	—	—	172.838, 172.826, 172.842, 172.515, 173.340, 178.3400	—	9005-71-4
Polysorbate 80 (poly oxy ethylene (20) sorbitan monooleate)	—	2917	172.840, 573.860, 172.515, 173.340, 178.3400	—	9005-65-6
Propylene glycol mono- and diesters of fatty acids	—	4208	—	—	1323-39-3
rice bran wax	—	—	172.890, 172.615	—	8016-60-2
salts of fatty acids	—	—	172.863, 573.914	—	—
sodium lauryl sulfate	—	—	172.210, 178.822	—	151-2-3
sorbitan monolaurate	—	—	178.3400, 172.842	—	1338-92-2
sorbitan monooleate	—	—	173.75	8770	1338-43-8
sorbitan monopalmitate	—	—	178.3400, 172.842	—	26266-57-9
sorbitan monostearate	—	3028	3028/172.842, 573.960, 173.340	—	1338-41-6
sorbitan trioleate	—	—	178.3400, 172.842	—	26266-58-0
sorbitan tristearate	—	—	178.3400, 172.842	—	26658-19-5
stearic acid	—	3035	184.1090, 172.210, 172.615, 172.860, 173.340	—	57-11-4
succinylated monoglycerides	—	—	172.83	—	—
sucrose fatty acid esters	—	—	172.859, 172.867 (OlestraTM)	—	—
synthetic isoparafiinic petroleum hydrocarbons	—	—	172.882	—	—
sodium lauryl sulfate	C12H25NaSO4	4437	—	—	151-21-3

Chart 144 Enhancers

Compound	Empirical Formula	FEMA GRAS #	CAS#
mono sodium glutamate	C5H8NO4Na	2756-	142-47-2
disodium 5′ inosinate*	C10H11N4O8Na2P	3669-	4691-65-0
disodium 5′ guanylate*	C10H12N5O8Na2P	3668-	12/9/5550

*denotes listed elsewhere as well

Chart 145 Essences and Distillates

Essences and Distillates	NAS#
Apple Essence	6400
Apple Essence 150x	6541
Apple Essence 2500x	6528
Apple Essence 3000x	6542
Apricot Essence 150x	6509
Banana Essence	6537
Banana Essence 150x	6544
Banana Essences 600x	6506
Blackberry Essence	6627
Blueberry Essence	6510
Boysenberry	6631
Cherry	6551
Cherry 100X	6507
Cherry 150X	6511
Cherry Bark, Wild Distillate	6536
Coffee Distillate	6538
Cranberry	6512
Fig	6563
Grape	6395
Grapefruit	6396
Lemon Distillate	6653
Passionfruit	6665
Peach	6513
Peach 100X	6588
Peach 150X	6508
Pear	6514
Pear Juice Essence	6572
Plum	6596
Raspberry	6518
Rum, Jamaican	6671
Strawberry	6515
Strawberry 150X	6607
Tangerine	6398
Tea	6558

Chart 146 Alkyl Esters - Grouped by Alcohol Moiety

Alkyl esters (for unsaturated esters, see under that heading)

Compound	Empirical Formula	FEMA GRAS #	CFR	CAS#
methyl esters				
methyl acetate	C3H6O2	2676	—	79-20-9
methyl propionate	C4H8O2	2742	172.515	554-12-1
methyl butyrate	C5H10O2	2693	172.515	623-42-7
methyl isobutyrate	C5H10O2	2694	172.515	547-63-7
methyl 2 methyl butyrate	C6H12O2	2719	172.515	868-57-5
methyl valerate	C6H12O2	2752	172.515	624-24-8
methyl isovalerate	C6H12O2	2753	172.515	556-24-8
methyl hexanoate	C7H14O2	2708	172.515	106-70-7
methyl 2 methyl pentanoate	C7H14O2	3707	—	2177-77-7
methyl benzoate	C8H8O2	2683	172.515	93-58-3
methyl heptanoate	C8H16O2	2705	172.515	106-73-0
methyl octanoate	C9H18O2	2728	172.515	111-11-5
methyl nonanoate	C10H20O2	2724	172.515	1731-84-6
methyl laurate	C13H26O2	2715	172.515	111-82-0
methyl myristate	C15H30O2	2722	172.515	124-10-7
ethyl esters				
ethyl formate	C3H6O2	2434	184.1295	109-94-4
ethyl acetate	C4H8O2	2414	173.228,177.560, 182.60, 582.60	141-78-6
ethyl pyruvate*	C5H8O3	2457	172.515	617-35-6
ethyl propionate	C5H10O2	2456	172.515	105-37-3
ethyl lactate*	C5H10O3	2440	172.515	97-64-3
ethyl aceto acetate	C6H10O3	2415	172.515	141-97-9
ethyl butyrate	C6H12O2	2427	182.60, 582.60	105-54-4
ethyl isobutyrate	C6H12O2	2428	172.515	97-62-1
ethyl tiglate*	C7H12O2	2460	172.515	5837-78-5
ethyl levulinate	C7H12O3	2442	172.515	539-88-8
ethyl pentanoate (valerate)	C7H14O2	2462	172.515	539-82-2
methyl 4 methyl valerate	C7H14O2	2721	172.515	2412-80-8
ethyl 2 methyl butyrate	C7H14O2	2443	172.515	7452-79-1
ethyl isovalerate	C7H14O2	2463	172.515	108-64-5
ethyl sorbate*	C8H12O2	2459	172.515	2396-84-1
ethyl 2-hexenoate	C8H14O2	4613	—	1552-67-6
ethyl hexanoate (caproate)	C8H16O2	2439	172.515	123-66-0
ethyl 3 methyl pentanoate	C8H16O2	3679	—	5870-68-8
ethyl 2 methyl pentanoate	C8H16O2	3488	—	39255-32-8
ethyl 4-methylpentanoate	C8H16O2	4343	—	25415-67-2
ethyl 2-ethylbutyrate	C8H16O2	4344	—	2983-38-2
ethyl heptanoate	C9H18O2	2437	172.515	106-30-9
ethyl 2-ethylhexanoate	C10H20O2	4345	—	2983-37-1
ethyl octanoate (caprylate)	C10H20O2	2449	172.515	106-32-1
ethyl nonanoate (pelargonate)	C11H22O2	2447	172.515	123-29-5
ethyl decanoate (caprate)	C12H24O2	2432	172.515	110-38-3
ethyl undecanoate	C13H24O2	3492	172.515	627-90-7
ethyl 5-formyloxydecanoate	C13H24O4	4765	—	1367348-37-5
ethyl dodecanoate (laurate)	C14H28O2	2441	172.515	106-33-2

Chart 146 *Continued*

Alkyl esters (for unsaturated esters, see under that heading)

Compound	Empirical Formula	FEMA GRAS #	CFR	CAS#
ethyl tetradecanoate (myristate)	C16H32O2	2445	172.515	124-06-1
ethyl hexadecanoate (palmitate)	C18H36O2	2451	—	628-97-7
ethyl octadecanoate (stearate)	C20H40O2	3490	—	111-61-5
propyl esters				
isopropyl formate	C4H8O2	2944	172.515	625-55-8
propyl formate	C4H8O2	2943	172.515	110-74-7
propyl acetate	C5H10O2	2925	172.515	109-60-4
isopropyl acetate	C5H10O2	2926	172.515	108-21-4
isopropyl propionate	C6H12O2	2959	172.515	637-78-5
propyl propionate	C6H12O2	2958	172.515	106-36-5
isopropyl butyrate	C7H14O2	2935	172.515	638-11-9
propyl isobutyrate	C7H14O2	2936	—	644-49-5
iso propyl isobutyrate	C7H14O2	2937	172.515	617-50-5
propyl butyrate	C7H14O2	2934	172.515	105-66-8
iso propyl isovalerate	C8H16O2	2961	172.515	32665-23-9
iso propyl 2 methyl butyrate	C8H16O2	3699	—	66576-71-4
propyl isovalerate	C8H16O2	2960	172.515	557-00-6
iso propyl tiglate*	C8H15O2	3229	—	6284-46-4
Methyl 5-acetoxyhexanoate	C9H16O4	4055	—	35234-22-1
Ethyl 3-acetoxy-2-methyl butyrate	C9H16O4	4038	—	139564-43-5
iso propyl hexanoate	C9H18O2	2950	172.515	2311-46-8
propyl hexanoate	C9H18O2	2949	172.515	626-77-7
propyl heptanoate	C10H20O2	2948	172.515	7778-87-2
iso propyl myristate	C17H34O2	3556	—	110-27-0
butyl esters				
isobutyl formate	C5H10O2	2197	172.515	542-55-2
butyl formate	C5H10O2	2196	172.515	592-84-7
butyl acetate	C6H12O2	2174	172.515	123-86-4
isobutyl acetate	C6H12O2	2175	172.515	110-19-0
isobutyl propionate	C7H14O2	2212	172.515	540-42-1
butyl propionate	C7H14O2	2211	172.515	590-01-2
butyl lactate	C7H14O3	2205	172.515	138-22-7
isobutyl butyrate	C8H16O2	2187	172.515	539-90-2
butyl isobutyrate	C8H16O2	2188	172.515	97-87-0
butyl butyrate	C8H16O2	2186	172.515	109-21-7
isobutyl isobutyrate	C8H16O2	2189	172.515	97-85-8
butyl aceto acetate	C8H14O2	2176	172.515	591-60-6
isobutyl aceto acetate	C8H14O2	2177	172.515	7779-75-1
butyl levulinate	C9H16O3	2207	172.515	2052-15-5
butyl isovalerate	C9H18O2	2218	172.515	109-19-3
2 methyl propyl 3 methyl butyrate	C9H18O2	3369	—	589-59-3
butyl valerate	C9H18O2	2217	172.515	591-68-4
n butyl 2 methyl butyrate	C9H18O2	3393	—	15706-73-3
isobutyl hexanoate	C10H20O2	2202	172.515	105-79-3
butyl hexanoate	C10H20O2	2201	172.515	626-82-4

Chart 146 *Continued*

Alkyl esters (for unsaturated esters, see under that heading)

Compound	Empirical Formula	FEMA GRAS #	CFR	CAS#
isobutyl heptanoate	C11H22O2	2200	172.515	7779-80-8
butyl heptanoate	C11H22O2	2199	172.515	5454-28-4
butyl laurate	C16H32O2	2206	172.515	106-18-3
butyl stearate	C22H44O2	2214	172.515	123-95-5
amyl esters				
amyl formate	C6H12O2	2068	172.515	638-49-3
isoamyl formate	C6H12O2	2069	172.515	110-45-2
isoamyl acetate	C7H14O2	2055	172.515	123-92-2
2 methyl butyl acetate	C7H14O2	3644	—	624-41-9
iso amyl pyruvate*	C8H14O2	2083	172.515	7779-72-8
ethyl butyl acetate	C8H16O2	2425	172.515	10031-87-5
2-Pentyl acetate	C8H16O2	4012	—	626-38-0
isoamyl propionate	C8H16O2	2082	172.515	105-68-0
3 methyl butyl 2 methyl propionate	C9H18O2	3507	172.515	2050-01-03
2-Pentyl butyrate	C9H18O2	3893	—	60415-61-4
amyl butyrate	C9H18O2	2059	172.515	540-18-1
isoamyl butyrate	C9H18O2	2060	172.515	106-27-4
3 methyl butyl 2 methyl butyrate	C10H20O2	3505	—	27625-35-0
2 methyl butyl 2 methyl butyrate	C10H20O2	3359	—	2445-78-5
2 methyl butyl 3 methyl butyrate	C10H20O2	3506	172.515	2445-77-4
isoamyl isovalerate	C10H20O2	2085	172.515	659-70-1
2-Pentyl 2-methylpentanoate	C11H22O2	4401	—	CAS Pending
isoamyl hexanoate	C11H22O2	2075	172.515	2198-61-0
amyl octanoate	C13H2602	2079	172.515	638-25-5
isoamyl octanoate	C13H26O2	2080	172.515	2035-99-6
isoamyl nonanoate	C14H28O2	2078	172.515	7779-70-6
isoamyl laurate (isoamyl decanoate)	C17H34O2	2077	172.515	6309-51-9
hexyl esters				
hexyl formate	C7H14O2	2570	172.515	629-33-4
hexyl acetate	C8H16O2	2565	172.515	142-92-7
hexyl propionate	C9H18O2	2576	172.515	2445-76-3
hexyl isobutyrate	C10H20O2	3172	—	2349-07-07
hexyl butyrate	C10H20O2	2568	172.515	2639-63-6
4-Methylpentyl isovalerate	C11H22O2	4347	—	850309-45-4
hexyl 2 methyl butyrate	C11H22O2	3499	—	10032-15-2
hexyl isovalerate	C11H22O2	3500	172.515	10032-13-0
hexyl hexanoate	C12H24O2	2572	172.515	6378-65-0
4-methylpentyl 4-methylvalerate	C12H24O2	4749	—	35852-42-7
Hexyl heptanoate	C13H26O2	4337	—	1119-06-8
hexyl octanoate	C14H28O2	2575	172.515	1117-55-1
Hexyl nonanoate	C15H30O2	4339	—	6561-39-3
Hexyl decanoate	C16H32O2	4342	—	10448-26-7

Chart 146 *Continued*

Alkyl esters (for unsaturated esters, see under that heading)

Compound	Empirical Formula	FEMA GRAS #	CFR	CAS#
heptyl esters				
heptyl formate	C8H16O2	2552	172.515	112-23-2
heptyl acetate	C9H18O2	2547	172.515	112-06-1
(+/−) Heptan-3-yl acetate	C9H18O2	3980	—	5921-83-5
5-Methylhexyl acetate	C9H18O2	4346	—	180348-60-1
heptyl butyrate	C11H22O2	2549	172.515	5870-93-9
(+/−) Heptan-2-yl butyrate	C11H22O2	3981	—	39026-94-3
heptyl isobutyrate	C11H22O2	2550	172.515	2349-13-5
Heptyl heptanoate	C14H28O2	4341	—	624-09-9
heptyl octanoate	C15H30O2	2553	172.515	4265-97-8
octyl esters				
octyl formate	C9H18O2	2809	172.515	112-32-3
(+/−) Octan-3-yl formate	C9H18O2	4009	—	84434-65-1
octyl acetate	C10H20O2	2806	172.515	112-14-1
3 octyl acetate	C10H20O2	3583	172.515	4864-61-3
octyl propionate	C11H22O2	2813	172.515	142-60-9
3-Octyl butyrate	C12H24O2	4402	—	20286-45-7
octyl butyrate	C12H24O2	2807	172.515	110-39-4
octyl isobutyrate	C12H24O2	2808	172.515	109-15-9
octyl isovalerate	C13H26O2	2814	172.515	7786-58-5
octyl 2 methyl butyrate	C13H26O2	3604	—	29811-50-5
octyl heptanoate	C15H30O2	2810	172.515	5132-75-2
octyl octanoate	C16H32O2	2811	172.515	2306-88-9
nonyl esters				
(+/−) Nonan-3-yl acetate	C11H22O2	4007	—	60826-15-5
nonyl acetate	C11H22O2	2788	172.515	143-13-5
nonyl isovalerate	C14H28O2	2791	172.515	7786-47-2
nonyl octanoate	C17H34O2	2790	172.515	7786-48-3
decyl esters				
decyl acetate	C12H24O2	2367	172.515	112-17-4
decyl propionate	C13H26O2	2369	172.515	5454-19-3
decyl butyrate	C14H28O2	2368	172.515	5454-9-1
dodecyl esters				
lauryl acetate (dodecyl acetate)	C14H28O2	2616	172.515	112-66-3
Dodecyl butyrate	C14H28O2	4340	—	3724-61-6
Dodecyl propionate	C15H30O2	4338	—	6221-93-8
dodecyl isobutyrate	C16H32O2	3452	—	6624-71-1

Chart 147 Ethers

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
ethylene oxide	C2H4O	2433	172.710, 172.808, 175.105, 176.180, 178.3120, 178.3520, 193.200	—	75-21-8
1,1 dimethoxy ethane	C4H10O2	3426	—	—	534-15-6
maltol (VeltolTM)	C6H6O3	2656	172.515	—	118-71-8
furfuryl methyl ether	C6H8O2	3159	—	—	13679-46-6
para ethoxy phenol (hydroquinone mono ethyl ether)	C6H9O2	3695	—	—	622-62-8
2,2,4 trimethyl 1,3 oxa cyclo pentane	C6H12O2	3441	—	—	1193-11-9
(+/−)-1-Acetoxy-1-ethoxyethane	C6H12O3	4069	—	—	1608-72-6
sec butyl ethyl ether	C6H14O	3131	—	—	2679-87-0
anisole (methoxy benzene)	C7H8O	2097	172.515	—	100-66-3
ethyl maltol (Veltol plus™)	C7H8O2	3487	—	—	4940-11-8
4 methyl 2,6 dimethoxy phenol	C7H12O3	3704	—	—	6638-5-7
n-Hexyl methyl ether	C7H14O	4291	—	—	4747-07-3
1 ethoxy 3 methyl 2 butene	C7H14O	3777	—	—	22094-00-4
1,1-Dimethoxy-trans-2-hexene	C7H14O	4098	—	—	18318-83-7
piperonal (heliotropine)	C8H6O	2911	182.60, 582.60	—	120-57-0
meta dimethoxy benzene (resorcinol dimethyl ether)	C8H10O2	2385	172.515	—	151-10-0
para dimethoxy benzene (dimethyl hydro quinone)	C8H10O2	2386	172.515	—	150-78-7
2,6 dimethoxy phenol	C8H10O2	3137	—	—	91-10-1
benzyl ethyl ether	C8H12O	2144	172.515	—	539-30-0
2 butyl 5 or 6 keto 1,4 dioxane	C8H14O3	2204	—	—	65504-95-2
ortho vinyl anisole (1 methoxy 2 vinyl benzene) Removed from GRAS list (formerly GRAS# 3248)	—	—	—	—	—
1,1-dipropoxyethane	C8H18O2	4688	—	—	105-82-8
p ethoxy benzaldehyde	C9H10O2	2413	172.515	—	10031-82-0
methyl ortho methoxy benzoate	C9H10O3	2717	172.515	—	606-45-1
3 ethoxy 4 hydroxy benzaldehyde(ethyl vanillin)	C9H10O3	2464	163.53, 163.111, 163.112, 163.113, 13.114, 163.117, 163.123, 163.130, 163.135, 163.145, 163.150, 164.155, 182.60, 582.60	—	121-32-4
ortho methyl anisole	C9H10O3	2680	172.515	—	578-58-5
methyl phenyl ethyl ether	C9H12O	3198	—	—	3558-60-9
2,4-Dimethylanisole or (1-Methoxy-2, 4-dimethylbenzene)	C9H12O	3828	—	—	6738-23-4
2 amyl 5 or 6 keto 1,4 dioxane	C9H16O3	2076	—	—	65504-96-3
4 methyl 2 pentyl 1,3 dioxolan	C9H18O2	3620	—	—	6563-74-6
2,3 dimethyl benzo furan	C10H10O	3535	—	—	3782-00-1
difurfuryl ether	C10H10O3	3337	—	—	4437-22-3
trans anethole	C10H12O	2086	182.60,582.6	—	4180-23-8

Chart 147 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
dimethoxy 1 vinyl benzene	C10H12O2	3138	—	—	6380-23-0
iso eugenol (2 methoxy 1 hydroxy 4 propenyl benzene)	C10H12O2	2468	172.515	—	97-54-1
para propyl anisole	C10H14O	2930	172.515	—	104-45-0
3,6 dihydro 4 methyl 2 (2 methyl propen 1 yl) 2H pyran (nerol oxide)	C10H16O	3661	—	—	1786-08-9
rose oxide (tetrahydro 4 methyl 2 (2 methyl propen 1 yl) pyran	C10H18O	3236	—	—	16409-43-1
2,6,6 trimethyl 6 vinyl tetra hydro pyran (bois de rose oxide)	C10H18O	3735	—	—	7392-19-0
linalool oxide (5 ethenyl tetrahydro alpha, alpha 5 trimethyl 2 furan methanol)	C10H18O2	3746	172.515	—	1365-19-1
1-Menthyl methylether	C10H20O	4054	—	—	1565-76-0
Sodium 4-Methoxybenzoyloxyacetate	C10H24O4	4016	—	—	10414-68-3 (free acid)17114-82-8 (Na salt)
beta-naphthyl methyl ether	C11H10O	4704	—	—	93-04-9
3 propylidene phthalide	C11H10O2	2952	172.515	—	17369-59-4
4 (3,4 methylene dioxy phenyl) 2 butanone (piperonyl acetone)	C11H12O3	2701-	—	—	55418-52-5
isoeugenyl methyl ether	C11H14O2	2476	172.515	—	93-16-3
4 propyl 2,6 dimethoxy phenol	C11H14O2	3729	—	—	6766-82-1
4 propenyl 2,6 dimethoxy phenol	C11H14O3	3728	—	—	20675-95-0
1 methyl 3 methoxy 4 isopropyl benzene	C11H160	3436-	—	—	1076-56-8
benzyl butyl ether	C11H16O	2139	172.515	—	588-67-0
1,2 di [(1′ ethoxy) ethoxy] propane	C11H24O4	3534	—	—	67715-79-1
diphenyl ether (diphenyl oxide)	C12H10O	3667	—	—	101-84-8
beta naphthyl ethyl ether	C12H12O	2768	—	—	93-18-5
3 butylidene phthalide	C12H12O2	3333	—	—	551-08-6
3 n-butyl phthalide	C12H14O2	3334	—	—	6066-49-5
isoeugenyl ethyl ether	C12H16O2	2472	172.515	—	7784-67-0
carvyl ethyl ether	C12H18O	2246	172.515	—	4732-13-2
vanillyl butyl ether	C12H18O3	3796	—	—	82654-98-6
ethyl linalyl ether	C12H22O	4591	—	—	72845-33-1
myrcenyl methyl ether	C12H22O2	4592	—	—	24202-00-4
2-(l-Menthoxy)ethanol	C12H26O2	4154	—	—	38618-23-4
trans- and cis-1-Methoxy-1-decene	C13H20O	4161	—	—	79930-37-3
isoamyl phenethyl ether	C13H20O	4635	—	—	56011-02-0
theaspirane (2,6,10,10 tetramethyl 1 oxaspiro 4,5 dec 6 ene)	C13H22O	3774-	—	—	36431-72-8
6 hydroxy dihydro theaspirane	C13H24O2	3549	—	—	65620-50-0
dibenzyl ether	C14H14O	2371	172.515	—	103-50-4
beta naphthyl isobutyl ether	C14H16O	3719	—	—	2173-57-1
butyl beta-naphthyl ether	C14H16O	4634	—	—	10484-56-7
2-[(2-(p-menthyloxy)ethoxy] ethanol	C14H28O3	4718	—	—	28804-53-7

Chart 147 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
6 acetoxy dihydro theaspirane (2,6,10,10, tetramethyl 1 oxaspiro [4.5] decan 6 ol acetate)	C15H26O3	3651-	—	5789	2003-3-27
(2r)-3′,5-dihydroxy-4′-methoxyflavanone	C16H12O5	4799	—	—	1449417-52-0
3′,7-dihydroxy-4′-methoxyflavan	C16H16O4	4708	—	—	76426-35-2
1,5,5,9 tetra methyl 13 oxatricyclo [8.3.0.0**4.9] tridecane (the ** as in mathematical notation indicates a superscript) (AmbroxTM)	C16H28O	3471	—	—	3738-00-9
N1-(2-methoxy-4-methylbenzyl)-N2-(2-(pyridin-2-yl)ethyl) oxalamide	C16H30O2N2	4231	—	—	745047-97-6
N1-(2,4-Dimethoxybenzyl)-N2-(2-(pyridin-2-yl)ethyl)oxalamide	C16H30O3N2	4233	—	—	745047-53-4
isoeugenyl benzyl ether	C17H18O2	3698	172.515	—	120-11-6
N1-(2-Methoxy-4-methylbenzyl)-N2-(2-(5-methylpyridin-2-yl) ethyl)oxalamide	C17H33O2N2	4234	—	—	745047-94-3
(-)-matairesinol	C20H22O6	4762	—	—	580-72-3
digeranyl ether	C20H34O	4664	—	—	31147-36-1

Chart 148 Ethylene Oxide

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
ethylene oxide	C2H4O	2433	172.710, 172.808, 175.105, 176.180, 178.3120, 178.3520, 193.200	—	75-21-8

Chart 149 Eugenyl Esters

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
isoeugenyl methyl ether	C11H14O2	2476	172.515	—	93-16-3
eugenyl formate	C11H12O3	2473	172.515	—	10031-96-6
isoeugenyl formate	C11H12O3	2474	172.515	—	7774-96-1
eugenyl methyl ether	C11H14O2	2475	172.515	—	93-15-2
isoeugenyl ethyl ether	C12H16O2	2472	172.515	—	7784-67-0
eugenyl acetate	C12H14O3	2469	172.515	—	93-28-7
isoeugenyl acetate	C12H14O3	2470	172.515	—	93-29-8
eugenyl isovalerate	C15H20O3	4118	172.515	—	61114-24-7
isoeugenyl benzyl ether	C17H18O2	3698	172.515	—	120-11-6
eugenyl benzoate	C17H16O3	2471	172.515	—	531-26-0
isoeugenyl phenyl acetate	C18H18O3	2477	172.515	—	120-24-1

Chart 150 Extracts

Commonly used extracts are as follows:

	FEMA GRAS #	NAS#	CAS#
Alfalfa Extract (Medicago Sativa L.)	2013	—	84082-36-0
Alkanet Root, Extract		8819	999999-01-8
Aloe Extract (Aloe Spp.)	2047	—	8001-97-6
Angelica Root Extract (Angelica Archangelica L.)	2087	—	8015-64-3
Angelica Seed Extract (Angelica Archangelica L.)	2089	—	8015-64-3
Angostura Extract (Galipea Offincinalis Hancock)	2092	—	91697-93-7
Annatto Extract (Bixa Orellana L.)	2103	—	8015-67-6
Apricot Extract	—	6504	—
Arnica Flower Extract	—	6339	—
Asafetida Fluid Extract (Ferula Assafoetida L.)	2106	—	9000-8-4
Ash Bark, Prickly, Extract (Xanthoxylum Spp.)	2110	—	999999-19-9
Asparagus, Seed/root Extract	—	6372	—
Balm Leaves Extract (Melissa Officinalis L.)	2112	—	8014-71-9
Bay Leaves, W. Indian, Extract (Laurus Nobilis)	—	6176	—
Bay Leaves, West Indian, Extract (Pimenta Acris Kostel)	2121	—	91721-75-4
Black Raspberry Extract	—	6323	—
Blackberry Bark Extract (Rubus Spp. of Section Eubatus)	2155	—	84787-69-9
Blackberry, Fruit, Extract	—	6700	—
Buchu Leaves Extract	—	6301	—
Buckbean Leaves, Extract (Menyanthes Trifoliata L.)	—	6018	—
Calumba Root, Extract (Jateorhiza Palmata (Lam.) Miers)	—	6021	—
Capsicum Extract (Capsicum Spp.)	2233	—	8023-77-6
Cascara Bitterless Extract (Rhamnus Purshiana Dc.)	2253	—	8007-5-6
Cascarilla Bark Extract (Croton Spp.)	2254	—	8007-5-6
Cassia Bark Extract (Cinnamomum Cassia Blume)	2257	—	8007-80-5
Castoreum Extract (Castor Spp.)	2261	—	8023-83-4
Catechu Extract (Acacia Catechu Willd.)	2264	—	8001-76-1
Celery Seed Extract (Apium Graveolens L.)	2269	—	8015-90-5
Celery Seed Extract Solid (Apium Graveolens L.)	2270	—	8015-90-5
Chamomile Flower, Roman, Extract (A. nobilis L.)	2274	—	8015-92-7
Cherry Bark, Wild, Distillate		6536	--
Cherry Bark, Wild, Extract (Prunus Serotina Ehrh.)	2276	—	84604-07-9
Cherry Pits Extract (Prunus Spp.)	2278	—	8000-44-0
Chervil, Extract (Anthriscus Cerefolium (L.) Hoffm.)	—	6185	—
Chestnut Leaves, Extract Solid (Castanea Dentata (Marsh.) Borkh.)	—	6034	—
Chestnut Leaves, Extract (Castanea Dentata (Marsh.) Borkh.)	—	6033	—
Chicory Extract (Cichorium Intybus L.)	2280	—	68650-43-1
Chinotta Extract	—	8814	—
Chirata, Extract (Swertia Chirata Buch. Ham.)	—	6036	—
Chocolate Extract	—	6502	—
Cinchona Bark Red Extract (Cinchona Succirubra Pav. or its hybrids)	2282	—	68990-12-5
Cinchona Bark Yellow Extract (Cinchona Spp.)	2284	—	68990-12-5
Cinchona Extract (Cinchona Spp.)	2285	—	68990-12-5
Cinnamon Bark Extract (Cinnamomum Spp.)	2290	—	8007-80-5
Citrus Peels Extract (Citrus Spp.)	2318	—	94266-47-4
Clove Bud Extract (Eugenia Spp.)	2322	—	8000-34-8
Clover Tops Red Extract Solid (Trifolium Pratense L.)	2326	—	85085-25-2
Clover, Extract (Trifolium Spp.)	—	6188	—
Coca Leaf Extract (Decocainized)(Erythroxylon Coca Lam.)	2329	—	84775-48-4
Cochineal Extract; Carmine	—	1309	1260-17-9

Chart 150 *Continued*

Commonly used extracts are as follows:

	FEMA GRAS #	NAS#	CAS#
Cocoa Distillate	—	6638	—
Cocoa Extract	—	6376	—
Coffee Distillate	—	6538	—
Coffee, Extract (Coffea Spp.)	—	6192	—
Corn Silk, Extract (Zea Mays L.)	—	6190	—
Crab Extract	—	6640	—
Curacao Peel Extract (Citrus Aurantium L.)	2344	—	94266-47-4
Dandelion Fluid Extract (Taraxacum Spp.)	2357	—	68990-74-9
Dandelion Root Extract Solid (Taraxacum Spp.)	2358		68990-74-9
Deer Tongue Solid Extract		8811	68606-82-6
Doggrass Extract (Agropyron Repens (L.) Beauv.)	2403	—	84649-79-6
Dragon's Blood Extract (Daemonorops Spp. or other Botanical Sources)	2404	—	9000-19-5
Elder Flowers Extract (Sambucus Canadensis L. and S. Nigra L.)	—	6193	—
Elderberry Fluid Extract	—	6552	—
Elecampane Root, Extract (Inula Helenium L.)	—	6054	—
Fenugreek Extract (Trigonella Foenum-graecum L.)	2485	—	68990-15-8
Filbert Extract	—	6453	—
Galangal Root Extract (Alpinia Spp.)	2499	—	8023-91-4
Genet Extract (Spartium Junceum L.)	2505	—	8023-80-1
Gentian Root Extract (Gentiana Lutea L.)	2506	—	72968-42-4
Geranium, East Indian, Extract (Cymbopogon Martini Stapf.)	—	6197	—
Geranium, Extract (Pelargonium Spp.)	—	6195	—
Germander, Chamaedrys, Extract (Teucrium Chamaedrys L.)	—	6069	—
Germander, Chamaedrys, Extract Solid (Teucrium Chamaedrys L.)	—	6070	—
Ginger Extract (Zingiber Officinale Rosc.)	2521	—	8007-7-8
Grape Skin Extract (Enocianina)	—	1310	—
Guaiac Gum Extract (Guaiacum Spp.)	2531	—	8052-39-9
Guaiac Wood Extract (Guaiacum Spp.)	2533	—	8016-23-7
Haw Bark Black Extract (Viburnum Prunifolium L.)	2538	—	84929-54-4
Hazelnut Extract	—	6517	—
Hickory Bark Extract (Carya Spp.)	2577	—	91723-46-5
Hops Extract (Humulus Lupulus L.)	2578	—	8007-3-4
Hops Extract Solid (Humulus Lupulus L.)	2579	—	8007-3-4
Horehound (Hoarhound) Extract (Marrubium Vulgare L.)	2581	—	84696-20-8
Horsemint Leaves Extract (Monarda Spp.)	2582	—	8006-85-7
Hyssop Extract (Hyssopus Officinalis L.)	2590	—	8006-83-5
Immortelle Extract (Helichrysum Augustifolium Dc.)	2592	—	8023-95-8
Irish Moss Extract	2596	—	9000-1-7
Iva, Extract (Achillea Moschata Jacq.)	—	6090	—
Juniper Extract (Juniperus Communis L.)	2603	—	8012-91-7
Kola Nut Extract (Cola Acuminata Schott et Endl.)	2607	—	68916-19-8
Laurel Leaves Extract (Laurus Nobilis L.)	2613	—	8006-78-8
Lemon Distillate	—	6653	—
Lemon Extract (Citrus Limon (L.) Burm. F.)	2623	—	84929-31-7
Lemon Peel Extract	—	6647	—
Licorice Extract (Glycyrrhiza Spp.)	2628	—	68916-91-6
Licorice Extract Powder (Glycyrrhiza Glabra L.)	2629	—	8008-94-4
Linden Flowers, Extract (Tilia Spp.)	—	6202	—
Linseed Oil Extract	—	6519	—
Lobster Extract	—	6454	—

Chart 150 *Continued*

Commonly used extracts are as follows:

	FEMA GRAS #	NAS#	CAS#
Locust (Carob) Bean Extract (Ceratonia Siliqua L.)	2243	—	84961-45-5
Lovage Extract (Levisticum Officinale Koch)	2650	—	8016-31-7
Malt, Extract (Hordeum Vulgare L. Or Other Grains)	—	6205	—
Mango Extract	—	6455	—
Mate Yerba Solid Extract	—	6656	—
Melon Extract	—	6456	—
Molasses, Extract (Saccharum Officinarum L.)	—	6206	—
Mountain Maple Extract Solid (Acer Spicatum Lam.)	2757	—	91770-23-9
Mushroom Extract	—	6657	—
Mustard, Brown, Extract (Brassica Spp.)	—	6208	—
Mustard, Yellow, Extract (Brassica Spp.)		6207	—
Naringen Extract (Citrus Paradisi Macf.)	2769	—	14259-46-2
Oak Chips Extract (Quercus Alba L.)	2794	—	68917-11-3
Oak Wood Extract	—	6441	—
Onion Extract	—	6516	—
Orange Peel, Bitter Extract	—	6535	—
Orange Peel, Sweet, Extract (Citrus Sinensis L. Osbeck)	2824	—	8028-48-6
Orris Root Extract (Iris Florentina L.)	2830	—	8002-73-1
Passion Flower Ext.	—	6411	8057-62-3
Passion Flower, Herb Ext.	—	6383	—
Peach Extract	—	6458	—
Peach Kernel, Extract (Prunus Persica Sieb et Zucc.)	—	6209	—
Peanut Butter Extract	—	6459	—
Peanut Extract	—	6460	—
Pear Essence	—	6514	—
Pine Bark, White, Extract Solid (Pinus Strobus L.)	—		—
Pipsissewa Leaves Extract (Chimaphila Umbellata Nutt.)	2914	—	89997-56-8
Pomegranate Bark Extract (Punica Granatum L..)	2918	—	84961-57-9
Pyroligneous Acid. Extract	2968	—	8030-97-5
Quassia Extract (Picrasma Excelsa (Sw.) Planch.-quassia Amara L.)	2971	—	68915-32-2
Quebracho Bark Extract	2972	—	999999-24-5
Quince Seed Extract (Cydonia Spp.)	2974	—	85117-13-1
Raisin Extract	—	6526	—
Rhatany Extract (Krameria Spp.)	2979	—	84775-95-1
Rhubarb Extract		6461	—
Rose Hips Extract (Rosa Spp.)	2990	—	8007-01-0
Rye Extract, Solid	—	6316	—
Saffron Extract (Crocus Sativus L.)	2999	—	8022-19-3
Sage Extract	—	6527	—
Sarsaparilla Extract (Smilax Spp.)	3009	—	91770-66-0
Sassafras Bark Extract (Safrol-free) (Sassafras Albidum (Nutt.) Nees)	3010	—	84787-72-4
Senna Leaves Flavor Extract	—	6602	—
Senna Leaves Solid Extract	—	6603	—
Sloe Berries Extract (Prunus Spinosa L.)	3021	—	90105-94-5
Sloe Berries Extract Solid (Prunus Spinosa L.)	3022	—	90105-94-5
Spearmint Extract (Mentha Spicata L.)	3031	—	8008-79-5
Spikenard Extract	—	6462	8022-22-8
St. John's Bread Extract	—	6463	—
Styrax Extract (Liquidambar Spp.)	3037	—	8046-19-3
Sugar Beet Extract Flavor Base	—	6421	8016-79-3
Tamarind Extract (Tamarindus Indica L.)	—	6215	—

Chart 150 *Continued*

Commonly used extracts are as follows:

	FEMA GRAS #	NAS#	CAS#
Tea, Extract	—	6384	84650-60-2
Thistle, Blessed, Extract (Cnicus Benedictus L.)	—	6158	—
Thistle, Blessed, Extract Solid (Cnicus Benedictus L.)	—	6159	—
Thyme, Wild or Creeping, Extract (Thymus Serpyllum L.)	—	6217	—
Tolu, Balsam, Extract (Myroxylon Spp.)	3069	—	9000-64-0
Turmeric Extract (Curcuma Longa L.)	3086	—	8024-37-1
Valerian Root Extract (Valeriana Officinalis L.)	3099	—	8008-88-6
Vanilla Extract (Vanilla Spp.)	3105	—	8024-4-6
Walnut Hull Extract (Juglans Spp.)	3111	—	84012-43-1
Walnut Leaves, Extract (Juglans Spp.)	—	6168	—
Wintergreen Extract (Gaultheria Procumbens L.)	3112	—	68917-75-9
Witch hazel Leaf Extract, Solid	—	6343	—
Wormwood Extract (Artemisia Absinthium L.)	3115	—	8008-93-3
Yeast Extract	—	481	8013-2-1
Yeast Extract, Autolyzed	—	1500	—
Yeast-malt Sprout Extract	—	1187	—
Yerba Santa Fluid Extract	3118	—	999999-27-9
Yerba Santa, Solid Extract	—	6308	—
Yucca Mohave Extract (Yucca Spp.)	3121	—	90147-57-2
Zedoary Bark Extract (Curcuma Zedoaria (Berg.) Rosc.)	3123	—	84961-49-9

Chart 151 Elder Flowers

Name	FEMA GRAS #	NAS #	CFR	CAS #	Type
Elder Flowers (Sambucus Nigra L.) (Flowers & Leaves					
flowers (S. canadensis L.))	2406		182.10, 582.10	91722-58-6	bitter principle
flower extract	—	6193+	182.20, 582.20		
sureau leaves extract	—	6053+**** This product should have less than 25 ppm prussic acid.	172.510 (alcoholic beverages only)		
berry fluid extract	—	6552+			
berry juice concentrate	—	6580+			

Chart 152 Elecampane

	NAS #	CFR	Type
Elecampane (*Indula heleniium* L.)			
root extract	6054+	172.51	bitter principle
root oil	6055+	172.51	bitter principle
root	6378+	172.51	bitter principle

Chart 153 Elemi

	FEMA GRAS #	CFR	CAS #	Type
Elemi (Canarium commune L. or C. luzonicum Mig.)				
oil	2408	172.51	8023-89-0	terpene type
gum	2407	172.51	8023-89-0	balsamic
green type				

Chart 154 Erigeron

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Erigeron (Fleabane) (Erigeron canadensis L.)					
	2409	172.51	—	8007-27-0	bitter principle

Chart 155 Eucalyptus

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Eucalyptus (Globulus) Alcohols - Eucalyptol (1-8 Cineole).					
oil	2466	172.510	—	8000-48-4	aromatic type

Chart 156 Fennel

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
(Foeniculum vulgare Mill. var. amara = Common Fennel)					
	2481	182.10, 582.10	—	8006-84-6	aromatic spice
(Foeniculum vulgare Mill. var. dulce = Sweet Fennel)					
botanical	2482	182.20, 582.20	—	8006-84-6	sweet spice
oil (use directly as a food)	2483	182.20, 582.20	—	8006-84-6	sweet spice

Chart 157 Foenugreek

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
botanical	2484	182.10, 582.10	—	68990-15-8	brown type
extract	2485	182.20, 582,20	—	—	brown type
oleoresin	2486	182.20, 582.20	—	—	brown type

Chart 158 Fir Balsam

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
balsam oleoresin	2115	—	—	8021-28-1	balsamic
balsam oil	2114	—	—	8024-15-5	terpene type
needles and twigs	—	172.510	—	8021-28-1	terpene type

Chart 159 Fir Pine

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Abies sibirica Ledeb. (Siberian fir)					
Twigs & needles	2905	172.510	—	8021-29-2	balsamic
oil	—	172.510	—	—	terpene type
solid extract	—	172.510	—	—	terpene type
A. alba Mill. (Silver or European fir)					
	—	—	—	—	terpene type
A. sachalinensis Masters or A. mayriana Miyabe & Kudo (Japanese fir)					
	—	—	—	—	terpene type

Chart 160 Fusel Oil

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
refined oil	2497	172.515	—	8013-75-0	aromatic
wine fusel oil	—	—	6679	—	woody

Chart 161 Glyceryl Compounds

Name	Empirical Formula	FEMA GRAS #	CFR	CAS#
Glyceryl Esters, Aconitates and Glyceride Compounds				
Glyceryl Esters				
glyceryl 5 hydroxy decanoate	C13H16O5	3685	—	26466-31-1
glyceryl 5 hydroxy dodecanoate	C15H30O5	3686	—	26466-32-2
glyceryl monooleate	C21H40O4	2526	184.1-323	111-03-5
glyceryl monostearate	C22H42O4	2527	139.110, 139.150, 172.515, 184.1324, 582.1324	123-94-4, 11099-07-3, 31566-31-1
glyceryl tribenzoate	C24H19O6	3398	—	614-33-5
Aconitates				
ethyl aconitate (mixed esters)	C8H10O6, C10H14O6, C12H18O6	2417	172.515	1321-30-8
Oxo acid glycerides				
3 oxohexanoic acid glyceride	C6H9O3R	3770	—	91052-72-1
3 oxooctanoic acid glyceride	C8H13O3R	3771	—	91052-68-5
3 oxodecanoic acid glyceride	C10H17O3R	3767	—	91052-69-6
3 oxododecanoic acid glyceride	C12H21O3R	3768	—	91052-70-9
3 tetradecanoic acid glyceride	C14H25O3R	3772	—	91052-73-2
3 oxohexadecanoic acid glyceride	C16H29O3R	3769	—	91052-71-0
Note: in the above, R=mono or diglyceride				
Glyceryl-lacto esters of fatty acids	mixture	4124	—	98084-79-8
Mono- and diglycerides of fatty acids	mixture	4186	—	67701-32-067701-33-168990-53-4
Polyglycerol esters of fatty acids	mixture	4201	—	79665-93-3
Propylene glycol mono- and diesters of fatty acids	mixture	4208	—	1323-39-3

Chart 162 Glycidates

Compound	Empirical Formula	FEMA GRAS #	CFR	CAS #
methyl beta-phenylglycidate	C10H10O3	4654	—	37161-74-3
ethyl 3 phenyl glycidate	C11H12O3	2454	172.515	121-39-1
ethyl methyl phenyl glycidate (aldehyde C-16, or Strawberry Aldehyde)	C12H1403	2444	182.60	77-83-8
ethyl methyl para tolyl glycidate	C13H16O3	3757	—	74367-97-8
ethyl alpha-ethyl-beta-methyl-beta-phenylglycidate	C14H18O3	4653	—	19464-94-9

Chart 163 Guaiacyl Esters

Compound	Empirical Formula	FEMA GRAS #	NAS #	CFR	CAS#
guaiacyl acetate	C9H10O3	3687	—	172.515	613-70-7
guaiacol propionate	C10H12O3	4609	—	—	7598-60-9
guaiacol butyrate	C11H14O3	4607	—	—	4112-92-9
guaiacol isobutyrate	C11H14O3	4608	—	—	723759-62-4
guaiacyl phenyl acetate	C15H14O3	2535	—	172.515	4112-89-4

Chart 164 Gums and Thickeners

Name	FEMA GRAS #	CFR	NAS #	Note	CAS#
Gums that do not thicken					
turpentine gum	3088		—		9005-90-7
ghatti gum	2519	184.1333, 582.7333	—	(~80–90% soluble in water, as a natural buffer it can be effective in a reasonable range of pH)	90000-28-6
dulse rhodymenia palmata (L.) Grev.	2405	582.30, 582.40	—	botanical & extracts	999999-22-3
elemi gum	2407	172.51	—	—	8023-89-0
guarana gum	2536	172.51	—	—	999999-22-8
guaiac gum	2531	582.3336, 172.510	—	—	8052-39-9
			—	—	
Gums which thicken			—	—	
gum acacia	2001	184.13-30, 582.7330, 172.510, 169.179 (in vanilla powder)	—	—	9000-1-5
agar	2012	184.11-15, 582.7115, 150.141 (jelly), 150.161 (preserves)	—	—	9002-18-0
brown algae	—	CFR184.1120, 582.30, 582.40	—	—	9005-38-3
red algae	—	CFR184.1121, 582.30, 582.40, 133.178, 133.179, 150.141, 150.161	—	—	
algin	2014		—	—	9005-38-3
alginate	2015	582.30, 582.40	—	—	9005-35-0
sodium	—	184.1224	—	—	
calcium	—	182.1187	—	—	
ammonium	—	184.1333	—	—	
ammonium alginate	—	CFR184.1133, 582.30, 582.40	—	—	9005-35-0
alginic acid	—	CFR184.1011, 582.30, 582.40	—	—	
arabinogalactan (larch gum)	3254	3254/CFR172.610, 172.230 (micro capsules)	—		9036-66-2
carboxy methyl cellulose	2239	182.1745, 582.1745, 133.178 (Nuefchatel with other cheese foods), 133.179 (Pastuerized processed cheese spread)	—		9000-11-7
ethyl cellulose		172.868, 573.42	1072+		9004-57-3
furcelleran		CFR172.655	—		
gellan gum		CFR172.665 (pure), 172.660 (salts)	—		

guar gum (cyamopsis tetragonolobus (L.)	2537	184.1339, 133.124, 133.178, 133.179, 150.141, 150.161, 184.1339, 501.22 animal feeds, 501.110 animal feeds, 582.7339	—	A useful thickener, this gum is both a powerful viscosity builder and inexpensive. Like most gums, however, some adverse textural properties (sliminess) and off tastes (cereal type flavors) can be exhibited at higher gum levels.	9000-30-0
Irish moss (carrageenan extract)					
botanical	2596	133.178, 133.179, 136.110, 139.121, 139.122, 150.141, 150.161, 172.620, 172.623, 172.626, 182.7255	—		9000-07-1
ammonium salt	—	133.178, 133.179, 136.110, 139.121, 139.122, 150.141, 150.161, 172.620, 172.623, 172.626, 182.7255	—		9000-07-1
calcium salt	—	133.178, 133.179, 136.110, 139.121, 139.122, 150.141, 150.161, 172.620, 172.623, 172.626, 182.7255	—		9000-07-1
potassium salt	—	133.178, 133.179, 136.110, 139.121, 139.122, 150.141, 150.161, 172.620, 172.623, 172.626, 182.7255	—		9000-07-1
sodium salt	—	133.178, 133.179, 136.110, 139.121, 139.122, 150.141, 150.161, 172.620, 172.623, 172.626, 182.7255	—		9000-07-1
karaya gum (sterculia urens Roxb.) (stercula) One of the least soluble gums in water.	2605	184.1349, 133.178, 133.179, 150.141, 150.161, 184.1379	—		9000-36-6
kelp (see also brown and red algae) any of the following species:Analupis japonicus, Eisenia bicyclis, Hizikia fusiforme, Kjellmaniella gyrata, Laminaria angastata, Laminaria claustonia, Laminaria digitata, Laminaria japonica, Laminaria longicruris, Laminaria longissima, Laminaria ochotensis, Laminaria saccharina, Macrocystis pyrifera, Petalonia fascia, Scytosiphon lomentaria, Undaria pinnatifida		2606/CFR172.365, 184.1120,184.1121, 582.30, 582.40	—		92128-82-0

Chart 164 *Continued*

Name	FEMA GRAS #	CFR	NAS #	Note	CAS#
locust bean gum (carob gum)	2648	184.1343, 150.141, 582.7343	—		9000-40-2
methyl cellulose	2696	150.141, 150.161	—		9004-67-5
propylene glycol alginate	2941	173.340 (defoamer), 172.858, 133.178 (pasteurized Neufchatel/other foods), 133.179 (pasteurized processed cheese food)	—		9005-37-2
tragacanth gum (astragalus spp.)	3079	133.178, 184.1351, 582.7351, 150.161 (preserves), 150.141 (jelly)	—	A powerful gum probably the most viscous of all gums.	9000-65-1
xanthan gum	—	172.695, 573.1010,	544+		11138-66-2
xanthomonas campestris	—	150.161 (preserves), 150.141 (jelly), 133.178 (pasteurized Neufchatel with other foods), 133.179 (pasteurized processed cheese food)	—		
microcrystalline cellulose	—	150.161 (preserves), 150.141 (jelly), 133.178 (pasteurized Neufchatel with other foods), 133.179 (pasteurized processed cheese food)	8735+		9004-34-6
Sodium carboxyl methylcellulose	—	150.161 (preserves), 150.141 (jelly), 133.178 (pasteurized Neufchatel with other foods), 133.179 (pasteurized processed cheese food)	186+		9004-32-4
Guyanese arrowroot	—	food	—		
starch made from yams	—	food	—		
tapioca starch	—	food	—		
starch derived from the casava plant	—	food	—		
starch derived from corn - all types	—	food	—		
	—		—		
Gum arabic, hydrogen octenylbutane dioate	4227	—	—		455885-22-0

Chart 165 Galanga Root

Name	FEMA GRAS #	CFR	NAS #	CAS #	Note
root	2498	182.10, 582.10	—	8023-91-4	bitter principle, aromatic type
root extract	2499	182.2	—	8023-91-4	bitter principle, aromatic type
root oil	2500	182.20, 582.20	—	8023-91-4	aromatic type
Alpinia galanga (more Ginger like)	—	172.510**alcoholic beverages only	6194+	8024-40-6	aromatic type

Chart 166 Galbanum

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Ferula galbanuiflua Boiss. & Other spp.					
resin	2502	172.510	—	9000-24-2	terpene type
oil	2501	172.510	—	—	vegetable-like

Chart 167 Gambia

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Uncaria gambia (Huner) Roxb.					
extract	2264	172.510	—	8001-76-1	Resinous
powder	2265	172.510	—	8001-76-1	Resinous
gum	2265	172.510	—	8001-76-1	Resinous

Chart 168 Garlic

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
oil	2503	184.1317	—	8000-78-0	sulfur type
botanical	—	184.1317	—	—	sulfur type
oleoresin	—	—	6566	—	sulfur type
granulated	—	—	6466	—	sulfur type
powder	—	—	6522	—	sulfur type

Chart 169 Genet

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
absolute	2504	172.510	—	90131-21-8	sweet herb
extract	2505	172.510	—	8023-80-1	brown type

Chart 170 Gentian

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
	2506	172.510	—	72968-42-4	bitter principle
stemless	—	172.510**alcoholic beverages only	6352	—	bitter principle

Chart 171 Geranium

Botanical	FEMA GRAS #	CFR	NAS #	CAS #	Type
geranium rose oil	2508	182.20, 582.20	—	8000-46-2	floral type
botanical	—	182.10, 582.10	—	—	vegetable type
extract	—	182.20, 582.20	6197	—	floral type
pelargonium spp. extract	—	—	6195	—	floral type
oil	—	182.20, 582.20	—	—	floral type
oil, pelargonium spp.	—	—	6196	—	floral type
absolute (generic)	—	—	6440	—	floral type
cymbopogon martini Stapf. Oil	—	—	6198	—	floral type

Chart 172 Germander and Golden Germander

Botanical	FEMA GRAS #	CFR	NAS #	CAS #	Descriptor
Germander, Golden (Teucrium polium L.)	—	172.510	6071	—	bitter principle
botanical	—	172.510	6068	—	bitter principle
extract	—	172.510	6069	—	bitter principle
solid extract	—	172.510	6070	—	bitter principle

Chart 173 Ginger

Botanical	FEMA GRAS #	CFR	NAS #	CAS #	Descriptor
botanical	2520	182.10, 582.10	—	8007-7-8	aromatic type
extract	2521	182.20, 582.20	—	8007-7-8	aromatic type
oil	2522	182.20, 582.20	—	8007-7-8	aromatic type
spice	2523	182.20, 582.20	—	8007-7-8	aromatic type

Chart 174 Glycerrhiza

Botanical	FEMA GRAS #	CFR	NAS #	CAS #	Descriptor
ammoniated	2528	184.1408	53956-04-0	53956-04-0	brown type
root	2630	184.1408	68916-91-6	68916-91-6	brown type
root extract	2628	184.1408	68916-91-6	68916-91-6	brown type
extract powder	2629	184.1408	8008-94-4	8008-94-4	brown type

Chart 175 Grains of Paradise

Botanical	FEMA GRAS #	CFR	NAS #	CAS #	Descriptor
	2529	182.10, 582.10	—	90320-21-1	bitter

Chart 176 Grapefruit

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Grapefruit					
food	—	—	—	—	fruit
essence	—	182.20, 582.20	—	—	terpene type
oil	2530	182.20, 582.20	—	8016-20-4	terpene type
oil concentrate	—	182.20, 582.20	—	—	terpene type
oil concentrate tailings	—	—	6533	—	terpene type
oil terpenes	—	—	6445	—	
naringin extract	2769	182.20, 582.20	—	14259-46-2	bitter principle

Chart 177 Guaiac Wood

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
wood oil	2534	172.510	—	8016-23-7	vegetable like
gum	—	172.510, 175.300, 181.24, 582.3336	—	—	green type
extract	2531	172.510	—	8052-39-9	floral type
wood extract	2533	172.510	—	8016-23-7	woody type

Chart 178 Guarana

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
gum	2536	172.510	—	999999-22-8	bitter principle
extract	—	—	—	—	brown type

Chart 179 Guava

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
food	—	182.20, 582.20	6199	—	fruit type
juice concentrate	—	—	6581	—	fruit type

Chart 180 Hexenyl Esters

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
cis 3 hexenyl formate	C7H12O2	3353	—	—	33467-73-1
2 hexenyl acetate	C8H14O2	2564	172.515 trans isomer	—	2497-18-9
cis 3 hexenyl acetate	C8H14O2	3171	—	—	3681-71-8
cis 3 hexenyl lactate	C9H16O3	3690	—	—	61931-81-5
cis 3 hexenyl butyrate	C10H18O2	3402	—	—	16491-36-4
cis 3 hexenyl isovalerate	C11H20O2	3498	172.515	—	10032-11-8
cis 3 hexenyl 2 methyl butyrate	C11H20O2	3497	172.515	—	10094-41-4
cis 3 hexenyl cis 3 hexenoate	C12H20O2	3689	—	—	61444-38-0
cis 3 hexenyl hexanoate	C12H22O2	3403	—	—	31501-1-8
cis 3 hexenyl benzoate	C13H16O2	3688	—	—	251552-85-6
cis 3 hexenyl phenyl acetate	C14H18O2	3633	172.515	—	42436-07-7

Chart 181 Inorganic Ingredients

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
Note: it is generally accepted that carbon dioxide and carbonates are oxides of carbon and can be regarded as inorganic compounds for this list.					
ammonium bicarbonate	NH3HCO3	—	184.1135	—	1066-33-7
ammonium carbonate	(NH3)2CO3	—	184.1137	—	506-87-6
ammonium chloride	NH3Cl	—	184.1138	—	12125-02-9
ammonium hydroxide	NH3OH	—	184.1139	—	1336-21-6
ammonium phosphate, dibasic	(NH3)2PO4	—	184.1141 b	—	7783-28-0
ammonium monosulfide (ammonium sulfide)	NH3S	2053	172.515	—	12135-76-1
calcium sulfate	CaSO4	—	184.123	—	7778-18-9
calcium dioxide	CaO2	—	184.124	—	1305-79-9
carbon dioxide	CO2	—	582.124	—	124-38-9
hydrochloric acid	HCl	—	114.90, 131.111, 131.136, 131.144, 133.129, 137.350, 155.191, 155.194, 160.105, 160.185, 182.1057, 582.1057	—	7647-01-0
hydrogen sulfide	H2S	3779-	—	—	7783-06-4
nitrogen	N2	—	184.154	—	7727-37-9
nitrous oxide (laughing gas, or facetious air)	N2O	2779	184.1545	—	10024-97-2
ammonium phosphate monobasic (APM)	(NH4)H2PO4	—	CFR184.1141(a), 582.1141	—	7722-76-1
ammonium phosphate dibasic (APD)	(NH4)2HPO4	—	CFR184.1141(b), 582.1141	—	7783-28-0
calcium diphosphate (see below calcium pyrophosphate)					
calcium hexametaphosphate	Ca3P6O18	—	CFR182.6203	—	10102-76-8
calcium phosphate (CPT)(calcium phosphate, tribasic)	Ca3(PO4)2	—	CFR182.1216, 121.010(d)	—	1306-06-5
calcium phosphate, monobasic (see mono calcium phosphate)				—	—
calcium pyrophosphate (CPP)(calcium diphosphate)	Ca3P6O18	—	CFR182.5223, 182.1223	—	7790-76-3
dicalcium phosphate (DCP)	CaHPO4	—	CFR182.6215	—	7789-77
dipotassium phosphate (DKP) (potassium phosphate, dibasic)	K2HPO4	—	CFR182.1638, 121.101(d)	—	7758-11-4

disodium diphosphate (disodium pyrophosphate, (see sodium acid pyrophosphate) disodium hydrogen phosphate)					
disodium phosphate (DSP) or disodium pyrophosphate (disodium diphosphate, disodium hydrogen phosphate) (see below sodium acid pyrophosphate)	Na2HPO4	—	CFR182.1778, 182.5778, 182.8778, 582.1778, 582.5778, 582.6778, 182.6290, 582.6290, 121.101(d), 184.1779	—	7558-79-4
ferric phosphate (ferric ortho phosphate)	FePO4	—	CFR182.5301, 184.1301, 582.5301, 121.101(d)	—	10045-86-0
ferric pyrophosphate	Fe4(P2O7)3	—	CFR182.5304	—	10058-44-3
ferric sodium pyrophosphate	Fe3Na(P2O7)3	—	CFR182.5306	—	35725-46-3
magnesium phosphate	Mg3(PO4)2	—	CFR182.5434, 184.1434, 582.5434, 121.101(d)	—	7757-87-1
manganese glycerophosphate	$C_3H_7MnO_6P \bullet xH_2O$	—	CFR182.5455	—	1320-46-3
monocalcium phosphate (MCP)	Ca(H2PO4)2	—	CFR182.1215, 182.6215, 582.6215, 121.101(d)	—	7758-23-8
mono potassium phosphate (MKP) (see potassium phosphate, monobasic)					
monosodium phosphate (MSP)(sodium phosphate, monobasic, sodium acid phosphate)	NaH2PO4	—	CFR182.1778, 182.5778, 182.8778, 582.1778, 582.5778, 582.6778, 184.1780, 182.6085, 582.6085, 184.1722, 121.101(d)	—	7558-80-7
phosphoric acid	H3PO4	—	CFR121.101(d), 182.1073	—	7664-38-2
potassium glycero phosphate	C3H9O6PK	—	CFR182.5628	—	1319-69-3
potassium phosphate, dibasic (see dipotassium phosphate)					
potassium phosphate, mono (potassium biphosphate) basic (MKP)	KH2PO4	—	CFR184.1639	—	7778-77-0
potassium phosphate, tribasic (TKP) (tripotassium phosphate)	K3PO4	—	CFR184.1639a	—	7778-53-2
potassium pyrophosphate (see tetra potassium pyrophosphate)					
potassium tri poly phosphate (KTPP) (pentapotassium triphosphate) low sodium moisture binding	K5H5P3O10	—	CFR184.1644	—	13845-36-8
sodium acid phosphate (see monosodium phosphate)					
sodium acid pyrophosphate (SAPP)	Na2H2P2O7	—	CFR121.101(d), 182.1087	—	7758-16-9
sodium aluminum phosphate (SALP)	Na3Al2H14 15(PO4)8 - acidic or Na15Al2.8(PO4)8 - basic	3027	CFR182.1781, 582.1781, 121.101(d	—	7785-88-8
sodium hexa meta phosphate (SHMP)	Na6P6O18	—	133.169, 133.173, 133.179, 150.141, 150.161, 169.115, 173.310, 182.90, 182.6760, 121.101(d), 184.1760	—	1024-56-8

Chart 181 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
sodium metaphosphate (Kurrol's salt)	(NaPO3)n	—	CFR182.6769	—	233-343-1
sodium phosphate (see trisodium phosphate)					
sodium phosphate, dibasic (see above disodium phosphate)					
sodium phosphate, monobasic (see monosodium phosphate)					
sodium phosphate, tribasic (see trisodium phosphate)					
sodium pyrophosphate (see tetra sodium pyrophosphate)					
sodium tri poly phosphate	Na5P3O10	—	CFR182.1810,182.6810	—	7758-29-4
tetrapotassium pyro phosphate (TKPP)	K4P2O7	—	CFR184.1870	—	7320-34-5
tetrasodium pyro phosphate (TSPP)	Na4P2O7	—	CFR121.101d, 182.6787, 182.6789, 184.1872	—	7722-88-5
tricalcium phosphate (TCP)	Ca5(PO4)3(OH)	3081	137.105, 137.155, 137.160, 137.165, 137.170, 137.175, 137.180, 137.185, 169.179, 169.182, 182.1217, 182.5217, 182.8217, 121.101(d)	—	7758-87-4
tripotassium phosphate (TKP) (see potassium phosphate, tribasic)					
trisodium phosphate (TSP)	Na3PO4	—	2398/182.1778, 182.5778, 182.8778, 582.1778, 582.5778, 582.6778, 121.101(d)	—	10101-89-0
potassium bicarbonate	KHCO3	—	184.1613	—	298-14-6
potassium carbonate	K2CO3	—	184.1619	—	584-08-7
sodium carbonate	NaCO3	—	184.1736	—	497-19-8
sodium chloride	NaCl	—	fruits, 155 (canned vegetables), 161 (seafood products), 163 (chocolate products), 166.110 (margarine), 168 (syrups), 169 (dressings), 501.22 (animal foods), 131 all (cheeses), 145 (canned	—	7647-14-5
sulfur dioxide	SO2	—	168.111, 168.120, 172.892, 182.3862, 582.3862	—	7446-9-5

Chart 182 Ionones

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
4 (2,6,6 trimethyl cyclohexa 1,3 dienyl) but 2 en 4 one (beta damascenone)	C13H18O	3420	—	—	23696-85-7
dehydro dihydro ionone (4 (2,6,6 trimethyl 1,3 cyclohexadiene 2 butanone))	C13H20O	3447	—	—	20483-36-7
alpha ionone	C13H20O	2594	172.515	—	127-41-3
beta ionone	C13H20O	2595	172.515	—	14901-07-6
gamma ionone	C13H20O	3175	—	—	79-76-5
delta damascone	C13H20O	3622	—	—	57378-68-4
alpha damascone	C13H20O	3659	—	—	43052-87-5
beta-Ionone epoxide	C13H20O2	4144	—	—	23267-57-4
trans-alpha-Damascone	C13H20O	4088	—	—	24720-09-0
Cycloionone ('6,6,7,8,8a-Tetrahydro-2,5,5,8a-tetramethyl-5H-1-benzopyran)	C13H20O	3822	—	—	5552-30-7
dihydro alpha ionone (4 (2,6,6 trimethyl 2 cyclohexenyl) butane 2 one)	C13H22O	3628	—	—	31499-72-6
dihydro beta ionone (4 (2,6,6 trimethyl 1 cyclohexenyl) butane 2 one)	C13H22O	3626	—	—	1783-81-7
dehydro dihydro ionol (alpha 2, 6, 6 tetramethyl 1,3 cyclohexadiene 1 propanol)	C13H22O	3446	—	—	57069-86-0
alpha ionol	C13H22O	3624	—	—	25312-34-9
beta ionol	C13H22O	3625	—	—	22029-76-1
4 (2,6,6 trimethyl cyclohexa 1 enyl) but 2 en 4 one (beta damascone)	C13H20O	3243	—	—	23726-92-3
2,6-Dimethyl-2,6,8-undecatrien-10-one or Pseudoionone	C13H20O	4299	—	—	141-10-6
dihydro beta ionol (alpha 2,6,6, tetramethyl beta 1 cyclohexene 1 propanol)	C13H24O	3627	—	—	3293-47-8
tetrahydro pseudo ionone (dihydro geranyl acetone)	C13H24O	3059	172.515	—	4433-36-7
alpha irone	C14H22O	2597	172.515	—	79-69-6
methyl alpha ionone	C14H22O	2711	172.515	—	127-42-4
methyl beta ionone	C14H22O	2712	172.515	—	127-43-5
methyl delta ionone (so-called) (4(2,6,6, trimethyl 3 cyclohexen 1 yl 3 methyl 3 butene 2 one, or iso methyl beta ionone)	C14H220	2713	172.515	—	7784-98-7
iso methyl alpha ionone (methyl gamma ionone so-called)	C14H22O	2714	172.515	—	127-51-5
beta-Isomethylionone	C14H22O	4151	—	—	79-89-0
beta-Ionyl acetate	C15H24O2	3844	—	—	22030-19-9
allyl alpha ionone	C16H24O	2033	172.515	—	79-78-7
alpha-Isomethylionyl acetate	C16H26O2	3845	—	—	68555-61-3

Chart 183 Jasmones and Jasmonates

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
jasmone (3 methyl 2 (2 pentenyl) 2 cyclopenten 1 one)	C11H16O	3196	—	—	488-10-8
isojasmone (2 hexyl cyclopenten 2 one 1)	C11H18O	3552	172.515	—	11050-62-7
methyl jasmonate	C13H20O3	3410	—	—	1211-29-6
methyl dihydro jasmonate	C13H2203	3408	—	—	24851-98-7

Chart 184 Juice and Juice Concentrates

Name of Juice	Brix as Obtained Directly from Food	NAS #
Acerola	6.0	—
Apple	11.5	6624
Apricot	11.7	6626
Banana	22.0	—
Blackberry	10.0	6618
Blueberry	10.0	6629
Boysenberry	10.0	—
Cantaloupe Melon	9.6	—
Carambola	7.8	—
Carrot	8.0	—
Casaba Melon	7.5	—
Cashew (Caju)	12.0	—
Celery	3.1	6701
Cherry, Dk Sweet	20.0	—
Cherry, Rd Sour	14.0	—
Crabapple	15.4	—
Cranberry	7.5	—
Cucumber	4.0	6579
Currant, Black	11.0	6702, 6562
Currant, Red	10.5	—
Date	18.5	—
Dewberry	10.0	—
Elderberry	11.0	—
Fig	18.2	—
Gooseberry	8.3	—
Grape	16.0	—
Grapefruit	10.0	—
Guanabana	16.0	—
Guava	7.7	—
Honeydew Melon	9.6	—
Kiwi	15.4	—
Lemon	24.5	—
Lime	24.5	—
Loganberry	24.5	—
Mango	13.0	—
Nectarine	11.8	—
Orange	11.8	—
Papaya	11.5	—
Passionfruit	14.0	—
Pear	12.0	—
Pineapple	12.8	—
Plum	14.3	—
Pomegranate	16.0	—
Prune	18.5	—
Quince	13.3	—
Raspberry (Black)	11.1	—
Raspberry (Red)	9.2	—
Rhubarb	5.7	—
Strawberry	8.0	6708
Tangerine	11.8	—
Tomato	5.0	—
Watermelon	7.8	—
Youngberry	10.0	—

Chart 185 Keto and Hydroxy Esters

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
ethyl pyruvate	C5H8O3	2457	172.515	—	617-35-6
ethyl lactate	C5H10O3	2440	172.515	—	97-64-3
methyl 3-hydroxybutyrate	C5H10O3	4450	—	—	1487-49-6
methyl levulinate	C6H10O3	4478	—	—	624-45-3
propyl pyruvate	C6H10O3	4484	—	—	20279-43-0
ethyl 3 hydroxy butyrate	C6H12O3	3428	—	—	5405-4-4
2-oxo-3-ethyl-4-butanolide	C6H8O3	4460	—	—	923291-29-6
methyl 2 oxo 3 methyl pentanoate	C7H12O3	3713	—	—	3682-42-6
methyl 2 hydroxy 4 methyl pentanoate	C7H14O3	3706	—	—	40348-72-9
butyl lactate	C7H14O3	2205	172.515	—	138-22-7
Ethyl 2-methyllactate or (+/−)-Ethyl 2-hydroxy-2-methylbutyrate	C7H14O3	4268	—	—	77-70-3
(+−)-Ethyl 3-hydroxy-2-methylbutyrate	C7H14O3	4391	—	—	27372-03-8
ethyl 2,4 dioxo hexanoate	C8H12O4	3278	—	—	13246-52-1
iso amyl pyruvate	C8H14O3	2083	172.515	—	7779-72-8
butane 3 one 2 yl butanoate	C8H14O3	3332	172.515	—	84642-61-5
ethyl oxo hexanoate	C8H14O3	3683	—	—	3249-68-1
propyl levulinate	C8H14O3	4480	—	—	645-67-0
dimethyl adipate	C8H14O4	4472	—	—	627-93-0
methyl 3-acetoxy-2-methylbutyrate	C8H14O4	4451	—	—	139564-42-4
ethyl 3 hydroxy hexanoate	C8H16O3	3545	—	—	2305-25-1
Ethyl 2-ethyllactate or (+/−)-Ethyl 2-hydroxy-3-methylvalerate	C8H16O3	4269	—	—	24323-38-4
isobutyl angelate (isobutyl cis 2 methyl 2 butenoate)	C9H16O2	2180	172.515	—	7779-81-9
3 hexenyl lactate	C9H16O3	3690	—	—	61931-81-5
2-methoxy-6-(2-propenyl)phenol	C10H12O2	4490	—	—	579-60-2
ethyl 5-hydroxyoctanoate	C10H12O3	4610	—	—	75587-05-2
isoamyl levulinate	C10H18O3	4481	—	—	71172-75-3
ethyl 2-acetylhexanoate	C10H18O3	4452	—	—	1540-29-0
ethyl 3-hydroxyoctanoate	C10H20O3	4453	—	—	7367-90-0
4-formyl-2-methoxyphenyl 2-hydroxypropanoate	C11H12O5	4606	—	—	930587-76-1
butyl hydroxy benzoate	C11H14O3	2203	172.515	—	94-26-8
ethyl 2-hydroxy-3-phenylpropionate	C11H14O3	4598	—	—	15399-05-0
butyl butyryl lactate	C11H20O4	2190	172.515	—	7492-70-8
methyl 3-acetoxyoctanoate	C11H20O4	4454	—	—	35234-21-0
ethyl 5-oxodecanoate	C12H22O3	4457	—	—	93919-00-7
ethyl 2-acetyloctanoate	C12H22O3	4459	—	—	29214-60-6
dipropyl adipate	C12H22O4	4473	—	—	106-19-4
diisopropyl adipate	C12H22O4	4474	—	—	6938-94-9
ethyl 5-acetoxyoctanoate	C12H22O4	4443	—	—	35234-25-4
ethyl 5-hydroxydecanoate	C12H24O3	4444	—	—	75587-06-3
ethyl 5-formyloxydecanoate	C13H24O4	4765	—	—	1367348-37-5
diisobutyl adipate	C14H26O4	4475	—	—	141-04-8
dodecyl lactate	C15H30O3	4482	—	—	6283-92-7
isopropylideneglyceryl 5-hydroxydecanoate	C16H30O5	4611	—	—	172201-58-0
hexadecyl lactate	C19H37O3	4483	—	—	35274-05-6
dioctyl adipate	C22H42O4	4476	—	—	123-79-5

Note: 3 nonanonyl acetate was removed from the GRAS list. (99999-20-6)

Chart 186 Ketones - Aliphatic

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
acetone	C3H6O	3326	173.210	—	67-64-1
dihydroxyacetone	C3H6O3	4033	—	—	96-26-4 (monomer) 62147-49-3 (dimer)
diacetyl	C4H6O2	2370	184.1278	—	431-03-8
2 butanone	C4H8O	2170	172.515	—	78-93-3
acetoin (acetyl methyl carbinol)	C4H8O2	2008	182.60	—	513-86-0
1 hydroxy 2 butanone	C4H8O2	3173	—	—	5077-67-8
2 pentanone	C5H10O	2842	172.515	—	107-87-9
3 hydroxy 2 pentanone	C5H10O2	3550	—	—	3142-66-3
3 penten 2 one	C5H8O	3417	—	—	625-33-2
1 penten 3 one	C5H8O	3382	—	—	1629-58-9
cyclopentanone	C5H8O	3910	—	—	120-92-3
2,3 pentan dione	C5H8O2	2841	172.515	—	600-14-6
4 methyl 3 penten 2 one	C6H10O	3368	—	—	141-79-7
4 hexen 3 one	C6H10O	3352	—	—	2497-21-4
cyclohexanone	C6H10O	3909	—	—	108-94-1
2, 3 hexane dione	C6H10O2	2558	172.515	—	3848-24-6
3, 4 hexane dione	C6H10O2	3168	—	—	4437-51-8
4 methyl 2,3 pentane dione	C6H10O2	2730	172.515	—	7493-58-5
2 acetoxy 3 butanone	C6H10O3	3526	—	—	4906-24-5
3 hexanone	C6H12O	3290	—	—	589-38-8
4 methyl 2 pentanone	C6H12O	2731	172.515	—	108-10-1
1-hydroxy-4-methyl-2-pentanone	C6H12O2	4463	—	—	68113-55-3
2 furyl methyl ketone (2 acetyl furan)	C6H6O2	3163	—	—	1192-62-7
maltol (Veltol™) (hydroxy 2 methyl pyrone)	C6H6O3	2656	—	—	118-71-8
1 methyl 1 cyclopenten 3 one	C6H8O	3435	—	—	2758-18-1
2-cyclohexenone	C6H8O	4517	—	—	930-68-7
methyl cyclopentene olone	C6H8O2	2700	172.515	—	80-71-7
4 hydroxy 2 cyclohexene 1 one	C6H8O2	3458	—	—	10316-66-2
3 methyl 2 cyclohexene 1 one	C7H10O	3360	—	—	1193-18-6
1 methyl 2,3 cyclohexadione	C7H10O2	3305	—	—	3008-43-3
3,4 dimethyl 1,2 cyclopentane dione	C7H10O2	3268	—	—	13494-06-9
3,5 dimethyl 1,2 cyclopentane dione	C7H10O2	3269	—	—	13494-07-0
3 ethyl 2 hydroxy 2 cyclopenten 1 one	C7H10O2	3152	—	—	21835-01-8
5 methyl 3 hexen 2 one	C7H12O	3409	—	—	5166-53-0
5 methyl 5 hexen 2 one	C7H12O	3365	—	—	9/3/3240
3 hepten 2 one	C7H12O	3400	—	—	1119-44-4
2 hepten 4 one	C7H12O	3399	—	—	4643-25-8
2-methylcyclohexanone	C7H12O	3946	—	—	583-60-8
3-methylcyclohexanone	C7H12O	3947	—	—	591-24-2
4-methylcyclohexanone	C7H12O	3948	—	—	589-92-4
5 methyl 2,3 hexane dione	C7H12O2	3190	—	—	13706-86-0
2,3 heptane dione	C7H12O2	2543	172.515	—	96-04-8
5 methyl 2,3 hexane dione	C7H12O2	3190	—	—	13706-86-0
2 heptanone	C7H14O	2544	172.515	—	110-43-0
3 heptanone	C7H14O	2545	172.515	—	106-35-4
4 heptanone	C7H14O	2546	172.515	—	123-19-3
methyl 3 hydroxy hexanoate	C7H14O3	3508	—	—	21188-58-9

Chart 186 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
3(2)-Hydroxy-5-methyl-2(3)-hexanone	C7H15O2	3989	—	—	163038-04-8
(2 furyl) 2 propanone	C7H8O2	2496	172.515	—	6975-60-6
ethyl maltol (Veltol plus™) (hydroxy 2 ethyl pyrone)	C7H8O2	3487	—	—	11/8/4940
1-(2-Furyl)butan-3-one	C8H10O2	4120	—	—	699-17-2
6 methyl 3,5 hepta dien 2 one	C8H12O	3363	172.515	—	1604-28-0
(E,E)-3,5-Octadien-2-one	C8H12O	4008	—	—	30086-02-3
2 ethyl 2 hydroxy 4 methyl cyclopent 2 en 1 one	C8H12O2	3453	—	—	42348-12-9
5 ethyl 2 hydroxy 3 methyl cyclopent 2 en 1 one	C8H12O2	3454	—	—	53263-58-4
1-(2-Furyl)butan-3-one	C8H12O2	4120	—	—	699-17-2
5 methyl 2 heptene 4 one	C8H14O	3761	—	—	81925-81-7
6 methyl 5 heptene 2 one	C8H14O	2707	172.515	—	110-93-0
3 octene 2 one	C8H14O	3416	—	—	1669-44-9
1 octene 2 one	C8H14O	3515	—	—	4312-99-6
2 octene 4 one	C8H14O	3603	—	—	4643-27-0
(E)-6-Methyl-3-hepten-2-one	C8H14O	4001	—	—	20859-10-3
1,5-Octadien-3-one	C8H14O	4405	—	—	65213-86-7
2,3-Octanedione	C8H14O2	4060	—	—	585-25-1
4,5-octanedione	C8H14O2	4533	—	—	5455-24-3
4-Octen-3-one	C8H15O	4328	—	—	14129-48-7
2 octanone	C8H16O	2802	172.515	—	111-13-7
3 octanone	C8H16O	2803	172.515	—	106-68-3
2-methylheptan-3-one	C8H16O	4000	—	—	13019-20-0
3 octanone 1 ol	C8H16O2	2804	172.515	—	65405-68-7
5 hydroxy 4 octanone	C8H16O2	2587	172.515	—	496-77-5
3-hydroxy-2-octanone	C8H17O2	4139	—	—	37160-77-3
4 (2 furyl) 3 butene 2 one	C8H8O2	2495	—	—	623-15-4
methyl para hydroxy benzoate	C8H8O3	2710	172.141	—	99-76-3
4′ methyl acetophenone	C9H10O	2677	172.515	—	122-00-9
para methyl anisole	C9H10O	2681	172.515	—	104-93-8
propiophenone (phenyl ethyl ketone)	C9H10O	3469	—	—	93-55-0
2,6,6 trimethyl cyclohex 2 ene 1,4 dione	C9H12O2	3421	—	—	1125-21-9
epoxyoxophorone or 3,5,5-trimethyl-2,3-epoxycyclohexane-1,4-dione	C9H12O3	4109	—	—	38284-11-6
isophorone (3,5,5 trimethyl 2 cyclohexene 1 one)	C9H14O	3553	—	—	78-59-1
4-Isopropyl-2-cyclohexenone	C9H14O	3939	—	—	500-02-7
2 hydroxy 3,5,5 trimethyl 2 cyclohexene 1 one	C9H14O2	3459	—	—	4883-60-7
2,6,6 trimethyl cyclohexanone	C9H16O	3473	—	—	2408-37-9
2 pentyl 2 butene 3 one	C9H16O	3725	—	—	63759-55-7
(E)-7-Methyl-3-octen-2-one	C9H16O	3868	—	—	33046-81-0
3-nonen-2-one	C9H16O	3955	—	—	14309-57-0
(E)-2-nonen-4-one or trans-2-nonen-4-one	C9H16O	4301	—	—	27743-70-0
5-nonen-trans-2-one	C9H16O	4326	—	—	27039-84-5

Chart 186 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
2,6,6-trimethyl-2-hydroxycyclohexanone	C9H16O2	4531	—	—	7500-42-7
1-(2-hydroxy-4-methylcyclohexyl)ethanone	C9H16O2	4742	—	—	917750-72-2
2,6 dimethyl 4 heptanone	C9H18O	3537	—	—	108-83-8
2 nonanone	C9H18O	2785	121.1164	—	821-55-6
3 nonanone	C9H18O	3440	—	—	925-78-0
8-nonen-2-one	C9H18O	4408	—	—	5009-32-5
3 (hydroxy methyl) 2 octanone	C9H18O2	3292	—	—	59191-78-5
dehydro mentho furo lactone (5,6 dihydro 3,6 dimethyl 2(4H benzofuranone))	C10H12O2	3755	—	—	75640-26-5
mint lactone (5, 6, 7, 7a tetrahydro 3,6 dimethyl 2(4H benzofuranone)) (also de hydroxy mentho furo lactone)	C10H14O2	3764	—	—	13341-72-5
pentyl 2 furyl ketone	C10H14O2	3418	—	—	14360-50-0
dihydrocarvone	C10H16O	3565	172.515	—	7764-50-3
3 methyl 5 propyl 2 cyclohexene 1 one	C10H16O	3577	172.515	—	3720-16-9
d-camphor (d- 2 camphanone)	C10H16O	2230	172.515	—	464-49-3
1,4 dimethyl 4 acetyl 1 cyclohexene	C10H16O	3449	—	—	43219-68-7
(+/−)-2-Hydroxypiperitone	C10H16O	4143	—	—	490-03-9
2-cyclopentylcyclopentanone	C10H16O	4514	—	—	4884-24-6
methyl acetoxy cyclohexyl ketone	C10H16O3	3701	—	—	52789-73-8
2 sec butyl cyclo hexanone	C10H18O	3261	—	—	14765-30-1
isomenthone	C10H18O	3460	172.515	—	491-07-6
3 decen 2 one	C10H18O	3532	172.515	—	10519-33-2
9-decen-2-one	C10H18O	4706	—	—	35194-30-0
2 hexyl 5 or 6 keto 1,4 dioxane	C10H18O3	2574	—	—	65504-97-4
(±)-3-hydroxy-3-methyl-2,4-nonanedione	C10H18O3	4687	—	—	544409-58-7
3-decanone	C10H20O	3966	—	—	928-80-3
Methyl n-octyl ketone or 2-Decanone	C10H20O	4271	—	—	693-54-9
3-methyl-2,4-nonedione	C10H21O2	4057	—	—	113486-29-6
7 methyl 4, 4a, 5, 6 tetrahydro 2 (3H) naphthalenone	C11H14O	3715	—	—	34545-88-5
jasmone (3 methyl 2 (2 pentenyl) 2 cyclopenten 1 one)	C11H16O	3196	—	—	488-10-8
yuzunone™ (6Z,8E)-undeca-6,8,10-trien-3-one	C11H16O	4691	—	—	1009814-14-5
2 hexylidene cyclopentanone	C11H18O	2573	172.515	—	17373-89-6
dihydro jasmone (3 methyl 2 (n pentanyl) cyclopenten 1 one)	C11H18O	3763	—	—	1128-08-1
isojasmone (2 hexyl cyclopentene 2 one 1)	C11H18O	3552	172.515	—	11050-62-7
(E) & (Z)-4,8-Dimethyl-3,7-nonadien-2-one	C11H18O	3969	—	—	817-88-9
3,5-undecadien-2-one	C11H18O2	4746	—	—	68973-20-6
2 undecanone	C11H22O	3093	172.515	—	112-12-9
6-Undecanone	C11H22O	4022	—	—	927-49-1
10-Undecen-2-one	C11H22O	4406	—	—	36219-73-5
2,3 undecadione	C11H22O2	3090	172.515	—	7493-59-6
methyl beta naphthyl ketone	C12H10O	2723	172.515	—	93-08-3
2,3,3-trimethylindanone	C12H14O	4556	—	—	54440-17-4

Chart 186 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
tetramethyl ethyl cyclohexenone (mixture of isomers)	C12H20O	3061	172.515	—	999999-25-9
Jasminone or 2-(trans-2-Pentenyl) cyclopentanone	C12H22O	4284	—	—	51608-18-5
4 (2,6,6 trimethyl cyclohexa 1,3 dienyl) but 2 en 4 one (beta damascenone)	C13H18O	3420	—	—	23696-85-7
4-(2-butenylidene)-3,5,5-trimethylcyclohex-2-en-1-one	C13H18O2	4663	—	—	13215-88-8
4 (2,6,6 trimethyl cyclohexa 1 enyl) but 2 en 4 one (beta damascone)	C13H20O	3421	—	—	1125-21-9
alpha damascone (trimethyl cyclohexyl butenone)	C13H20O	3659	—	—	43052-87-5
delta damascone (trimethyl cyclohexyl butenone)	C13H20O	3622	—	—	57378-68-4
trans-alpha-Damascone	C13H20O	4088	—	—	24720-09-0
2,6-Dimethyl-2,6,8-undecatrien-10-one or psuedoionone	C13H20O	4299	—	—	141-10-6
cycloionone or '6,6,7,8,8a-tetrahydro-2,5,5,8a-tetramethyl-5H-1-benzopyran	C13H20O	3822	—	—	5552-30-7
beta-ionone epoxide	C13H20O2	4144	—	—	23267-57-4
4-hydroxy-4-(3-hydroxy-1-butenyl)-3,5,5-trimethyl-2-cyclohexen-1-one	C13H20O3	4661	—	—	24427-77-8
6, 10 dimethyl 5,9 undeca dien 2 one (geranyl acetone)	C13H22O	3542	—	—	3796-70-1
(E)-2-(2-Octenyl)cyclopentanone	C13H22O	3889	—	—	65737-52-2
virginione or (+/−)-[R-(E)]-5-isopropyl-8-methylnona-6,8-dien-2-one	C13H22O	4331	—	—	2278-53-7
2 tridecanone	C13H26O	3388	—	—	593-08-8
beta-isomethylionone	C14H22O	4151	—	—	79-89-0
nootkatone (4, 4a, 5, 6, 7, 8 hexahydro 6 isopropenyl 4, 4a dimethyl 2 (3H) naphthalenone)	C15H22O	3166	172.515	—	4674-50-4
dihydro nootkatone (octahydro 4, 4a dimethyl 6 (methyl ethenyl) 2 (1H) naphthalenone)	C15H24O	3776	—	—	20489-53-6
2-(3,7-dimethyl-2,6-octadienyl) cyclopentanone	C15H24O	3829	—	—	68133-79-9
beta-ionyl acetate	C15H24O2	3844	—	—	22030-19-9
2 pentadecanone	C15H30O	3724	—	—	2345-28-0
alpha-isomethylionyl acetate	C16H26O2	3845	—	—	68555-61-3
2,6,10 trimethyl 2,6,10 pentadeca trien 14 one (found in tomato)	C18H30O	3442	—	—	762-29-8

Chart 187 Ketones - Aromatic

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
acetophenone	C8H8O	2009	172.515	—	98-86-2
2 hydroxy acetophenone	C8H8O2	3548	—	—	118-93-4
1-(4-hydroxyphenyl)-1-ethanone or 4-hydroxyacetophenone	C8H8O2	4330	—	—	99-93-4
dihydroxy acetophenone	C8H8O3	3662	—	—	28631-86-9
1-(2-methylphenyl)ethanone or 2-methylacetophenone	C9H10O	4316	—	—	577-16-2
acetanisole (methoxy acetone)	C9H10O2	2005	172.515	—	100-06-1
2-hydroxy-5-methylacetophenone	C9H10O2	4594	—	—	1450-72-2
2-methoxyacetophenone	C9H11O2	4163		—	579-74-8
1 phenyl 1,2 propane dione	C9H8O2	3266	—	—	579-07-7
4 phenyl 2 butene 2 one	C10H10O	2881	172.515	—	122-57-6
2,4 dimethyl acetophenone	C10H12O	2387	172.515	—	89-74-7
1 (para methoxy phenyl) 1 propanone	C10H12O2	2674	172.515	—	122-84-9
4 (para hydroxy phenyl) 2 butanone	C10H12O2	2588	172.515	—	5471-51-2
3-Hydroxy-4-phenylbutan-2-one	C10H12O2	4052	—	—	5355-63-5
3 methyl 4 phenyl 3 butene 2 one	C11H12O	2734	172.515	—	1901-26-4
vanillydine acetone	C11H12O3	3738	—	—	1080-12-2
4 (3,4 methylene dioxy phenyl) 2 butanone (piperonyl acetone)	C11H12O3	2701	—	—	55418-52-5
4 (para tolyl) 2 butanone	C11H14O	3074	172.515	—	7774-79-0
para iso propyl acetophenone	C11H14O	2927	172.515	—	645-13-6
4 (para methoxy phenyl) 2 butanone	C11H14O2	2672	172.515	—	104-20-1
1 (para methoxy phenyl) 1 pentene 3 one	C12H14O2	2673	172.515	—	104-27-8
4 (para acetoxy phenyl) 2 butanone	C12H14O3	3652	—	—	10599-70-9
4 methyl 1 phenyl 2 pentanone	C12H16O	2740	172.515	—	5349-62-2
benzophenone	C13H10O	2134	172.515	—	119-61-9
1 (4 methoxy phenyl) 4 methyl 1 pentene 3 one	C13H16O2	3760	172.515	—	103-13-9
benzoin (benzoyl phenyl carbinol)	C14H12O2	2132	172.515	—	119-53-9
3 benzyl 4 heptanone	C14H20O	2146	172.515	—	7492-37-7
1,3 diphenyl 2 propanone	C15H14O	2397	172.515	—	102-04-5
Phloretin or 3-(4-Hydroxy-phenyl)-1-(2,4,6-trihydroxy-phenyl)-propan-1-one	C15H14O5	4390	—	—	60-82-2
(+/−)-Hesperetin or 5,7-Dihydroxy-2-(3-hydroxy-4-methoxy-phenyl)-chroman-4-one	C16H14O6	4313	—	—	69097-99-0
1-(2,4-dihydroxyphenyl)-3-(3-hydroxy-4-methoxyphenyl)propan-1-one	C16H16O5	4764	—	—	50297-39-7
1-(4-hydroxy-3-methoxyphenyl)decan-3-one	C17H26O3	4665	—	—	27113-22-0
hydroxyacetone	C3H6O2	4462	—	—	116-09-6
(±)-4-hydroxy-6-methyl-2-heptanone	C8H16O2	4784	—	—	57548-36-4
2 hydroxy acetophenone	C8H8O2	3548	—	—	118-93-4
1-(4-hydroxyphenyl)-1-ethanone or 4-hydroxyacetophenone	C8H8O2	4330	—	—	99-93-4
dihydroxy acetophenone	C8H8O3	3662	—	—	28631-86-9
1-(2-methylphenyl)ethanone or 2-methylacetophenone	C9H10O	4316	—	—	577-16-2
acetanisole (methoxy acetone)	C9H10O2	2005	172.515	—	100-06-1
2-hydroxy-5-methylacetophenone	C9H10O2	4594	—	—	1450-72-2
2-methoxyacetophenone	C9H11O2	4163		—	579-74-8
1 phenyl 1,2 propane dione	C9H8O2	3266	—	—	579-07-7

Chart 188 Lactate Esters

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
ethyl lactate	C5H10O3	2440	172.515	—	97-64-3
ferrous l-lactate	C6H10FeO6	4699	—	—	85993-25-5
butyl lactate	C7H14O3	2205	172.515	—	138-22-7
Ethyl 2-methyllactate or (+/−)-Ethyl 2-hydroxy-2-methylbutyrate	C7H14O3	4268	—	—	77-70-3
Ethyl 2-ethyllactate or (+/−)-Ethyl 2-hydroxy-3-methylvalerate	C8H16O3	4269	—	—	24323-38-4
3 hexenyl lactate	C9H16O3	3690	—	—	61931-81-5
butyl butyryl lactate	C11H20O4	2190	172.515	—	7492-70-8
dodecyl lactate	C15H30O3	4482	—	—	6283-92-7
hexadecyl lactate	C19H37O3	4483	—	—	35274-05-6

Chart 189 Lactones

Compound	Empirical	FEMA	FDA	CAS#
4-Hydroxy-2-butenoic acid *gamma*-lactone	C4H4O2	4138	—	497-23-4
gamma butyrolactone (4 hydroxy butanoic acid lactone)	C4H6O2	3291	—	96-46-0
gamma 4 hydroxy 3 pentenoic acid lactone (angelica lactone)	C5H6O2	3293	—	591-12-8
beta angelica lactone (2 Methyl (2H) furana 5 one) (2 pentene 4 olide)	C5H6O2	4438	—	591-11-7
gamma valerolactone	C5H8O2	3103	—	108-29-2
2 oxo 3 ethyl 4 butanolide	C6H8O3	4460	—	923291-29-6
delta hexalactone	C6H10O2	3167	—	823-22-3
gamma hexalactone	C6H10O2	2556	172.515	695-06-7
4-Hydroxy-4-methyl-5-hexenoic acid *gamma* lactone or Lilac lactone	C7H10O2	4051	—	1073-11-6
5-Hydroxy-4-methylhexanoic acid *delta*-lactone	C7H12O2	4141	—	10413-18-0
gamma heptalactone	C7H12O2	2539	172.515	105-21-5
Phthalide or 2-Hydroxymethylbenzoic acid gamma lactone,	C8H6O2	4195	—	87-41-2
gamma octalactone	C8H14O2	2796	172.515	104-50-7
delta octalactone	C8H14O2	3214	—	698-76-0
benzodihydropyrone (dihydrocoumarin, a delta lactone)	C9H8O2	2381	—	119-84-6
2-Nonenoic acid *gamma*-lactone	C9H14O2	4188	—	21963-26-8
4-Hydroxy-3-nonenoic acid lactone or 5-Pentyl-3H-furan-2-one	C9H14O2	4323	—	51352-68-2
gamma nonylactone	C9H16O2	2781	172.515	104-61-0
delta nonylactone	C9H16O2	3356	—	3301-94-8
6 methyl coumarin (a delta lactone)	C10H8O2	2699	—	92-48-8
dehydro mentho furo lactone (5,6 dihydro 3,6 dimethyl 2(4H benzofuranone)	C10H12O2	3755	—	75640-26-5
mint lactone (5, 6, 7, 7a tetrahydro 3,6 dimethyl 2(4H benzofuranone)	C10H14O2	3764	—	13341-72-5
2 hydroxy 2,4 decadienoic acid lactone	C10H14O2	3696	—	27593-23-3
5 hydroxy 7 decenoic acid delta lactone (jasmine lactone)	C10H16O2	3745	—	25524-95-2

Chart 189 *Continued*

Compound	Empirical	FEMA	FDA	CAS#
5 hydroxy 8 decenoic acid delta lactone	C10H16O2	3758	—	68959-28-4
gamma jasmolactone (7 decen 4 olide)	C10H16O2	4439	—	67114-38-9
9 decen 5 olide	C10H16O2	4440	—	74585-00-5
8 decen 5 olide	C10H16O2	4441	—	32764-98-0
5 hydroxy 2 decenoic acid delta lactone (massoia lactone)	C10H16O6	3744	—	54814-64-1
Dihydromintlactone or 3,6-Dimethylcyclohexylacetolactone	C10H16O2	4032	—	92015-65-1
1a,7b-dihydrocyclopropa[c]chromen-2(1H)-one or 2-(2-Hydroxyphenyl) cyclopropanecarboxylic acid delta lactone or Cyclopropyl coumarin	C10H6O2	4270	—	5617-64-1
gamma decalactone	C10H18O2	2360	172.515	706-14-9
delta decalactone	C10H18O2	2361	172.515	705-86-2
epsilon decalactone	C10H18O2	3613	—	5579-78-2
6 hydroxy 3,7 dimethyl octanoic acid lactone	C10H18O2	3355	—	499-54-7
2-(2-Hydroxy-4-methyl-3-cyclohexenyl) propionic acid *gamma*-lactone or Wine Lactone	C11H16O2	4140	—	57743-63-2
2-Hydroxymethylbenzoic acid *gamma* lactone or Bovolide	C11H16O2	4050	—	774-64-1
Orin Lactone (4,8 dimethyl non 7 en 4 olide)	C11H18O2	4449	—	134359-15-2
(+/−) 3-Methyl-*gamma*-decalactone	C11H20O2	3999	—	67663-01-8
(+/−)-(2,6,6-Trimethyl-2-hydroxycyclohexylidene)acetic acid *gamma*-lactone	C11H20O2	4020	—	15356-74-8
gamma methyl decalactone	C11H20O2	3786	—	7011-83-8
gamma undecalactone (Aldehyde C-14 so-called)	C11H20O2	3091	172.515	104-67-6
delta undecalactone	C11H20O2	3294	—	710-04-3
Tuberose lactone or 2(3H)-Furanone, dihydro-5-(2,5-octadienyl)-, (Z,Z)-	C12H18O2	4067	—	153175-57-6
(Z) 4 hydroxy 6 dodecenoic acid lactone	C12H20O2	3780	—	18679-18-0
9 dodecene 5 olide	C12H20O2	4445	—	15456-68-5
gamma dodecalactone	C12H22O2	2400	172.515	2305-05-07
4,4 dibutyl gamma butyrolactone	C12H22O2	2372	172.515	7774-47-2
delta dodecalactone	C12H22O2	2401	172.515	713-95-1
epsilon dodecalactone	C12H22O2	3610	—	16429-21-3
9 tetradecen 5 olide	C14H24O2	4448	—	15456-70-9
delta tetra decalactone	C14H26O2	3590	—	2721-22-4
omega pentadecalactone (angelica lactone, also Exaltolide™, Thibetolide™) *not alpha angelica lactone*	C15H28O2	2840	172.515	106-02-5
omega 6 hexadecene lactone	C16H28O2	2555	172.515	7779-50-2
delta-hexadecalactone	C16H30O2	4673	—	7370-44-7
delta octadecalactone	C18H34O2	4447	—	1227-51-6
gamma octadecalactone	C18H34O2	4446	—	502-26-1
massoia bark oil (massoia lactone)	R-C5H5O2 where R = C5H11, C7H15 or C9H19	3747-	—	85085-26-3

Chart 190 Leavening Agents

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
Leavening Agents					
potassium acid tartrate	KC4H5O6	—	184.1077	—	526-83-0
ammonium bicarbonate	NH4HCO3	—	184.1135	—	1066-33-7
ammonium carbonate	(NH4)2CO3	—	184.1137	—	10361-29-2
ammonium chloride	NH4Cl	—	184.1138	—	12125-02-9
ammonium hydroxide	NH4OH	—	184.1139	—	1336-21-6
ammonium phosphate, dibasic	(NH4)3PO4	—	184.1141 b	—	7783-28-0
calcium lactate	C6H10O6	—	184.1207	—	814-80-2
calcium sulfate	CaSO4	—	184.123	—	7778-18-9
calcium dioxide	CaO2	—	184.124	—	1305-78-8
glucono delta lactone	C6H10O6	—	184.1318	—	90-80-2
Carbon Dioxide and Related CO2 Producing Compounds					
ammonium bicarbonate	NH4HCO3	—	184.1135	—	1066-33-7
calcium dioxide	CaO2	—	184.124	—	1305-78-8
carbon dioxide	CO2	—	582.125	—	124-38-9
potassium bicarbonate	KHCO3	—	184.1613	—	298-14-6
potassium carbonate	K2CO3	—	184.1619	—	584-08-7
sodium carbonate	Na2CO3	—	184.1736	—	497-19-8
Aerating Agents					
methyl ethyl cellulose	—	—	172.872	—	
chloro penta flouro ethane	C2ClF5	—	173.345	—	
octa flouro cyclobutane	C4F8	—	173.36	—	
n-butane and iso butane	C4H8	—	184.1165	—	
calcium dioxide	CaO2	—	184.124	—	1305-78-8
nitrogen	N2	—	184.154	—	
nitrous oxide	NO	2779	184.1545	—	9004-69-7
propane	C3H6	—	184.1655	—	74-98-6

Chart 191 Levulinates

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
methyl levulinate	C6H10O3	4478	—	—	624-45-3
ethyl levulinate (ethyl 4 oxo pentanoate)	C7H12O3	2442	172.515	—	539-88-8
propyl levulinate	C8H14O3	4480	—	—	645-67-0
butyl levulinate (butyl 4 oxopentanoate)	C9H16O3	2207	172.515	—	2052-15-5
isoamyl levulinate	C10H18O3	4481	—	—	71172-75-3

Chart 192 Maillard Reaction

Amino acid	Result
Alanine	Caramel
Aspartic Acid	Weak, non-descript
Arginine	Weak, non-descript
Cysteine	Sulfur, Meaty
Cystine	Sulfur, Meaty
Glutamic acid	Chicken Broth
Glycine	Weak
Histidine	Weak
Hydroxyproline	Weak, like proline
Isoleucine	Like leucine
Leucine	Cheesy, baked potato, cocoa, chocolate
Lysine	Brown
Methionine	Baked potato
Phenylalanine	Honey, rose like, chocolate
Proline	Bread-like flavor
Serine	Weak, brown
Taurine	Meaty flavor
Threonine	Weak
Tryptophan	Strong, Indole- like
Tyrosine	Weak
Valine	Yeasty, HVP-like

Chart 193 Malonates

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
diethyl malonate	C7H12O4	2375	172.515	—	105-53-3
diethyl malate	C8H14O5	2374	172.515	—	7554-12-3
butyl ethyl malonate	C9H16O4	2195	172.515	—	17373-84-1

Chart 194 Maltol and Related Products

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
maltol (TM)(VeltolTM)	C6H6O3	2656	172.515	—	118-71-8
ethyl maltol (TM) (Veltol Plus™)	C7H8O2	3487	—	—	4940-11-8
maltyl isobutyrate	C10H12O4	3462	—	—	65416-14-0
ethyl maltol isobutyrate	C10H12O4	4534	—	—	852997-28-5

Chart 195 Massoia Bark

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
Massoia Bark Oil (Cryptocaria massoio) massoia bark oil (massoia lactone) (where R = C5H11, C7H15 or C9H19)	R-C5H5O2	3747	—	—	85085-26-32

Chart 196 Menthol Menthone Derivatives and Coolants

Compound	Empirical Formula	FEMA GRAS #	GRAS #	NAS#	CAS#
neomenthol (d beta pulegyl menthol)	C10H12O	2666	172.515	—	20752-34-5
para mentha 1,8 dien 7 al or (perilla aldehyde)	C10H14O	3557	—	—	2111-75-3
para mentha 1,4(8) diene 3 one or (piperitenone)	C10H14O	3560	—	—	491-09-8
para mentha 1,3 diene (alpha terpinene)	C10H16	3558	172.515	—	99-86-5
para mentha 1,4 diene (gamma terpinene)	C10H16	3559	172.515	—	99-85-4
para menth 8 en 2 one (dihydro carvone)	C10H16O	3565	172.515	—	7764-50-3
para mentha 1,8 dien 7 ol (perilla alcohol)	C10H16O	2664	172.515	—	536-59-4
para menth 8 en 2 one (dihydro carvone)	C10H16O	3565	172.515	—	7764-50-3
d-8-p-menthene-1,2-epoxide	C10H16O	4655	—	—	1195-92-2
l-8-p-menthene-1,2-epoxide	C10H16O	4656	—	—	203719-53-3
menthone	C10H18O	2667	172.515	—	89-80-5
para menth 8 en ol (beta terpineol)	C10H18O	3564	172.515	—	138-87-4
para menth 1 en 3 ol	C10H18O	3179	—	—	491-04-3
para menth 3 en 1 ol	C10H18O	3563	172.515	—	586-82-3
para menthan 2 one	C10H18O	3176	—	—	499-70-7
para mentha 8 thiol 3 one(black currant flavor (in buchu leaf oil))	C10H18OS	3177	—	—	38462-22-5
Z- and E-l-Mercapto-p-menthan-3-one or cis- and trans-l-Mercapto-p-menthan-3-one	C10H18OS	4300	—	—	29725-66-4
1 para menthene 8 thiol(found in grapefruit juice)	C10H18S	3700	—	—	71159-90-5
menthol	C10H20O	2665	172.515	—	89-78-1
para menthan 2 ol (carvomenthol)	C10H20O	3562	—	—	499-69-4
p-menthane-3,8-diol (coolact 38d, pmd38)	C10H20O2	4053			42822-86-6
2-isopropyl-n,2,3-trimethylbutyramide (ws-23)	C10H21NO	3804			51115-67-4
para menth 1 ene 9 al (carvomenthenal)	C11H18O	3178	—	—	29548-14-9
isopulegol - coolact p	C11H18O	2962			89-79-2
menthyl formate	C11H20O2	4509	—	—	2230-90-2
l-menthyl methylether	C11H22O	4054			1565-76-0
1 para menthene 9 yl acetate	C12H20O2	3566	—	—	17916-91-5
l menthyl acetate	C12H22O2	2668	172.515	—	16409-45-3
2-(l-menthoxy)ethanol - coolact 5	C12H24O2	4154			38618-23-4
l menthyl lactate	C13H23O3	3748	—	—	59259-38-0
menthyl propionate	C13H24O2	4510	—	—	86014-82-6
l-menthone 1,2-glycerol ketal	C13H24O3	3807			63187-91-7
d,l-menthone 1,2-glycerol ketal- frescolat mga (r)	C13H24O3	3808			63187-91-7
l-menthol ethylene glycol carbonate - frescolat mgc (r)	C13H24O4	3805			156324-78-6
l-menthol 1- and 2-propylene glycol carbonate - frescolat mpc (r)	C13H24O4	3806			30304-82-6
n-ethyl-2-isopropyl-5-methylcyclohexane carboxamide (ws-3)	C13H25NO	3455			39711-79-0
3 (1 menthoxy) propane 1,2 diol	C13H26O3	3784	—	—	87061-04-9
mono-menthyl succinate (mms)	C14H24O4	3810			77341-67-4
l-menthyl butyrate	C14H26O2	4524	—	—	68366-64-3
menthyl methyllactate or l-menthyl (R,S)-3-hydroxybutyrate	C14H26O3	4308	—	—	108766-16-1
2-[(2-(p-menthyloxy)ethoxy]ethanol	C14H28O3	4718	—	—	28804-53-7
3-(l-menthoxy)-2-methylpropane-1,2-diol	C14H28O3	3849			195863-84-4
l-monomenthyl glutarate ((physcool 2, mmg)	C15H26O4	4006			220621-22-7
n-[(ethoxycarbonyl)methyl)-p-menthane-3-carboxamide (ws-5)	C15H27NO3	4309			68489-14-5

Chart 196 *Continued*

Compound	Empirical Formula	FEMA GRAS #	GRAS #	NAS#	CAS#
l menthyl isovalerate	C15H28O2	2669	172.515	—	16409-46-4
3,9-dimethyl-6-(1-methylethyl)-1,4-dioxaspiro[4.5] decan-2-one	C15H29O2	4285	—	—	831213-72-0
(+/−)-n,n-dimethyl menthyl succinamide	C16H30N2O2	4230			544714-08-1
vanillin 3-(l -menthoxy)propane-1,2-diol acetal (vanillin mpd)	C21H3205	3904			180964-47-0
dimenthyl glutarate	C25H44O4	4604	—	—	406179-71-3

Chart 197 Musks

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
ethylene brassylate	C15H26O4	3543	172.515	—	105-95-3
omega pentadecalactone (angelica lactone, also Exaltolide™, Thibetolide™) (not alpha angelicalactone)	C15H28O2	2840	172.515	—	106-02-5
d l muscone (3 methyl 1 cyclopenta decanone)	C16H10O	3434	—	—	541-91-3
sclareolide (decahydro tetra methyl naphtho furanone)	C16H26O2	3794	—	—	564-20-5
omega 6 hexadecene lactone	C16H28O2	2555	172.515	—	7779-50-2
Civettone™ (cycloheptadeca 9 en 1 one)	C17H30O	3425	—	—	542-46-1
Isoambrettolide or Oxacycloheptadec-10-en-2-one	C17H30O	4145	—	—	28645-51-4
ambrettolide (cyclopentadecanolide) not GRAS and musk ambrette formerly FEMA # 2758 was delisted					
Indane musks					
4 acetyl 6 tertiary butyl 1,1, dimethyl indane (Celestolide™, or crysolide)	C17H24O	3653	—	—	13171-00-1

Chart 198 Indoles and Skatole

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
indole or (2,3, benzopyrrole)	C8H7N	2593	172.515	—	120-72-9
skatole (methyl indole)	C9H9N	3019	172.515	—	83-31-1

Chart 199 Haw Bark Extract

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
bark extract	2538	172.510	—	84929-54-4	bitter principle

Chart 200 Hemlock

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Hemlock (Spruce)					
Tsuga canadensis (L.) Carr Eastern Hemlock					
T. heterophylla (Raf.) Sarg.Western Hemlock					
Picea glauca (Moench.) Voss.Canadian or White Spruce					
P. mariana Canadian Black Spruce					aromatic terpene type
Tsuga Spp. spruce oil	—	172.510	6076	—	aromatic terpene type
Tsuga Spp. needles twigs and oil	—	172.510	6076	—	aromatic terpene type
Tsugu and Picea spp. Oil	3034	—	—	8008-80-8	aromatic terpene type
Spruce (Picea spp.)needles & twigs extract	—	172.510	—	—	aromatic terpene type
Spruce (Picea spp.)needles & twigs oil	—	172.510	—	—	aromatic terpene type

Chart 201 Hickory Bark

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Hickory Bark (Carya species)					
	2577	182.20, 582.20	—	91723-4-5	woody type

Chart 202 Hops

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Hops (Humulus lupulus L.)					
extract	2578	182.20, 582.20	—	8007-4-3	aromatic type
solid extract	2579	182.20, 582.20	—	8007-4-3	bitter principle
oil	2580	182.20, 582.20	—	8007-4-3	terpene type

Chart 203 Horehound

Botanical	FEMA GRAS #	CFR	CAS #	Type	
Horehound (Hoarhound) (Marrubium vulgare (Tourn) L.)					
botanical	—	—	182.10, 582.10	—	bitter principle
solid extract	—	—	182.20, 582.20	—	balsamic type
extract	2581	—	182.20, 582.20	84696-20-8	balsamic type
generic	—	6200+	—	—	balsamic type

Chart 204 Horsemint

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Horsemint (Monarda punctata L.)					
	2582	182.20, 582.20	—	8006-85-7	aromatic type

Chart 205 Horseradish

Botanical	NAS #	CFR	Type
Horseradish (*Armoracia rusticana*) Sulfur.			
food	6201+	101.12, 101.22, 155.200, 182.10, 501.22, 582.10	spice
natural flavor (oil)	6311+	101.22	spice

Chart 206 Hyacinth

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Hyacinth (Hyacinthus orientalis L.)					
floral type					
flowers	—	172.510	6085	8023-94-7	green type
absolute	—	172.510	6084	6084-94-7	green type

Chart 207 Hyssop

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Hyssop (Hyssopus officinalis L.)					
botanical	2589	182.10, 582.10	—	8006-83-5	aromatic type
extract	2590	182.20, 582.20	—	8006-83-5	bitter principle
oil	2591	182.20, 582.20	—	8006-83-5	mint

Chart 208 Iceland Moss

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Iceland Moss (Cetrartia islandica (L.) Ach.)					
(alcoholic beverages only)	—	172.510	6086	—	bitter principle

Chart 209 Immortelle

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Immortelle (Everlasting or Helichrysum) Helichrysum angustifolium DC.					
extract or oil	2592	182.20, 582.20	—	8023-95-8	floral type

Chart 210 Imperatoria

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Imperatoria (Peucedanum ostruthium (L.) Koch) Imperatoria Ostruthium L.					
(alcoholic beverages only)	—	172.510	6087	—	tonic like bitter principle

Chart 211 Iva

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Iva (Achillea moschata Jacq.) alcoholic bev. Only					
botanical	—	172.510	6089	—	bitter principle
extract	—	172.510	6090	—	bitter principle

Chart 212 Jambu

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Jambu	3783	—	—	90131-24-1	Fruity Floral

Chart 213 Jasmine

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Jasmine (Jasminum officinale L. & Other Jasminum species)					
absolute	2598	182.20, 582.20	—	8022-96-6	floral type
concrete	2599	182.20, 582.20	—	8022-96-6	floral type
oil	2600	182.20, 582.20	—	8022-96-6	floral type
spirits	2601	182.20, 582.20, 172.515	—	8022-96-6	floral type

Chart 214 Juniper Berry

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Juniper Berry (Juniperus communis L.)					
botanical	2602	182.20, 582.20	—	84603-69-0	bitter principle
extract	2603	182.20, 582.20	—	80812-91-7	bitter principle
oil	2604	182.20, 582.20	—	80812-91-7	bitter principle

Chart 215 Kola Nut

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Kola Nut (Cola Nut) (Cola spp.)	2607	182.20, 582.20	—	68916-19-8	bitter principle

Chart 216 Labdanum

Botanical	FEMA GRAS #	CFR	CAS #	Type
Labdanum (*Cistus* spp.)				
absolute	2608	172.51	8016-26-0	*balsamic*
oil	2609	172.51	8016-26-0	*resinous*
oleoresin	2610	172.51	8016-26-0	*resinous*

Chart 217 Lavandin

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Lavandin (Lavandula hybrida Rev.)					
oil	2618	182.20, 582.20	—	8022-15-9	camphoraceous
floral	2618	—	—	8022-15-9	linalool type

Chart 218 Lavender

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Lavender (Lavandula officinalis Chaix)					
botanical	2619	182.10, 582.10	—	8000-28-0	floral linalool type
absolute	2620	182.20, 582.20	—	8000-28-0	floral linalool type
concrete	2621	182.20, 582.20	—	8000-28-0	floral linalool type
oil	2622	182.20, 582.20	—	8000-28-0	floral linalool type

Chart 219 Lavender - Spike

Botanical	FEMA GRAS #	CFR	CAS #	Type
Lavender, Spike (Lavandula latifolia Vill) (L. spica D.C.)				
	3033	182.20, 582.20	8016-78-2	camphoraceous linalool

Chart 220 Leek

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Leek (Allium porrum)					
oil	—	—	6380	—	sulfur type

Chart 221 Lemon

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
extract	2623	182.20, 582.20	—	84929-31-7	citrus type
oil	2625	182.20, 582.20	—	8008-56-8	citrus type
terpeneless oil	2626	—	—	68648-39-5	citrus type
peel extract	—	182.20, 582.20	—	—	citrus type
peel granules	—	172.51	—	—	citrus type
lemon petitgrain oil	2853	182.20, 582.20	—	8008-56-8	citrus type
distillate	—	—	6653	—	citrus type
essence oil	—	—	6546	—	citrus type
peel extract	—	—	6647	—	citrus type
peel granules	—	—	6406	—	citrus type
terpenes	—	—	6337	—	citrus type
meyer lemon oil, cold pressed, citrus x meyeri	4770	—	—	1370641-98-7	citrus type

Chart 222 Lemongrass

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Lemongrass (Cymbopogon citratus Dc or Andropogon nardus var. ceriferus = West Indian Type)					
oil	2624	182.20, 582.20	—	8007-2-1	lemon

Chart 223 Lemon Verbena

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Lemon Verbena (Lippia citriodora H.B.K.)					
herb (alcoholic bev. only)	—	6354	172.510	80024-12-2	lemon

Chart 224 Lime

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Lime (Citrus aurantifolia Swingle)					
distilled or expressed oil	2631	182.20, 582.20	—	8008-26-2	citrus
terpeneless oil	2632	182.20, 582.20	—	8008-26-2	citrus
dry lime juice	—	182.20, 582.20	—	—	citrus
expressed oil	—	—	6315	—	citrus
lime oil tailings	—	—	6554	—	citrus
lime oil terpenes	—	—	6442	—	citrus
lime essence oil	—	—	6560	—	citrus
juice concentrate	—	—	6655	—	citrus
mexican lime oil, expressed	4743	—	—	8008-26-2	citrus
persian lime oil, expressed	4744	—	—	8008-26-2	citrus

Chart 225 Linaloe Wood

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Linaloe (Wood or Seed) (Bursera delpechiana Poiss. & Other Bursera Species)					
oil	2634	172.510	—	8006-86-8	floral type

Chart 226 Linden Flowers

Form	FEMA GRAS #	CFR	NAS #	CAS #	Descriptor
Linden Flowers (Tilia Species)					
botanical	2647	182.10, 582.10	—	90063-53-9	floral type
extract	—	182.20, 582.20	6202	90063-53-9	floral type
leaves (alcoholic bev. only)	—	172.510, 182.10, 582.10	6095	90063-53-9	floral type

Chart 227 Liquid Smoke

Botanical	FEMA GRAS #	CFR	CAS #	Type
Liquid Smoke See Smoke.	2968	172.515	7732-18-5	phenolic

Chart 228 Lovage

Form	FEMA GRAS #	CFR	NAS #	CAS #	Descriptor
Lovage (Levisticum officinale Koch.)					
botanical	2649	172.51	—	8016-31-7	brown type
extract	2650	172.51	—	8016-31-7	vegetable type
oil	2651	172.51	—	8016-31-7	brown type

Chart 229 Lungmoss

Botanical	FEMA GRAS #	NAS #	CFR	CAS #	Type
Lungmoss (Lungwort)	—	172.510	6355	39354-45-5	bitter principle

Chart 230 Mace

Botanical	FEMA GRAS #	CFR	NAS #	CAS #	Type
Mace (Myristica fragrans Hourt.)					
botanical	2652	182.10, 582.10	—	8007-12-3	terpene type
oil	2653	182.20, 582.20	—	8007-12-3	aromatic
oleoresin	2654	182.20, 582.20	—	8007-12-3	aromatic

Chart 231 Maidenhair Fern

Botanical	FEMA GRAS #	CFR	CAS #	Type
Maidenhair Fern (*Adiantum capillus* - Veneris L.)				
(alcoholic bev. only)	172.510	6097+	—	bitter principle

Chart 232 Malt

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Malt (Hordeum vulgare L. and Other Grains). See Barley.					
extract	—	—	6205	1002-46-65	Brown

Chart 233 Mandarin

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Mandarin (Citrus reticulate Blanco)					
botanical	2657	182.20, 582.20	—	8008-31-9	citrus type
petitgrain mandarin oil	2854	182.20, 582.20	—	8014-17-3	citrus type
tangerine essence		182.20, 582.20	—	—	citrus type
tangerine oil	3041	182.20, 582.20	—	8008-31-9	citrus type
terpenes	—	—	6448	—	citrus type
mandarin petitgrain terpeneless	—	—	6529	—	citrus type
mandarin terpenes	—	—	6446	—	citrus type
mandarin essence	—	—		—	citrus type

Chart 234 Mountain Maple

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Maple, Mountain (Acer spicatum Lam.)					
botanical	—	172.510	—	—	brown type
bark	—	172.510	6112	—	brown type
solid extract	2757	172.510	—	91770-23-9	brown type
concentrate	—	—	6427	—	brown type

Chart 235 Marigold

Botanical	FEMA GRAS #	CFR	CAS #	Type
Marigold, Pot (Calendula officinalis L.)	2658	182.10, 582.10	70892-20-5	herbaceous

Chart 236 Marjoram

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Marjoram, Pot (Marjorana onites (L.) Benth. (Origanum vulgare))					
	2660	182.10, 582.10	—	84012-24-8	aromatic spice
Marjoram, Sweet (Origanum majorana L. (Majorana hortensis Moench.))					
botanical	2662	182.10, 582.10	—	8015-1-8	aromatic spice
oil	2663	182.20, 582.20	—	8015-1-8	aromatic spice
oleoresin	2659	182.20, 582.20	—	8015-1-8	aromatic spice
seed	2601	182.10, 582.10	—	8015-1-8	aromatic spice

Chart 237 Mate

Botanical	FEMA GRAS #	CFR	CAS #	Type
Maté (Paraguay Tea) (Ilex paraguariensis St. Hil.)	6381+	182.20, 582.20	68916-96-1	tea
absolute	6204+	—	68916-96-1	tea
Yerba Maté solid extract	6656+	—	84082-59-7	tea

Chart 238 Extraction Solvents for Flavorings

Solvent Name	Status or Maximum Residue Permitted in Final Food (Except Footnotes 5 and 9) (mg/kg)				
	IOFI[1]	Codex[2]	EU[3]	USA[4]	Japan[9+10]
Acetone	2	30	GMP	30 [5]	30
Amyl Acetate	P[6]	GMP	—	P[6]	—
Benzyl Alcohol	P[6]	GMP	—	P[6]	—
Butane	1	1	GMP	—	GMP
Butane 1,3 Diol	—	GMP	—	GMP	—
Butan 1-ol	10	1000	1	—	GMP
Butan 2-ol	P[6]	1	1	P[6]	GMP
Carbon Dioxide	GMP	GMP	GMP	GMP	GMP
Cyclohexane	1	1	1	—	GMP
Dibutyl Ether	2	2	—	—	—
Dichlorodiflouromethane	—	1	—	—	—
1,2 Dichloroethane	—	—	—	30 [5]	—
Dichloromethane	2	2	0.02	30 [5]	30 [8]
Dichloromonoflouromethane	—	1	—	—	—
Dichlorotetraflouromethane	—	1	—	—	—
Diethyl Citrate	—	GMP	—	—	—
Diethyl Ether	2	2	2	—	GMP
Ethanol	P[6]	GMP	GMP	P[6]	GMP
Ethyl Acetate	10	GMP	GMP	—	GMP
Ethyl Methyl Ketone	2	2	1 [7]	—	GMP
Glycerol	—	—	—	—	GMP
Glyceryl Tripropionate	P[6]	GMP	—	—	—
Heptane	—	1	—	—	—
Hexane	1	0.1	1 [7]	25 [5]	25
Isobutane	1	1	—	—	—
Isopropyl Alcohol	P[6]	—	10	50 [5]	50
Isopropyl Myristate	—	GMP	—	—	—
Methanol	10	—	10	50 [5]	50
Methyl Acetate	P[6]	1	1	P[6]	GMP

Chart 238 *Continued*

Solvent Name	Status or Maximum Residue Permitted in Final Food (Except Footnotes 5 and 9) (mg/kg)				
	IOFI[1]	**Codex[2]**	**EU[3]**	**USA[4]**	**Japan[9+10]**
2-Methyl Propan 1 ol	P[6]	1	—	P[6]	—
Methyl tert butyl ether	2	—	—	—	—
Nitrous Oxide	—	GMP	GMP	—	GMP
Pentane	—	1	—	—	—
Petroleum Ether (Light)	1	1	—	—	—
Propane	1	1	GMP	—	GMP
Propane 1,2 diol	P[6]	GMP	—	—	GMP
Propan 1-ol	P[6]	GMP	1	P[6]	GMP
1,1,1,2 Tetraflouroethane	—	—	0.02	P[6]	GMP
Toluene	1	1	—	—	—
Tributyrin	P[6]	GMP	—	—	—
1,1,2 Trichloroethylene	—	2	—	30 [5]	30 [8]
Trichloroflouromethane	—	1	—	—	—

1-IOFI Code of practice E12 Jan 1997
2-Codex Alimentrius Volume 1A-1999 Section 5
3-Council of Europe Directive 88/344/EEC as amended by Directivers 92/115-94/52-97/60
4-21 CFR 173 Subpart C
5-Spice Extracts only (NB:Total chlorinated solvents should not exceed 30 mg/kg)
6-Permitted as flavoring or carrier solvent
7-Combined use of Hexane and Ethyl methyl ketone prohibited
8-Total of Dichloromethane and 1,1,2 trichloroethane
9-Residue in extract, derived from listed raw materials in the "Standard for Manufacturing", Japan's Specification and Standards for Food Additives, 8th Edition, 2007
10-Residue in extract (Recommendation of the Japan Flavor and Fragrance Materials Association for Manufacturing natural flavorings in general)

Chart 239 Mimosa

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Mimosa (*Acacia decurrens* Willd. var. *dealbata*)	2755	172.510	—	93685-96-2	floral type

Chart 240 Molasses

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Molasses (Saccharum officinarum L.)					
botanical	—	182.20, 582.20	6206	68476-78-8	brown type
Molasses, Beet	—	182.20, 582.20	—	68476-78-8	brown type
Molasses, Blackstrap	—	182.20, 582.20	—	8052-35-5	brown type
Molasses, Corn-Sugar	—	182.20, 582.20	—	8052-91-3	brown type
concentrate	—	182.20, 582.20	—	—	brown type
extract	—	182.20, 582.20	—	—	brown type

Chart 241 Mullein

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Mullein (Verbascum phlomoidea L., V. thapsiforme Schrad., V. thapsus L. or V. latius Dod.)					
(alcoholic bev. only)	—	172.510	6356	—	tonic type

Chart 242 Musk Tonquin

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Musk Tonquin (Moschus moschiferus L.) (Musk deer)					
	2759	182.50, 582.50	—	8001-4-5	musk type

Chart 243 Mustard

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Mustard Only the black and brown mustards (B. nigra and B. junica)	—	—	—	8007-40-7	aromatic
Brassica nigra Koch = Black or Brown Mustard	—	—	—	8007-40-7	aromatic
B. junica (L.) Cosson (Brown Mustard), Russian Mustard, or Sarepta	—	—	—	8007-40-7	aromatic
B. hirta Moench or B. alba Boiss (White Mustard) or Classified Sinapsis alba	—	—	—	8007-40-7	aromatic
black or brown	2760	—	182.10, 582.10	8007-40-7	aromatic
white or yellow	2761	—	182.10, 582.10	8007-40-7	aromatic
brown	—	—	182.10, 582.10	8007-40-7	aromatic
brown extract	—	6208	182.20, 582.20	—	aromatic
mustard oil	—	6547	182.20, 582.20	—	aromatic
yellow extract	—	6207	182.20, 582.20	—	aromatic
seed oleoresin	—	6681	—	—	aromatic
seed powder	—	1397	—	—	aromatic
seed whole	—	1399	—	—	aromatic

Chart 244 Myrrh

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Myrrh (Commiphora molmol Engl. = Somalian Myrrh) (C. abyssinica (Berg.) Engl. = Arabian Myrrh & Other Commiphora Species)					
gum	2765	172.510	—	8016-37-3	aromatic type
oil	2766	172.510	—	8016-37-3	balsamic
botanical	—	172.510	—	—	balsamic
absolute	—	172.510	—	—	balsamic

Chart 245 Myrtle

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Myrtle (Myrtus communis L.) (alcoholic bev. only)	—	172.510	6114	—	bitter principle

Chart 246 Naphthyl Compunds

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
2 naphthyl mercaptan	C10H8S	3314	—	—	91-60-1
1 methyl naphthalene	C11H10	3193	—	—	90-12-0
beta-naphthyl methyl ether	C11H10O	4704	—	—	93-04-9
methyl beta naphthyl ketone	C12H10O	2723	172.515	—	93-08-3
beta naphthyl ethyl ether (nerolin bromelia, also bromelia)	C12H12O	2768	—	—	93-18-5
octahydro-4,8a-dimethyl-4a(2h)-naphthol	C12H22O	4682	—	—	23333-91-7
raspbilene or alpha-ionene or 4,4, 7-trimethyl-2,3-dihydro-1H-naphthalene	C13H18	4264	—	—	475-03-6
beta naphthyl isobutyl ether	C14H16O	3719	—	—	2173-57-1
butyl beta-naphthyl ether	C14H16O	4634	—	—	10484-56-7
beta naphthyl anthranilate	C17H13NO2	2767	—	—	63449-68-3

Chart 247 Non Flavoring Ingredients

The following is a list of some ingredients approved by the CFR that are not on the GRAS lists:

Ingredient	Empirical Formula	FEMA GRAS #	CFR Citation	Use	CAS#
Note: < in this list means less than or equal to, or not to exceed. At GMP levels < means levels needed for intended use.					
(2) Non-flavoring GRAS List Ingredients (See also separate definitions)					
3-oxodecanoic acid glyceride	C10H17O3R (R=Fatty Acid)	3767	—	Emulsifiers	128331-45-3
3-oxododecanoic acid glyceride	C12H21O3R (R=Fatty Acid)	3768	—	Emulsifiers	128362-26-5
3-oxohexadecanoic acid glyceride	C16H29O3R (R=Fatty Acid)	3769	—	Emulsifiers	91052-71-0
3-oxohexanoic acid glyceride	C6H9O3R (R=Fatty Acid)	3770	—	Emulsifiers	91052-72-1
3-oxooctanoic acid glyceride	C8H13O3R (R=Fatty Acid)	3771	—	Emulsifiers	91052-68-5
3-oxotetradecanoic acid glyceride	C14H25O3R (R=Fatty Acid)	3772	—	Emulsifiers	91052-73-2
acesulfame potassium (6 methyl 1,2,3 oxathiazine (CAS# 55589-62-3)4(3H) one 2,2, dioxide (acesulfame K)	C4H4KNO4S	—	172.800	artificial sweetener.	55589-62-3
acetic acid	C2H5COOH	2006	—	pH Control Agents – Active as Consumed, Flavors and Flavor Modifiers	71-50-1
acetone	C3H6O	3326	—	Solvents/Carriers/Encapsulating Agents, Flavors and Flavor Modifiers	67-64-1
acetone peroxide	C6H12O4 (dimer), C9H18O6 (trimer)	—	172.802	dough conditioner, artificial maturing agent.	17088-37-8
acetylated monoglycerides	—	—	172.828	GMP.	977051-34-5
aconitic acid	C6H6O6	—	184.1007	0.0035% for soft candy to 5% for condiments.	4023-65-8
adipic acid	C6H10O4	2011	184.1009	pH Control Agents – Active as Consumed	124-04-9
agar-agar	—	2012	184.1115	Stabilizers and Thickeners	9002-18-0

Chart 247 *Continued*

Ingredient	Empirical Formula	FEMA GRAS #	CFR Citation	Use	CAS#
alanine, or DL-alanine	C3H7NO2	3252	172.540	enhancer for sweeteners in pickling brines at <1% of brine. Flavors and Flavor Modifiers, Nutrient	338-69-2
alginates	(C6H8O6)n, (C6H8O6)n-Ca (calcium), -K (potassium), -NH4 (ammonmium),-Na (sodium)	2015	—	Stabilizers and Thickeners, Texturizers	Alginic Acid 9005-32-7, Sodium Alginate 9005-38-3,Calcium Alginate 9005-35-0, Potassium Alginate 9005-36-1, Ammonium Alginate 9005-34-9
alginic acid	(C6H8O6)n	—	184.1011	colloidal hydrophillic polysaccharide thickener.	9005-32-7
aloe extract	—	2047	—	Moisture Control Agents	94349-62-9
alpha tocopherol or [2R,4′R,8prime;R]-2,5,7,8-tetramethyl-2-(4′,8′,12′-trimethyl-tridecyl)-6-chromanol	C27H46O2	—	184.1890	nutrient.	59–02–9 (d), 10191–41–0 (dl)
aluminum ammonium sulfate	AlNH4(SO4)2.12H2O	—	182.1127	at GMP levels.	7784-26-1
aluminum calcium silicate	AlCa(SiO4)	—	182.2122	anticaking agent <2%.	1327-39-5
aluminum potassium sulfate	(KAl(SO4)2·12H2O	—	182.1129	at GMP levels.	10043-67-1
aluminum sodium sulfate	(NaAl(SO4)2·12H2O	—	182.1131	at GMP levels.	7784-24-9
aluminum sulfate	Al2(SO4)3.18H2O	—	182.1125	at GMP levels.	10043-01-3
ammonium alginate	NH4(C6H8O6)n	—	184.1133	thickener.	9005-34-9
ammonium bicarbonate	NH4HCO3	—	184.1137	leavening agent.	1066-33-7
ammonium chloride	NH4Cl	—	184.1138	dough strengthener.	12125-02-9
ammonium citrate, dibasic	(NH4)2HC6H5O7	—	184.1140	pH control agent in alcoholic beverages.	3012-65-5
ammonium hydroxide	NH4OH	—	184.1139	leavening agent.	1336-21-6
ammonium phosphate dibasic	NH4H2PO4	—	184.1141a	firming agent.	7722-76-1
ammonium sulfate	(NH4)2SO4	—	184.1143	dough strengthener and firming agent.	7783-20-2
annatto extract	—	2103	—	Appearance Control Agents – Colors and Color Modifiers	1393-63-1

annatto seed	—	2104	—	Appearance Control Agents – Colors and Color Modifiers	1393-63-1
anoxomer	polymer	—	172.105	antioxidant for fats and oil <5000 ppm of total oil.	60837-57-2
Arabic gum	—	2001	—	Appearance Control Agents – Other Than Colors, Solvents/ Carriers,Emulsifiers, Stabilizers and Thickneres.	9000-01-5
Arabic Gum, hydrogen octenylbutane dioate, or Gum arabic, hydrogen octenylbutane dioate	—	4227	—	Clarifying or Flocculating Agents	455885-22-0
arabinogalactan (see also gums)	[(C5H6O4)(C6H10O5)6]x	3254	172.610	emulsifier, binder, thickener at GMP levels.	9036-66-2
arabinose, or l arabinose	C5H1O05	3255	—	Flavors and Flavor Modifiers, Nutrient	10323-20-3
ascorbic acid	C6H8O6	2109	182.3013	preservatives, antimicrobial agents, nutrients, antioxidants.	50-81-7
ascorbyl palmitate	C22H38O7	—	182.3149	preservatives	137-66-6
Aspartame (1 methyl n l alpha aspartyl l phenyl alanine)Must state phenylketonuric: contains phenyl alanine. The monograph states specific uses and limitations.	C14H18N2O5	—	172.804	artificial sweetener.	22839-47-0
aspartic acid, or l aspartic acid	C4H7NO4	3656	—	Flavors and Flavor Modifiers, Nutrient	56-84-8
azodicarbonamide	C2H4N4O2	—	172.806	not to exceed 45 ppm. As a bleaching agent in cereals, as a dough conditioner in bread.	123-77-3
baker's yeast glycan	—	—	172.898	emulsifier <5% of dressing, or stabilizer, thickener, or texturizer at GMP levels.	977014-12-2
bakers yeast extract	—	—	184.1983	at GMP levels.	—
beeswax (yellow and white)	—	—	184.1973	lubricant and surface finishing agent at GMP levels.	8012–89–3
bentonite	Al2O34SiO2nH2O	—	184.1155	filter aid.	1302-0978-99
benzoic acid	C7H6O2	—	184.1021	antimicrobial <0.1% of food.	65-85-0
benzoic acid	C7H6O2	2131	—	Flavors and Flavor Modifiers, antioxidant.	65-85-0

Chart 247 *Continued*

Ingredient	Empirical Formula	FEMA GRAS #	CFR Citation	Use	CAS#
benzoyl peroxide	(C6H5CO)2O2	—	184.1157	bleaching agent for cheese.	94-36-0
Besides the listing of ingredients on the FEMA GRAS lists, CFR Title 21 Part 184 lists direct food substances affirmed as GRAS from 184.1005 to 184.1984					
BHA or Butylated Hydroxy Methyl Phenol or 4 hydroxy methyl 2,6 tert butyl phenol	C11H16O2	—	172.110, 172.150	antioxidant from 2ppm to 1000 ppm depending on use.	25013-16-5
BHT	C15H24O	—	172.115	same as BHA in oils or fats <0.02% of oil	58500-82-6
brominated vegetable oil	—	2168	180.300	weighting agent <15 ppm in finished beverage. Appearance Control Agents – Other Than Colors	8016-94-2
butyl paraben	C11H14O3	2203	—	antioxidants	94-26-8
butylated hydroxy anisole	C11H16O2	2183	182.3169	antioxidant <0.02 % of fat.	25013-16-5
butylated hydroxy toluene	C15H24O	2184	182.3173	antioxidant <0.02 % of fat.	128-37-0
caffeine or trimethylxanthine, theine, mateine, guaranine, methyltheobromine	C8H10N4O2	—	182.118	at GMP levels.	58-08-2
calcium acetate	Ca(C2H3O2)2	2228	184.1185	<0.0001% general, to 0.2% in baked goods, depending on product usage. pH Control Agents – Active as Consumed	62-54-4
calcium alginate	Ca(C6H8O6)n—	—	184.1187	stabilizer and thickener.	9005-35-0
calcium ascorbate	Ca(C6H7O6)2	—	182.3189	preservatives	5743-28-2
calcium carbonate	CaCO3	—	184.1191	gas forming agent	471-34-1
calcium chloride	CACl2-2H2O	—	184.1193	anticaking agent, humectant, antimicrobial agent, pH control agent, stabilizer, thickener, from 0.05% in general to 0.4% dependent on usage.	10035-04-8 or 10043-52-4 (Anhydrous)

calcium citrate	(Ca3(C6H5O7)2-4H2O	—	184.1195	used in infant formulations.	813-0994-095
calcium disodium EDTA (ethylene diamine tetra acetate)	C10H12CaN2Na2O8·2H2O	—	172.120	sequestering agent, preservative, and stabilizer from <25 ppm to 340 ppm, depending on use.	23411-34-9
calcium gluconate	[CH2OH(CHOH)4COO]2Ca	—	184.1199	sequestrant, stabilizer, or thickener at 0.01% to 1.75% depending on usage.	299-28-5
calcium glycerophosphate	C3H7CaO6P	—	184.1201	nutrient substance, or in puddings at GMP levels.	27214-00-2
calcium hydroxide	Ca(OH)2,	—	184.1205	at GMP levels.	1305-62-0
calcium iodate	Ca(IO3)2-H2O	—	184.1206	in bread at <0.0075%.	7789-80-2
calcium lactate	C6H10CaO6.xH2O	—	184.1207	firming agent, flavor enhancer, stabilizer, thickener at GMP levels not to be used in infant formulae.	814-80-2
calcium lactobionate -4, beta d galactosido d gluconic acid	—	—	172.720	firming agent in dry pudding mixes, at intended level. Made by the oxidation of lactose.	5001-51-4
calcium oxide	CaO	—	184.1210	at GMP levels.	1305-78-8
calcium pantothenate	(C9H16NO5)2Ca	—	184.1212	nutrient supplement at GMP levels.	137-08-6
calcium phosphate	Ca3(PO4)2	—	182.1217	at GMP levels.	7757-93-9
calcium propionate	C6H10CaO4	—	184.1221	microbial agent, baked goods, cheese, gelatins and puddings at GMP levels.	4075-81-4
calcium silicate	Ca(SiO)3	—	172.410, 182.2227	anticaking agent <2% of food, <5% of baking powder.	1344-95-2, or 10101-39-0
calcium stearate	(Ca(C17H35COO)2	—	184.1229	lubricant at GMP levels.	1529-23-0
calcium steroyl 2-lactylate	C24H44O6Ca	—	172.844	dough conditioner <0.5% of flour used, whipping agent <0.05% of egg whites, <0.5% of dried egg white or dehydrated potatoes.	5793-94-2
calcium sulfate	CaSO4	—	184.1230	color, color adjunct, anticaking agent, dough strengthener, flour treating agent, leavening agent, nutrient supplement, pH control agent, stabilizer, thickener from 0.4% to 3.0% depending on use.	7778-18-9
candelilla wax	—	3479	184.1976	lubricant and surface finishing agent at GMP levels. Appearance Control Agents – Other Than Colors, levening agent.	8006–44–8

Chart 247 *Continued*

Ingredient	Empirical Formula	FEMA GRAS #	CFR Citation	Use	CAS#
caprylic acid	C8H16O2	—	184.1025	0.001% general applications to 0.04% for cheese.	124-07-2
caramel color	—	2235	182.1235	Appearance Control Agents – Colors and Color Modifiers	8028-89-5
carbon dioxide	CO2	—	184.1240	leavening agent, propellant, aerating agent, carbonating agent for sodas. See Dry Ice.	124-38-9
carmine	—	2242	—	Appearance Control Agents – Colors and Color Modifiers	215-724-4
carnauba wax	—	—	184.1978	lubricant and surface finishing agent at GMP levels.	008–015–869
carrageenan (see also gums)	—	—	172.620	hydrocolloid from Chondrus crispus, C. ocellatus, Eucheuma cottonii, E. spinosum, Gigartina acicularis, G. pistillata, G. radula, or G. stellata.	9000-07-1
carrageenan with polysorbate 80	—	—	172.623	processing aid for carrageenan.	—
castor oil	—	2263	172.876	Flavors and Flavor Modifiers, Release or Antisticking Agnet <500 ppm in hard candy.	8001-79-4
catechu	—	2264	—	Appearance Control Agents – Colors and Color Modifiers, flavor and flavor modifier.	8001-76-1
catechu powder	—	2265	—	Appearance Control Agents – Colors and Color Modifiers, flavor and flavor modifier.	8001-76-1
chewing gum base	—	—	172.615	See Chewing Gums.	—
citric acid	C6H8O7	2306	184.1033	pH Control Agents – Active as Consumed, Sequestrants.	77-92-9
cochineal	—	2330	—	Appearance Control Agents – Colors and Color Modifiers	2611-82-7
cocoa butter substitute primarily from palm oil or triglyceride 1-palmitoyl-2-oleoyl-3-stearin	—	—	184.1259	at GMP levels.	—

cocoa butter substitutes from	—	—	172.861	at GMP levels. coconut and/or palm kernel oils.	—
cocoa powder with dioctyl sodium sulfonate	—	—	172.520	at GMP levels.	—
copolymer condensates ethylene (oxide and propylene oxide)	—	—	172.808	stabilizer in flavors. Processing aid of wetting agent in combination with Dioctyl sodium sulfosuccinate, foam controller, and dough conditioner in yeast leavened bakery products.	—
Copper gluconate (cupric gluconate)	(CH2OH(CHOH)4COO)2Cu	—	184.1260	used in food at levels not to exceed current good manufacturing practice	527-09-3
copper sulfate	CuSO4-5H2O	—	184.1261	nutrient supplement.	7758-98-7
corn gluten	—	—	184.1321	nutrient.	66071-96-3
corn silk	—	—	184.1262	from <4 to <30 ppm depending on extract use.	—
corn sugar	C6H12O6	—	184.1857	sweetener.	50–99–7
corn syrup	—	—	184.1865	sweetener.	8029-43-4
Curpous Iodide	CuI	—	184.1265	not to exceed 0.01 percent in Table Salt for Iodine content	7681-65-4
Cyclodextrin, or beta-Cyclodextrin	C42H70O35·H2O	4028	—	Clarifying or Flocculating Agents	92517-02-7, 7585-39-9 (Base), 68168-23-0 (Hydrate), 85490-99-9 (Undecahydrate)
cysteine mono hydrochloride, or l cysteine mono hydrochloride	C3H7O2NS HCl H2O	3263	184.1272, 184.1271	dough strengthener from 0.009% of dough. Flavors and Flavor Modifiers, Nutrient	52-89-1
dehydroacetic acid and salts	C8H8O4	—	172.130	preservative for cut/peeled squash <65 ppm.	520-45-6
dextrin	(C6H10O5)n-H2O	—	184.1277	good manufacturing practice	9004-53-9
diacetyl	C4H6O2	—	184.1278	flavoring at GMP levels.	431-03-8
diacetyl tartaric acid esters of mono and diglycerides	—	—	184.1101	emulsifier.	977051-29-8
dietary supplements	—	—	172.310, 172.399, 182.5013 to 182.5997	minerals and vitamins.	—
dilauryl thiopropionate	C28H57O2S	—	182.3280	antioxidant <0.02% of fat.	—
dimethyl dicarbonate	C4H6O5	—	172.133	<200 ppm of wine, <250 ppm in tea, used in wine to replace sulfites.	4525-33-1

Chart 247 *Continued*

Ingredient	Empirical Formula	FEMA GRAS #	CFR Citation	Use	CAS#
dioctyl sodium sulfosuccinate	C20H37NaO7S	—	172.810	wetting agent in fumaric acid containing dry desserts. <10ppm final. Processing aid in sugar production. <25ppm. Solubilizing agent on gums and colloids. <0.5% in gum. Emulsifying agent for cocoa butter for beverages. <25ppm final beverage. In combination with 172.808 as wetting and processing agent in dry beverage mixes.	577-11-7
disodium EDTA	C8H16N2O8Na	—	172.135	sequestrant at GMP levels.	60-00-4
disodium guanylate	C10H14N5O8P	—	172.530	flavor enhancer at GMP levels.	5550-12-9
disodium inosinate	C10H11N2Na2O8.xH2O	—	172.535	flavor enhancer at GMP levels.	80702-47-2
disodium phosphate	Na2HPO4-7H2O	2398	—	Appearance Control Agents – Other Than Colors, Moisture Control Agent	7558-79-4
dried yeasts	—	—	172.896	dried versions of Saccharomyces cerevisiae, S. fragilis (Kluveromyces fragilis), or Candida utilis (Torulopsis utilis).	8013-01-2
enzyme modified fats	—	—	184.1287	flavoring at GMP levels.	—
erythorbic acid or Iso-Ascorbic Acid	C6H8O6	2410	182.3041	preservatives	89-65-6
ethoxylated mono and diglycerides	—	—	172.834	varying limitations as cited (<0.2 to diglycerides <0.4 as emulsifying agent).	61163-33-5
ethoxyquin or 6-ethoxy-1,2-dihydro- 2,2,4-trimethylquinoline	C14H19NO	—	172.140	preserving color of paprika from 0.5 ppm to 5 ppm in fats, meats and eggs. None allowed in milk.	91-53-2
ethyl alcohol	C2H5OH	2419	184.1293	microbial agent on pizza dough, flavor and flavor modifier, solvent at gmp	64-17-5
ethyl cellulose	—	—	172.868	binder, filler or protective coating in vitamins or fixative in flavor compounds.	9004-57-3

ethyl formate	C3H6O2	—	184.1295	flavoring from 0.01% in general products to 0.05% in baked goods.	109-94-4
ethylene oxide	C2H4O	2433	—	Sanitizing/Fumigating Agents, antimicrobial agent.	75-21-8
ethylene oxide polymer	—	—	172.770	foam stabilizer in malt beverages.	977092-23-1
fatty acids	CnH(2n+1)COOH	—	172.86	lubricants, binders and defoamers at GMP levels.	See Separate Lisintgs Under Fatty Acids
ferric ammonium citrate	C6H8O7.nFe.nH3N	—	184.1296	nutrient additive.	1333-00-2 or 1332-98-5
ferric chloride	FeC13	—	184.1297	nutrient.	7705-08-0
ferric citrate	C6H5FeO7	—	184.1298	nutrient.	2338-05-8
ferric phosphate	FePO4-xH2O	—	184.1301	nutrient.	10045-86-0
ferric pyrophosphate	Fe4(P207)3-xH2O	—	184.1304	nutrient.	10058-44-3
ferric sulfate	Fe2(SO4)3	—	184.1307	nutrient.	10028-22-5
ferrous ascorbate	Fe(C6H7O6)3	—	184.1307a	nutrient.	14536-17-5
ferrous carbonate	FeCO3	—	184.1307b	nutrient.	563-71-3
ferrous citrate	C6H6FeO7	—	184.1307c	nutrient.	23383-11-1
ferrous fumarate	C4H2FeO4	—	184.1307d	nutrient.	141-01-5
ferrous gluconate	C12H22FeO14-2H2O	—	184.1308	nutrient.	6047-12-7
ferrous lactate	C6H10FeO6	—	184.1311	nutrient.	5905-52-2
ferrous sulfate	FeSO4-7H2O	—	184.1315	nutrient.	7782-63-0
ficin (fig protease)	—	—	184.1316	good manufacturing practice	9001-33-6
food starch modified	—	—	172.892	starch that is chemically altered by the use of alkylating or phosphatizing chemicals to alter the structure of the starch molecule in a given way.	65996-63-6
fumaric acid	C4H4O4	2488	—	pH Control Agents – Active as Consumed	110-17-8
furcelleran (see also gums)	—	—	172.655	at GMP levels.	977043-65-4
gellan gum (see also gums)	—	—	172.665	at GMP levels.	71010-52-1
ghatti gum	—	2519	—	Solvents/Carriers/Encapsulating Agents, emulsifier, stabilizer, thickener.	9000-28-6
gibberilic acid and potassium gibberilate	C19H22O6, C19H21KO6 (Potassium)	—	172.725	used in the malting process of barley, <0.5 ppm in final.	77-06-5, 125-67-7 -Potassium
glucono delta lactone	C6H10O6	—	184.1318	curing agent, pickling agent, pH control at GMP levels.	90-80-2
glutamic acid	C5H9NO4	3285	182.1045	Flavors and Flavor Modifier, Nutrient at GMP levels.	56-86-0
glutamic acid hydrochloride	C5H9NO4·HCl	—	182.1047	at GMP levels.	138-15-8

Chart 247 *Continued*

Ingredient	Empirical Formula	FEMA GRAS #	CFR Citation	Use	CAS#
glutamine, or l glutamine	C5H10N2O3	3684	—	Flavors and Flavor Modifiers, Nutrient	200-292-1
glycerin, or glycerol	C3H8O3	2525	182.132	Solvents/Carriers/Encapsulating Agents, Moisture Control Agents at GMP	56-81-5
glycerol esters of wood rosin	—	—	172.735	weighting agent, <100 ppm in final rosin.	1314-13-2
glycero-lacto esters of fatty acids	—	—	172.852	emulsifiers, plasticizers at GMP levels.	—
glyceryl 5-hydroxy decanoate	C13H29O5	3685	—	Emulsifiers	—
glyceryl 5-hydroxy dodecanoate	C15H33O5	3686	—	Emulsifiers	—
glyceryl behenate	—	—	184.1328	excipient in tablets. Glyceryl behenate is a mixture of glyceryl esters of behenic acid made from glycerin and behenic acid (a saturated C22 fatty acid). The mixture contains predominately glyceryl dibehenate	—
glyceryl mono oleate	C21H40O4	2526	184.1323	Surface Tension Control Agents, Emulsifier. flavoring agent, solvent at GMP levels.	25496-72-4
glyceryl mono stearate	C21H42O4	2527	—	Surface Tension Control Agents, Emulsifier.	123-94-4
glyceryl monostearate sometimes mixed with glyceryl mono palmitate	C21H42O4 and C19H38O4	—	184.1324	at GMP levels.	31566-31-1 (Stearate), 26657-96-5 (Palmitate)
glyceryl palitostearate	—	—		excipient in tablets.	—
glyceryl triacetate – See triacetin	—	—	—	—	—
glyceryl tribenzoate or tribenzoin	C3H5N3O9	3398	—	Appearance Control Agents – Other Than Colors	614-33-5
glyceryl tripropionate (tripropionin)	C12H20O6	3286	—	Solvents/Carriers/Encapsulating Agents	139-45-7
glyceryl tristearate	C57H110O6	—	172.811	general catalyst and processing aid.	555-43-1

glycine	CH2NH2 COOH	3287	172.812	masking agent to saccharine bitterness <0.2 ppm in final. Stabilizer in mono and diglycerides <0.02% of m&d, flavor and flavor modifier, nutrient.	5680-79-5 or 56-40-6
glycyrrhizin ammoniated - See Licorice	—	—	—	—	—
guar gum	—	2537	—	Emulsifier, stabilizer, thickener.	9000-30-0
helium	He	—	184.1355	gas agent	7440-59-7
heptyl paraben	C14H20O3	—	172.145	inhibit microbiological spoilage <20 ppm.	1085-12-7
high fructose corn syrup	—	—	182.1866	sweetener at GMP levels.	8029-43-4
histidine, or l histidine	C6H9N3O2	3694	—	Flavors and Flavor Modifiers, Nutrient	71-00-1
hydrochloric acid	HCl	—	182.1057	buffer and neutralizing agent at GMP levels.	7647-01-0
hydrogen peroxide	H2O2	—	184.1366	at GMP levels.	7722-84-1
hydrogenated and partially hydrogenated menhaden oil	—	—	184.1472	edible fat, at GMP levels.	—
hydroxy propyl methyl cellulose	—	—	172.874	emulsifier, film former, protective coating, thickener, suspending agent or stabilizer at GMP levels.	9004-65-3
hydroxylated lecithin	—	—	172.814	used with other ingredients as an emulsifier.	8029-76-3
hydroxypropyl cellulose	—	—	172.870	emulsifier, stabilizer, binder, film former, protective colloid, suspending agent, thickener, at GMP levels.	9004-65-3
inositol	C6H12O6	—	184.1370	nutrient supplement.	87-89-8
insoluble glucose isomerase enzyme preparation	—	—	184.1372	enzyme to convert glucose to fructose in high fructose corn syrup.	—
invert sugar	—	—	184.1859	sweetener.	8013–17–0
iron ammonium citrate	C6H8O7.nFe.nH3N	—	172.430	anticaking agent <25 ppm of salt.	1185-57-5
iron elemental	Fe	—	184.1375	nutrient.	7439-89-6
isoleucine, or dl isoleucine	C6H13NO2	3295	—	Flavors and Flavor Modifiers, Nutrient	75-86-5
Isopropyl alcohol	C3H8O	2929	—	Leavening Agents	67-63-0
isopropyl citrate	C9H14O7	—	184.1386	antioxidant, sequestrant and solvent, at GMP levels.	39413-05-3

Chart 247 *Continued*

Ingredient	Empirical Formula	FEMA GRAS #	CFR Citation	Use	CAS#
karaya gum	—	2605	—	Emulsifier, stabilizer, thickener.	9000-36-6
lactase enzyme preparation	—	—	184.1388	enzyme for consumption for those lactose intolerant, from kluveromyces lactis etc.	—
lactic acid	C3H6O3	—	184.1001	antimicrobial.	50-21-5
lactylic esters of fatty acids	—	—	172.848	emulsifiers, plasticizers, stabilizers at GMP levels.	25383–99-7
lecithin	—	—	184.1400	phospholipid lubricant, film forming agent.	8002-43-5
leucine, or l leucine	C6H13O2N	3297	—	Flavors and Flavor Modifiers, Nutrient	61-90-5
licorice and licorice (monoammoniated glycerrhizinate)	C42H61O16NH45H2O	2528	184.1408	vitamin or mineral supplement and derivatives non-nutritive sweetener, flavorant.	1407-03-0
linoleic acid	C18H32O2	—	184.1065	at GMP levels.	79050-23-0
locust bean gum	—	2648	—	Solvents/Carriers/Encapsulating Agents, emulsifier, stabilizer, thickener.	9000-40-2
magnesium carbonate or magnesium carbonate hydroxide	(MgCO3)4-Mg(OH)2-5H2O	—	184.1425	anticaking agent, lubricant, releasing agent at GMP levels.	39409-82-0
magnesium chloride	MgC12-6H2O	—	184.1426	nutrient at GMP levels.	7786-30-3
magnesium hydroxide	Mg(OH)2	—	184.1428	nutrient at GMP levels.	1309-42-8
magnesium oxide	MgO	—	184.1431	nutrient at GMP levels.	1309-48-4
magnesium phosphate	MgHPO4·3H2O	—	184.1434	nutrient at GMP levels.	7782–0975–094
magnesium silicate	Mg2SiO3	—	182.2437	anticaking agent <2%.	1343-88-0
magnesium stearate	(Mg(C17H34COO)2	—	184.1440	nutrient at GMP levels.	557–04–0
magnesium sulfate	MgSO4·7H2O	—	184.1443	nutrient at GMP levels.	10034–99–8
malic acid	C4H6O5	2655	184.1009	flavor enhancer, acidulant, pH Control Agents – Active as Consumed, chewing gum additive.	6915-15-7
malt syrup, malt extract	—	—	184.1445	flavoring agent and adjuvant at GMP levels.	—
maltodextrin	(C6H10O5)n	—	184.1444	DE less than 20, at GMP levels.	9050–36–6
manganese chloride	MnCl2·4H2O	—	184.1446	nutrient at GMP levels.	7773–01–5

manganese citrate	$Mn3(C6H5O7)2$	—	184.1449	nutrient at GMP levels.	1002–46–65
manganese gluconate	$C12H22MnO14{\cdot}2H2O$	—	184.1452	nutrient at GMP levels.	648–0953–0998
manganese sulfate	$MnSO4{\cdot}H2O$	—	184.1461	nutrient at GMP levels.	7785–0987–097)
mannitol	$C6H14O6$	—	180.250	anticaking agent, free flow agent. <98% in pressed mints. 40% in soft candy. <5% in all other hard candy or cough drops. Must list on label; Excess consumption may have a laxative effect.	69-65-8
Masticatory Substances	—	—	—	Leavening Agents	—
methacrylic divinylbenzene copolymer	—	—	172.775	cross-linking agent (divinyl benzene) is <4% of polymer. Used as a carrier to vitamin B12.	40623-75-4
methionine, or dl methionine	$C_5H_{11}NO_2S$	3306	—	Flavors and Flavor Modifiers, Nutrient	59-51-8 (DL-methionine) 63-68-3 (L-methionine) 348-67-4 (D-methionine)
methyl cellulose	—	2696	—	Stabilizers and Thickeners	9004-67-5
methyl ethyl cellulose	—	—	172.872	aerating, emulsifying and foaming agent at GMP levels.	9004-30-2
methyl glucoside-coconut oil ester	—	—	172.816, 172.3600	crystallization aid for sucrose and dextrose at GMP levels. Molasses surfactant <320 ppm.	8028-43-1
methyl paraben	—	2710	184.1490	antioxidants at GMP levels.	—
methylated silica	—	3185	—	Material Handling Aids	67762-90-7
methylcellulose	—	—	182.148	at GMP levels.	9004-67-5
microparticulated protein	—	—	184.1498	in frozen desserts to replace milk fat product.	—
mixed carbohydrase and enzymes	—	—	184.1027	immobilized enzymes for the protease conversion of proteins or carbohydrates.	—
modified cottonseed products	—	—	172.894	at GMP levels.	977100-17-6 – Modified Cottonseed Flour, 977050-54-6 – Modified Cottonseed Flour Partially Defatted & Cooked, 977043-56-3 – Glandless Raw Cottonseed Kernels, 977043-78-9 – Glandless Kernels Roasted
modified hop extract	—	—	172.560	flavoring agent for beer.	8016-25-9

Chart 247 *Continued*

Ingredient	Empirical Formula	FEMA GRAS #	CFR Citation	Use	CAS#
mono and diglycerides	—	—	184.1505	emulsifier, lubricant, solvent, stabilizer, thickener, release agent at GMP levels.	—
monoammonium glutamate	C5H12N2O4	—	182.150	at GMP levels.	7558-63-6
monoglyceride citrate or Mixture of Glyceryl Monooleate and its citric acid monoester	—	—	172.832	a synergist and stabilizer for antioxidants in fats and oils.	36291-32-4
monopotassium glutamate	C5H8KNO4	—	182.1516	at GMP levels.	19473-49-5
monosodium phosphate derivatives	—	—	184.1521	emulsifier and emulsifier salt at GMP levels of mono and diglycerides.	—
n butane and iso butane	C4H10	—	184.1165	propellant and aerating agent.	106-97-8 and 75-28-5
Name	Empirical Formula	FEMA GRAS#	CFR	Note	CAS #
natamycin	C33H47NO13	—	172.155	antimycotic agent for surface of cheese.	7681-93-8
niacin	C6H5NO2	—	184.1530	nutrient.	59–67–6
niacinamide	C6H6N2O	—	184.1535	nutrient.	98–92–0
nickel	Ni	—	184.1537	used in hydrogenation of oils – catalyst.	7440–02–0
nisin preparation made from fermentations of certain strains of Streptococcus lactis Lancefield Group N	—	—	184.1538	antibiotic.	1414–45–5
nitrogen	N2	—	184.1540	propellant and aerating agent at GMP levels.	7727–37–9
nitrous oxide	N2O,	2779	184.1545	propellant and aerating agent in dairy products.	10024–97–2
nutrients	—	—	182.8013 to 182.8997	minerals and vitamins. See Nutritional Additives.	—
odorless light petroleum hydrocarbons	(CH)n	—	172.884	processing aid oil at GMP levels.	8009-03-8
oil of rue	—	—	184.1699	<0.05% of soups.	8014-29-7
oleic acid from tall oil fatty acids	—	—	172.862	lubricant, binder, defoamer at GMP levels.	61790-12-3

ox bile extract	—	—	184.1560	<0.002% in cheese, surfactant.	8008–63–7
oxystearin	—	—	172.818	crystallization inhibitor in vegetable oils. <0.125% of oil.	8028-45-3
ozone	O3	—	184.1563	antimicrobial in bottled water at GMP levels.	10028–15–6
Pancreatin	—	—	184.1583	enzyme at GMP	8049–47–6
papain	—	—	184.1585	enzyme as processing aid.	9001-73-4
paraffin wax	—	3216	—	Appearance Control Agents – Other Than Colors	8002-74-2
pectin	—	—	184.1588	thickener.	9000–69–5
pepsin	—	—	184.1595	enzyme at GMP	9001–75–6
peptones	—	—	184.1553	a mixture of polypeptides, oligopeptides, and amino acids as nutrient supplements.	—
petrolatum	—	—	172.880	same function as white mineral oil at levels from 0.02% of dry fruits or vegetables to 0.15% of bakery on final use.	8009-03-8
petroleum wax	—	—	172.886	chewing gum, as a defoamer. See 173.340 and 172.230. 0.5% of final product, or <50% of micro capsules.	8002-74-2
PG alginates	C3H8O2-(C6H8O6)n	2941	172.858	emulsifier, thickener, stabilizer or surfactant at level <0.3–<1.7 depending on intended use. Antifoaming Agents, Leavening Agents, Texturizers	9005-37-2
PG mono and diesters of fats	—	—	172.856	at GMP levels fatty acids.	—
phenylalanine, or dl phenyl alanine	$C_9H_{11}NO_2$	3726 (dl), 3585 (l)	—	Flavors and Flavor Modifiers, Nutrient	D-phenylalanine-673-06-3, L-phenylalanine-63-91-2, DL-phenylalanine-150-30-1
phosphoric acid	H3PO4	2900	182.1073	pH Control Agents – Active as Consumed at GMP levels.	7664-38-2
polydextrose	—	—	172.841	water soluble polymer which can be used as a bulking agent and processing aid in many systems.	68424–04–4
polyethylene glycol	H(OCH2CH2)nOH	—	172.820	tableting aid, bodying agent for non-nutritive sweeteners, dispersing aid in mineral preparations. Coating on sodium nitrite for anticaking.	25322-68-3

Chart 247 *Continued*

Ingredient	Empirical Formula	FEMA GRAS #	CFR Citation	Use	CAS#
polyglycerol esters of fatty acids	—	—	172.854	emulsifiers and cloud inhibitors at GMP levels.	—
polysorbate 20	(CH2CH2O)20	2915	—	Emulsifiers	9005-64-5
polysorbate 60	(CH2CH2O)60	2916	172.836, or	in whipped topping <0.27 of topping,appearance Control Agents – Other Than Colors, emulsifier	9005-67-8
polysorbate 65	(CH2CH2O)65	—	172.838, or	or as an emulsifier <0.5% of confection	9005-71-4
polysorbate 80	(CH2CH2O)80	2917	172.840, or	Using cocoa products, or <0.46% of icing or appearance Control Agents – Other Than Colors, emulsifier.	9005-65-6
potassium 2(1-ethoxy) ethoxy propionate	C7H10O4K	3752	—	antimicrobial agents	—
potassium alginate	K(C6H8O6)n	—	184.1610	thickener.	9005–36–1
potassium bicarbonate	KHCO3	—	184.1613	pH control, nutrient at GMP levels.	298–14–6
potassium bisulfite	KH2SO3	—	182.3616	exceptions are not to be used in meats, sources of vitamin B1, on fruits and vegetables, or to be presented to consumers as fresh.	7773-03-7
potassium bromate	KBrO3	—	172.730	used in the malting process of barley, <25 ppm bromide.	77587-01-2
potassium carbonate	KCO3	—	184.1619	pH control, nutrient at GMP levels.	584–08–7
potassium chloride	KCl	—	184.1622	pH control, nutrient at GMP levels.	7447–40–7
potassium citrate	C6H5K3O7·H2O	—	184.1625	pH control, nutrient at GMP levels.	6100–0905–096
potassium hydroxide	KOH	—	184.1631	pH control, nutrient at GMP levels.	1310–58–3
potassium iodate	KIO3	—	184.1635	pH control, nutrient at GMP levels.	7758–05–6
potassium iodide	KI	—	184.1634	pH control, nutrient at GMP levels.	7681–11–0
potassium lactate	C3H5O3K	—	184.1639	pH control, nutrient at GMP levels.	996–31–6
potassium metabisulfite	K2S2O5	—	182.3637	exceptions are not to be used in meats, sources of vitamin B1, on fruits and vegetables, or to be presented to consumers as fresh.	16731-55-8
potassium nitrate	KNO3	—	172.160	curing agent in cod roe at <200 ppm of roe.	7757-79-1

potassium sorbate	C6H7O2K	—	182.3640	at GMP levels.	590-00-1
potassium sulfate	K2SO4	—	184.1643	pH control, nutrient at GMP levels.	7778–80–5
propane	C3H8	—	184.1655	propellant and aerating agent at GMP levels.	74–98–6
Propellants	—	—	—	Leavening Agents	—
propionic acid	C3H6O2	—	184.1081	microbial agent.	79-09-4
propyl alcohol	C3H7OH	2929	—	Flavors and Flavor Modifiers	71-23-8
propyl gallate	C10H12O5	2947	184.1660	antioxidant.	121-79-9
propyl para hydroxy benzoate	C10H12O3	2951	—	antioxidants	94-13-3
propyl paraben or propyl p-hydroxybenzoate	C10H12O3	—	184.1670	antimicrobial agent at GMP levels.	94-13-3
propylene glycol	C3H8O2	2940	184.1666	solvent, antioxidant, anticaking agent, thickener, surfactant, texturizer, encapsulating agent at GMP levels.	57–55–6
propylene glycol alginate	C3H8O2-(C6H8O6)n	2941	—	Antifoaming Agents, Leavening Agents, Texturizers	9005-37-2
propylene glycol dibenzoate	C20H22O5	3419	—	Appearance Control Agents – Other Than Colors	27138-31-4
propylene glycol stearate	C21H42O3	2942	—	Leavening Agents, Texturizer	1323-39-3
pyridoxine hydrochloride	C8H11NO3·HCl	—	184.1676	nutrient supplement at GMP levels	58–56–0
quaternary ammonium chloride combinations	—	—	172.165	antimicrobial action at <0.25 to 12ppm depending on use. The additive contains the following compounds: n-dodecyl dimethyl benzyl ammonium chloride (CAS Reg. No. 139-07-1); n-dodecyl dimethyl ethylbenzyl ammonium chloride (CAS Reg. No. 27479-28-3); n-hexadecyl dimethyl benzyl ammonium chloride (CAS Reg. No. 122-18-9); n-octadecyl dimethyl benzyl ammonium chloride (CAS Reg. No. 122-19-0); n-tetradecyl dimethyl benzyl ammonium chloride (CAS Reg. No. 139-08-2); n-tetradecyl dimethyl ethylbenzyl ammonium chloride (CAS Reg. No. 27479-29-4).	See Note

Chart 247 *Continued*

Ingredient	Empirical Formula	FEMA GRAS #	CFR Citation	Use	CAS#
quillaia	—	2973	—	Appearance Control Agents – Other Than Colors	
quinine as hydrochloride or sulfate salt	Base: C20H24N2O2 Hydrochloride: C20H24N2O2 ·HCl· 2H2O Sulfate: (C20H24N2O2)2H2SO4.2H2O	—	172.575	<83 ppm as quinine.	Base:130-95-0 (anhydrous), Quinine bisulphate: 549-56-4, Quinine dihydrochloride: 60-93-5, Quinine ethyl carbonate: 83-75-0, Quinine hydrobromide: 549-49-5, Quinine hydrochloride: 130-89-2 (anhydrous), Quinine hydrochloride: 6119-47-7 (dihydrate), Quinine sulphate: 804-63-7 (anhydrous), Quinine sulphate: 6119-70-6 (dihydrate)
rapeseed oil	—	—	184.1555	low uricic acid (canola oil) edible fat and oil.	—
red algae	—	—	184.1121	thickener.	9002-18-0
reduced lactose whey	—	—	184.1979a	at GMP levels.	—
reduced minerals whey	—	—	184.1979b	at GMP levels.	—
rennet (animal derived) or Chymosin	—	—	184.1685	coagulating agent for cheese and chymosin (fermentation) derived.	9001–98–3
rhamnose, or l rhamnose	C6H12O5	3730	—	Flavors and Flavor Modifiers, Nutrient	10485-94-6
riboflavin	C17H20N4O6	—	184.1695	nutrient at GMP levels.	83–88–5
riboflavin 5′ phosphate sodium	C17H20N4O9PNa·2H2O	—	184.1697	nutrient at GMP levels.	130–40–5
ribose, or d ribose	C5H10O5	3793	—	Flavors and Flavor Modifiers, Nutrient	50-69-1
rice bran wax	—	—	172.890	candy coating <50 ppm, chewing gum plasticizer <2 ½.	557-61-9
rue	—	—	184.1698	<4 to <10ppm according to usage.	8014-29-7

saccharin, ammonium	C7H8N2SO3Na	—	180.370	beverages <12 mg/ounce, sugar calcium, and sodium. substitute <20mg/teaspoon, in processed foods <30 mg/serving.	81-07-2
saccharine sodium salt	—	2997	—	Sweeteners – Nutritive and Non-nutritive	
saffron	—	2298	—	Appearance Control Agents – Colors and Color Modifiers, flavor and flavor modifier.	
saffron extract	—	2299	—	Appearance Control Agents – Colors and Color Modifiers, flavor and flavor modifier.	
safrole free extract of sassafras	—	—	172.580	used as a flavoring.	68917-09-9
salts of carrageenan (see also gums)	—	—	172.626	at GMP levels.	64366-24-1 – Potassium, 9061-82-9 – Sodium, 9049-05-2 – Calcium, 60063-90-3 Ammonium, 977043-69-8 – General CAS
salts of fatty acids	CnH(2n+1)COOX	—	172.863	binder, emulsifier, anticaking agent at GMP levels.	—
salts of furcelleran (see also gums)	—	—	172.660	at GMP levels.	977089-77-2 – Ammonium, 977089-78-3 – Calcium, 977089-79-4 – Potassium, 977089-80-7 – Sodium
sequestrants	—	—	182.6085 to 182.681	See Sequestrants.	—
Sheanut Oil	—	—	184.1702	as a coating at GMP	977159-94-6
silica aerogel, or silica gel	—	—	182.1711	antifoaming agent at GMP levels.	63231-67-4
silicon dioxide	SiO2	—	172.480	anticaking agent <2% of food.	14808-60-0
sodium 2(4-methoxy phenoxy) propionate	C11H10O4Na	3773	—	antimicrobial agents	
sodium acetate	C2H3O2Na, C2H3O2Na·3H2O (Hydrate)	3024	184.1721	flavoring agent, adjuvant, pH Control Agents – Active as Consumed at GMP	127–09–3, 6131–90–4 (Hydrate)
sodium acid pyrophosphate	Na2H2P2O7	—	182.1087	at GMP levels.	1314-13-2
sodium alginate	(C6H8O6)nNa	—	184.1724	thickener.	9005–38–3
sodium aluminum phosphate	Na2AlPO4·12H2O	—	182.1781	at GMP levels.	7785-88-8
sodium aluminum silicate or sodium silico aluminate	Na2OAl2O36SiO2	—	182.2727	anticaking agent <2%.	1344-00-9

Chart 247 *Continued*

Ingredient	Empirical Formula	FEMA GRAS #	CFR Citation	Use	CAS#
sodium ascorbate	C6H9O7Na	—	182.3771	at GMP levels.	134-03-2
sodium benzoate	C7H5NaO2	3025	184.1733	antimicrobial agent <0.1% of final.	532-32-1
sodium bicarbonate	$NaHCO_3$	—	184.1736	pH control, leavening agent, at GMP levels.	144-55-8
sodium bisulfite	NaHSO3	—	182.3739	exceptions are not to be used in meats, sources of vitamin B1, on fruits and vegetables, or to be presented to consumers as fresh.	7631-90-5
sodium calcium aluminosilicate hydrated or Zeolite ®	(NaCa)=12[-(AlO2)(SiO2)]12H2O	—	182.2799	anticaking agent <2%.	1344-01-0
sodium carbonate	Na_2CO_3	—	184.1742	pH control, leavening agent, at GMP levels.	497-19-8
sodium carboxymethyl cellulose	—	—	182.1745	at GMP levels.	9004-32-4
sodium caseinate	—	—	182.1748	at GMP levels.	9005-46-3
sodium citrate	Na3C6H5O7	3026	184.1751	Material Handling Aid, GMP levels.	018996-35-5
sodium diacetate	C4H7O4Na·xH2O	—	184.1754	<0.05 for snacks to 0.4% in baked goods dependent on use.	126–96–5
sodium hexa meta phosphate	H5P6O18nA	3027	—	Appearance Control Agents – Other Than Colors, Sequestrants	10124-56-8
Sodium hydroxide	NaOH	—	184.1763	pH Adjuster at GMP	1310–73–2
sodium hypophosphate	NaH2PO2	—	184.1764	emulsifier or stabilizer at GMP levels.	7681–53–0
sodium lactate	C3H5O3Na	—	184.1768	emulsifier, enhancer, pH control agent at GMP levels.	72–17–3
sodium lauryl sulfate	CH3(CH2)11SO3Na	—	172.822	whipping agent <0.5% of gelatin in marshmallows, surfactant in fumaric acid based dry beverage drinks, <25ppm finished. Wetting agent <10ppm in oils.	151-23-3
sodium metabisulfite	Na2S2O5	—	182.3766	exceptions are not to be used in meats, sources of vitamin B1, on fruits and vegetables, or to be presented to consumers as fresh.	7681-57-4

sodium metasilicate	anhydrous-(Na_2SiO_3), pentahydrate-($Na_2SiO_3 \cdot 5H_2O$), nonahydrate-($Na_2SiO_3 \cdot 9H_2O$).	—	184.1769a	as a surface cleaning and abrading agent, at GMP levels.	6834–92–0
sodium mono & dimethyl naphthalene sulfonates	—	—	172.824	crystallization of sodium carbonate naphthalene sulfonates <250ppm of Na_2CO_3. Anticaking in sodium nitrite <0.1% meat. To aid in washing or peeling of fruits or vegetables.	977052-10-0
sodium nitrate	$NaNO_3$	—	172.170	often used with sodium nitrite as a color fixative and preservative in meat at <500 ppm and nitrite at <200 ppm in the finished meat.	7631-99-4
sodium nitrite, sodium nitrite used in processing smoked chub	$NaNO_2$	—	172.175, 172.177	see 172.170, to inhibit growth of clostridium botulinum type E in smoked chub.	7632-00-0
sodium phosphate	$Na_3PO_4 \cdot 12H_2O$	—	182.1778	at GMP levels.	10101-89-0
sodium potassium tartrate	$C_4H_4KNaO_6 \cdot 4H_2O$	—	184.1804	emulsifier at GMP levels.	304–59–6
sodium propionate	$C_3H_5NaO_2$	—	184.1784	antimicrobial agent at GMP levels.	137–40–6
Sodium sesquicarbonate	$Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O$	—	184.1792	pH control at GMP	533–96–0
sodium sorbate	$C_6H_7NaO_2$	—	182.3795	at GMP levels.	7757-81-5
sodium stearoyl fumarate	$C_{22}H_{39}NaO_4$	—	172.826	dough conditioner <0.25% of flour. Conditioner of dehydrated potatoes <0.5%. Stabilizer in non-yeast leavened products. <1% of flour. As Conditioner in cereals <1% of dry cereal. Conditioner in starch or flour thickened foods.	977052-10-0 or 4070-80-8
sodium steroyl lactylate	$C_{24}H_{44}O_6Na$	—	172.846	dough strengthener <0.5% of flour, surfactant <0.2% of final, emulsifier, stabilizer, <0.3% of final emulsion, in Potatoes <0.5%, snack dips <0.2%, cheese substitutes <0.2%, sauces and gravies <0.25%.	25383–99-7
sodium sulfite	$NaHSO_3$	—	182.3798	exceptions are not to be used in meats, sources of vitamin B1, on fruits and vegetables, or to be presented to consumers as fresh.	7757-83-7

Chart 247 *Continued*

Ingredient	Empirical Formula	FEMA GRAS #	CFR Citation	Use	CAS#
sodium tartrate	C4H4Na2O6·2H2O	—	184.1801	emulsifier at GMP levels.	868–18–8
sodium thiosulfate	Na2S2O3·5H2O	—	184.1807	<0.00005% in alcoholic beverages, <0.1% in salt reducing agent.	10102–917–97
sodium tripolyphosphate	Na5P3O10	—	182.1810	at GMP levels.	7758-29-4
sorbic acid	C6H8O2	—	182.3089	preservatives	110-44-1
sorbitan monostearate	—	3028	172. 842	cake filling, or <0.2% of sugar coating, or <4.5% as a foaming agent, or <0.5% of flour as dough conditioner, or <4.5% of powdered soft drink mix, or <0.5% of pudding mix, or <3.6% of gelatin mix, or <0.05% of chocolate syrup, emulsifier.	1338-41-6
sorbitol	C6H14O6	3029	184.1835	anticaking agent, free flow agent. <75% in chewing gums, <98% in soft candy, <99% in all other hard candy or cough drops, <30% in jams and jellies. Must list on label: Excess consumption may have a laxative effect. Sweeteners – Nutritive and Non-nutritive	50-70-4
stabilizers-chondrus extract	—	—	182.7255	at GMP levels.	000000-10-2
stannous chloride	SnCl2	—	184.1845	antioxidant <0.0015%.	7772–99–8
stannous chloride dihydrate	SnCl2-2H2O	—	172.180	color retention in glass packed asparagus. <20 ppm as tin.	7772-99-8
starter distillate	—	—	184.1848	flavoring at GMP levels.	50–99–7
stearic acid	C18H36O2	—	184.1090	at GMP levels.	57-11-4
stearyl citrate	C24H44O7	—	184.1851	emulsifier, antioxidant, sequestrant at GMP levels.	1337-33-3
stearyl monoglyceridyl citrate	—	—	172.755	emulsion stabilizer for emulsified shortenings.	55840-13-6
succinic acid	C4H604	—	184.1091	flavor enhancer, 0.084% in relish.	110-15-6
succistearin (stearoyl propylene glycol hydrogen succinate)	—	—	172.765	emulsion stabilizer in variety of baked goods.	27216-62-2

succynilated monoglycerides	—	—	172.830	emulsifier in shortenings <3% & dough conditioner in breads. <0.5% of flour.	977009-45-2
sucrose	C12H22O11	—	184.1854	sweetener.	57–50–11–1
sucrose fatty acid esters	—	—	172.859	texturizers in biscuit mixes and protective coatings on fruits and vegetables.	42922-74-7 (monoctanoate), 58064-47-4 (Dooctanoate)
sugar beet extract flavor base	—	—	172.585	used as a flavoring.	8016-79-3
sulfur dioxide	SO2	3039	182.3862	exceptions are not to be used in meats, sources of vitamin B1, on fruits and vegetables, or to be presented to consumers as fresh. Color Control Agents, Sanitizing, Fumigating Agent.	7446-09-5
sulfuric acid	H2SO4	—	184.1095	pH control agent.	7664-93-9
synthetic fatty alcohols	CnH(2n+1)COH	—	172.864	as replacers of natural fatty alcohols at GMP levels.	See Separate Lisintgs Under Alcohols
synthetic glycerine by hydrogenolysis of carbohydrates	C3H3O3	—	172.866	at GMP levels.	56-81-5
synthetic isoparafinnic petroleum hydrocarbons (Yellow Petrolatum)	(CH)n	—	172.882	processing aid oil at GMP levels.	8009-03-8
synthetic petroleum wax	—	—	172.888	similar to 172.886.	8002-74-2
tannic acid	C76H52O46	—	184.1097	used as a flavoring.	1401-55-4
tartaric acid	C4H606	3044	184.1099	acidulant, pH Control Agents – Active as Consumed, Clarifying/Flocculating Agents	526-83-0
TBHQ or Tert Butyl Hydroxy Quinone	$(CH_3)_3CC_6H_3(OH)_2$	—	172.185	used alone or in combination with BHA or BHT <0.02% of oil.	1948-33-0
thaumatin	—	3732	—	Sweeteners – Nutritive and Non-nutritive	53850-34-3
THBP trihydoxy butyro phenone	C10H12O4	—	172.190	antioxidants alone or in combination with other antioxidants, the total antioxidant content of a food containing the additive will not exceed 0.02 percent of the oil or fat content of the food, including the essential (volatile) oil content of the food.	1421-63-2

Chart 247 *Continued*

Ingredient	Empirical Formula	FEMA GRAS #	CFR Citation	Use	CAS#
thiamine hydrochloride	C12H17C1N4OS·HCl	3322	184.1875	nutrient, flavor and flavor modifier	67–03–8
thiamine mononitrate	C12H17N5O4S	—	184.1878	nutrient.	532–43–4
thiodipropionic acid	S(CH2CH2CO2H)2	—	182.3109	preservatives	111-17-1
tocopherols	—	—	182.3890	at GMP levels.	1406-66-2
tragacanth gum	—	3079	—	Emulsifiers, thickining agents	9000-65-1
triacetin or glyceryl triacetate	C8 H14O6	2007	184.1901	humectant, solvent at GMP levels.	102–76–1
tributyl acetyl citrate	C13H23O6	3080	—	Solvents/Carriers/Encapsulating Agents	77-90-7
tributyrin or glyceryl tributyrate	C15H26O6	—	184.1903	humectant, solvent at GMP levels.	60–01–5
tricalcium phosphate	Ca3(PO4)2	3081	—	Material Handling Aids	7758-87-4
tricalcium silicate	Ca_3SiO_5	—	182.2906	anticaking agent <2%.	12168-85-3
triethyl citrate	C12H20O7	3083	184.1911	humectant, solvent at GMP levels. Solvents/Carriers/Encapsulating Agents, Flavor Modifier, Sequestrant.	77–93–0
trypsin	—	—	184.1914	enzymer prep from bovine pancreas used at GMP	9002–07–7
turmeric	—	3085	—	Appearance Control Agents – Colors and Color Modifiers, Flavors and Flavor Modifiers	—
turmeric extract	—	3086	—	Appearance Control Agents – Colors and Color Modifiers, Flavors and Flavor Modifiers	458-37-7
turmeric oleoresin	—	3087	—	Appearance Control Agents – Colors and Color Modifiers, Flavors and Flavor Modifiers	8024-37-1
tyrosine, or l tyrosine	C9H11NO3	3736	—	Flavors and Flavor Modifiers, Nutrient	60-18-4
urea	CO(NH2)2	—	184.1923	formula aid, fermentation aid at GMP levels.	57–13–6
urease enzyme preparation	—	—	184.1924	enzyme to convert urea to ammonia from lactobacillus. fermentation and carbon dioxide.	9002–13–5

valine, or dl valine	C5H11NO2	3444	—	Flavors and Flavor Modifiers, Nutrient	72-18-4
vitamin A or retinol or 9,13-dimethyl-7-(1,1,5-trimethyl-6-cyclohexen-5-yl)-7,9,11,13-nonatetraen-15-ol	C20H30O, C22H32O2 (acetate), C36H46O2 (palmitate)	—	184.1930	nutrient.	68–26–8, Vitamin A acetate (retinyl acetate; CAS Reg. No. 127–47–9, Vitamin A palmitate (retinyl palmitate); CAS Reg. No. 79–81–2)
vitamin B12	C63H88CoN14O14P	—	184.1945	nutrient.	68–0919–099
vitamin D	C28H44O (D2), C27H44O (D3)	—	184.1950	nutrient.	50–14–6 (D2), 67–97–0 (D3)
wheat gluten	—	—	184.1322	nutrient.	8002-80-0
whey	—	—	184.1979	at GMP levels.	—
whey protein concentrate	—	—	184.1979c	at GMP levels.	—
white mineral oil	—	—	172.878	defoamer, release agent, lubricant, and other uses at levels from 0.095% of meat to 0.6% of a capsule depending on final use.	8012-95-1
xanthan gum (see also gums)	—	—	172.695	at GMP levels.	11138-66-2
xylose, or d xylose	C5H10O5	3606	—	Sweeteners – Nutritive and Non-nutritive	58-86-6 (D), 609-06-3 (L), 41247-05-6 (DL)
yeast-malt sprout extract	—	—	172.590	used as a flavoring.	—
yellow prussate of soda	$Na_4Fe(CN)_6 \cdot 10(H_2O)$	—	172.490	anticaking agent <13 ppm in salt.	13601-19-9
yucca tree, Joshua	—	3120	—	Appearance Control Agents – Other Than Colors	—
yucca tree, mohave extract	—	3121	—	Appearance Control Agents – Other Than Colors	90147-57-2
zein	—	—	184.1984	a component of corn gluten, surface finishing agent at GMP levels.	—

Chart 248 Nucleic Acids and Related Compounds

Compound	Empirical Formula	FEMA GRAS #	CFR	CAS#
Adenine	C5H5N5	Not GRAS	—	73-24-5
Adenosine	C10H13N5O4	4224	—	58-61-7
Adenosine 5′ Monophosphoric Acid	C10H14N5O7P	Not GRAS	—	61-19-8
Guanine (2 Amino 6 hydroxy 2H purine)	C5H5N5O	Not GRAS	—	73-40-5
Disodium guanosine 5′ monophosphate	C10H21N5Na2O8P	3668	—	5550-12-9
Hypoxanthine	C5H4N4O	Not GRAS	—	68-94-0
Inosine	C10H12N4O5	Not GRAS	—	53-63-9
Disodium Inosine 5′ monophosphate	C10H11N4Na2O8P	3669	—	4691-65-0

Chart 249 Nutrient Claims

Claim	Necessary Change
less/reduced	at least 25% less.
more	at least 10% more.
light/lite	at least 50% reduction. (foods 50% or greater calories from fat)
light/lite	at least 33 1/3% reduction. (foods 50% or less calories from fat)
high	at least 20% more RDI or DRV.
good source of	10–19% of RDI or DRV.
Free	
calories	<5 calories.
sugar	<0.5 gram.
sodium	<5 mg.
fat	<0.5 gram.
cholesterol	<2 mg and 13 gram total fat, with 2 g saturated fat.
gluten	<20 ppm gluten
Low	
calories	40 calories.
sodium	140 mg.
fat	3 gram.
cholesterol	20 mg with 2 gram saturated fat.
saturated fat	1 gram with 15% of total calories.

Chart 250 Nutritional Additives

Nutrient Additive	Empirical Formula	FEMA GRAS #	CFR	Enrichment	CAS #
aluminum nicotinate	Al(C6H4NO2)	—	172.310	Vitamin B3 – nicotinamide (Niacin)	1976-28-9
amino acids	—	—	172.320	amino acids = One or more of: L-Alanine, L-Arginine, L-Asparagine, L-Aspartic acid, L-Cysteine, L-Cystine, L-Glutamic acid, L-Glutamine, Aminoacetic acid (glycine), L-Histidine, L-Isoleucine, L-Leucine, L-Lysine, L-Methionine (not for infant foods), L-Methionine, L-Phenylalanine, L-Proline, L-Serine, L-Threonine, L-Tryptophan, L-Tyrosine, L-Valine.	See Section on Individual Amino Acids
ascorbic acid	C6H8O6	2109	182.5013, 182.8013	Vitamin C	50-81-7
baker's yeast protein	—	—	172.325	protein	—
calcium pantothenate / calcium chloride double salt	—	—	172.330	calcium	**6363-38-8**
Calcium Salts	—	—	182.5191, or calcium citrate 182.5195, or calcium glycerophosphate 182.5201, or calcium oxide 182.5210, or calcium phosphate 182.5217, 182.8217, or calcium pyrophosphate 182.5223, 182.8233 calcium pantothenate (calcium and pantothenic acid)	Calcium	—
carotene	C40H56	—	182.5245	Vitamin A	7235-40-7
Choline Salts	—	—	choline bitartrate 182.5250, 182.8250, choline chloride 182.5252, 182.8252	Choline	—
copper gluconate	Cu(C6H11O7)2	—	182.5260	Copper	527-09-3
d pantothenyl alcohol	C9H19NO4	—	182.5580	Vitamin B5 Alcohol	137-08-6
d-pantothenamide	C9H17NO5	—	172.335	Vitamin B5 – pantothenic acid	137-08-6

Chart 250 *Continued*

Nutrient Additive	Empirical Formula	FEMA GRAS #	CFR	Enrichment	CAS #
ferric salts	—	—	ferric phosphate 182.5301 or, ferric pyrophosphate 182.5304 or, ferric sodium pyrophosphate 182.5306 or, ferrous gluconate 182.5308 or, ferrous lactate 182.5311, or ferrous sulfate 182.5315	Iron	—
folic acid (folacin)		—	172.435	Vitamin B9 – folic acid	59-30-3
fumaric acid and salts of fumaric acid	—	—	172.350	Iron as Ferrous Fumarate	—
inositol	C6H12O6	—	182.5370	B Complex (But not considered a vitamin because it can be produced by the body itself).	87-89-8
iron choline citrate complex or iron (III) choline citrate or ferrocholinate	C11H24FeNO11	—	172.370	Iron	1336-80-7
iron reduced	Fe	—	182.5375	Iron	7439-89-6
kelp	—	2606	172.365, 184.1120	Iodine	92128-82-0
linoleic acid	C18H32O2	—	106.25, 106.30, 107.10, 107.100, 175.100, 181.5065, 182.5065, 184.1065, 573.640, 582.5065	Linoleic Acid (Essential Fatty Acid)	2420-56-6
Magnesium Salts	—	—	magnesium oxide 182.5431, or magnesium phosphate 182.5434, or magnesium sulfate 182.5443 (magnesium)	Magnesium	—
Manganese Salts	—	—	manganese chloride 182.5446, or manganese citrate 182.5449, or manganese gluconate 182.5452, or manganese glycerophosphate 182.5455, or manganese hypophosphate 182.8458, or manganese sulfate 182.5461, or manganous oxide 182.5464	Manganese	—
n acetyl l methionine	C7H13NO3S	—	172.372	Methionine	65–82–7
Niacin, Nicotinic Acid, Vitamin B 3	C6H5NO2	—	niacin 182.5530, or niacinamide 182.5535	Niacin – Vitamin B3	59-67-6
nicotinamide-ascorbic acid complex	—	—	172.315	Vitamin C – ascorbic acid and Vitamin B3 – nicotinamide (Niacin)	—
potassium iodide	KI	—	172.375	Iodine	7681-11-0

Potassium Salts	—	—	potassium chloride 182.5622 (potassium), potassium glycerophosphate 182.5628, (potassium) pyroxidine hydrochloride 182.5676	Potassium	—
Riboflavin and Salts	—	—	riboflavin 182.5695, riboflavin 5 phosphate 182.5697	Riboflavin – Vitamin B2	—
sodium pantothenate	C9H16NO5Na	—	182.5772	Sodium Vitamin B5	867-81-2
Sodium Salts	—	—	sodium phosphate 182.5778, 182.8778, 182.6778, 182.8778, 582.1778, 582.5778, 582.6778	Sodium	—
Thiamine	$C_{12}H_{17}N_4OS$	—	thiamine hydrochloride 3322/ CFR182.5875, 184.5875, 582.5875 (vitamin B1), thiamine hydrochloride and/ CFR182.5878, 184.1878, 582.5878 thiamine mononitrate	Vitamin B1	59-43-8
Tocopherols or 3,4-Dihydro-2,5,7, 8-tetramethyl-2-(4,8, 12-trimethyltridecyl)- 2H-1-benzopyran-6-ol or 5,7,8-Trimethyltocol	C27H46O2	—	tocopherols 182.5890, 182.8890, (vitamin E), alpha tocopherol acetate 182.5892, 182.8892 (vitamin E)	Vitamin E	1406-66-2
Vitamin A and Salts	—	—	vitamin A 182.5930, or vitamin A acetate 182.5923, or vitamin A palmitate 182.5936 (vitamin A)	Vitmain A	—
vitamin B12 or Cyanocobalamin	C63H88CoN14O14P	—	182.5945	vitamin B12	68-19-9
vitamin D2 or Ergocalciferol	C28H44O	—	182.5950	vitamin D2	50-14-6
vitamin D3 or Cholecalciferol	C27H44O	—	182.5953	vitamin D3	67-97-0
whole fish protein concentrate	—	—	172.385	protein	—
xylitol	C5H12O5	—	172.395	Non Nutrient Sweetener	87-99-0
zinc methionine sulfate		—	172.399	Zinc, Methionine	56329-42-1
Zinc Salts	—	—	zinc chloride 182.5985, 182.8985, or zinc gluconate 182.5988, 182.8988, or zinc oxide 182.5991, 182.8991, or zinc stearate 182.5994, 182.8994, or zinc sulfate 182.5997, 182.8997 (zinc). See Vitamins, Minerals.	Zinc	—

Chart 251 Nutritional Requirements - Minimum Daily Require

Nutrient	Requirement
Vitamin A	5000 International Units (IU)
Vitamin C (Ascorbic Acid)	60 mg
Calcium	1,000 mg
Iron	18 mg
Vitamin D	400 IU
Vitamin E	30 IU
Vitamin K	80 micrograms
Thiamine (Vitamin B1)	1.5 mg
Riboflavin (Vitamin B2)	1.7 mg
Niacin	20 mg
Vitamin B6	2.0 mg
Folate (Folic Acid or Folacin)	400 micrograms
Vitamin B12	6 micrograms
Biotin	300 micrograms
Pantothenic Acid	10 mg
Phosphorous	1,000 mg
Iodine	150 micrograms
Magnesium	400 mg
Zinc	15 mg
Selenium	70 micrograms
Copper	2.0 mg
Manganese	2.0 mg
Chromium	120 micrograms
Molybdenum	75 micrograms
Chloride	3,400 mg
Fat (Including Saturated Fatty Acids (20g), Cholesterol (300 mg))	65 g
Total Carbohydrates (Including Fiber)	300 g
Sodium	2400 mg
Potassium	3500 mg
Protein	50 g

Note: Calories can also be designated as energy. Vitamin A present as beta carotene can be designated voluntarily. CFR21 101.9.

Chart 252 Oleoresins

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Allspice Oleoresin (Pimenta Officinalis Lindl.)	2019	—	—	8006-77-7	Spice
Balsam Fir Oleoresin (Abies Balsamea (L.) Mill.)	2115	—	—	8012-28-1	
Basil Oleoresin (Ocimum Basilicum L.)	2120	—	—	8015-73-4	Spice
Bay Leaves, W. Indian, Oleoresin (Laurus Nobilis)	—	101.22	6178	—	Spice
Bay Leaves, West Indian, Oleoresin (Pimenta Acris Kostel)	2123	—	—	99999-20-0	Spice
Bay Oleoresin	—	101.22	6574	—	Spice
Capsicum Oleoresin (Capsicum Spp.)	2234	—	—	8023-77-6	Heat
Cardamom Oleoresin	—	101.22	6366	8000-66-6	Spice
Carrot Oleoresin	—	101.22	6575	—	Spice
Cassia Oleoresin	—	101.22	6576	—	Spice
Celery Seed, Oleoresin	—	101.22	6422	8015-90-5	Spice
Chili Oleoresin	—	101.22	6340	—	Spice
Cinnamon Oleoresin	—	101.22	6425	—	Spice
Clove Bud Oleoresin (Eugenia Spp.)	2324	—	—	8000-34-8	Spice
Clove Stem Oleoresin	—	101.22	6309	—	Spice
Cumin, Oleoresin	—	101.22	6571	—	Spice
Fenugreek Oleoresin (Trigonella Foenumgraecum L.)	2486	—	—	68990-15-8	Brown
Garlic Oleoresin	—	101.22	6566	—	Spice
Ginger Oleoresin (Zingiber Officinale Rosc.)	2523	—	—	8007-8-7	Spice
Jambu Oleoresin	3783	—	—	90131-24-1	Fruity
Labdanum Oleoresin (Cistus Spp.)	2610	—	—	8016-26-0	Resinous
Mace Oleoresin (Myristica Fragrans Houtt.)	2654	—	—	8007-12-3	Spice
Marjoram Oleoresin (Marjorana Hortensis Moench-origanum Majorana L.)	2659	—	—	8015-1-8	Spice
Molle Oleoresin	—	101.22	6583	—	Brown
Mustard Seed Oleoresin	—	101.22	6681	—	Spice
Nutmeg Oleoresin (Myristica Fragrans Houtt)	—	101.22	6365	8007-12-3	Spice
Oak Bark Oleoresin	—	101.22	6660	—	Woody
Onion Oleoresin	—	101.22	6567	—	Spicy
Oregano Oleoresin	—	101.22	6539	—	Spice
Paprika Oleoresin (Capsicum Annuum L.)	2834	—	—	84625-29-6	Spice
Parsley Oleoresin	2837	—	—	84012-33-9	Spice
Pepper, Black, Oleoresin (Piper Nigrum L.)	2846	—	—	84929-41-9	Spice
Pepper, Red, Oleoresin	—	101.22	6707	—	Spice
Pepper, White, Oleoresin (Piper Nigrum L.)	2852	—	—	84929-41-9	Spice
Pimento Oleoresin	—	101.22	6592	—	Spice
Rosemary, Oleoresin	—	101.22	6388	—	Spice
Sage Oleoresin (Salvia Officinalis L.)	3002	—	—	8022-56-8	Spice
Savory, Summer, Oleoresin (Satureja Hortensis L.)	3014	—	—	8016-68-0	Spice
Savory, Winter, Oleoresin (Satureja Montana L.)	3017	—	—	90106-57-3	Spice
Thyme, Oleoresin	—	101.22	6389	—	Spice
Turmeric Oleoresin (Curcuma Longa L.)	3087	—	—	8024-37-1	Color
Vanilla Oleoresin (Vanilla Spp.)	3106	—	—	84650-63-5	Vanilla

Chart 253 Pathogenic Organisms

Organism	Food Product	Source	Prevention of Disease
Bacteria and Viruses			
Bacillus cereus	meat products, soups	from soil or dust,sauces or vegetables,cooked rice or pasta	thorough heating & rapid cooling of foods
Clostridium botulinum toxin	vegetables, fruits, meats, fish, poultry,condiments	honey, soil, improperly canned items - Anaerobic conditions	do not feed honey to infants, do not eat from swollen off-odor cans
Clostridium perfringens	meat and poultry	soil, raw foods	thorough heating & rapid cooling of foods
Campylobacter jejuni	chicken, raw fish	infected animals	cook chicken, fish and any poultry thoroughly, pasteurize milk products.
Vibrio cholerae	raw or undercooked seafood	marine fecal contamination	cook seafood thoroughly, employ good seafood sanitation practices.
Vibrio parahaemolyticus	fish and seafood	marine contamination	cook fish & seafood thoroughly.
Vibrio vulnificus	raw oysters and clams	marine contamination	cook shellfish thoroughly.
Escherichia coli	raw or undercooked, E. coli 0157:H7 especially harmful. Has caused fatal outbreaks	fecal contamination foods, including meat, milk	cook foods thoroughly, pasteurize milk.
Listeria monocytogenes	raw milk, cheese & vegetables	soil, infected animals, animal manure	pasteurize milk, cook foods thoroughly.
Salmonella sp.	raw or undercooked milk, eggs, meat or poultry.	infected livestock, human feces	cook eggs, poultry & meat thoroughly, pasteurize milk.
Shigella sp.	raw foods	human fecal contamination.	sanitation, cook foods thoroughly.
Staphylococcus aureus	all meats, cream filled pastries, dairy products	human contamination	thorough heating & rapid cooling of foods.
Streptococcus pyogenes	raw milk, deviled eggs	human contamination with strep. Infections	general sanitation, pasteurization of milk.
Hepatitis A virus	raw or undercooked shellfish, sandwiches, salads, etc.	human fecal contamination.	cook shellfish thoroughly, general sanitation.
Norwalk & related viruses	raw or undercooked shellfish, sandwiches & salads	human fecal contamination	cook shellfish thoroughly, general sanitation.
Rotaviruses	raw or mishandled foods	probably fecal contamination	general sanitation.
Yersinia enterocolitica	raw or undercooked pork or beef, tofu packed in spring water	infected animals (swine), infected water	cook meats thoroughly, chlorinate water.
Protozoa and Parasites			
Entamoeba histolytica	raw or mishandled foods	cysts in human feces	general sanitation, thorough cooking.
Cryptosporidium parvum	mishandled foods	oocysts in human feces	general sanitation, thorough cooking.

Chart 253 *Continued*

Organism	Food Product	Source	Prevention of Disease
Giardia lamblia	mishandled foods	cysts in human or animal feces, water	general sanitation, thorough cooking.
Toxoplasma gondii	raw or undercooked meats, raw milk, mishandled foods	cysts in human or animal feces, water	cook meat thoroughly, pasteurize milk, general sanitation.
Nematodes, Anisakiasis simplex, or Pseudoterranova decipiens	raw or undercooked marine fish, squid, octopus	contaminated seafood	cook fish thoroughly or freeze at -4 F for 30 days.
Ascaris lumbricoides	raw fruits or vegetables	eggs in soil, from grown near soil, human feces	sanitary disposal of waste, cooking of food.
Trichinella spiralis	raw or undercooked pork or meat of carnivorous animals	larva encysted animal muscle	thorough cooking of meat, freezing of pork @ 5F for 30 days, irradiation.
Tapeworms, cestodes Taenia saginata	raw or undercooked beef	infected animal muscle	cook beef thoroughly or freeze below 23F.
Diphyllobothrium latum	raw or undercooked fresh water fish	infected animal muscle	cook fish 5 min at 133F, or freeze 24 h at 0F.
Taenia solium	raw or undercooked pork, or any food handled by human carrier.	infected muscle or human feces with T. solium eggs	cook pork thoroughly or freeze below 23F, good sanitation.
Ciguatera poisoning (ciguatoxin)	reef and island fish, grouper, sturgeon, barracuda, pompano, snapper, etc.	sporadic concentration in food chain, from algae	eat only small fish.
Puffer fish poisoning	puffer fish (many species)	toxins collect in gonads and viscera.	do not eat puffer fish
Scombroid or histamine poisoning	scombroid fish, including tuna, mackerel, mahimahi, etc.	bacterial action	refrigerate fish immediatley when caught.
Shellfish poisoning (domoic acid)	mussels, clams	from algae	heed surveillance warnings.
Paralytic shellfish poisoning (saxitoxin, etc.)	mussels, clams, scallops, oysters	from “red tide” algae	heed surveillance warnings.
Fungus			
Aspergillus flavus (aflatoxin)	grains, nuts and stored foods, especially peanuts yields potential liver cancer	high moisture environment, mold growth	store all grains, foods and peanuts in dry areas.
Claviceps pupurea (ergot)	grains, especially rye - produces gangrene, mental disorders	high moisture environment mold growth	store all grains, especially rye in dry areas.

Chart 254 Phenyl Ethyl Compounds and Phenylacetates

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
Phenyl acetate	C8H7O2	3958	—	—	122-79-2
phenyl ethyl formate	C9H10O2	2864	172.515	—	104-62-1
methyl phenyl acetate	C9H10O2	2733	172.515	—	101-41-7
methyl phenyl ethyl ether	C9H12O	3198	—	—	3558-60-9
phenyl ethyl acetate	C10H12O2	2857	172.515	—	103-45-7
ethyl phenyl acetate	C10H12O2	2452	172.515	—	101-97-3
allyl phenyl acetate	C11H12O2	2039	172.515	—	1797-74-6
allyl phenoxy acetate	C11H12O2	2038	172.515	—	7493-74-5
alpha, alpha dimethyl phenyl ethyl formate	C11H14O2	2395	172.515	—	10058-43-2
propyl phenyl acetate	C11H14O2	2955	172.515	—	4606-15-9
phenyl ethyl propionate	C11H14O2	2867	172.515	—	122-70-3
iso propyl phenyl acetate	C11H14O2	2956	172.515	—	4861-85-2
ethyl-2-(4-hydroxy-3-methoxy-phenyl)acetate	C11H14O4	4810	—	—	60563-13-5
(+/−)-n-lactoyl tyramine	C11H15NO3	4550	—	—	781674-18-8
alpha, alpha dimethyl phenyl ethyl acetate	C12H16O2	2392	172.515	—	151-05-3
butyl phenyl acetate	C12H16O2	2209	172.515	—	122-43-0
2 phenoxy ethyl isobutyrate	C12H16O3	2873	172.515	—	103-60-6
isobutyl phenyl acetate	C12H16O2	2210	172.515	—	102-13-6
phenyl ethyl butyrate	C12H16O2	2861	172.515	—	103-52-6
phenyl ethyl isobutyrate	C12H16O2	2862	172.515	—	103-48-0
Phenyl salicylate	C13H10O3	3960	—	—	118-55-8
phenyl ethyl 2 furoate	C13H12O3	2865	—	—	7149-32-8
methyl para tert butyl phenyl acetate	C13H13O2	2690	172.515	—	3549-23-3
phenyl ethyl tiglate	C13H16O2	2870	172.515	—	55719-85-2
phenyl ethyl senecioate (phenyl ethyl 3,3 dimethyl acrylate)	C13H16O2	2869	172.515	—	42078-65-9
dihydrogalangal acetate	C13H16O4	4555	—	—	129319-15-9
isoamyl phenyl acetate	C13H18O2	2081	172.515	—	102-19-2
phenyl ethyl 2 methyl butyrate	C13H18O2	3632	172.515	—	24817-51-4
phenyl ethyl isovalerate	C13H18O2	2871	172.515	—	140-26-1
alpha methyl phenyl butyrate	C13H18O2	3197	—	—	68922-11-2
3 hexenyl phenyl acetate	C14H18O2	3633	172.515	—	42436-07-7
phenyl ethyl hexanoate	C14H20O2	3221	—	—	6290-37-5
hexyl phenyl acetate	C14H20O2	3457	172.515	—	5421-17-0
alpha, alpha dimethyl phenyl ethyl butyrate	C14H20O2	2394	172.515	—	10094-34-5
ethyl 3-(2-hydroxyphenyl)propanoate	C11H14O3	4758	—	—	20921-04-4
isoamyl phenethyl ether	C13H20O	4635	—	—	56011-02-0
phenyl ethyl benzoate	C15H14O2	2860	172.515	—	94-47-3
benzyl phenyl acetate	C15H14O2	2149	172.515	—	102-16-9
para tolyl phenyl acetate	C15H14O2	3077	172.515	—	101-94-0
phenyl ethyl salicylate	C15H14O3	2868	172.515	—	87-22-9
phenyl ethyl anthranilate	C15H15NO2	2859	172.515	—	133-18-6
propyl 4-tert-butylphenylacetate	C15H22O2	4619	—	—	92729-55-0
phenyl ethyl phenyl acetate	C16H16O2	2866	172.515	—	102-20-5
octyl phenyl acetate	C16H24O2	2812	172.515	—	122-45-2
phenyl ethyl octanoate	C16H24O2	3222	—	—	5457-70-5
phenyl ethyl cinnamate	C17H16O2	2863	172.515	—	103-53-7
isoeugenyl phenyl acetate	C18H18O3	2477	172.515	—	120-24-1
geranyl phenyl acetate	C18H24O2	2516	172.515	—	102-22-7
linalyl phenyl acetate	C18H24O2	3501	—	—	7143-69-3
rhodinyl phenyl acetate (mostly citronellyl phenyl acetate) See Rhodinol.	C18H26O2	2985	172.515	—	10486-14-3
citronellyl phenyl acetate	C18H26O2	2315	172.515	—	139-70-8
beta-Phenylethyl caprate or phenethyl decanoate	C18H28O2	4314	—	—	61810-55-7

Chart 255 Phenyl Propyl and Phenyl Butyl Esters

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
		Phenyl Propyl Esters			
3 phenyl propyl formate	C10H12O2	2895	172.515	—	104-64-3
methyl 3 phenyl propionate	C10H12O2	2741	172.515	—	103-25-3
3 phenyl propyl acetate	C11H14O2	2890	172.515	—	122-72-5
ethyl 3 phenyl propionate	C11H14O2	2455	172.515	—	2021-28-5
methyl 4 phenyl butyrate	C11H14O2	2739	172.515	—	2046-17-5
3 phenyl propyl propionate	C12H16O2	2897	172.515	—	122-74-7
ethyl 4 phenyl butyrate	C12H16O2	2453	172.515	—	10031-93-3
ethyl 2 acetyl 3 phenyl propionate	C13H16O3	2416	172.515	—	620-79-1
2 (3 phenyl propyl) tetrahydro furan	C13H18O	2898	172.515	—	3208-40-0
ethyl 2 ethyl 3 phenyl propionate	C13H18O2	3341	—	—	2983-36-0
2 phenyl propyl butyrate	C13H18O2	2891	172.515	—	80866-83-7
2 phenyl propyl isobutyrate	C13H18O2	2892	172.515	—	65813-53-8
3 phenyl propyl isobutyrate	C13H18O2	2893	172.515	—	103-58-2
2 methyl 4 phenyl 2 butyl acetate	C13H18O2	2735	172.515	—	103--07-1
3 phenyl propyl isovalerate	C14H20O2	2899	172.515	—	7/3/5452
3 phenyl propyl hexanoate	C15H22O2	2896	172.515	—	6281-40-9
2 methyl 4 phenyl 2 butyl isobutyrate	C15H22O2	2736	172.515	—	10031-71-7
phenyl propyl cinnamate	C18H18O2	2894	172.515	—	122-68-9
		Phenyl Butyl Esters			
4 phenyl 2 butyl acetate	C12H16O2	2881	172.515	—	10415-88-0

Chart 256 Phosphates

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
ammonium phosphate monobasic (APM)	(NH4)H2PO4	—	184.1141(a), 582.1141	—	7722-76-1
ammonium phosphate dibasic (APD)	(NH4)2HPO4	—	184.1141(b), 582.1141	—	7783-28-0
calcium diphosphate (see below calcium pyrophosphate)					
calcium glycero phosphate	C3H9O6PCa	—	182.5201 dietary supplement, 182.8201 nutrient	—	27214-00-2
calcium hexametaphosphate	Ca3P6O18	—	182.6203 sequestrant	—	—
calcium phosphate (CPT)	Ca3(PO4)2	—	182.1216, 121.010(d)dietary supplement, nutrient	—	7758-87-4
calcium phosphate, monobasic (see below, mono calcium phosphate)					
calcium pyrophosphate (CPP)	Ca3P6O18	—	182.5223, dietary supplement 182.1223	—	9790-78-3
dicalcium phosphate (DCP)	Ca2HPO4	—	182.6215 sequestrant, nutrient	—	7757-93-9
dipotassium phosphate (DKP) (potassium phosphate, dibasic)	K2HPO4	—	182.1638, sequestrant, 121.101(D)	—	7758-11-4
disodium diphosphate (disodium pyrophosphate, disodium hydrogen phosphate) (see below sodium acid pyrophosphate)					
disodium (di)hydrogen phosphate (disodium diphosphate, disodium) (see below sodium acid pyrophosphate)					

Chart 256 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
disodium phosphate (DSP)	Na2HPO4	—	182.1778, setting salt, 182.5778, 182.8778 chelator, 582.1778, 582.5778 stabilizer, 582.6778, 182.6290 dispersing agent 582.6290, 121.101(d), 184.1779	—	7558-79-4
disodium pyrophosphate (disodium diphosphate, disodium hydrogen phosphate) (see below sodium acid pyrophosphate)				—	
ferric phosphate (ferric ortho phosphate)	FePO4	—	182.5301, nutrient 184.1301, 582.5301, 121.101(d)	—	10045-86-0
ferric pyrophosphate	Fe4(P2O7)3	—	182.5304 dietary supplement	—	10402-25-2
ferric sodium pyrophosphate	Fe3Na(P2o7)3	—	182.5306 dietary supplement	—	—
magnesium phosphate	Mg3(PO4)2	—	182.5434 nutrient, 184.1434, 582.5434, 121.101(d)dietary supplement	—	7757-87-1
manganese glycerophosphate		—	182.5455 dietary supplement, nutrient	—	—
monocalcium phosphate (MCP)	Ca(H2PO4)2	—	182.1215, sequestrant 182.6215, 582.6215, 121.101(d)	—	7758-23-6
mono potassium phosphate (MKP) (see below potassium phosphate, monobasic)					
monosodium phosphate (MSP) or Sodium phosphate monobasic	NaH2PO4	—	182.1778, 182.5778, 182.8778, 582.1778, 582.5778, 582.6778, 184.1780, 182.6085, 582.6085, sequestrant 184.1722, 121.101(d)	—	7558-80-7
phosphoric acid	H3PO4	—	121.101(d), clarifier, nutrient, acidulant 182.1073	—	7664-38-2
potassium glycero phosphate	C3H9O6PK	—	182.5628 dietary supplement, nutrient	—	1319-69-3
potassium phosphate, dibasic (see above dipotassium phosphate)					
potassium phosphate, monobasic (MKP)or (potassium biphosphate)	KH2PO4	—	184.1639 nutrient supplement	—	7778-77-0
potassium phosphate, tribasic (TKP) (tripotassium phosphate)	K3PO4	—	184.1639a	—	7778-53-2
potassium pyrophosphate (see below tetra potassium pyrophosphate)					
potassium tri poly phosphate (KTPP) (pentapotassium triphosphate)	K5P3O10	—	184.1644 low sodium moisture binding	—	13845-36-8
sodium acid phosphate (see monosodium phosphate)					
sodium acid pyrophosphate (SAPP)	Na2H2P2O7	—	121.101(d),182.1087 cure accelerator, browning prevention,crystal prevention	—	7758-16-9

Chart 256 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
sodium aluminum phosphate (SALP)	Na3Al2H14 or 15(PO4)8 -acidic Na15A2.8(PO4)8 -basic	—	182.1781, 582.1781, 121.101(d)	—	7785-88-8
sodium hexa meta phosphate (SHMP)	Na6P6O18	3027	prevents protein precipitation, stabilizer, maintain tenderness, sequestrant: 133.169, 133.173, 133.179, 150.141, 150.161, 169.115, 173.310, 182.90, 182.6760, 121.101(d), 184.1760	—	10124-56-8
sodium metaphosphate or (Kurrol's salt)	(NaPO3)n	—	182.6769 sequestrant	—	—
sodium phosphate, dibasic (see above disodium phosphate)					
sodium phosphate, monobasic (see above monosodium phosphate)					
sodium phosphate, tribasic (see below trisodium phosphate)					
sodium pyrophosphate (see below tetra sodium pyrophosphate)					
sodium tri poly phosphate	Na5P3O10	—	182.1810, 182.6810 moisture binding, sequestrant	—	7758-29-4
tetra potassium pyro phosphate (TKPP)	K4P2O7	—	184.1870 low sodium moisture binding	—	7320-34-5
tetrasodium pyro phosphate (TSPP)	Na4P2O7	—	121.101(d), chelator, emulsifier, stabilizer, setting salt 182.6787, 182.6789, 184.1872	—	7722-88-5
tricalcium phosphate (TCP)	Ca5(PO4)3(OH) 3081/	—	137.105, 137.155, anticaking agent 137.160, 137.165, 137.170, 137.175, 137.180, 137.185, 169.179, 169.182, 182.1217, 182.5217, 182.8217, 121.101(d)	—	7758-87-4
tripotassium phosphate (TKP) (see above potassium phosphate, tribasic)					
trisodium phosphate (TSP)	Na3PO4	2398	dietary supplement, sequestrant, 182.1778, 182.5778, 182.8778, 582.1778, 582.5778, 582.6778, 121.101(d)	—	7601-54-9

Chart 257 Phthalides

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
Phthalide or 2-Hydroxymethylbenzoic acid gamma lactone	C8H2Cl4O2	4195	—	—	87-41-2
3 propylidene phthalide	C11H10O2	2952	172.515	—	17369-59-4
3 butylidene phthalide	C12H12O2	3333	—	—	551-08-6
3 n-butyl phthalide	C12H14O2	3334	—	—	6066-49-5

Chart 258 Piperonyl Esters

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
piperonyl acetate	C10H10O4	2912	172.515	—	326-61-4
piperonyl isobutyrate	C12H14O4	2913	172.515	—	8/5/5461

Chart 259 Polysorbates and Sorbitan Esters

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
polysorbate 20	(CH2CH2O)20	2915	—	—	9005-64-5
polysorbate 60	(CH2CH2O)60	2916	172.836	—	9005-67-8
polysorbate 65	(CH2CH2O)65	—	172.838	—	9005-71-4
polysorbate 80	(CH2CH2O)80	2917	172.840	—	9005-65-6
Sorbitan Monooleate	C24H4406	—	173.75	—	1338-43-8
Sorbitan Monostearate or Span ® 60	C24H46O6	—	172.842, 573.960	—	1338-41-6
Polysorbates 20, 60 and 80 may be blended with sorbitan monostearate (65)	—	—	172.842, 573.960	—	—

Chart 260 Propenyl Guaethol

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
Propenyl Guaethol	C11H14O	2922	172.515	—	94-86-0

Chart 261 Proposition 65

Chemical	FEMA GRAS #	CAS#	Prop 65 Listing Date
Acetaldehyde	2003	75-07-0	1-Apr-88
Estragole or Methyl chavicol	2411	140-67-0	29-Oct-99
Ethyl acrylate	2418	140-88-5	1-Jul-89
2,4-Hexadienal (89% trans, trans isomer; 11% cis, trans isomer)**	not GRAS	—	4-Mar-05
Methyl Eugenol, or Eugenyl Methyl Ether	2475	97-15-2	16-Nov-01
Beta Myrcene	2762	123-35-3	27-Mar-15
Pulegone	2963	89-82-7	18-Apr-14
Pyridine, or azine	2966	110-86-1	17-May-02
Silica, crystalline (airborne particles of respirable size)	cancer	—	1-Oct-88
Furfuryl Alcohol	2491	98-00-0	9-30-16

** Note Trans Trans (or E E) 2,4 hexadienal is GRAS = 3429 and CAS # 142-83-6

The Prop 65 list is periodically updated by the State of California. The reference internet site should be checked periodically and compared with items on the GRAS list to verify accuracy.

Chart 262 Propylene Glycol Derivatives

Compound	Empirical Formula	FEMA GRAS #	CFR	CAS#
Propylene Glycol	C3H8O2	2940	169.175, 169.176, 169.177, 169.178, 169.180, 169.181, 184.1666, 582.46	57-55-6
PG Alginate	—	2941	133.133, 133.134, 133.178, 133.179, 172.210, 172.858, 173.340	9005-37-2
1,3-propanediol	C3H8O2	4753	504-63-2	
propyleneglycol diacetate	C7H12O4	4464	—	623-84-7
propyleneglycol monobutyrate	C7H14O3	4488	—	29592-95-8
propyleneglycol mono-2-methylbutyrate	C8H16O3	4467	—	923593-56-0
propyleneglycol dipropionate	C9H16O4	4465	—	10108-80-2
propyleneglycol monohexanoate	C9H18O3	4469	—	39556-41-7
propyleneglycol dibutyrate	C11H20O4	4466	—	50980-84-2
propyleneglycol di-2-methylbutyrate	C13H24O4	4468	—	155514-30-0
PG Dibenzoate	C14H18O4	3419-	—	19224-26-1
propyleneglycol dihexanoate	C15H28O4	4470	—	50343-36-7
propyleneglycol dioctanoate	C19H36O4	4471	—	7384-98-7
PG Stearate	C21H42O3	2942-	—	142-75-6

Chart 263 Pulegyl Esters

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
iso pulegyl acetate	C12H20O2	2965	172.515	—	57576-09-7

Chart 264 Pyrazines

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
Pyrazine	C4H4N2	4015	—	—	290-37-9
2 methyl pyrazine	C5H6N2	3309	—	—	109-08-0
methoxy pyrazine	C5H6N2O	3302	—	—	3149-28-8
2 mercapto methyl pyrazine	C5H6N2OS	3299	—	—	59021-02-2
pyrazinyl methyl sulfide	C5H6N2S	3231	—	—	21948-70-9
2 ethyl pyrazine	C6H8N2	3281	—	—	13925-00-3
2,3 dimethyl pyrazine	C6H8N2	3271	—	—	5910-89-4
2,5 dimethyl pyrazine	C6H8N2	3272	—	—	123-32-0
2,6 dimethyl pyrazine	C6H8N2	3273	—	—	108-50-9
2,5 or 6 methoxy methyl pyrazine	C6H8N2O	3183	—	—	68378-13-2
2 acetyl pyrazine	C6H6N2O	3126	—	—	22047-25-2
2 ethyl (or methyl) 3,5 & 6 methoxy pyrazine methyl	C6H8N2O (13%) ethyl C7H10N2O (85%)	3280	—	—	99999-18-1
(methyl thio) methyl pyrazine	C6H8N2S	3208	—	—	2882-20-4
pyrazine ethane thiol	C6H8N2S	3230	—	—	32250-53-4
isopropenyl pyrazine	C7H8N2	3296	—	—	38713-14-6
2-Ethyl-6-methylpyrazine or Filbert Pyrazine	C7H10N2	3919	—	—	13925-03-6

Chart 264 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
2-Isopropylpyrazine	C7H10N2	3940	—	—	29460-90-0
Propylpyrazine	C7H10N2	3961	—	—	18138-03-9
2,3,5 trimethyl pyrazine	C7H10N2	3244	—	—	14667-55-1
3 ethyl 2 methyl pyrazine	C7H10N2	3155	—	—	15707-23-0
2 ethyl 5 methyl pyrazine	C7H10N2	3154	—	—	13360-64-0
2-Ethyl-6-methylpyrazine or Filbert Pyrazine	C7H10N2	3919	—	—	13925-03-6
2-Isopropylpyrazine	C7H10N2	3940	—	—	29460-90-0
2 methyl 3,5 or 6 ethoxy pyrazine	C7H10N2O	3569	—	—	32737-14-7
2 ethyl 3 methyl thio pyrazine	C7H10N2S	4631	—	—	72987-62-3
2-ethyl-3-methylthiopyrazine	C7H10N2S	4631	—	—	72987-62-3
2 methyl 5 vinyl pyrazine = removed from GRAS list	C7H8N2	was{3211}	—	—	13925-08-1
2-Acetyl-3-methylpyrazine	C7H8ON2	3964	—	—	23787-80-6
5 hydroxy 5 methyl 6,7 dihydro cyclopenta (b) pyrazine or (5H methyl 6,7 dihydro cyclopenta (b) pyrazine)	C8H10N2	3306	—	—	23747-48-0
2 acetyl 3 ethyl pyrazine	C8H10N2	3250	—	—	32974-92-8
5H 5 methyl 6,7 dihydro cyclo penta (b) pyrazine	C8H10N2	3306	—	—	23747-48-0
cyclohexyl pyrazine (5,6,7,8, tetrahydro quinoxaline)	C8H10N2	3321	—	—	34413-35-9
2 acetyl 3,5 (and 6) dimethyl pyrazine	C8H10N2O	3327	—	—	54300-08-2
2 ethyl 3(5 or 6) dimethyl pyrazine	C8H12N2	3149	—	—	13925-07-0
3 ethyl 2,6 dimethyl pyrazine	C8H12N2	3150	—	—	13925-07-0
5 isopropyl 2 methyl pyrazine	C8H12N2	3554	—	—	13925-05-8
2,3,4,5 tetramethyl pyrazine	C8H12N2	3237	—	—	1124-11-4
2,3 diethyl pyrazine	C8H12N2	3136	—	—	15707-24-1
5 ethyl 2,3 dimethyl pyrazine	C8H12N2	4434	—	—	15707-34-3
5-ethyl-2,3-dimethylpyrazine	C8H12N2	4434	—	—	15707-34-3
2 methoxy 3(5 & 6) isopropyl pyrazine	C8H12N2O	3358	—	—	25773-40-4
2 ethoxy 3 ethyl pyrazine	C8H12N2O	4633	—	—	35243-43-7
2-ethoxy-3-ethylpyrazine	C8H12N2O	4633	—	—	35243-43-7
6,7-Dihydro-2,3-dimethyl-5H-cyclopentapyrazine	C9H12N2	3917	—	—	38917-63-4
2(3), 5-dimethyl-6,7-dihydro-5h-cyclopentapyrazine	C9H12N2	4702	—	—	38917-62-3
3,5-Diethyl-2-methylpyrazine	C9H14N2	3916	—	—	18138-05-1
2,5-Diethyl-3-methylpyrazine	C9H14N2	3915	—	—	32736-91-7
2,3 diethyl 5 methyl pyrazine	C9H14N2	3336	—	—	1838-04-0
2 isobutyl 3 methyl pyrazine	C9H14N2	3133	—	—	13925-06-9
2 isobutyl 3 methoxy pyrazine	C9H14N2O	3132	—	—	24683-00-9
2 methoxy 3(1 methyl propyl)	C9H14N2O	3433	—	—	24168-70-5
2 ethoxy 3 isoporopyl pyrazine	C9H14N2O	4632	—	—	5444-75-7
2-ethoxy-3-isopropylpyrazine	C9H14N2O	4632	—	—	72797-16-1
2 methyl 3,5 or 6 (furfuryl thio) pyrazine	C10H10N2OS	3189	—	—	65530-53-2
3,5- and 3,6-Dimethyl-2-isobutylpyrazine	C10H16N2	4100	—	—	38888-81-2
cyclohexyl methyl pyrazine	C11H16N2	3631	—	—	28217-92-7

Chart 265 Nitrogen Containing - Non Pyrazine

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
pyrrole	C4H5N	3386	—	—	109-97-7
1-Pyrroline, or 3,4-Dihydro-(2H)-pyrroline	C4H7N	3898	—	—	5724-81-2
pyrrolidine	C4H9N	3523	—	—	123-75-1
piperidine	C5H11O	2908	172.515	—	110-89-4
pyridine	C5H5N	2966	172.515, 177.158	—	110-86-1
2,4-Dimethyl-3-oxazoline	C5H9NO	4429	—	—	77311-02-5
choline chloride (also includes choline)	C5H14NO	4500	—	—	67-48-1
2-Acetyl-1-pyrroline	C6H10NO	4249	—	—	99583-29-6
2,4,5 trimethyl delta 3 oxazoline	C6H11NO	3525	—	—	22694-96-8
2-Methylpiperidine	C6H13N	4244	—	—	109-05-7
2,4,6-Trimethyldihydro-4H-1,3,5-dithiazine	C6H13NS2	4018	—	—	638-17-5
1-Methyl-2-formylpyrrole or 1-Methyl-1H-pyrrole-2-carboxaldehyde	C6H7NO	4332	—	—	1192-58-1
methyl pyrrolyl ketone	C6H7NO	3202	—	—	1072-83-9
Methoxy pyridine	C6H7NO	4435	—	—	1628-89-3
2-methoxypyridine	C6H7NO	4639	—	—	1628-89-3
2 pyridine methane thiol	C6H7SN	3232	—	—	2044-73-7
Trimethyloxazole	C6H9NO	4394	—	—	20662-84-4
2,5-Dimethyl-4-ethyloxazole	C7H11NO	4395	—	—	30408-61-8
2-Propionylpyrroline	C7H12NO	4063	—	—	133447-37-7
2 acetyl pyridine	C7H7NO	3251	—	—	1122-62-9
3 acetyl pyridine	C7H7NO	3424	—	—	350-03-8
methyl 3 carbomethyl pyridine	C7H7NO2	3709	—	—	93-60-7
2,4-Dimethylpyridine	C7H8N	4389	—	—	108-47-4
2,6 dimethyl pyridine	C7H9N	3540	—	—	108-48-5
3 ethyl pyridine	C7H9N	3394	—	—	536-78-7
1 methyl 2 acetyl pyrrole	C7H9NO	3184	—	—	932-16-1
2 propionyl pyrrole	C7H9NO	3614	—	—	1073-26-3
Tea pyrrole or 1-Ethyl-2-pyrrolecarboxaldehyde	C7H9NO	4317	—	—	2167-14-8
5 ethyl 2 methyl pyridine	C8H11N	3546	—	—	104-90-5
2-Propylpyridine	C8H11N	4065	—	—	622-39-9
1 ethyl 2 acetyl pyrrole	C8H11NO	3147	—	—	39741-41-8
2 ethyl 4,5 dimethyl oxazole	C8H11NO	3672	—	—	53833-30-0
2-Methyl-3-(1-oxopropoxy)-4H-pyran-4-one	C8H12O4	3941	—	—	68555-63-5
2-Propyl-4,5-dimethyloxazole	C8H13NO	4396	—	—	53833-32-2
2-Methyl-4,5-benzoxazole	C8H7NO	4398	—	—	95-21-6
2(2 methyl propyl) pyridine	C9H13N	3370	—	—	6304-24-1
3(2 methyl propyl) pyridine	C9H13N	3371	—	—	14159-61-1
2-Isobutyl-4,5-dimethyloxazole	C9H15NO	4397	—	—	26131-91-9
quinoline	C9H7N	3470	—	—	21-22-5
isoquinoline	C9H7N	2978	172.515	—	119-65-35
5 methyl quinoxiline	C9H8N2	3203	—	—	13708-12-8
2 acetyl 4 isopropenyl pyridine	C10H11NO	4636	—	—	142896-11-5
4 acetyl 2 isopropenyl pyridine	C10H11NO	4637	—	—	142896-12-6
2-acetyl-4-isopropenylpyridine	C10H11NO	4636	—	—	142896-11-5
4-acetyl-2-isopropenylpyridine	C10H11NO	4637	—	—	142896-12-6
2 acetyl 4 isopropyl pyridine	C10H13NO	4638	—	—	142896-09-1
2-acetyl-4-isopropylpyridine	C10H13NO	4638	—	—	142896-09-1
2 pentyl pyridine	C10H15N	3383	—	—	2294-76-0

Chart 265 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
6 methyl quinoline	C10H9N	2744	172.515	—	91-62-3
6-methoxyquinoline	C10H9NO	4640	—	—	5263-87-6
(+/−)-n-lactoyl tyramine	C11H15NO3	4550	—	—	781674-18-8
1 phenyl 3 or 5 propyl pyrazole	C12H14N2	3727	—	—	65504-93-0
8,9-dehydrotheaspirone	C13H18O2	4518	—	—	85248-56-2
1-(2-hydroxyphenyl)-3-(pyridin-4-yl) propan-1-one	C14H13NO2	4721	—	—	1186004-10-3
2(3 phenyl propyl) pyridine	C14H15N	3751	—	—	2110-18-1
2-(3,4-dihydroxyphenyl)-5,7-dihydroxy-4-chromanon	C15H12O6	4715	—	—	4049-38-1
1-(2-hydroxy-4-methoxyphenyl)-3-(pyridin-2-yl)propan-1-one	C15H15NO3	4723	—	—	1190229-37-8
(−)-Homoeriodictyol, sodium salt, or 4H-1-Benzopyran-4-one, 2,3-dihydro-5,7-dihydroxy-2-(4-hydroxy-3-methoxyphenyl)-, sodium salt (Bitter Mask)	C16H11O6	4228	—	—	462631-45-4
2-(((3-(2,3-dimethoxyphenyl)-1h-1,2,4-triazol-5-yl)thio)methyl)pyridine	C16H16N4O2S	4798	—	—	902136-79-2
N1-(2-Methoxy-4-methylbenzyl)-N2-(2-(5-methylpyridin-2-yl)ethyl)oxalamide	C16H30N2O2	4234	—	—	745047-94-3
N1-(2,4-Dimethoxybenzyl)-N2-(2-(pyridin-2-yl) ethyl)oxalamide	C16H30N2O3	4233	—	—	745047-53-4
piperine	C17H19NO3	2909	172.515	—	94-62-2
N1-(2-methoxy-4-methylbenzyl)-N2-(2-(pyridin-2-yl)ethyl)oxalamide	C17H33N2O2	4231	—	—	745047-97-6
1-(2-hydroxy-4-isobutoxyphenyl)-3-(pyridin-2-yl)propan-1-one	C18H21NO3	4722	—	—	1190230-47-7
(s)-1-(3-(((4-amino-2,2-dioxido-1h-benzo[c] [1,2,6]thiadiazin-5-yl)oxy)methyl) piperidin-1-yl)-3-methylbutan-1-one	C18H26N4O4S	4802	—	—	1469426-64-9
3-(1-((3,5-dimethylisoxazol-4-yl)methyl)-1h-pyrazol-4-yl)-1-(3-hydroxybenzyl) imidazolidine-2,4-dione	C19C19N5O4	4725	—	—	1119831-25-2
3-(1-((3,5-dimethylisoxazol-4-yl)methyl)-1h-pyrazol-4-yl)-1-(3-hydroxybenzyl)-5,5-dimethylimidazolidine-2,4-dione	C21H23N5O4	4726	—	—	1217341-48-4
ammonia (also includes ammonium chloride)	NH3	4494	—	—	7664-41-7
ammonia (also includes ammonium chloride)	NH3Cl	4494	—	—	7664-41-7

Chart 266 Pyrimidines etc

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
5,7 dihydro 2 methyl thieno (3, 4d) pyrimidine	C6H12N2S	3338	—	—	36267-71-7
4 acetyl 2 methyl pyrimidine	C7H8N2O	3654	—	—	67860-38-2
2 (4) isopropyl 4(2),6 dimethyl dihydro 4H 1,3,5 dithiazine	C8H17NS2	3782	—	—	104691-41-0
2 (4) isobutyl 4(2), 6 dimethyl dihydro 4H 1,3,5 dithiazine	C9H19NS2	3781	—	—	101517-87-7

Chart 267 Pyruvate

Compound	Empirical Formula	FEMA GRAS #	CFR	CAS#	
ethyl pyruvate	C5H8O3	2457	172.515	617-35-6	
propyl pyruvate	C6H10O3	4484	—	—	20279-43-0
iso amyl pyruvate	C8H14O3	2083	172.515	7779-72-8	

Chart 268 Nutmeg

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Nutmeg (Myristica fragrans Houtt.)					
botanical	2792	182.10, 582.10	—	8007-40-7	terpene type
oil	2793	182.20, 582.20	—	8007-40-7	aromatic type
oleoresin	—	182.20, 582.20	6365	8007-12-3	aromatic type

Chart 269 Oak Quercus Alba and Robur

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Oak (Quercus robur L.) or (English Oak)					
	—	172.510 (alcoholic bev. only)	6115		bitter principle
Oak, White Chips (Quercus alba L.)					
extract	2794	172.510	6441	68917-11-3	astringent
botanical	—	172.510	—	—	woody
bark oleoresin	—	172.510	6660		woody
concrete	—	172.510	—	—	woody

Chart 270 Oak Moss

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Oak Moss (Evernia prunastri (L.) Ach., E. furfuracea (L.) Mann					
absolute	2795	—	—	90000-50-4	vegetable type
botanical thujone free	—	172.510	—	—	mossy

Chart 271 Olibanum

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Olibanum (Frankincense) (Boswellia carterii Birdw. And other Boswellia species.)					
oil	2816	172.510	—	8016-72-0	balsamic

Chart 272 Onion

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Onion (Allium cepa L.)					
oil	2817	182.20, 582.20	—	8002-72-0	sulfur type
generic	—	—	6408	—	sulfur type
extract	—	—	6516	—	sulfur type
granules	—	—	6409	—	sulfur type
oleoresin	—	—	6507	—	sulfur type
powder	—	—	6567	—	sulfur type
minced dry	—	—	6410	—	sulfur type

Chart 273 Opopanax

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Opopanax (Bisabol Myrrh, Sweet Myrrh) (Opopanax chironium Koch (True Opopanax) or Commiphora erythraea Eng. var. glabrescens)					
gum	2765	172.510	6121	9000-78-6	balsamic
botanical	—	172.510	6120	9000-78-6	balsamic
oil	2766	172.510	6122	9000-78-6	balsamic
tincture	—	172.510	6322	9000-78-6	balsamic

Chart 274 Orange Flower

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Orange Flower, Bitter (Citrus aurantium L. subspecies Amara L.)					
terpene type					
absolute	2818	182.20, 582.20	—	8030-28-2	floral type
flowers	2819	182.20, 582.20	—	8030-28-2	citrus type
leaf	2820	182.20, 582.20, 172.51	—	8030-28-2	floral type
peel (undesignated species)	—	182.20, 582.20	—		citrus type
Curacao peel extract	2344	182.20, 582.20	—	942766-47-4	citrus type
Citrus Aurantium peel	—	182.20, 582.20	—	—	citrus type
Juice, Curacao	—	172.51	—	—	citrus type
Leaves, Curacao	—	172.51	—	—	floral type
bitter orange peel oil,(Curacao)	2345	182.20, 582.20	—	942766-47-4	citrus type
bitter orange peel oil	2823	182.20, 582.20	—	68916-04-1	citrus type
oil	2771	182.20, 582.20	—	80116-38-4	citrus type
peel extract	—	—	6535	—	citrus type

Chart 275 Orange Sweet

Form	FEMA GRAS #	CFR	NAS #	CAS #	Descriptor
Orange, Sweet (Citrus sinensis L. Osbeck and C. Aurantium var. dulcis L.)					
distilled oil	2821	182.20, 582.20, 146.146, 146.151	—	68606-94-0	terpene type
terpeneless oil	2822	—	—	8008-57-9	terpene type
sweet orange extract	2824	182.20, 582.20	—	8028-48-6	fruit
sweet orange peel oil	2825	182.20, 582.20	—	8028-57-9	terpene type
sweet oil terpeneless	2826	182.20, 582.20	—	68606-94-0	terpene type
peel (undesignated species)	—	182.20, 582.20	—	—	bitter principle
aroma water	—	—	6413	—	fruit
orange carbonyls	—	—	6585	—	fruit
orange essence	—	—	6705	—	terpene type
orange essence oil	—	—	6706	—	terpene type
orange juice concentrate	—	182.20, 582.20	6620	—	fruit
orange peel	—	—	6392	—	terpene type
orange terpenes	—	—	6444	68647-72-3	terpene type

Chart 276 Oregano

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Oregano (Mexican Oregano) (Lippia spp.)					
	2827	182.10, 582.10, 182.20, 582.20	—	8007-11-2	aromatic type
oleoresin	—	—	6539	—	vegetable type

Chart 277 Orris

Form	FEMA GRAS #	NAS#	NAS#	CAS #	Descriptor
Orris (*Iris germania* L. and Other Species & Varieties)					
concrete, liquid and oil	2829	172.510	—	8002-73-1	green type
root extract	2830	—	—	—	vegetable type
powder	—	—	6545	—	vegetable type

Chart 278 Osmanthus

Botanical or Food Name	FEMA GRAS	NAS #	CFR	CAS#	Type
Osmanthus (Osmanthus fragrans Lour.)					
absolute	3750	—	—	92347-12-2	green vegetable type

Chart 279 Palmarosa

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Palmarosa (Cymbopogon martini Stapf. var. motia)					
oil	2831	—	—	8014-19-5	floral type

Chart 280 Pansy

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Pansy (Viola tricolor L.)	—	172.510 (alcoholic bev. only)	6123	—	sweet spice

Chart 281 Parrafin Wax

Botanical or Food Name	FEMA GRAS	NAS #	CFR	CAS#	Type
Paraffin Wax	3216	—	—	8002-74-2	waxy

Chart 282 Parsley

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Parsley (Petroselinum sativum Hoffman.)					
botanical	2835	182.10, 582.10	—	8000-68-8	herbal type
oil seed and leaves	2836	182.20, 582.20	—	8000-68-8	green type
oleoresin	2837	182.20, 582.20	—	84012-33-9	vegetable type
dehydrated	—	—	6124	—	green type

Chart 283 Passionflower

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Passion Flower (Passiflora incarnata L.)					
flower	—	6124	172.510	—	floral
flower extract	—	6411	172.510	8057-62-3	floral
herb extract	—	6383	—	—	floral

Chart 284 Passionfruit

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Passion Fruit (Passiflora species)					
essence	—	6665	—	—	fruity
essence oil	—	6543	—	—	fruity
juice concentrate	—	6666	—	—	fruity

Chart 285 Patchouli

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Patchouly (Pogostemon cablin Benth. & P. heyeanus Benth.)					
	2838	172.51	—	8014-9-3	green herbal

Chart 286 Peach

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Peach (Prunus persica Sieb et Zuc. (kernels only) and P. persica L. Batsch)					
kernel		182.40, 582.40		—	nut type
peach leaves	—	172.510 (Alcoholic bev. only) (Not to exceed 25 ppm of prussic acid)	—	—	fruit
leaves extract	—	172.510	—	084012-34-0	green
peach essence	—	—	6513	—	fruit
peach essence 100×	—	—	6588	—	fruit
peach essence 150×	—	—	6508	—	fruit
peach extract	—	—	6458	—	fruit
peach juice concentrate	—	—	6667	—	fruit
peach kernel extract	—	—	6209	084012-34-0	nut type
peach leaves	—	—	6125	—	green

Chart 287 Peanut

Botanical or Food Name	FEMA GRAS	CFR	NAS #	CAS#	Type
peanut butter extract	—	—	6459	8002-3-7	sulfur
peanut extract	—	—	6460	8002-3-7	fatty/creamy
Stearine	—	182.40, 582.40	—	977051-59-4	fatty

Chart 288 Pear

Botanical or Food Name	FEMA GRAS	CFR	NAS #	CAS#	Type
pear essence	—	—	6514	—	fruit
pear juice concentrate	—	—	6590	—	fruit
pear juice essence	—	—	6572	—	fruit

Chart 289 Pennyroyal

Botanical or Food Name	FEMA GRAS	NAS #	CFR	CAS#	Type
Pennyroyal (Hedeoma pidegioides (L.) Pers. = American Pennyroyal) (Mentha pulegium L. = European Pennyroyal) See Terpene Ketones - Pulegone.					
American Pennyroyal	—	—	172.51	8007-44-1	minty
European Pennyroyal	2839	—	172.51	8013-99-8	

Chart 290 Pepper Black and White

Botanical or Food Name	FEMA GRAS #	CFR	NAS #	CAS#	Type
Pepper (Piper nigrum L.)					
black, botanical	2844	182.10, 582.10	—	8006-82-4	pungent
black, oil	2845	182.20, 582.20	—	8006-82-4	terpene type
black, oleoresin	2846	182.20, 582.20	—	84929-41-9	aromatic
white	2850	182.10, 582.10	—	84929-41-9	aromatic
white, oil	2851	182.20, 582.20	—	8006-82-4	aromatic
white, oleoresin	2852	182.20, 582.20	—	84929-41-9	aromatic

Chart 291 Pepper Sweet Bell Types

Botanical or Food Name	FEMA GRAS #	CFR	NAS #	CAS#	Type
Pepper Sweet (Capsicum Annuum.)					
food	2849	—	—	—	vegetable
green bell	—	—	6532	—	green
paprika oleaoresin C. Annuun and C. Frutescens	2834	—	—	84625-29-6	color

Chart 292 Peppermint

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Peppermint (Mentha piperita)					
leaves	2847	145.131, 155.120, 155.130, 155.170, 155.200, 182.10, 582.10	—	8006-90-4	mint
oil	2848	182.20, 582.20	—	8006-90-4	mint
botanical (plant)	—	182.10, 582.10	—	8006-90-4	mint
terpeneless	—	—	6561	8006-90-4	mint
terpenes	—	—	6341	8006-90-4	mint

Chart 293 Peru Balsam

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Peru Balsam (Peruvian Balsam) (Myroxylon pereirae Klotzsch)					
botanical extract	2116	182.20, 582.20	524.2620 Liquid crystalline trypsin, Peru balsam, castor oil. Rtopical use only.	8007-00-9	brown flavor
oil	2117	1812.20, 582.20	—	8007-00-9	brown flavor

Chart 294 Petitgrain

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Pettitgrain (P. bigarade or Paraguay Pettitgrain)					
oil	2855	182.20, 582.20	—	8014-17-3	terpene type
pettitgrain oil terpeneless	—	—	6317	8014-17-3	linalool type

Chart 295 Pimento

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Pimento (Pimenta, Allspice, Jamaican Pepper) (Pimenta officinalis Lindl.)					
leaf oil	2901	182.20, 582.20	—	8006-77-7	spice
botanical	2017	182.10, 582.10	—	8006-77-7	spice
oil	2018	182.20, 582.20	—	8006-77-7	spice
oleoresin	2019	182.20, 582.20	—	8006-77-7	spice
generic	—	—	6592	8006-77-7	spice

Chart 296 Pine

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Pine (Pinus spp.)					
Pinus mugo Turra var. pumilio (Haenke) Zenari = Dwarf Pine					
needle oil	2904	172.510	—	8000-26-8	terpene type
Pinus sylvestris L. = Scotch Pine					
oil	2906	172.510	—	8023-99-2	terpene type
Pinus strobus L. = White Pine, Pine Fir					
oil	—	172.510	6133	—	terpene type
bark solid extract	—	172.510	6131	—	terpene type
Pinus Spp.					
oil	2907	172.515		97435-14-8	terpene type
bark oil	—	172.510 (alcoholic bev. only)	—	—	terpene type
white pine bark generic	—	—	6420	—	terpene type
generic botanical	—	—	6130	—	terpene type
Pine Tar (Pinus palustris & Other Pinus species)					
oil	2907	—	—	8011-48-1	phenolic

Chart 297 Pipsissewa

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Pipsissewa (Cyanophile umbellata (L.) Nutt.)					
leaf extract	2914	182.20, 582.20	—	89997-56-8	aromatic type

Chart 298 Plum

Plum (*Prunus* spp.)	NAS #
concentrate	6595+
juice concentrate	6668+
essence	6596+

Chart 299 Pomegranate

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Pomegranate (Punica granatum L.)					
bark extract	2918	182.20, 582.20	—	84961-57-9	acid type
food	—	—	—	—	fruity type

Chart 300 Poplar

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Poplar (Populus balsamifera L. and Other Populus Species)					
buds	—	172.510 (alcoholic bev. only)	6138	—	balsamic type

Chart 301 Poppy Seed

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Poppy Seed (Papaver somniferum L.)	2919	—	182.10, 582.10	84650-40-8	fatty type

Chart 302 Pyroligneous Acid

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Pyroligneous Acid	2967	—	—	8030-97-5	smoky
extract	2968	172.515	—	—	smoky

Chart 303 Priorities Chart

	NOT IMPORTANT	IMPORTANT
URGENT	[C]	[A]
NON-URGENT	[D]	[B]

Chart 304 Quinine Compounds

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
quinine bisulfate	C20H24N2O2-H2SO4+7H2O	2975	172.575	—	549-56-4
quinine hydrochloride	C20H24N2O2-HCl+2H2O	2976	172.575	—	130-89-2
quinine sulfate	(C20H24N2O2)2-H2SO4+7H2O	2977	172.575	—	6119-70-6

Chart 305 RDI

Vitamin	RDI
Vitamin A	5,000 IU
Vitamin C	60 mg
Calcium	1.0 g
Iron	18 mg
Vitamin D	400 IU
Vitamin E	30 IU
Thiamin	1.5 mg
Riboflavin	1.7 mg
Niacin	20 mg
Vitamin B6	2.0 mg
Folate	0.4 mg
Vitamin B12	6.0 mg
Biotin	0.3 mg
Pantothenic Acid	10 mg
Phosphorus	1.0 g
Iodine	150 mcg
Magnesium	400 mg
Zinc	15 mg
Copper	2.0 mg

Chart 306 Rhodinyl Esters

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
* denotes compound is listed elsewhere as well					
rhodinyl formate	C11H20O2	2984	172.515	—	141-09-3
rhodinyl acetate	C12H24O2	2981	172.515	—	141-11-7
rhodinyl isobutyrate	C14H26O2	2983	172.515	—	138-23-8
rhodinyl butyrate	C14H26O2	2982	172.515	—	141-15-1
rhodinyl isovalerate	C15H28O2	2987	172.515	—	7778-96-3
rhodinyl phenyl acetate*	C18H26O2	2985	172.515	—	10486-14-3

Chart 307 Salicylates

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#	
methyl salicylate	C8H8O3	2745	—	—	119-36-8	
ethyl salicylate	C9H10O3	2458	172.515	—	118-61-6	
butyl salicylate	C11H14O3	3650	—	—	2052-14-4	
iso butyl salicylate	C11H14O3	2213	172.515	—	87-19-4	
iso amyl salicylate	C12H16O3	2084	172.515	—	87-20-7	
Phenyl salicylate	C13H10O3	3960	—	—	118-55-8	
cis-3-hexenyl salicylate	C13H16O3	4750	—	—	65405-77-8	salicylate
ortho tolyl salicylate	C14H12O3	3734	—	—	617-01-6	
benzyl salicylate	C14H12O3	2151	172.515	—	118-58-1	

Chart 308 Salicylic Aldehyde

Chemical	Empirical Formula	FEMA GRAS #	CFR	CAS#
salicylic aldehyde	C7H6O2	3004	172.515	90-02-8

Chart 309 Salts

Chemical	Empirical Formula	FEMA GRAS #	NAS #	CFR	CAS#
aluminum sulfate	AlSO4	—	11	182.1125, 582.1125, 172.892 (modified food starch)	1628-11-8
calcium acetate	Ca2C2H5O2	2228	—	184.1185, 582.6185	62-54-4
calcium carbonate	CaCO3	—	38	73.1070, 137.105, 1347.185, 137.350, 169.115, 181.29, 182.5191, 184.1191, 582.1191, 582.5191, 558.3	471-34-1
calcium citrate	Ca(C6H7O7)2	—	40	182.5195, 582.1195, 184.1195, 582.5195, 582.6195	813-94-5
calcium diphosphate (calcium pyrophosphate, or CPP)	Ca3P6O18	—	48	182.5223, 182.1223	7757-93-9 or 9790-78-3
calcium disodium EDTA	C10H12CaN2O8*2Na	—	532	155.201, 161.173, 166.173, 166.110, 169.115, 169.140, 169.150, 172.120	62-33-9
calcium gluconate	C6H12O7*1/2 Ca	—	41	150.141, 150.161, 184.1199, 582.1199, 582.6199	299-28-5
di sodium phosphate	HNa2O4P	—	—	133.169, 133.173, 135.110, 137.305, 139.110, 150.141, 150.161, 182.6290, 582.6290	7558-79-4
disodium 5′ guanylate	C10H12N5O8Na2P	3668	—	172.530	5550-12-9
disodium 5′ inosinate	C10H11N4O8Na2P	3669	—	172.535	4691-65-0
disodium succinate	C4H4Na2O4-6H2O	3277-	—	—	150-90-3
ferric ammonium citrate	unknown**Fe(15–17%), NH3(7.5–9%), Cit. (65–75%)	—	380	73.1025, 184.1296, 73.1025, 184.1296, 573.560	1185-57-5
potassium 2(1′ ethoxy) ethoxy propanoate	KC7H13O4	3752-	—	—	999999-00-3
potassium acetate	C2H4O2K	2920	—	172.515	127-08-2
potassium chloride	KCl	—	151	182.5622, 184.1622, 582.5622, 150.141, 150.161, 166.110	7447-40-7
potassium hydroxide	KOH	—	154	73.85 (caramel), 163.111 and 163.112 (chocolate and cocoa), 172.841, (polydextrose), 184.1631, 582.1631	1310-58-3
potassium sorbate	C6H7KO2	2921	—	133.118, 133.123, 133.124, 133.169, 133.173, 133.179, 133.187, 133.188, 150.141, 150.161, 582.3640	590-00-1
potassium sulfate	KSO4	—	159	582.1643	7778-80-5
sodium 2 (methoxy phenoxy) propionate	C10H11O4Na	3773-	—	—	13794-15-5
sodium acetate	C2H3NaO2	3024	—	150.141 (jelly), 150.161 (preserves), 184.1721	127-09-3
sodium ascorbate	NaC6H7O6	—	180	182.3731, 582.3731	134-03-2

Chart 309 *Continued*

Chemical	Empirical Formula	FEMA GRAS #	NAS #	CFR	CAS#
sodium benzoate	C7H5NaO2	3025	—	146,152, 146.154, 150.141, 150.161, 166.40, 166.110, 181.23, 184.1733, 582.3733	532-32-1
sodium bicarbonate	Na2HCO3	—	182	73.854, 137.180, 137.270, 155.191, 163.110, 161.111, 163.112, 184.1259, 184.1736, 582.1736	144-55-8
sodium carbonate	Na2CO3	—	185	73.85, 137.105, 163.110, 163.111, 169.115, 184.1742, 582.80, 582.1742	5968-11-6
sodium caseinate	--	—	187	—	9005-46-3
sodium chloride	NaCl	—	188	101.9, 101.22, 101.36, 101.61, 101.74, 105.69, 107.10, 107.100, 123.3, 133.118, 133.187, 133.188, 155.3, 155.191, 155.194, 155.200, 156.3, 166.110, 501.22	7647-14-5
sodium citrate	C6H5Na3O7-2H2O	3026	—	131.111, 131.112, 131.136, 131.138, 131.144, 131.146, 131.160, 131.179, 131.185, 133.169, 150.141, 150.161, 166.110, 172.1751, 173.179, 182.6751, 184.1751, 582.1751, 582.6751	68-04-2
sodium diacetate	C2H4O2*1/2Na	—	190	184.1754, 582.6754	126-96-5
sodium gluconate	C6H12O7*Na	—	191	182.6757, 582.6757	527-07-1
sodium hexameta phosphate	(NaPO3)x	3027	—	133.169, 133.173, 133.179, 150.141, 150.161, 169.115, 173.310, 182.6760, 582.6760	10124-56-8
sodium phosphate monobasic	H2PO4Na	—	198	182.5778, 582.1778	7558-80-7
sodium sulfate	Na2SO4	—	1252	73.85 (caramel), 172.615 (chewing gum), 173.165 (candida lipolytica), 178.3620 and 178.3770 (for use in tests), 186.1797	7727-73-3
tricalcium phosphate	Ca3(PO4)2	3081	—	137.105 (flour), 169.179 (vanilla powder), 182.1217, 582.1217	7758-79-4

Chart 310 Santalyl Esters

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
santalyl acetate	C17H26O2	3007	—	172.515	1323-00-8
santalyl phenyl acetate	C23H30O2	3008	—	172.515	1323-75-7

Chart 311 Sebacates

Chemical	Empirical Formula	FEMA GRAS #	NAS #	CFR	CAS#
diethyl sebacate	C14H26O4	2376	—	172.515	110-40-7
dibutyl sebacate	C18H34O4	2373	—	172.515	109-43-3

Chart 312 Sequestrants

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
ethylenediaminetetraacetic acid disodium salt	C10H14N2Na2O8+2H2O	4520	—	—	6381-92-6
sodium lauryl sulfate	C12H25NaSO4	4437	—	—	151-21-3
sodium acid phosphate or (monososium phosphate)	NaH2PO4	—	182.6085	—	7758-80-7
calcium diacetate	(CH3COO)2Ca	—	182.6197	—	62-54-4
calcium hexameta phosphate	Ca3P6O18	—	182.6203	—	—
monobasic calcium phosphate	Ca(H2PO4)2	—	182.6215	—	7758-23-6
dipotassium phosphate	K2HPO4	—	182.6285	—	7758-11-4
disodium phosphate	Na2HPO4	—	182.629, 182.6778	—	7758-79-4
sodium gluconate	NaC6H11O7	—	182.6757	—	527-07-1
sodium hexameta phosphate	Na6P6O18	—	182.676	—	10124-56-8
sodium metaphosphate	(NaPO3)n	—	182.6769	—	—
sodium phosphate or trisodium phosphate	Na3PO4	—	182.6778	—	7601-54-9
sodium pyrophosphate or tetrasodium pyrophosphate	Na4P2O7	—	182.6787, 182.6789	—	7722-88-5
sodium tripolyphosphate	Na5P3O10	—	182.6810	—	7758-29-4

Chart 313 Silica and Silicates

Chemical	Empirical Formula	FEMA GRAS #	NAS #	CFR	CAS#
calcium silicate	CaSiO3	—	—	172.410, 573.2160	10101-39-0
methylated silica	N/A	—	3185	—	681-84-5
silicon dioxide	SiO2	—	—	172.480, 573.940	7631-86-9
aluminum calcium silicate	Al2CaSiO6	—	—	182.2122, 582.2122	1327-39-5 or 12252-33-4

Chart 314 Solvents

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
propyleneglycol dibutyrate	C11H20O4	4466	—	50980-84-2	
tripropionin (glyceryl tripropionate)	C12H20O6	3286-	—	—	139-45-7
triethyl citrate	C12H20O7	3083	172.1911, 184.1191	—	77-93-0
propyleneglycol di-2-methylbutyrate	C13H24O4	4468	—	155514-30-0	
PG Dibenzoate	C14H18O4	3419-	—	19224-26-1	
tributyrin (glyceryl tributyrate)	C15H26O6	2223	184.1903, 582.6	—	60-01-5
propyleneglycol dihexanoate	C15H28O4	4470	—	50343-36-7	
propyleneglycol dioctanoate	C19H36O4	4471	—	7384-98-7	
PG Stearate	C21H42O3	2942-	—	142-75-6	
ethanol	C2H6O	2419	169.3, 169.175, 169.176, 169,177, 169.178, 169.180, 169.181, 172.340, 172.560, 184.1293	—	64-17-5
propylene glycol	C3H8O2	2940	169.175, 169.176, 169.177, 169.178, 169.180, 169.181, 184.1666, 582.4666	—	57-55-6
Propylene Glycol	C3H8O2	2940	169.175, 169.176, 169.177, 169.178, 169.180, 169.181, 184.1666, 582.46	57-55-6	
1,3-propanediol	C3H8O2	4753	504-63-2		
glycerine (glycerol)	C3H8O3	2525	169.175, 169.176, 169.177, 169.178, 169.180, 169.181, 182.90, 182.1320	—	56-81-5
propyleneglycol diacetate	C7H12O4	4464	—	623-84-7	
propyleneglycol monobutyrate	C7H14O3	4488	—	29592-95-8	
benzyl alcohol	C7H8O	2137	172.515	—	100-51-6
propyleneglycol mono-2-methylbutyrate	C8H16O3	4467	—	923593-56-0	
propyleneglycol dipropionate	C9H16O4	4465	—	10108-80-2	
propyleneglycol monohexanoate	C9H18O3	4469	—	39556-41-7	
triacetin (glyceryl triacetate)	C9H21O6	2007	184.1901	—	102-76-1
propyleneglycol dibutyrate	C11H20O4	4466	—	50980-84-2	
tripropionin (glyceryl tripropionate)	C12H20O6	3286-	—	—	139-45-7
triethyl citrate	C12H20O7	3083	172.1911, 184.1191	—	77-93-0
propyleneglycol di-2-methylbutyrate	C13H24O4	4468	—	155514-30-0	
PG Dibenzoate	C14H18O4	3419-	—	19224-26-1	
tributyrin (glyceryl tributyrate)	C15H26O6	2223	184.1903, 582.6	—	60-01-5
propyleneglycol dihexanoate	C15H28O4	4470	—	50343-36-7	
propyleneglycol dioctanoate	C19H36O4	4471	—	7384-98-7	
propyleneglycol stearate	C21H42O3	2942-	—	142-75-6	

Chart 315 Sorbates

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
methyl sorbate	C7H10O2	3714-	—	—	698-89-4
ethyl sorbate	C8H12O2	2459	172.515	—	2396-84-1
allyl sorbate	C9H12O2	2041	172.515	—	30895-79-5
propyl sorbate	C9H14O2	4614	—	—	10297-72-0

Chart 316 Chart 316 Spectrum Attribute Scale®

Hardness Intensity	Reference
1	cream cheese
4.5	American cheese slices
6	olives
9.5	peanuts
11	almonds
14.5	peppermint hard candy

Chart 317 Starter Cultures

Culture Name	Action	Examples
Starter Cultures Starter Cultures are microbiological strains that are added to foods, especially dairy products to produce cheese, butter, etc. These include:		
Brevibacterium linens	surface ripening on cheese surfaces	Brie, and other Cheeses
Lactobacillu helveticus	thermophillic lactic fermentation	Swiss Cheese, Yogurt
Lactococcus lactis		
subsp. lactis	mesophillic lactic fermentation	Cheddar, Gouda,
subsp. cremoris	slow proteolysis	Soft cheeses
subsp. diacetylactis	diacetyl production	(All)
Leuconostoc lactis	diacetyl production	Butter cultures
Priopionibacterium sp.	propionic acid production,	Swiss Cheese eye formation
Streptococcus thermophilus	lactic fermentation	Yogurt
Candida kefir	alcoholic fermentation	Kefir
Penicillium camemberti	displacement of undesirable molds,	Camembert surface ripening
Penicillium roqueforti	methyl ketone formation	Roquefort, Bleu Cheese
Bifidobacterium sp.	probiotic action	Intestine
Lactobacillus acidophilus	probiotic action	Intestine

Chart 318 Structural Character Predominance

Strength of the odor of a chemical with the following moieties;
(1) some pyrazines and mercaptans
(2) any sulfur atom
(3) triple bond aldehyde or multiple double bond aldehyde
(4) triple bond alcohol or multiple double bond alcohol
(5) double bond alcohol or double bond aldehyde
(6) ionone like structures
(7) any pyrazine, thiazole, pyrrolidine or related structures
(8) unsaturated esters, thio esters
(9) indole, skatole
(10) woody character
(11) simple phenolic structures
(12) aliphatic aldehydes
(13) lactones
(14) volatile fatty acids
(15) aromatic aldehydes
(16) esters
(17) alcohols
(18) compounds with higher molecular weight (approaching a molecular weight of 300)

Chart 319 Succinates

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
sodium succinate	C4H4Na2O4-6H2O	3277-	—	—	150-90-3
dimethyl succinate	C6H10O4	2396	—	172.515	106-65-0
diethyl succinate	C8H14O2	2377	—	172.515	123-25-1
mono menthyl succinate	C14H25O5	3810-	—	—	—

Chart 320 Sweetener Regulatory Status

Compound	Empirical Formula	FEMA GRAS #	CFR	CAS#
Lactose	C12H22O11	—	CFR73.85 (Caramel), 101.9, 131.111, 131.112, 131.136, 131.138, 131.144, 131.144, 131.146, 131.147, 131.170, 131.200, 131.203, 131.206, 133.124, 133.178, 133.179, 135.110, 135.140, 166.110, 168.122, 169.179, 173.357	63-42-3
Maltose	C12H22O11	—	CFR131.111, 131.112, 131.136, 131.138, 131.144, 131.146, 131.170, 131.200, 131.203, 131.206, 133.214, 133.178, 133.179	69-79-4
Lactitol (A dimeric sugar produced by catalytic hydrogenation of lactose)	C12H24O11-H2O	—	GRAS	585-86-4 or 81025-04-9
Mannitol	C6H14O6	—	CFR100.130, 101.9, 180.25, 582.5470	123897-58-5, or 69-65-8, or 75398-80-0, or 85085-15-0

Chart 320 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	CAS#
Sorbitol	C6H14O6	—	CFR100.130, 101.9, 184.1835, 582.5835	50-70-4
Erythritol	C4H10O4	—	GRAS	10030-58-7, or 149-32-6, or 188346-77-2
Glucose (Dextrose) Syrup	C6H12O6	—	CFR168.120, 168.121, 173.357, 182.1866, 184.1865	50-99-7 (D-glucose), or 921-60-8 (L-glucose)
Maltitol	C12H24O11	—	GRAS	585-88-6
Dextrose	C6H12O6	—	CFR73.85, 133.124, 133.178, 145.3, 145.134, 145.180, 145.180, 146.3, 146.140, 146.145, 146.146, 155.200, 168.110, 168.111, 168.120, 168.122, 169.175, 169.179	50-99-7 (D-glucose), or 921-60-8 (L-glucose)
Sucrose	C12H22O11	—	CFR73.85, 101.9, 131.111, 131.112, 131.136, 131.138, 131.144, 131.146, 131.170, 131.200, 131.203, 145.3, 145.110, 145.115, 145.120, 145.125, 145.130, 145.135, 145.140, 145.145, 145.170, 145.175, 145.180, 145.185, 145.190, 146.3, 146.114, 146.132, 146.185, 155.3, 155.200, 156.3, 170.3, 184.1854	57-50-01
Xylose	C5H10O5	3606-	—	58-86-6 (D), 609-06-3 (L), 41247-05-6 (DL)
sodium saccharine	C7H4NO3SNa	2997	145.116, 145.126, 145.131, 145.136, 145.171, 145.181, 150.140 and 150.160 (Fruit Jams and Jellies)	128-44-9
thaumatin	—	3732	—	53850-34-3
Acesulfame K (Sunnett)-Hoescht Celanese™ or (oxathiazinone dioxide K) FDA approved - heat stable	C4H4O4NSK	—	172.800	55589-62-3
Aspartame™ (l-Aspartyl l-Phenyl Alanine)dipeptide amide from l-aspartic acid and d-alanine.	C14H18N2O5	—	172.804	22839-47-0
neo Hesperidin Dihydro Chalcone	C28H36O15	3811	—	20702-77-6
Sucralose Tate & Lyle Specialty Sweeteners™ - Sugar with three hydroxyl groups replaced by tightly bound chlorine molecules. FDA approved 4/1/98 (Splenda ®)	C12H19Cl3O8	—	—	56038-13-2

Chart 320 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	CAS#
Alitame Pfizer™ - waiting FDA approval (2000 X Sucrose)	C14H25N3O4S	—	—	80863-62-3 (Hydrate 99016-42-9)
Stevia - Not approved for use in the U.S. as a sweetener but can be used as a food supplement.	—	—	—	—
naringin dihydrochalcone	C27H34O14	4495	—	18916-17-1

Chart 321 Sugar Esters

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
sucrose octa acetate	C28H38O14	3038	—	172.515	126-14-7
sucrose monopalmitate	C28H52O12	4713	—	—	26446-38-8

Chart 322 Sulfur Containing Compounds

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
		Inorganic Sulfur Compounds, Sulfates, etc.			
hydrogen sulfide	H2S	3779/CFR168.111, 168.120,172.892 (limits), 184.1095, 582.3862		7783-6-4	
Sulfur dioxide	SO2	3039	172.515, 182.3862	—	7446-9-5
ammonium sulfide	(NH4)2S	2053	172.515	—	12124-99-1
		Isothiocyanates			
Methyl isothiocyanate	C2H3NS	4426	—	—	556-61-6
Ethyl isothiocyanate	C3H5NS	4420	—	—	542-85-8
Isopropyl isothiocyanate	C4H7NS	4425	—	—	2253-73-8
allyl iso thio cyanate or (mustard oil)	C4H5NS	2034	172.515	—	57-06-7
Butyl isothiocyanate	C5H9NS	4082			592-82-5
3 methyl thio propyl isothiocyanate	C5H9NS2	3312	—	—	505-79-3
3-Butenyl isothiocyanate	C5H5NS	4418	—	—	3386-97-8
2-Butylisothiocyanate	C5H7NS	4419	—	—	4426-79-3
Isobutyl isothiocyanate	C5H9NS	4424	—	—	591-82-2
Amyl isothiocyanate	C6H11NS	4417	—	—	629-12-9
Isoamyl isothiocyanate	C6H11NS	4423	—	—	628-03-5
4-(Methylthio)butyl isothiocyanate	C6H11NS2	4414	—	—	4430-36-8
4-Pentenyl isothiocyanate	C6H9NS	4427	—	—	18060-79-2
5-Hexenyl isothiocyanate	C7H11NS	4421	—	—	49776-81-0
Hexyl isothiocyanate	C7H13NS	4422	—	—	4404-45-9

Chart 322 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
5-(Methylthio)pentyl isothiocyanate	C7H13NS2	4416	—	—	4430-42-6
Benzyl isothiocyanate	C7H5NS	4428	—	—	622-78-6
6-(Methylthio)hexyl isothiocyanate	C8H15NS2	4415			4430-39-1
		All Other Sulfur Componds			
**FEMA ruling: total of all dithiols should not exceed 1.0 ppm.					
Thioacetic acid	C2H4OS	4210	—	—	507-09-5
Methylsulfinylmethane or DMSO, Dimethyl sulfoxide	C2H6OS	3875	—	—	67-68-5
2-hydroxyethanethiol	C2H6OS	4582	—	—	60-24-2
dimethyl sulfide	C2H6S	2746	172.515	—	75-18-3
ethyl mercaptan or ethane thiol	C2H6S	4258	—	—	75-08-1
ethane dithiol	C2H6S2	3484		—	540-63-6
dimethyl disulfide	C2H6S2	3536	172.515	—	624-92-0
Methylthiomethylmercaptan	C2H6S2	4185	—	—	29414-47-9
Ethane-1,1-dithiol	C2H6S2	4111	—	—	69382-62-3
dimethyl trisulfide	C2H6S3	3275	—	—	3658-80-8
2 mercapto propionic acid (thiolactic acid)	C3H6O2S	3180	—	—	79-42-5
3-mercaptopropionic acid	C3H6O2S	4587	—	—	107-96-0
2 (methyl thio) acetaldehyde	C3H6OS	3206	—	—	23328-62-3
1-Mercapto-2-propanone	C3H6OS	3856	—	—	24653-75-6
allyl mercaptan	C3H6S	2035	172.515	—	870-23-5
2-(Methylthio)ethanol	C3H8OS	4004	—	—	5271-38-5
Methyl ethyl sulfide	C3H8S	3860	—	—	624-89-5
2-Propanethiol	C3H8S	3897	—	—	75-33-2
1,3 propanedithiol	C3H8S2	3588-**	—	—	109-80-8
1,2 propanedithiol	C3H8S2	3520-**	—	—	814-67-5
Ethyl methyl disulfide	C3H8S2	4040	—	—	20333-39-5
bis-(Methylthio)methane	C3H8S2	3878	—	—	1618-26-4
1,1-propanedithiol	C3H8S2	4670	—	—	88497-17-0
Methyl ethyl trisulfide	C3H8S3	3861	—	—	31499-71-5
Trithiahexane-2,3,5	C3H8S3	4021	—	—	42474-44-2
propanethiol	C3H9S	3521	172.515	—	107-03-9
2 mercapto 3 butanol	C4H10OS	3502	—	—	37887-04-0
3 (methyl thio) propanol	C4H10OS	3415	—	—	505-10-2
ethyl 2-hydroxyethyl sulfide	C4H10OS	4562	—	—	110-77-0
1 butane thiol	C4H10S	3478	—	—	109-79-5
2-Methyl-1-propanethiol	C4H10S	3874	—	—	513-44-0
Diethyl sulfide	C4H10S	3825	—	—	352-93-2
1,2 butane dithiol	C4H10S2	3528-**	—	—	16128-68-0
1,3 butane dithiol	C4H10S2	3529-**	—	—	24330-52-7
2,3 butane dithiol	C4H10S2	3477-**	—	—	4532-64-3
methyl propyl disulfide	C4H10S2	3201	—	—	2179-60-4
1,2-bis(methylmercapto)ethane or 2,5-dithiahexane	C4H10S2	4298	—	—	6628-18-8
methyl propyl trisulfide	C4H10S3	3308	—	—	17619-36-2
3-(methylthio)propylamine	C4H11NS	4649	—	—	4104-45-4
thienyl mercaptan*	C4H4S2	3062	172.515	—	7774-74-5

Chart 322 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
2 thienyl mercaptan*	C4H4S2	3062	172.515	—	7774-74-5
4,5 dihydro 3(2H) thiophenone	C4H6OS	3266	—	—	1003-04-9
2-oxothiolane	C4H6OS	4570	—	—	1003-10-7
4-methyl-3-thiazoline	C4H7NS	4644	—	—	52558-99-3
2,5-Dihydroxy-1,4-dithiane	C4H8O2S2	3826	—	—	40018-26-6
2 keto 4 butane thiol	C4H8OS	3357	—	—	34619-12-0
4 mercapto 2 butanone (2 keto 4 butane thiol)	C4H8OS	3298	—	—	40789-98-8
3 (methyl thio) propanal	C4H8OS	2747	172.515	—	3268-49-3
1-Methylthio-2-propanone	C4H8OS	3882	—	—	14109-72-9
1-(methyldithio)-2-propanone	C4H8OS2	4696	—	—	122861-78-3
methyl 1-propenyl sulfide	C4H8S	4574	—	—	10152-77-9
methyl 1 propenyl disulfide	C4H8S2	3576	—	—	5905-47-5
allyl methyl disulfide	C4H8S2	3127	—	—	2179-58-0
2 methyl 1,3 dithiolane	C4H8S2	3705	—	—	5616-51-3
1,4-Dithiane	C4H8S2	3831	—	—	505-29-3
Diethyl disulfide	C4H8S2	4093	—	—	110-81-6
allyl methyl trisulfide	C4H8S3	3253	—	—	34135-85-8
3,5 dimethyl 1,2,4 trithiolane	C4H8S3	3541	—	—	23654-92-4
3 methyl 1,2,4 trithiane	C4H8S3	3718	—	—	43040-01-3
Diethyl trisulfide	C4H8S3	4029	—	—	3600-24-6
3 mercapto 2 pentanone	C5H10OS	3300	—	—	67633-97-0
3 (methyl thio) butanal	C5H10OS	3374	—	—	16630-52-7
4 (methyl thio) 2 butanone	C5H10OS	3375	—	—	3407-39-7
4-(Methylthio)-2-pentanone	C5H10OS	4182	—	—	143764-28-7
4-Mercapto-2-pentanone	C5H10OS	4157	—	—	92585-08-5
3-(Methylthio)-2-butanone	C5H10OS	4181	—	—	53475-15-3
2-Methyl-2-(methyldithio) propanal	C5H10OS2	3866	—	—	67952-60-7
cyclopentane thiol	C5H10S	3262	—	—	1679-07-8
4 (methyl thio) butanal	C5H10S	3414	—	—	42919-64-2
1-Buten-1-yl methyl sulfide	C5H10S	3820	—	—	32951-19-2
Prenylthiol, ′3-Methyl-2-butenyl mercaptan	C5H10S	3896	—	—	5287-45-6
1 (methyl thio) 2 butanone	C5H10SO	3207	—	—	13678-58-5
4 (methyl thio) butanol	C5H12OS	3600	—	—	999999-26-9
erythro and *threo*-3-mercapto-2-methylbutan-1-ol, or 1-butanol, 3-mercapto-2-methyl-3-mercapto-2-methylbutyl alcohol	C5H12OS	3993	—	—	227456-33-9
4-mercapto-3-methyl-2-butanol	C5H12OS	4698	—	—	33959-27-2
(±)-3-mercapto-1-pentanol	C5H12OS	4792	—	—	548740-99-4
2 methyl 1 butane thiol	C5H12S	3303	—	—	1878-18-8
2 pentane thiol	C5H12S	3792	—	—	2084-19-7
3 methyl 2 butane thiol	C5H12S	3304	—	—	2084-18-6
3-Methylbutanethiol	C5H12S	3858	—	—	541-31-1

Chart 322 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
amyl mercaptan or 1-pentanethiol	C5H12S	4333	—	—	110-66-7
3-pentanethiol	C5H12S	4694	—	—	616-31-9
Ethyl propyl disulfide	C5H12S2	4041	—	—	30453-31-7
Ethyl propyl trisulfide	C5H12S3	4042	—	—	31499-70-4
4-(Methylthio)-2-oxobutanoic acid	C5H7O3S	3881	—	—	583-92-6
2 methyl tetrahydro thiophenone	C5H8OS	3512	—	—	13679-85-1
Butyl isothiocyanate	C5H9NS	4082	—	—	592-82-5
3 methyl thio propyl iso thio cyanate	C5H9NS2	3312	—	—	505-79-3
methyl thio 2 (acetyl oxy) propionate *	C6H10O3S	3788	—	—	74589-09-7
allyl sulfide	C6H10S	2042	172.515	—	592-88-1
Di-(1-propenyl)-sulfide (mixture of isomers)	C6H10S	4386	—	—	65819-74-1, 37981-37-6, 37981-36-5
allyl disulfide	C6H10S2	2028	172.515	—	2179-57-9
diallyl trisulfide	C6H10S3	3265	—	—	2050-87-5
diallyl polysulfides	C6H10Sx = 2,3,4,OR 5	3533	—	—	72869-75-1
3-(allylthio)-alanine or S-allyl-L-cysteine	C6H11NO2S	4322	—	—	21593-77-1
2-ethyl-2,5-dihydro-4-methylthiazole	C6H11NS	4695	—	—	41803-21-8
2 (methyl thio) methyl 2 butenal	C6H11OS	3601	—	—	40878-72-6
5,7 dihydro 2 methyl thieno (3, 4d) pyrimidine	C6H12N2S	3338	—	—	36267-71-7
(+/−) Ethyl 3-mercaptobutyrate	C6H12O2S	3977	—	—	156472-94-5
2,5 dihydroxy 2,5 dimethyl 1,4 dithiane (2,5 dimethyl 2,5 dihydroxy 1,4 dithiane)	C6H12O2S2	3450	—	—	55704-78-4
4-Mercapto-4-methyl-2-pentanone	C6H12OS	3997	—	—	19872-52-7
propenyl propyl disulfide	C6H12S2	3227	—	—	5905-46-4
Methyl 3-methyl-1-butenyl disulfide	C6H12S2	3865	—	—	999999-91-3
Allyl propyl disulfide (a.k.a. Art. Onion Oil)	C6H12S2	4073	—	—	2179-59-1
Amyl methyl disulfide	C6H12S2	4025	—	—	72437-68-4
Butyl ethyl disulfide	C6H12S2	4027	—	—	63986-03-8
(+/−)-3,5-Diethyl-1,2,4-trithiolane	C6H12S3	4030	—	—	54644-28-9
Mixture of 3,6-Diethyl-1,2,4,5-tetrathiane and 3,5-diethyl-1,2,4-trithiolane	C6H12S4 and C6H10O2	4094	—	—	54717-12-3 54644-28-9

Chart 322 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
2-Methyl-1-methylthio-2-butene	C6H13S	4173	—	—	89534-74-7
methoxy methyl butane thiol	C6H14OS	3785	—	—	94087-83-9
(+/−)2-Mercapto-2-methylpentan-1-ol	C6H14OS	3995	—	—	258823-39-1
(+/−)-4-Mercapto-4-methyl-2-pentanol	C6H14OS	4158	—	—	31539-84-1
3-Mercapto-2-methylpentan-1-ol (racemic)	C6H14OS	3996	—	—	227456-27-1
3-Mercaptohexanol	C6H14OS	3850	—	—	51755-83-0
(+/−)-3-(ethylthio)butanol	C6H14OS	4282	—	—	117013-33-9
1-Hexanethiol	C6H14S	3842	—	—	111-31-9
2(3)-hexanethiol	C6H14S	4782	—	—	1679-06-7; 1633-90-5
1,6 hexane dithiol	C6H14S2	3495-**	—	—	1191-43-1
propyl disulfide	C6H14S2	3228	172.515	—	629-19-6
Methyl isopentyl disulfide	C6H14S2	4168	—	—	72437-56-0
Diisopropyl disulfide	C6H14S2	3827	—	—	4253-89-8
dipropyl trisulfide	C6H14S3	3276	—	—	6028-61-1
Diisopropyl trisulfide	C6H14S3	3968	—	—	5943-34-0
1,1′-thiobis-1-propanethiol or bis(1-mercaptopropyl)sulfide	C6H14S3	4297	—	—	53897-60-2
5 methyl 2 thiophene carboxaldehyde	C6H6OS	3209	—	—	13679-70-4
2,6 thio phenol (benzene thiol)	C6H6S	3616	172.515	—	108-98-5
2 methyl 5 thio methyl furan	C6H80S	3366	—	—	13678-59-6
2,5 dimethyl 3 furan thiol	C6H8OS	3451	—	—	55764-23-3
5-methylfurfurylmercaptan	C6H8OS	4697	—	—	59303-05-8
3,4-dimethylthiophene	C6H8S	4645	—	—	632-15-5
3-(Methylthio)methylthiophene	C6H8S2	4184	—	—	61675-72-7
1-(2-thienyl)ethanethiol	C6H8S2	4646	—	—	94089-02-8
1-(3,4-Dihydro-2H-1,4-thiazin-5-yl)ethanone or 5-Acetyl-2,3-dihydro-1,4-thiazine	C6H9NOS	4296	—	—	164524-93-0
5-Ethyl-2-methylthiazole	C6H9NS	4388	—	—	19961-52-5
2-Methyl-3-furyl methylthiomethyl disulfide	C7H11OS3	4320	—	—	333384-99-9
methyl thio 2(propionyl oxy) propionate *	C7H12O3S	3790	—	—	999999-90-9
2-isopropyl-4-methyl-3-thiazoline	C7H13NS	4767	—	—	67936-13-4
2(4)-ethyl-4(2),6-dimethyldihydro-1,3,5-dithiazine (mixture of isomers)	C7H13NS2	4667	—	—	54717-13-4
4 (methyl thio) 4 methyl 2 pentanone	C7H14OS	3376	—	—	23550-40-5
3-Methylthiohexanal	C7H14OS	3877	—	—	38433-74-8
4-mercapto-4-methyl-2-hexanone	C7H14OS	4583	—	—	851768-52-0

Chart 322 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
5-mercapto-5-methyl-3-hexanone	C7H14OS	4769	—	—	851768-51-9
(±)-2-mercaptoheptan-4-ol	C7H16O	4733	—	—	1006684-20-3
3 (methyl thio) 1 hexanol	C7H16OS	3438	—	—	51755-66-9
2-Heptanethiol	C7H16S	4128	—	—	628-00-2
1-heptylthiol or 1 heptane thiol	C7H16S	4259	—	—	1639-09-4
mixture of butyl propyl disulfide and propyl and butyl disulfide	C7H16S2	4577	—	—	72437-64-0
2,4,6-Trithiaheptane	C7H16S3	4214	—	—	6540-86-9
2-acetyl-5-methylthiophene	C7H8OS	4643	—	—	13679-74-8
2 methyl thio phenol (erroneously called ortho toluene thiol)	C7H8OS	3240	—	—	137-06-4
ortho (methyl thio) phenol, or (thioguaiacol)	C7H8OS	3210	—	—	1073-29-6
2-Mercaptoanisole	C7H8OS	4159	—	—	7217-59-6
benzyl mercaptan (alpha toluene thiol)	C7H8S	2147	172.515	—	100-53-8
benzyl mercaptan	C7H8S	2147	172.515	—	100-53-8
Methyl phenyl sulfide	C7H8S	3873	—	—	100-68-5
Methyl phenyl disulfide	C7H8S2	3872	—	—	14173-25-2
2-(4-Methyl-5-thiazolyl)ethyl formate	C7H9NO2S	4275	—	—	90731-56-9
1-(3-Hydroxy-5-methyl-2-thienyl)ethanone	C7H9O2	4142	—	—	133860-42-1
3 acetyl 2,5 dimethyl thiophene	C8H10OS	3527	—	—	2530-10-1
2,6 dimethyl thio phenol	C8H10S	3666	—	—	1197-01-9
2 ethyl thio phenol	C8H10S	3345	—	—	4500-58-7
methyl benzyl disulfide	C8H10S	3504	—	—	699-10-5
Phenylethyl mercaptan	C8H10S	3894	—	—	4410-99-5
methyl 2-methylphenyl disulfide	C8H10S2	4579	—	—	35379-09-0
benzyl methyl sulfide	C8H11S	3597	—	—	766-92-7
Furfuryl propyl disulfide	C8H12OS2	3979	—	—	252736-36-0
2-pentylthiazole	C8H13NS	4641	—	—	37645-62-8
(+/−)-1-Phenylethylmercaptan	C8H13S	4061	—	—	6263-65-6
di (butane 3 one 1 yl) sulfide	C8H14O2S	3335	—	—	40790-04-3
3-(acetylthio)hexanal	C8H14O2S	4791	—	—	22236-44-8
methialdol (2,8 dithianon 4 en 4 carboxaldehyde	C8H14OS2	3483	—	—	59902-01-1
Tetrahydro-2,4-dimethyl-4H-pyrrolo[2,1-d] -1,3,5-dithiazine or Pyrrolidino-[1,2E]-4H-2,4-dimethyl-1,3,5-dithiazine	C8H15NS2	4321	—	—	116505-60-3
2 methyl 4 propyl 1,3 oxathiane	C8H16OS	3578	—	—	67715-80-4
(+/−)-Isobutyl 3-methylthiobutyrate	C8H16OS	4150	—	—	127931-21-9

Chart 322 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
(±)-4-methyl-2-propyl-1,3-oxathiane	C8H16OS	4677	—	—	1064678-08-5
(±)-2-mercapto-5-methylheptan-4-one	C8H16OS	4779	—	—	1416051-88-1
2 (4) isopropyl 4(2),6 dimethyl dihydro 4H 1,3,5 dithiazine	C8H17NS2	3782	—	—	104691-41-0
2 (4) isopropyl 4(2),6 dimethyl dihydro 4H 1,3,5 dithiazine	C8H17NS2	3782	—	—	104691-41-0
methional diethyl acetal	C8H18O2S	4590	—	—	16630-61-8
(+/−)-3-(Methylthio)heptanal	C8H18OS	4183	—	—	51755-70-5
alpha methyl beta hydroxy propyl alpha methyl beta thio propyl sulfide*	C8H18OS2	3509	—	—	54947-02-7
alpha methyl beta hydroxy propyl alpha methyl beta thio propyl sulfide	C8H18OS2	3509	—	—	54957-02-7
butyl sulfide	C8H18S	2215	172.515	—	544-40-1
2-Ethylhexanethiol	C8H18S	3833	—	—	7341-17-5
1,8 octane dithiol	C8H18S2	3514-**	—	—	1191-62-4
di-sec-butyl disulfide	C8H18S2	4578	—	—	5943-30-6
(*S*1)-Methoxy-3-heptanethiol	C8H19OS	4162	—	—	400052-49-5
2 thienyl disulfide (2,2′ dithio dithiophene)	C8H6S4	3323	—	—	6911-51-9
4-amino-5,6-dimethylthieno[2,3-d] pyrimidin-2(1h) one and 4-amino-5,6-dimethylthieno[2,3-d] pyrimidin-2(1h)one hydrochloride	C8H9N3OS	4669	—	—	121746-18-7
2-(4-Methyl-5-thiazolyl)ethyl propionate	C9H13NO2S	4276	—	—	324742-96-3
2-pentylthiophene	C9H14S	4387	—	—	4861-58-9
4,5-dimethyl-2-isobutylthiazole	C9H15NS	4647	—	—	53498-32-1
4-methyl-2-(methylthiomethyl)-2-hexenal	C9H16OS	4566	—	—	99910-84-6
5-methyl-2-(methylthiomethyl)-2-hexenal	C9H16OS	4567	—	—	85407-25-6
1-(methylthio)-3-octanone	C9H18OS	4707	—	—	61837-77-2
trithioacetone	C9H18S3	3475	—	—	828-26-2
triethylthialdine	C9H19NS2	4748	—	—	54717-17-8
2 (4) isobutyl 4(2), 6 dimethyl dihydro 4H 1,3,5 dithiazine	C9H19NS2	3781	—	—	101517-87-7
methyl octyl sulfide	C9H20S	4573	—	—	3698-95-1
1,9 nonane dithiol	C9H20S2	3513-**	—	—	3489-28-9

Chart 322 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
3,3′ dithio bis (2 methyl furan), or (bis (2 methyl 3 furyl) disulfide	C10H10O2S2	3259	—	—	57500-00-2
2,2′ (dithio dimethylene) difuran	C10H10O2S2	3146	—	—	4437-20-1
Furfuryl 2-methyl-3-furyl disulfide	C10H10O2S2	4119	—	—	109537-55-5
2-(4-Methyl-5-thiazolyl)ethyl butanoate	C10H15NO2S	4277	—	—	94159-31-6
2-(4-Methyl-5-thiazolyl)ethyl isobutyrate	C10H15NO2S	4278	—	—	94021-42-8
spiro [2,4 dithia 1 methyl 8 oxa bicyclo [3.3.0] octane 3,3′ (1′ oxa 2′ methyl) cyclo-pentane] PLUS spiro [dithia 6 methyl 7 oxa bicyclo [3.3.0] octane 3,3′ (1′ oxa 2 methyl)] cyclopentane]	C10H16O2S2	3270	—	—	38325-25-6
2-Hexylthiophene	C10H16S	4137	—	—	18794-77-9
para mentha 8 thiol 3 one (black currant flavor, in buchu leaf oil)	C10H18OS	3177	—	—	38462-22-5
Z- and E-l-Mercapto-p-menthan-3-one or cis- and trans-l-Mercapto-p-menthan-3-one	C10H18OS	4300	—	—	29725-66-4
2,3 or 10 mercapto pinane (pinanyl mercaptan)	C10H18S	3503	—	—	23832-18-0
thio geraniol (mixed trans & cis isomers)	C10H18S	3472	—	—	39067-80-6
1 para menthene 8 thiol (found in grapefruit juice)	C10H18S	3700	—	—	71159-90-5
Z- and E-5-Ethyl-4-methyl-2-(2-butyl)-thiazoline or cis- and trans-5-Ethyl-4-methyl-2-(2-butyl)-thiazoline	C10H19NS	4318	—	—	83418-54-6
Z- and E-5-Ethyl-4-methyl-2-(2-methylpropyl)-thiazoline or cis and trans-5-Ethyl-4-methyl-2-(2-methylpropyl)-thiazoline	C10H19NS	4319	—	—	83418-53-5
(+/−)-2,8-Epithio-*cis*-*p*-menthane or Zestoril or Thiocineole	C10H19OS	4108	—	—	68398-18-5
2-(5-isopropyl-2-methyltetrahydrothiophen-2-yl)ethanol	C10H19OS	4813	—	—	1612888-42-2
diisoamyl disulfide	C10H22S2	4575	—	—	2051-04-9

Chart 322 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
diisoamyl trisulfide	C10H22S3	4580	—	—	955371-64-9
2 naphthyl mercaptan (naphthalene thiol)	C10H8S	3314	—	—	91-60-1
2 (methyl thio methyl) 3 phenyl propenal	C11H12OS	3717	—	—	65887-08-3
3-(methylthio)decanal	C11H22OS	4734	—	—	1256932-15-6
di phenyl disulfide	C12H10S2	3225	—	—	882-33-7
bis (2,5 dimethyl 3 furyl) disulfide	C12H14O2S2	3476	—	—	28588-73-0
2-(4-Methyl-5-thiazolyl)ethyl hexanoate	C12H19NO2S	4279	—	—	94159-32-7
di cyclohexyl disulfide	C12H22O2	3448	—	—	2550-40-5
2-pentenyl-4-propyl-1,3-oxathiane (mixture of isomers)	C12H22OS	4526	—	—	1094004-39-3
(+/−)-cis- and trans-2-pentyl-4-propyl-1,3-oxathiane	C12H24O8	4499	—	—	59323-81-8
dodecanethiol	C12H26S	4581	—	—	112-55-0
(+/−)-2,6,10,10-tetramethyl-1-oxaspiro[4,5] deca-2,6-dien-8-one	C13H18O2	4662	—	—	80722-28-7
benzyl disulfide	C14H14S2	3617	172.515	—	150-60-7
bis(2-methylphenyl) disulfide	C14H14S2	4576	—	—	4032-80-8
2-(4-Methyl-5-thiazolyl)ethyl octanoate	C14H23NO2S	4280	—	—	163266-17-9
1-(3-(methylthio)-butyryl)-2,6,6-trimethylcyclohexene	C14H24OS	4569	—	—	68697-67-6
alpha-bisabolol	C15H26O	4666	—	—	23089-26-1
2,4,6-Triisobutyl-5,6-dihydro-4H-1,3,5-dithiazine	C15H31NS2	4017	—	—	74595-94-1
2-(4-Methyl-5-thiazolyl)ethyl decanoate	C16H27NO2S	4281	—	—	101426-31-7

Chart 323 Sulfur Containing Esters

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS #	CAS#
For sulfur containing furyl compounds also look under furyl compound.					
Sodium 3-mercaptooxopropionate	C3H3O3S	3901	—	—	10255-67-1
S-Methyl thioacetate	C3H6O2S	3876	—	—	1534-08-3
S-Methyl propanethioate	C4H11S	4172	—	—	5925-75-7
Methyl (methylthio)acetate	C4H8O2S	4003	—	—	16630-66-3
ethyl thio acetate	C4H8OS	3282	—	—	625-60-5
ethyl 3 mercapto propionate	C5H10O2S	3677	—	—	5466-6-8

Chart 323 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS #	CAS#
ethyl 2 mercapto propionate	C5H10O2S	3279	—	—	19788-49-9
methyl 3 methyl thio propionate	C5H10O2S	2720	172.515	—	13532-18-8
Ethyl 2-(methylthio)acetate	C5H10O2S	3835	—	—	4455-13-4
Methyl 3-mercaptobutanoate	C5H10O2S	4167	—	—	54051-19-3
2-(methylthio)ethyl acetate	C5H10O2S	4560	—	—	5862-47-5
methyl thio butyrate	C5H10OS	3310	—	—	2432-51-1
propyl thioacetate	C5H10OS	3385	—	—	2307-10-0
3-Mercapto-3-methyl-1-butanol	C5H10OS	3854	—	—	34300-94-2
methyl isobutanethioate	C5H10OS	4586	—	—	42075-42-3
ethyl 3-(methylthio)-cis-2-propenoate	C6H10O2S	4563	—	—	136115-66-7
ethyl 3-(methylthio)-trans-2-propenoate	C6H10O2S	4564	—	—	26398-93-6
ethyl 3-(methylthio)-2-propenoate	C6H10O2S	4565	—	—	77105-51-2
methyl thio 2 (acetyl oxy) propionate*	C6H10O3S	3788	—	—	74586-09-7
allyl thio propionate	C6H10OS	3329	—	—	41820-22-8
S-ethyl 2-acetylamino ethanethioate or N,S-Diacetylcysteamine	C6H11NO2S	4039	—	—	4396-62-7
3-Mercaptobutyl acetate or (+/−)-3-Mercapto-1-butyl acetate	C6H12O2S	4325	—	—	89534-38-3
methyl 4 methyl thio butyrate	C6H12O2S	3412	—	—	53053-51-3
ethyl 3 methyl thio propionate	C6H12O2S	3343	—	—	13327-56-5
(+/−) Ethyl 3-mercaptobutyrate	C6H12O2S	3977	—	—	156472-94-5
3-Mercapto-3-methylbutyl formate	C6H12O2S	3855	—	—	50746-10-6
Methyl 3-(methylthio)butanoate	C6H12O2S	4166	—	—	207983-28-6
Methylthiomethyl butyrate	C6H12O2S	3879	—	—	74758-93-3
ethyl 2-mercapto-2-methylpropionate	C6H12O2S	4714	—	—	33441-50-8
Ethyl 2-(methyldithio)propionate	C6H12O2S2	3834	—	—	23747-43-5
3-(methylthio)propyl mercaptoacetate	C6H12O2S2	4561	—	—	852997-30-9
methyl 2 methyl thio butyrate	C6H12OS	3708	—	—	42075-45-6
3-Mercapto-2-methylpentanal	C6H12OS	3994	—	—	227456-28-2
S-Methyl 3-methylbutanethioate	C6H12OS	3864	—	—	23747-45-7
S-Propyl propane-1-sulfonothioate or Propyl propane thiosulfonate	C6H14O2S2	4263	—	—	1113-13-9
methyl 2 thio furoate	C6H6O2S	3311	—	—	13679-61-3
furfuryl thio acetate	C6H8O2S	3162	—	—	13678-68-7
(±)-2-methyltetrahydrofuran-3-thiol acetate	C7H12O2S	4686	—	—	252736-41-7
methyl thio 2(propionyl oxy) propionate*	C7H12O3S	3790	—	—	999999-90-9
prenyl thioacetate	C7H12OS	3895	—	—	33049-93-3
ethanethioic acid, S-(2-methyl-3-furanyl) ester	C7H13O3S	3973	—	—	55764-25-5
ethyl 4(methyl thio) butyrate	C7H14O2S	3681	—	—	22014-48-8
ethyl 3-(methylthio)butyrate	C7H14O2S	3836	—	—	999999-91-1
S-methyl hexanethioate	C7H14O2S	3862	—	—	2432-77-1
(+–)-ethyl 3-mercapto-2-methylbutanoate	C7H14O2S	4392	—	—	CAS Number pending
3-mercapto-3-methylbutyl acetate or 3-Mercapto-3-methyl-1-butyl acetate	C7H14O2S	4324	—	—	50746-09-3

Chart 323 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS #	CAS#
(+–)-Ethyl 3-mercapto-2-methylbutanoate	C7H14O2S	4392	—	—	CAS Number pending
S-Methyl 4-methylpentanethioate	C7H14OS	3867	—	—	61122-71-2
2-(4-Methyl-5-thiazolyl)ethyl formate	C7H9NO2S	4275	—	—	90731-56-9
2,5-dimethyl-3-furanthiol acetate	C8H10O3S	4034	—	—	55764-22-2
O-ethyl *S*-(2-furylmethyl)thiocarbonate	C8H10O3S	4043	—	—	376595-42-5
cis and *trans*-2,5-dimethyltetrahydro-3-furyl thioacetate	C8H11O2S	3972			252736-39-3
2-tetrahydrofurfuryl 2-mercaptopropionate	C8H14O3S	4535	—	—	99253-91-5
S-Isopropyl 3-methylbut-2-enethioate	C8H14OS	4260	—	—	34365-79-2
butyl beta-(methylthio)acrylate	C8H14OS	4571	—	—	77105-53-4
Methionyl butyrate	C8H15O2S	4160	—	—	16630-60-7
3-Mercaptohexyl acetate	C8H16O2S	3851	—	—	136954-20-6
Ethyl 5-(methylthio)valerate	C8H16O2S	3978	—	—	233665-98-0
Methylthiomethyl hexanoate	C8H16O2S	3880	—	—	74758-91-1
ethyl 3-(ethylthio)butyrate	C8H16O2S	4572	—	—	90201-28-8
S-Methyl benzothioate	C8H9S	3857	—	—	5925-68-8
methyl 3-(furfurylthio)propionate	C9H12O3S	4538	—	—	94278-26-9
2-(4-Methyl-5-thiazolyl)ethyl propionate	C9H13NO2S	4276	—	—	324742-96-3
prenyl thioisobutyrate	C9H16OS	4760	—	—	53626-94-1
Allyl thiohexanoate	C9H16O2S	4076	—	—	156420-69-8
3 (methyl thio) hexyl acetate	C9H18O2S	3789	—	—	51755-85-2
(+/–)-Isobutyl 3-methylthiobutyrate	C9H18O2S	4150	—	—	127931-21-9
3-Mercaptoheptyl acetate	C9H18O2S	4289	—	—	548774-80-7
ethyl 3(furfuryl thio) propionate	C10H14O3S	3674	—	—	94278-27-0
2-(4-Methyl-5-thiazolyl)ethyl butanoate	C10H15NO2S	4277	—	—	94159-31-6
2-(4-Methyl-5-thiazolyl)ethyl isobutyrate	C10H15NO2S	4278	—	—	94021-42-8
prenyl thioisovalerate	C10H18OS	4761	—	—	75631-91-3
3-Acetylmercaptohexyl acetate	C10H20O2S	3816	—	—	136954-25-1
3-Mercaptohexyl butyrate	C10H20O2S	3852	—	—	136954-21-7
3-(methylthio)propyl hexanoate	C10H20O2S	4436	—	—	906079-63-8
3-mercapto-3-methylbutyl isovalerate	C10H20O2S	4584	—	—	612071-27-9
o-ethyl s-1-methoxyhexan-3-yl carbonothioate	C10H20O3S	4730	—	—	1241905-19-0
2-ethylhexyl 3-mercaptopropionate	C11H22O2S	4588	—	—	50448-95-8
2-(4-Methyl-5-thiazolyl)ethyl hexanoate	C12H19NO2S	4279	—	—	94159-32-7
3-Mercaptohexyl hexanoate	C12H24O2S	3853	—	—	136954-22-8
2-(4-Methyl-5-thiazolyl)ethyl octanoate	C14H23NO2S	4280	—	—	163266-17-9
2-(4-Methyl-5-thiazolyl)ethyl decanoate	C16H27NO2S	4281	—	—	101426-31-7

Chart 324 Sulfur Containing Furans

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS #	CAS#
2 methyl 3 tetrahydro furan thiol	C5H10OS	3787-	—	—	57124-87-5
2 methyl 3 furan thiol	C5H6OS	3188-	—	—	28588-74-1
furfuryl mercaptan	C5H6OS	2493-	—	—	98-02-2
1-(2-furfurylthio)-propanone	C5H8O2	4676	—	—	58066-86-7
2-methyl-4,5-dihydrofuran-3-thiol	C5H8OS	4683	—	—	26486-13-5
cis and *trans*-2,5-dimethyltetrahydrofuran-3-thiol	C6H12OS	3971	—	—	26486-21-5
furan methane thiol formate	C6H6O2S	3158-	—	—	59020-90-5
2,5 dimethyl furan thiol	C6H8OS	3451-	—	—	55764-23-3
furfuryl methyl sulfide	C6H8OS	3160-	—	—	1438-91-1
2 methyl 5 (methyl thio) furan	C6H8OS	3366-	—	—	13678-59-6
2-Methyl-3-(methylthio)furan	C6H8OS	3949	—	—	63012-97-5
methyl 2 methyl 2 furyl disulfide	C6H8OS2	3573-	—	—	65505-17-1
2 methyl 3 thio acetoxy 4,5 dihydrofuran	C7H10O2S	3636-	—	—	26486-14-6
(±)-2-methyltetrahydrofuran-3-thiol acetate	C7H12O2S	4686	—	—	252736-41-7
Ethanethioic acid, S-(2-methyl-3-furanyl) ester	C7H13O3S	3973	—	—	55764-25-5
2,5-Dimethyl-3-furanthiol acetate	C8H10O3S	4034	—	—	55764-22-2
cis and *trans*-2,5-dimethyltetrahydro-3-furyl thioacetate	C8H11O2S	3972	—	—	252736-39-3
furfuryl isopropyl sulfide	C8H12OS	3161-	—	—	1883-78-9
propyl 2 methyl 3 furyl disulfide	C8H12OS2	3607-	—	—	61197-09-9
2-tetrahydrofurfuryl 2-mercaptopropionate	C8H14O3S	4535	—	—	99253-91-5
3-[(2-Methyl-3-furyl)thio]-2-butanone	C9H12O2S	4056	—	—	61295-44-1
3-[(2-methyl-3-furyl)thio]butanal	C9H12O2S	4501	—	—	915971-43-6
methyl 3-(furfurylthio)propionate	C9H12O3S	4538	—	—	94278-26-9
2, 2′ (dithio dimethylene) difuran (bis 2 furfuryl disulfide)	C10C10O2S2	3146-	—	—	4437-20-1
difurfuryl monosulfide (2, 2′ (thio dimethylene) difuran)	C10H10O2S	3238-	—	—	13678-67-6
bis (2 methyl 3 furyl) disulfide	C10H10O2S2	3259-	—	—	28588-75-2
bis (2 methyl 3 furyl) tetrasulfide (tetra thio bis (2-methyl furan)	C10H10O2S4	3260-	—	—	28588-20-1
4-[(2-Furanmethyl)thio]-2-pentanone	C10H14O2S	3840	—	—	180031-78-1
2-methyl-3-furyl 2-methyl-3-tetrahydrofuryl disulfide	C10H14O2S2	4545	—	—	252736-40-6
2,5 dimethyl 3 thio furoyl furan	C11H10O3S	3481-	—	—	65505-16-0
2,5 dimethyl 3 thio isovaleryl furan	C11H16O2S	3482-	—	—	55764-28-8
bis (2,5 dimethyl 3 furyl) disulfide	C12H14O2S2	3476-	—	—	28588-73-0
3 (2 methyl 3 furyl) thio 4 heptanone	C12H18O2S	3570-	—	—	61295-41-8
4 (2 methyl 3 furyl) thio 5 nonanone	C14H22O2S	3571-	—	—	61295-50-9
2,6 dimethyl 3[(2 methyl 3 furyl) thio] 4 heptenone	C14H22O2S	3538-	—	—	61295-51-0

Chart 325 Sulfur Containing Vitamins

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS #	CAS#
Vitamin U (dl (3 amino 3 carboxy propyl) dimethyl sulfonium chloride	C6H14NO2SCl	3445-	—	—	1115-84-0
Thiamine hydrochloride	C12H17N4OS-HCl	3322	172.5875, 184.1875	—	67-03-8

Chart 326 Tartrates

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
diethyl tartrate	C8H14O6	2378	—	172.515	87-91-2

Chart 327 Terpenes and Related Compounds

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
terpenes					
para alpha dimethyl styrene	C10H12	3144-	—	—	1195-32-0
para mentha 1,3 diene (alpha terpinene)	C10H16	3558	—	172.515	99-86-5
para mentha 1,4 diene (gamma terpinene)	C10H16	3559	—	172.515	99-85-4
camphene	C10H16	2229	—	172.515	79-92-5
ocimene (3,7 dimethyl 1,3,6 octatriene)	C10H16	3539-	—	—	13877-91-3
myrcene	C10H16	2762	—	172.515	123-35-3
d-limonene	C10H16	2633	—	182.20, 582.20, 182.60, 582.60 (d, dl and l forms)	5989-27-5
alpha phellandrene	C10H16	2856	—	172.515	99-83-2
alpha pinene (2 pinene)	C10H16	2902	—	172.515	80-56-8
beta pinene (nor pinane)	C10H16	2903	—	172.515	127-91-3
para cymene	C10H14	2356	—	172.515	99-87-6
terpinolene	C10H16	3046	—	172.515	586-62-9
alpha terpinene	C10H16	3558	—	172.515	99-86-5
gamma terpinene	C10H16	3559	—	172.515	99-85-4
delta-3-Carene	C10H16	3821	—	—	13466-78-9
sesquiterpenes					
alpha-Farnesene or 'trans-2,6,10-Trimethyl-2,6,9,11-dodecatetraene	C15H24	3839	—	—	502-61-4
beta caryophyllene	C15H24	2252	—	172.515	87-44-5
bisabolene (1 methyl 4 (1,5 dimethyl 1,4 hexadienyl) 1 cyclohexene) (also: limene)	C15H24	3331-	—	—	495-62-5
cadinene	C15H24	—	—	172.515	219350-73-0
cedrene	C15H24	—	—	172.515	11028-42-5
valencene	C15H24	3443	—	—	4630-7-3

Chart 328 Terpenes - Oxegynated etc

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
nerol oxide (2,6 dihydro 4-methyl 2-(2 methyl propen 1-yl) 2H pyran)	C10H16O	3661	—	—	1786-08-9
eugenol	C10H12O	2467	184.1257, 582.60	—	97-53-0
estragole (para methoxy allyl benzene)	C10H12O	2411	172.515, 182.20	—	140-67-0
thymol	C10H14O	3066	172.515	—	89-83-8
carvacrol (hydroxy cymene)	C10H14O	2245	172.515	—	499-75-2
para alpha, alpha trimethyl benzyl alcohol (para cymene 8 ol)*	C10H14O	3242	—	—	1197-01-9
para mentha 1,8 dien 7 al (perilla aldehyde)	C10H14O	3557	—	—	2111-75-3
para mentha 1,4(8) diene 3 one (piperitenone)	C10H14O	3560	—	—	491-09-8
carvone	C10H14O	2249	182.60, 582.60	—	99-49-0
Verbenone or Bicyclo[3.1.1]hept-3-en-2-one, 4,6,6-trimethyl-	C10H14O	4216	—	—	80-57-9
6-hydroxycarvone	C10H14O2	4523	—	—	51200-86-3
carveol	C10H16O	2247	172.515	—	99-48-9
verbenol	C10H16O	3594	—	—	473-67-6
2 (10) pinene 3 ol	C10H16O	3587	—	—	5947-36-4
myrtenol (2 pinene 10 ol)	C10H16O	3439	—	—	515-00-4
(E,R)-3,7-Dimethyl-1,5,7-octatrien-3-ol	C10H16O	3830	—	—	20053-88-7
campholenic aldehyde ((2,3,3, trimethyl cyclopent 3 en 1 yl) acetaldehyde)	C10H16O	3592	—	—	4501-58-0
citral (neral and geranial)	C10H16O	2303	182.60	—	5392-40-5
para mentha 1,8 dien 7 ol (perilla alcohol)	C10H16O	2664	172.515	—	536-59-4
3-Pinanone or Bicyclo[3.1.1]heptan-3-one, 2,6,6-trimethyl-	C10H16O	4198	—	—	18358-53-7
pulegone	C10H16O	2963	172.515	—	89-82-7
d camphor (d 2 camphanone)	C10H16O	2230	172.515	—	464-49-3
d piperitone	C10H16O	2910	172.515	—	6091-50-5
para menth 8 en 2 one (dihydro carvone)	C10H16O	3565	172.515	—	7764-50-3
fenchone	C10H16O	2479	172.515	—	4695-62-9
1,4 dimethyl 4 acetyl 1 cyclohexene	C10H16O	3449	—	—	43219-68-7
l-fenchone	C10H16O	4519	—	—	7787-20-4
dl-camphor	C10H16O	4513	—	—	76-22-2
Geranic acid or (E2),6-Octadienoic acid, 3,7-dimethyl-	C10H16O2	4121	—	—	459-80-3
d-limonen-10-ol	C10H16O3	4504	—	—	38142-45-9
Thujyl alcohol or Bicyclo[3.1.0]hexan-3-ol, 4-methyl-1-(1-methylethyl)-, (1S,3S,4R,5R)-	C10H17O	4079	—	—	21653-20-3
borneol (2 camphanol)	C10H18O	2157	172.515	—	507-70-0
iso borneol	C10H18O	2158	172.515	—	124-76-5
4 carvomenthenol	C10H18O	2248	172.515	—	562-74-3
dihydrocarveol	C10H18O	2379	172.515	—	619-01-2
eucalyptol	C10H18O	2465	172.515	—	470-82-6
fenchyl alcohol (trimethyl norbornanol)	C10H18O	2480	172.515	—	1632-73-1
geraniol	C10H18O	2507	182.60, 582.60	—	106-24-1
linalool (coriandrol)	C10H18O	2635	182.60, 582.60	—	78-70-6
nerol	C10H18O	2770	172.515	—	106-25-2
isopulegol	C10H18O	2962	172.515	—	89-79-2
alpha terpineol	C10H18O	3045	172.515	—	98-55-5
para menth 1 en 3 ol	C10H18O	3179	—	—	586-82-3
thujan 4 ol (sabinene hydrate)	C10H18O	3239	—	—	546-79-2
para menth 3 en 1 ol	C10H18O	3563	172.515	—	586-82-3
beta terpineol (para menth 8 en 1 ol)	C10H18O	3564	172.515	—	138-87-4

Chart 328 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
1,4 cineole	C10H18O	3658	172.515	—	470-67-7
alpha campholenic alcohol	C10H18O	3741	—	—	1901-38-8
citronellal	C10H18O	2307	172.515	—	106-23-0
menthone	C10H18O	2667	172.515	—	89-80-5
iso pulegone	C10H18O	2964	172.515	—	29606-79-9
para menthan 2 one	C10H18O	3176	—	—	499-70-7
iso menthone	C10H18O	3460	172.515	—	491-07-6
p-menth-1-en-9-ol	C10H18O	4508	—	—	18479-68-0
linalool oxide (5 ethenyl tetrahydro alpha, alpha 5 trimethyl 2 furan methanol)	C10H18O2	3746	172.515	—	1365-19-1
citronellic acid	C10H18O2	3142	—	—	502-47-6
para mentha 8 thiol 3 one	C10H18OS	3177	—	—	38462-22-5
1 para menthene 8 thiol (found in grapefruit juice)	C10H18S	3700	—	—	71159-90-5
2,3 or 10 mercapto pinane (pinanyl mercaptan)	C10H18S	3503	—	—	23832-18-0
thio geraniol (mixed trans & cis isomers)	C10H18S	3472	—	—	39067-80-6
menthol	C10H20O	2665	172.515, 182.20	—	89-78-1
d neo menthol	C10H20O	2666	172.515	—	20752-34-5
citronellol	C10H20O	2309	172.515	—	106-22-9
rhodinol (mixed isomers citronellol ex geranium)	C10H20O	2980	172.515	—	6812-78-8
para menthan 2 ol (carvomenthol)	C10H20O	3562	—	—	499-69-4
p-menthan-7-ol	C10H20O	4507	—	—	5502-75-0
dl-isomenthol	C10H20O	4729	—	—	3623-52-7
hydroxycitronellol	C10H20O2	2586	172.515	—	107-74-4
hydroxy citronellal	C10H20O2	2583	172.515	—	107-75-5
tetra hydro linalool	C10H22O	3060	172.515	—	78-69-3
dihydro citronellol (3,7 dimethyl 1 octanol)	C10H22O	2391	172.515	—	106-21-8
myrtenyl formate (2 hydroxy methyl 6,6 dimethyl bicyclo (3.1.1) hept 2 enyl formate)	C11H17O3	3405	—	—	72928-52-0
para menth 1 ene 9 al (carvomenthenal)	C11H18O	3178	—	—	29548-14-9
bornyl formate	C11H18O2	2161	172.515	—	7492-41-3
iso bornyl formate	C11H18O2	2162	172.515	—	1200-67-5
geranyl formate	C11H18O2	2514	172.515	—	105-86-2
linalyl formate	C11H18O2	2642	172.515	—	115-99-1
neryl formate	C11H18O2	2776	172.515	—	2142-94-1
terpinyl formate	C11H18O2	3052	172.515	—	2153-26-6
citronellyl formate	C11H20O2	2314	172.515	—	105-85-1
rhodinyl formate	C11H20O2	2984	172.515	—	141-09-3
1-carvacryl ethyl ether	C12H18O	2246	172.515	—	4732-13-2
carvyl acetate	C12H18O2	2250	172.515	—	97-42-7
para mentha 1,8 dien 7 yl acetate	C12H18O2	3561	172.515	—	1511-96-3
pinocarvyl acetate	C12H18O2	4807	—	—	1078-95-1
myrtenyl acetate (2 hydroxy methyl 6,6 dimethyl bicyclo (3.1.1) hept 2 enyl acetate)	C12H19O3	3765	—	—	1079-01-2
bornyl acetate	C12H20O2	2159	172.515	—	76-49-3
iso bornyl acetate	C12H20O2	2160	172.515	—	125-12-3
campholene acetate	C12H20O2	3657	—	—	36789-59-0
fenchyl acetate (trimethyl nornornyl acetate)	C12H20O2	3390	—	—	13851-11-1

Chart 328 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
geranyl acetate	C12H20O2	2509	182.60, 582.60	—	105-87-3
linalyl acetate	C12H20O2	2636	182.60, 582.60	—	115-95-7
1 para menthene 9 yl acetate	C12H20O2	3566	—	—	17916-91-5
neryl acetate	C12H20O2	2773	172.515	—	141-12-8
2 ethyl fenchol (2 ethyl 1,3,3, trimethyl 2 norbornanol)	C12H22O	3491	—	—	18368-91-7
citronellyl oxy acetaldehyde	C12H22O2	2310	172.515	—	7492-67-3
citronellyl acetate	C12H22O2	2311	172.515	—	150-84-5
l menthyl acetate	C12H22O2	2668	172.515	—	16409-45-3
rhodinyl acetate	C12H22O2	2981	172.515	—	141-11-7
terpinyl acetate	C12H23O2	3047	172.515	—	8007-35-0
carvyl propionate	C13H20O2	2251	172.515	—	97-45-0
dihydrocarvyl acetate	C13H20O2	2380	172.515	—	20777-49-5
6, 10 dimethyl 5,9 undeca dien 2 one (geranyl acetone)	C13H22O	3542	—	—	3796-70-1
iso bornyl propionate	C13H22O2	2163	172.515	—	2756-56-1
geranyl propionate	C13H22O2	2517	172.515	—	105-90-8
linalyl propionate	C13H22O2	2645	172.515	—	114-39-8
neryl propionate	C13H22O2	2777	172.515	—	105-91-8
terpinyl propionate	C13H22O2	3053	172.515	—	80-27-3
l menthyl lactate	C13H23O3	3748	—	—	59259-38-0
citronellyl propionate	C13H24O2	2316	172.515	—	141-14-0
rhodinyl propionate	C13H24O2	2986	172.515	—	105-89-5
3 (1 menthoxy) propane 1,2 diol	C13H26O3	3784	—	—	87061-04-9
pinocarvyl isobutyrate	C14H22O2	4525	—	—	929116-08-5
geranyl acetoacetate	C14H22O3	2510	172.515	—	10032-00-5
geranyl isobutyrate	C14H24O2	2513	172.515	—	2345-26-8
geranyl butyrate	C14H24O2	2512	172.515	—	106-29-6
linalyl butyrate	C14H24O2	2639	172.515	—	78-36-4
linalyl isobutyrate	C14H24O2	2640	172.515	—	78-35-3
neryl butyrate	C14H24O2	2774	172.515	—	999-40-6
neryl isobutyrate	C14H24O2	2775	172.515	—	2345-24-6
terpinyl butyrate	C14H24O2	3049	172.515	—	2153-28-8
terpinyl isobutyrate	C14H24O2	3050	172.515	—	7774-65-4
citronellyl butyrate	C14H26O2	2312	172.515	—	141-16-2
citronellyl isobutyrate	C14H26O2	2313	172.515	—	97-89-2
rhodinyl butyrate	C14H26O2	2982	172.515	—	141-15-1
rhodinyl isobutyrate	C14H26O2	2983	172.515	—	138-23-8
farnesol (2,6,10 trimethyl 2,6,10 dodecatrien 12-ol)	C15H20O	2478	172.515	—	4602-84-0
Dehydronootketone	C15H20O	4091	—	—	5090-63-1
sinesal (2,6 dimethyl 10 methylene 2,6,11 dodecatrienal)	C15H22O	3141	—	—	17909-77-2
nootketone (4,4a,5,6,7,8, Hexahydro 6 isopropenyl 4, 4a dimethyl 2 (3H) naphthalenone)	C15H22O	3166	172.515	—	4674-50-4
santalol (alpha & beta)	C15H24O	3006	172.515	—	77-42-9
Vetiverol or 6-Azulenol, 1,2,3,3a,4, 5,6,8a-octahydro-4,8-dimethyl-2-(1-methylethylidene)-	C15H24O	4217	—	—	89-88-3

Chart 328 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
dihydro nootketone (octahydro 4, 4a dimethyl 6 (methyl ethenyl) 2 (1H) naphthalenone)	C15H24O	3776	—	—	20489-53-6
caryophylla-3(4),8-dien-5-ol	C15H24O	4780	—	—	38284-26-3
caryophyllene alcohol	C15H26O	3741	172.515	—	4586-22-5
nerolidol	C15H26O	2772	172.515	—	7212-44-4
cedrol (cedrenol, cedar leaf alcohols)	C15H26O	CFR/	172.515	—	77-53-2
(+)-cedrol	C15H26O	4503	—	—	77-53-2
cubebol	C15H26O	4497	—	—	23445-02-5
bornyl iso valerate	C15H26O2	2165	172.515	—	76-50-6
iso bornyl iso valerate	C15H26O2	2166	172.515	—	7779-73-9
bornyl valerate	C15H26O2	2164	172.515	—	7549-41-9
geranyl isovalerate	C15H26O2	2518	172.515	—	109-20-6
linalyl isovalerate	C15H26O2	2646	172.515	—	1118-27-0
neryl isovalerate	C15H26O2	2778	172.515	—	3915-83-1
terpinyl isovalerate	C15H26O2	3054	172.515	—	1142-85-4
(+/−)-Dihydrofarnesol	C15H28O	4031	—	—	51411-24-6
citronellyl valerate	C15H28O2	2317	172.515	—	7540-53-6
l menthyl isovalerate	C15H28O2	2669	172.515	—	16409-46-4
rhodinyl isovalerate	C15H28O2	2987	172.515	—	7778-96-3
myrtenal (2 formyl 6,6 dimethyl bicyclo (3.1.1) hept 2 ene)	C16H14O	3395	—	—	564-94-3
geranyl 2 ethyl butyrate	C16H27O2	3339	—	—	999999-26-5
geranyl hexanoate	C16H28O2	2515	172.515	—	10032-02-7
linalyl hexanoate	C16H28O2	2643	172.515	—	7779-23-9
carvyl palmitate	C16H31O2	4515	—	—	929222-96-8
geranyl benzoate	C17H22O2	2511	172.515	—	94-48-4
linalyl benzoate	C17H22O2	2638	172.515	—	126-64-3
terpinyl anthranilate	C17H23NO2	3048	172.515	—	14481-52-8
caryophyllene acetate	C17H28O2	7624	172.515	—	32214-91-8
linalyl anthranilate*	C18H23NO2	2637	172.515	—	7149-26-0
geranyl phenyl acetate*	C18H24O2	2516	172.515	—	102-2207
linalyl phenyl acetate*	C18H24O2	3501	—	—	7143-69-3
citronellyl phenyl acetate*	C18H26O2	2315	172.515	—	139-70-8
rhodinyl phenyl acetate* **note rhodinol is a mixture of alcohols derived from geranium oil, chiefly citronellol, therefore empirical formulae are calculated as citronellyl esters.	C18H26O2	2985	172.515	—	10486-14-3
linalyl octanoate	C18H32O2	2644	172.515	—	10024-64-3
linalyl cinnamate	C19H24O2	2641	172.515	—	78-37-5
terpinyl cinnamate	C19H24O2	3051	172.515	—	10024-56-3
(–)-sclareol	C20H36O2	4502	—	—	515-03-7
Phytol	C20H40O	4196	—	—	150-86-7
Miscellaneous Compounds					
beta-Caryophyllene oxide	C15H24O	4085	—	—	1139-30-6
Carvone-5,6-oxide	C10H14O2	4084	—	—	18383-49-8
D,L-Menthol(+/−)-propylene glycol carbonate or Frescolat, Type MPC	C14H26O4	3992	—	—	156324-82-2
nerolidol oxide	C15H26O2	4536	—	—	1424-83-5

Chart 329 Thiazoles

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
Thiazole	C3H2NS	3615	—	—	288-47-1
4 methyl thiazole	C4H5NS	3716	—	—	693-95-8
2 acetyl thiazole	C5H5NOS	3328	—	—	24295-03-2
4,5 dimethyl thiazole	C5H7NS	3274	—	—	3581-91-7
2,5-Dimethylthiazole	C5H7NS	4035	—	—	4175-66-0
2-Acetyl-2-thiazoline	C5H7NOS	3817	—	—	29926-41-8
2 ethoxy thiazole	C5H7NOS	3340	—	—	15679-19-3
2 methyl 5 methoxy thiazole	C5H7NS	3192	—	—	38205-64-0
2-ethyl-2,5-dihydro-4-methylthiazole	C6H11NS	4695	—	—	41803-21-8
propionyl thiazole	C6H7NOS	3611	—	—	43039-98-1
4 methyl 5 vinyl thiazole	C6H7NS	3313	—	—	1759-28-0
1-(3,4-Dihydro-2H-1,4-thiazin-5-yl)ethanone or 5-Acetyl-2,3-dihydro-1,4-thiazine	C6H9NOS	4296	—	—	164524-93-0
2-Propionyl-2-thiazoline	C6H9NOS	4064	—	—	29926-42-9
4 methyl thiazole 5 ethanol (Sulfurol™)	C6H9NOS	3204	—	—	137-00-8
2 ethyl 4 methyl thiazole	C6H9NS	3680	—	—	15679-12-6
5-Ethyl-2-methylthiazole	C6H9NS	4388	—	—	19961-52-5
2,4,5 trimethyl thiazole	C6H9NS	3325	—	—	13623-11-5
2 isopropyl 4 methyl thiazole	C7H11NS	3555	—	—	15679-13-7
2 isobutyl thiazole	C7H11NS	3134	172.515	—	18640-74-9
2 (1 methyl propyl) thiazole	C7H11NS	3372	—	—	18277-27-5
4,5 dimethyl 2 ethyl 3 thiazoline	C7H13NS	3620	—	—	76788-46-0
2-isopropyl-4-methyl-3-thiazoline	C7H13NS	4767	—	—	67936-13-4
benzo thiazole	C7H5NS	3256	—	—	95-16-9
2-(4-Methyl-5-thiazolyl)ethyl formate	C7H9NO2S	4275	—	—	90731-56-9
2,4 dimethyl 5 acetyl thiazole	C7H9NS	3267	—	—	38205-60-6
2,4 dimethyl 5 vinyl thiazole	C7H9NS	3145	—	—	65505-18-2
2-pentylthiazole	C8H13NS	4641	—	—	37645-62-8
Tetrahydro-2,4-dimethyl-4H-pyrrolo[2,1-d]-1,3,5-dithiazine or Pyrrolidino-[1,2E]-4H-2,4-dimethyl-1,3,5-dithiazine	C8H15NS2	4321	—	—	116505-60-3
4 methyl thiazole 5 ethanol acetate (Sulfuryl Acetate™)	C9H11O2NS	3205	—	—	656-53-1
2-(4-Methyl-5-thiazolyl)ethyl propionate	C9H13NO2S	4276	—	—	324742-96-3
4,5-dimethyl-2-isobutylthiazole	C9H15NS	4647	—	—	53498-32-1
4,5 dimethyl 2 isobutyl 3 thiazoline	C9H17NS	3621	—	—	65894-83-9
2 (2 butyl) 4,5 dimethyl 3 thiazoline	C9H17NS	3619	—	—	65894-82-8
2-(4-Methyl-5-thiazolyl)ethyl butanoate	C10H15NO2S	4277	—	—	94159-31-6
2-(4-Methyl-5-thiazolyl)ethyl isobutyrate	C10H15NO2S	4278	—	—	94021-42-8
Z- and E-5-Ethyl-4-methyl-2-(2-butyl)-thiazoline or cis- and trans-5-Ethyl-4-methyl-2-(2-butyl)-thiazoline	C10H19NS	4318	—	—	83418-54-6
Z- and E-5-Ethyl-4-methyl-2-(2-methylpropyl)-thiazoline or cis and trans-5-Ethyl-4-methyl-2-(2-methylpropyl)-thiazoline	C10H19NS	4319	—	—	83418-53-5
2-(4-Methyl-5-thiazolyl)ethyl hexanoate	C12H19NO2S	4279	—	—	94159-32-7
2-(4-Methyl-5-thiazolyl)ethyl octanoate	C14H23NO2S	4280	—	—	163266-17-9
2-(4-Methyl-5-thiazolyl)ethyl decanoate	C16H27NO2S	4281	—	—	101426-31-7

Chart 330 Tiglates

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
ethyl tiglate	C7H12O2	2460	172.515	—	5837-78-5
allyl tiglate	C8H12O2	2043	172.515	—	7493-71-2
iso propyl tiglate	C8H15O2	3229	172.515	—	6284-46-4
benzyl trans 2 methyl 2 crotonate (benzyl tiglate)	C12H15O2	3330	—	—	37526-88-8
benzyl 2,3 dimethyl crotonate (benzyl methyl tiglate)	C12H16O2	2143	172.515	—	7492-69-5
1 ethyl hexyl tiglate	C13H24O2	3676	—	—	94133-92-3

Chart 331 Tolyl Esters

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
ortho tolyl acetate	C9H10O2	3072	172.515	—	533-18-6
para tolyl acetate	C9H10O2	3073	172.515	—	140-39-6
ortho tolyl iso butyrate	C11H14O2	3753		—	36438-54-7
para tolyl iso butyrate	C11H14O2	3075	172.515	—	103-93-5
ethyl (para tolyl oxy) acetate	C11H14O2	3157	—	—	67028-40-4
2 methyl 3 tolyl propionaldehyde	C11H14O	2748	172.515	—	41496-43-9
para tolyl 3 methyl butyrate	C12H16O2	3387	—	—	55066-56-3
ortho tolyl salicylate	C14H12O3	3734	—	—	617-01-6
para tolyl octanoate	C15H22O2	3733	—	—	59558-23-5
para tolyl phenyl acetate	C15H14O2	3077	172.515	—	101-94-0
para tolyl laurate (cresyl dodecanoate)	C19H30O2	3076	172.515	—	10024-57-4

Chart 333 Unsaturated Esters – Aliphatic

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
Aliphatic Unsaturated Esters					
Prenyl isobutyrate or Propanoic acid, 2-methyl-, 3-	C4H8O2	4206	—	—	76649-23-5
Methyl 2-methyl-2-propenoate	C5H10O2	4002	—	—	80-62-6
Isopropenyl acetate	C5H8O2	4152	—	—	108-22-5
ethyl acrylate (propenoate)	C5H8O2	2418	172.515	—	140-88-5
Prenyl benzoate or or 3-Methyl-2-butenyl benzoate	C6H10O2	4203	—	—	5205-11-8
Prenyl formate or 2-Buten-1-ol, 3-methyl-,formate	C6H10O2	4205	—	—	68480-28-4
ethyl trans 2 butenoate	C6H10O2	3486	172.515	—	10544-63-5
Methyl 4-pentenoate	C6H10O2	4353	—	—	818-57-5
Allyl crotonate	C7H10O2	4072	—	—	20474-93-5
Ethyl 4-pentenoate	C7H12O2	4360	—	—	1968-40-7
(E)-2-Hexenyl formate	C7H12O2	3927	—	—	53398-78-0
4-Pentenyl acetate	C7H12O2	4011	—	—	1576-85-8
Allyl valerate	C7H12O2	4074	—	—	6321-45-5

Chart 333 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
Isoprenyl acetate or 3-Methyl-3-butenyl acetate	C7H12O2	3991	—	—	5205-07-2
Methyl *cis*-3-hexenoate	C7H12O2	4164	—	—	13894-62-7
Prenyl acetate or 3-Methyl-2-butenyl acetate	C7H12O2	4202	—	—	1191-16-8
cis 3 hexenyl formate	C7H12O2	3353	—	—	33467-73-1
methyl 2 hexenoate	C7H12O2	2709	172.515	—	2396-77-2
ethyl tiglate	C7H12O2	2460	172.515	—	5837-78-5
methyl 3 hexenoate	C7H12O2	3364	—	—	2396-78-3
methyl 2 hexenoate	C7H12O2	2709	172.515	—	2396-77-2
2,4-Hexadienyl acetate	C8H12O2	4132	—	—	1516-17-2
ethyl 2 methyl 3,4 pentadienoate	C8H12O2	3678	—	—	60523-21-9
Ethyl 5-hexenoate	C8H14O2	3976	—	—	54653-25-7
ethyl 2-hexenoate	C8H14O2	4613	—	—	1552-67-6
ethyl *cis*-3-hexenoate	C8H14O2	4112	—	—	64187-83-3
ethyl 3 hexenoate	C8H14O2	3342	—	—	2396-83-0
2 methyl allyl butyrate	C8H14O2	2678	172.515	—	7149-29-3
ethyl 2 methyl 3 pentenoate	C8H14O2	3456	—	—	1617-23-8
ethyl 2 methyl 4 pentenoate	C8H14O2	3489	—	—	53399-81-8
ethyl trans 2 hexenoate	C8H14O2	3675	—	—	27829-72-7
2 hexenyl acetate	C8H14O2	2564	172.515 - trans isomer	—	2497-18-9
3 hexenyl acetate	C8H14O2	3171	—	—	3681-71-8
iso butyl 2 butenoate (isobutyl crotonate)	C8H14O2	3432	—	—	589-66-2
Ethyl (E)-2-methyl-2-pentenoate or Ethyl trans-2-methyl-2-pentenoate	C8H14O2	4290	—	—	1617-40-9
trans-3-Hexenyl acetate	C8H14O2	4413	—	—	3681-82-1
cis 3 and trans 2 hexenyl propionate	C912O2	3778	—	—	999999-90-8
2,4-Hexadienyl propionate	C9H14O2	4131	—	—	16491-25-1
methyl 2 octynoate	C9H14O2	2729	172.515	—	111-12-6
3-Hexenyl 2-oxopropionate or 'cis-3-Hexenyl pyruvate	C9H14O3	3934	—	—	68133-76-6
cis-3-Hexenyl propionate	C9H16O2	3933	—	—	33467-74-2
Ethyl *cis*-4-heptenoate	C9H16O2	3975	—	—	39924-27-1
Hept-*trans*-2-en-1-yl acetate	C9H16O2	4125	—	—	16939-73-4
Methyl *cis*-5-octenoate	C9H16O2	4165	—	—	41654-15-3
trans-2-Hexenyl propionate	C9H16O2	3932	—	—	53398-80-4
methyl cis 4 octenoate	C9H16O2	3367	—	—	21063-71-8
methyl trans 2 octenoate	C9H16O2	3712	—	—	2396-85-2
trans 3 heptenyl acetate	C9H16O2	3493	—	—	1576-77-8
cis 3 hexenyl lactate	C9H16O3	3690	—	—	61931-81-5
(±)-bicyclo[2.2.1]hept-5-ene-2-carboxylic acid, ethyl ester	C10H14O2	4790	—	—	10138-32-6
2,4-Hexadienyl butyrate	C10H16O2	4133	—	—	16930-93-1
2,4-Hexadienyl isobutyrate	C10H16O2	4134	—	—	16491-24-0
methyl 2 nonynoate	C10H16O2	2726	172.515	—	111-80-8

Chart 333 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
ethyl cis 4, 7 octadienoate	C10H16O2	3682	—	—	69925-33-3
1 octene 3 yl acetate	C10H16O2	3582	172.515	—	10/6/2442
(Z)-3-Hexenyl (E)-2-butenoate	C10H18O2	3982	—	—	65405-80-3
6-Methyl-5-hepten-2-yl acetate	C10H18O2	4177	—	—	19162-00-6
cis-3-Hexenyl isobutyrate	C10H18O2	3929	—	—	41519-23-7
trans-2-Hexenyl butyrate	C10H18O2	3926	—	—	53398-83-7
ethyl cis 4 octenoate	C10H18O2	3344	—	—	34495-71-1
ethyl trans 2 octenoate	C10H18O2	3643	—	—	7367-82-0
cis 3 hexenyl butyrate	C10H18O2	3402	—	—	16491-36-4
methyl 2 nonenoate	C10H18O2	2725	172.515	—	111-79-5
trans 2 octenyl acetate	C10H18O2	3516	—	—	3913-80-2
methyl 3 nonenoate	C10H18O2	3710	—	—	13481-87-3
hexyl 2 butenoate	C10H18O2	3354	—	—	19089-92-0
ethyl 3-octenoate	C10H18O2	4361	—	—	1117-65-3
2-Methylbutyl senecioate or 2-Methylbutyl 3-methyl-2-butenoate	C10H20O2	4306	—	—	97890-13-6
z-5-octenyl acetate	C10H18O2	4671	—	—	71978-00-2
(E,Z)-2,6-Nonadien-1-ol acetate	C11H18O2	3952	—	—	68555-65-7
(E,Z)-3,6-Nonadien-1-ol acetate	C11H18O2	3953	—	—	211323-05-6
Methyl (E)-2-(Z)-4- decadienoate	C11H18O2	3859	—	—	4493-42-9
cis-3-Hexenyl tiglate	C11H18O2	3931	—	—	67883-79-8
ethyl 2 nonynoate	C11H18O2	2448	172.515	—	10031-92-2
cis,cis-3,6-nonadienyl acetate	C11H18O2	4551	—	—	83334-93-4
(E)-2-Hexenyl 2-methylbutyrate or trans-2-Hexenyl 2-methylbutyrate	C11H20O2	4274	—	—	94089-01-7
(Z)-5-Octenyl propionate	C11H20O2	3890	—	—	196109-18-9
cis-3-Hexenyl valerate	C11H20O2	3936	—	—	35852-46-1
cis-3-Octenyl propionate	C11H20O2	4189	—	—	94134-03-9
Pent-2-enyl hexanoate	C11H20O2	4191	—	—	74298-89-8
Prenyl caproate or Hexanoic acid, 3-methyl-2-butenyl ester	C11H20O2	4204	—	—	76649-22-4
trans-2-Hexenyl isovalerate	C11H20O2	3930	—	—	68698-59-9
trans-2-Hexenyl pentanoate	C11H20O2	3935	—	—	56922-74-8
cis 3 hexenyl 2 methyl butyrate	C11H20O2	3497	172.515	—	10094-41-4
3 hexenyl 3 methyl butanoate	C11H20O2	3498	172.515	—	10032-11-8
methyl 3,7 dimethyl 6 octenoate	C11H20O2	3361	—	—	2270-60-2
trans 3 heptenyl 2 methyl propionate	C11H20O2	3494	—	—	67801-45-0
trans-2-nonenyl acetate	C11H20O2	4552	—	—	30418-89-4
cis-3-nonenyl acetate	C11H20O2	4553	—	—	13049-88-2
cis-6-nonenyl acetate	C11H20O2	4554	—	—	76238-22-7
Ethyl 2,4,7-decatrienoate	C12H18O2	3832	—	—	78417-28-4
methyl 2 undecynoate	C12H20O2	2751	172.515	—	10522-18-6
cis 3 hexenyl cis 3 hexenoate	C12H20O2	3689	—	—	61444-38-0
(E)-2-Hexenyl hexanoate	C12H22O2	3983	—	—	53398-86-0
cis-4-Decenyl acetate	C12H22O2	3967	—	—	67452-27-1
Hept-2-en-1-yl isovalerate	C12H22O2	4126	—	—	253596-70-2

Chart 333 *Continued*

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
Methyl 10-undecenoate	C12H22O2	4253	—	—	111-81-9
3-Hexenyl 2-hexenoate	C12H22O2	3928	—	—	53398-87-1
1 octene 3 yl butyrate	C12H22O2	3612	—	—	16491-54-6
trans 2 octenyl butyrate	C12H22O2	3517	—	—	999999-26-8
methyl 9 undecenoate	C12H22O2	2750	172.515	—	5760-50-9
cis 3 hexenyl hexanoate	C12H22O2	3403	—	—	31501-1-8
ethyl trans 2 decenoate	C12H22O2	3641	—	—	7367-88-6
ethyl trans 4 decenoate	C12H22O2	3642	—	—	76649-16-6
ethyl trans 2 cis 4 decadienoate	C12H22O2	3148	—	—	3025-30-7
hexyl trans 2 hexenoate	C12H22O2	3692	—	—	33855-57-1
hexyl 2 methyl 3 and 4 pentenoate	C12H22O2	3693	—	—	58625-95-9
cis 3 hexenyl benzoate	C13H16O2	3688	—	—	251552-85-6
(+/−)-*trans*- and *cis*-4,8-Dimethyl-3,7-nonadien-2-yl acetate	C13H22O2	4103	—	—	91418-25-6
propyl 2,4 decadienoate	C13H22O2	3648	—	—	84788-08-9
ethyl 10 undecenoate	C13H24O2	2461	172.515	—	692-86-4
10 undecenyl acetate	C13H24O2	3096	172.515	—	112-19-6
1,3 nonanediol acetate	C13H24O4	2783	172.515	—	1322-17-4
cis 3 hexenyl phenyl acetate	C14H18O2	3633	172.515	—	42436-07-7
allyl 10 undecenoate	C14H24O2	2044	172.515	—	7493-76-7
2-Hexenyl octanoate	C14H24O2	4135	—	—	85554-72-9
butyl 2 decenoate	C14H26O2	2194	172.515	—	7492-45-7
1,4 nonanediol diacetate	C15H24O4	3579	—	—	67715-81-5
Citronellyl tiglate or Citronellyl trans-2-methyl-2-butenoate	C15H26O2	4295	—	—	24717-85-9
butyl 10 undecenoate	C15H28O2	2216	172.515	—	109-42-2
Isobutyl 10-undecenoate	C15H28O2	4358	—	—	5421-27-2
3,7 dimethyl octa 2,6 dienyl 2 ethyl butanoate	C16H27O2	3339	—	—	999999-26-5
3,7,11-Trimethyldodeca-2,6,10-trienyl acetate	C17H26O2	4213	—	—	29548-30-9
methyl linoleate (48%) and methyl linoleneate (52%)	C19H32O2 and C19H32O2	3411	—	—	301-00-8
ethyl oleate (octadecenoate)	C20H38O2	2450	172.515	—	111-62-6
cis-9-Octadecenyl acetate	C20H38O2	4359	—	—	693-80-1

Chart 334 Unsaturated Esters – Aromatic

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
Aromatic Unsaturated Esters					
benzyl trans 2 methyl 2 crotonate (benzyl tiglate)	C12H15O2	3330	—	—	37526-88-8
benzyl 2,3 dimethyl crotonate or (benzyl methyl tiglate)	C12H16O2	2143	172.515	—	7492-69-5

Chart 335 Vanillyl Compounds

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS #	CAS#
vanillin	C8H8O3	3107	135.110, 163.111, 163.112, 163.113, 163.114, 163.117, 163.123, 163.130, 163.135, 163.140, 163.145, 163.150, 163.155, 182.60, 182.90, 582.60	—	121-33-5
vanillyl alcohol	C8H10O3	3737	—	—	498-00-0
veratraldehyde (vanillin methyl ether)	C9H10O3	3109	172.515	—	120-14-9
ethyl vanillin	C9H10O3	2464	163.53, 163.111, 163.112, 163.113, 163.114, 163.117, 163.123, 163.130, 163.135, 163.140, 163.145, 163.150, 163.155, 182.60, 182.90, 582.60	—	121-32-4
vanillyl acetate	C10H12O4	3108	172.515	—	881-68-5
vanillydine acetone	C11H12O3	3738	—	—	1080-12-2
vanillyl isobutyrate	C12H14O4	3754	—	—	20665-85-4
vanillyl butyl ether	C12H18O3	3796	—	—	82654-98-6
Ethyl vanillin isobutyrate	C13H16O4	3837	—	—	188417-26-7

Chart 336 Vitamins

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
Vitamin C (ascorbic acid)	C6H8O6	2109	CFR Citations: 137.105, 137.155, 137.160, 137.165, 137.170, 137.175, 137.180, 137.185, 137.200, 137.205, 145.110, 145.115, 145.116, 145.135, 145.136, 145.170, 145.171, 146.113, 146.187, 150.131, 150.141, 155.200, 156.145, 161.175, 182.3013, 182.5013, 182.8013, 240.1044	—	50-81-7
Vitamin U (dl (3 amino 3 carboxy propyl)) dimethyl sulfonium chloride	C6H14NO2SCl	3445	—	—	1115-84-0
Vitamin B1 (thiamine hydrochloride or 3(4 amino 2 methyl pyridimyl 5 methyl) 4 methyl 5(beta hydroxy ethyl) thiazolium)	C12H17CN4O	—	—	448	67-03-8
Vitamin B1 Hydrochloride (thiamine hydrochloride or 3(4 amino 2 methyl pyridimyl 5 methyl) 4 methyl 5(beta hydroxy ethyl) thiazolium hydrochloride)	C12H17CN4OS-HCl	3322	172.515, 184.1875	—	67-03-8
riboflavin (B2)	C17H20N4O6	—	—	169	83-88-5
alpha tocopherol	C29H50O2	—	—	230	59-02-9
gamma tocopherol	C28H48O2	—	—	233	54-28-4
mixed tocopherols	C29H50O2 (avg.)	—	—	237	1406-66-2

Chart 337 Zingerone

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS #	CAS#
zingerone	C11H41O3	3124	—	172.515	122-48-5

Chart 338 Theaspirane and Related Compunds

Chemical	Empirical Formula	FEMA GRAS #	NAS #	CFR	CAS#
theaspirane (2,6,10,10 tetra methyl 1 oxaspiro 4,5 dec 6 ene)	C13H22O	3774-			36431-72-8
6 acetoxy dihydro theaspirane (2,6,10,10, tetra methyl 1 oxaspiro [4.5] decan 6 ol acetate)	C15H26O3	3651-			57893-27-3
6 hydroxy dihydro theaspirane	C13H24O2	3549-			65620-50-0

Chart 339 Quassia

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
extract	2971	172.510	—	68915-32-2	bitter principle

Chart 340 Quebracho

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
	2972	172.51	—	999999-24-5	aromatic type

Chart 341 Quillaia

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
	2973	172.51	—	68990-67-0	foaming agent

Chart 342 Quince

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
seed	2974	182.40, 582.40	—	—	Fruit

Chart 343 Raisin

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
concentrate	—	—	6599	—	brown fruit
extract	—	—	6526	—	brown fruit
juice concentrate	—	—	6669	—	brown fruit

Chart 344 Raspberry

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
concentrate	—	—	6524	—	berry
essence	—	—	6518	—	berry
juice concentrate-red	—	—	6670	—	berry
concentrate-red	—	—	6600	—	berry

Chart 345 Rhatany Root

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Krameria triandra Ruiz & Pav. = Peruvian Rhatany Krameria argentea Mart. = Brazilian Rhatany					
extract	2979	172.51	—	84775-95-1	bitter principle

Chart 346 Rhubarb

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
R. rhaponticum & Other Species					
root	—	172.510	6141	97676-32-9	bitter principle
extract	—	—	6461	97676-32-9	bitter principle
R. rhaponticum L.	—	—	—	97676-32-9	bitter principle
garden root	—	172.510	6140	97676-32-9	bitter principle

Chart 347 Rose

Name	FEMA GRAS #	NAS #	CFR	CAS#	Type
absolute	2988	—	182.20, 582.20	8007-01-0	floral
bud	—	6212+	182.20, 582.20	8007-01-0	floral
bulgarian rose oil	2989	—	182.20, 582.20	8007-01-0	floral
True Otto *R. damascena*		—		8007-01-0	floral
flowers	6213+	—	182.20, 582.20	8007-01-0	floral
hips extract	2990	—	182.20, 582.20	8007-01-0	floral
leaves	6211+	—	182.20, 582.20	8007-01-0	floral
water, stronger	2993	—	182.20, 582.20	84604-12-6	floral

Chart 348 Roselle

Name	FEMA GRAS #	NAS #	CFR	CAS#	Type
	—	6357+	172.510 (alcoholic bev. only)	—	Supplement

Chart 349 Rosemary

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
botanical	2991	182.10, 582.10	—	8000-25-7	aromatic type
oil	2992	182.20, 582.20	—	8000-25-7	aromatic type
oleoresin	—	182.20, 582.20	6388	8000-25-7	aromatic type
rosemary oleoresin		4705	—	308083-85-4	modifier / antioxidant

Chart 350 Rue

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
botanical	2994	184.1698, 582.10	—	8014-29-7	herbaceous
oil	2995	184.1699, 582.20	—	8014-29-7	citrus type

Chart 351 Rum

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Jamaican essence	—	—	6671	—	Rum
Rum Fusel Oil	—	—	6672	—	Chemical

Chart 352 Rum Ether

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
	2996	—	—	8030-89-5	estery

Chart 353 Rye

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
solid extract	—	—	6316	—	Grainy

Chart 354 Saffron

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
dried stigma	2998	73.500, 182.10, 582.10	—	84604-17-1	aromatic spice, coloring
extract	2999	182.20, 582.20	—	84604-17-1	aromatic spice, coloring

Chart 355 Sage

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Salvia officinalis L.					
botanical	3000	182.10, 582.10	—	8022-56-8	aromatic type
oil	3001	182.20, 582.20	—	8022-56-8	aromatic type
oleoresin	3002	182.20, 582.20	—	8022-56-8	aromatic type
botanical (Greek Sage)	—	182.10, 582.10	6214	8022-56-8	aromatic type
Salvia triloba L. (Spanish Sage)					
	3003	182.20, 582.20		8022-56-8	aromatic type
Salvia lavendulaefolia Vahl.					
oleoresin	—	—	6533	8022-56-8	aromatic type
extract	—	—	6527	8022-56-8	aromatic type
Dalmation Sage generic	—	—	6568	8022-56-8	aromatic type

Chart 356 Saigon Cassia

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
	2289	182.10, 582.10,182.20, 582.20	—	84961-46-6	spicy

Chart 357 St. John's Wort

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
leaves, flowers, and caulis	—	172.510 (hypericin free)	6358	—	balsamic

Chart 358 Salsify

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
food	—	—	—	—	fishy
black salsify	—	—	—	—	savory

Chart 359 Sandalwood

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Sandalwood, Red (Pterocaerpus santalinus L.f.) (Saunders, Red) See Woody.	—	172.51 (alcoholic bev. only)	6145, 6302	—	woody
Sandalwood, White (East Indian Sandalwood, Yellow Sandalwood, Yellow or White Saunders) Santalum album L. = East Indian Sandalwood	—	—	—		woody
Eucarya spicata (R.br.) Sprag. & Summ. = Australian Sandalwood	—	—	—		
botanical	—	172.51	3005	8006-87-9	woody
oil east Indian sandalwood	—	—	6359	8006-87-9	woody
sandalwood austrocaledonicum oil	4815	—	—	91845-48-6; 1070895-66-7	woody

Chart 360 Sandarac

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
	—	172.51 (alcoholic bev. only)	6147	9000-57-1	terpene type

Chart 361 Sarsaparilla

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Smilax aristolochiaefolia Mill. = Mexican Sarsaparilla S. regelii Killip & Morton = Honduras Sarsaparilla S. febrifuga Kunth = Ecuadorean Sarsaparilla Smilax Species = Central American Sarsaparilla					
extract	3009	172.51	—	977022-67-5	sweet spice

Chart 362 Sassafras

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
bark extract safrole free	3010	172.58	—	84787-72-4	sweet spice
leaves safrole free	3011	172.51	—	84787-72-4	sweet spice

Chart 363 Sauterne

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Wine Concentrate 8x	—	—	6673	—	wine

Chart 364 Savory

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Savory, Summer (Satureia hortensis L.) See Aromatic, Camphoraceous.					
botanical	3012	182.10, 582.10	—	8016-68-0	aromatic
oil	3013	182.20, 582.20	—	8016-68-0	camphoraceous
oleoresin	3014	182.20, 582.20	—	8016-68-0	camphoraceous
Savory, Winter (Satureia montana L.) The oil has a medicinal spicy flavor similar to thyme or sage with a sharp character. See Aromatic, Camphoraceous.					
botanical	3015	182.10, 582.10	—	90106-57-3	aromatic
oil	3016	182.20, 582.20	—	8016-68-0	camphoraceous
oleoresin	3017	182.20, 582.20	—	90106-57-3	camphoraceous

Chart 365 Schinus Mole

Name	FEMA GRAS #	NAS #	CFR	CAS#	Type
3018	—	—	182.20, 582.20	—	*aromatic, pungent*

Chart 366 Senna

Name	FEMA GRAS #	NAS #	CFR	CAS#	Type
Senna italica Lamk.					
botanical	—	6148+	172.51	—	nuetraceutical
fluid extract	—	6602+	—	—	nuetraceutical
leaves, solid extract	—	6603	—	—	nuetraceutical

Chart 367 Snakeroot and Virginia Snakeroot - Serpentaria

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Serpentaria (Virginia Snakeroot) (Aristolochia serpentaria L.) See Alcoholic Beverages.					
Note: recent findings show this extract to be carcinogenic.	—	172.510 (alcoholic bev. only)	6360	—	aromatic
Snakeroot (Snake Root) (Asarum, Wild Ginger) (Asarum canadense L.)					
	—	172.51	3023	8016-69-1	spicy

Chart 368 Sesame

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
seed oil	—	182.10, 582.10	—	8008-84-0	oil
seed	—	172.854, 175.300	6407	—	seedy, fatty

Chart 369 Shallots

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
freeze dried	—	—	6534	—	sulfur type

Chart 370 Simaruba

Name	FEMA GRAS #	NAS #	CFR	CAS#	Type
	—	6361+	172.510 (alcoholic bev. only)	—	*bitter principle*

Chart 371 Sloe Berry

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
berries	3020	182.20, 582.20	—	90105-94-5	fruity
extract	3021	182.20, 582.20	—	90105-94-5	fruity
solid extract	3022	182.20, 582.20	—	90105-94-5	fruity

Chart 372 Smoke Flavor

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Smoke Flavor					
generic	—	—	8705	—	smoke
liquid smoke flavor	2968	172.515	—	—	smoke
Natural Hickory Smoke Flavor Oil	4222	—	—	74113-74-9	smoke

Chart 373 Non-Nutrative Sweeteners

Sweetener	DE (Rating)	Regulatory Status
Lactitol (A dimeric sugar produced by catalytic hydrogenation of lactose)	35	GRAS
Erythritol	35	GRAS
Mannitol	50	CFR100.130, 101.9, 180.25, 582.547
Inositol	50	Not GRAS
Sorbitol	60	CFR100.130, 101.9, 184.1835,582.5835
Maltitol	90	GRAS
Xylitol (Naturally occurring sugar alcohol which is produced by catalytic hydrogenation of d-xylose)	120	CFR172.395, 101.9
Glycyrrhizin	4000	GRAS as a flavoring not a sweetener.
Tagatose	9000	Bulk sweetener, flavor enhancing properties
Aspartame™ (l-aspartyl l-phenyl alanine)or (NutrasweetTM)	18,000	CFR172.804
Acesulfame K (Sunett)™	20,000	CFR172.800
Saccharin	30,000	CFR101.11
Saccharin, Ammonium	30,000	CFR101.11, 180.37
Saccharin, Sodium	30,000	CFR101.11, 145.116, 145.126, 145.131, 145.136, 145.171, 145.176, 145.181, 150.141, 150.161
Sucralose™ (1,6-dichloro 1,6-dihydroxy beta d-fructo furanoyl 4-chloro 4-deoxy alpha d-galacto pyranoside 4,1′,6′-trichloro galactosucrose)	60,000	Approved for use in the U.S., Apr 1 1998
Alitame™ (not approved in U.S. yet) or(l-alpha aspartyl n (2,2,4,4, tetramethyl 3 thienyl) d-alanine hydrate)	290,000	Applied for approval in U.S. pending - under review
Thaumatin	300,000	GRAS as a flavor enhancer not a sweetener.
Neotame	1,000,000	Approved for beverages, dairy and bakery and as a flavor enhancer in chewing gum

Chart 374 Spearmint and Varieties

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Spearmint Oil, Mentha Spicata L.					
botanical	3030	182.10, 582.10	—	8008-79-5	mint
extract	3031	182.20, 582.20	—	—	mint
oil	3032	182.20, 582.20	—	—	mint
oil, terpeneless	—	—	6557+	—	mint
terpenes	—	—	6449+	—	mint
Scotch Spearmint Oil, Mentha cardiaca L.	4221	—	—	91770-24-0	mint
erospicata oil, mentha spicata 'erospicata'	4777	—	—	pending	mint
curly mint oil, mentha spicata var. crispa	4778	—	—	98561-44-5	mint
Horsemint - mentha spicata var. longifolia oil	4756	—	—	90063-99-3	mint
Scotch Spearmint - Mentha × gracilis (syn. Mentha x gentilis L.; syn. Mentha cardiaca (S.F. Gray) Bak.)	4811	—	—	1505459-14-2	mint

Chart 375 Spikenard

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Spikenard extract	—	6462+	—	8022-22-8	aromatic

Chart 376 Starter Distillate

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
	2173	184.1848a	—	91745-88-9	buttery

Chart 377 Storax

Name	FEMA GRAS #	CFR	NAS #	CAS#	Type
Liquidamber orientalis Mill. = Asian or Levant Storax					
Liquidamber styraciflua L. = American Storax					
botanical	3036	172.515	—	8046-19-3	aromatic
extract	3037	172.515	—	8046-19-3	aromatic
oil	—	172.515	6464	8046-19-3	aromatic

Chart 378 Strawberry

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
concentrate	—	—	6525	—	fruity
essence	—	—	6515	—	fruity
essence 150x	—	—	6607	—	fruity
flavor	—	—	6569	—	fruity
juice	—	—	6708	—	fruity
juice concentrate	—	—	6675	—	fruity

Chart 379 Sugar Beet Extract

Form	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Beta vulgaris spp.		—	172.585	6421	8016-79-3	vegetable, earthy
Sugar Beet Juice extract (Beta vulgaris) (betanin)		4229	—	—	7659-95-2	coloring
Betanin	C24H27N2O13	—	—	—	7659-95-2	coloring

Chart 380 Tagettes

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
T. glandulifera oil	3040	172.510	—	8016-84-0	fruity sulfur

Chart 381 Tamarind

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
botanical	—	182.20, 582.20	—	—	fruity
extract	—	182.20, 582.20	—	72968-49-1	brown

Chart 382 Tangelo

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
oil	—	101.22	6342	72869-73-9	citrus
terpenes	—	101.22	6447	72869-73-9	citrus

Chart 383 Tansy

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
thujone free (alcoholic bev. only)	—	—	172.51	8016-87-3 (Canadian)	aromatic
oil thujone free (alcoholic bev. only)	—	—	172.51	8016-87-3 (Canadian)	bitter principle

Chart 384 Tarragon

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
botanical	3043	182.10, 582.10	—	8016-88-4	sweet spice
extract	—	182.20, 582.20	—	8016-88-4	sweet spice
oil	2412	182.20, 582.20	—	8016-88-4	sweet spice
absolute	—	—	6319	—	sweet spice

Chart 385 Tea

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Tea (Thea (Cammelia) sinensis L.) See Tea.					
extract	—	182.20, 582.20	6384	—	tea
essence	—	—	6558	—	tea
green tea	—	—	—	84650-60-2	tea
palmitoylated green tea extract catechins	4812	—	—	1448315-04-5	tea

Chart 386 Thistle, Blessed

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Thistle, Blessed (Cnicus benedictus L.) See Bitter.					
botanical	—	172.510	6157	977023-13-4	bitter principle
extract	—	—	6158	977023-13-4	bitter principle
solid extract	—	—	6159	977023-13-4	bitter principle
oil	—	—	6160	977023-13-4	bitter principle

Chart 387 Thyme

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Thymus vulgaris L. = Common Thyme					
	3063	182.1	—	8007-46-3	aromatic
red oil	3064	182.20, 582.20	—	8007-46-3	aromatic
white oil	3065	—	—	8007-46-3	aromatic
T. zygis L. var. gracillis Boiss. = White Thyme					
oil	—	182.20, 582.20	6218	8007-46-3	aromatic
T. serpyllum L. = Wild or Creeping Thyme					
botanical	—	182.10, 582.10	6216	8007-11-2	aromatic
extract	—	182.20, 582.20	6217	—	aromatic
T. capitatus Hoff. & Link = Spanish Origanum					
botanical	2828	172.510, 182.20, 582.20	—	—	aromatic
no species specified oleoresin	—	182.20, 582.20	6389	—	aromatic
T. zygis L. and T. vulgaris L.					
oil	—	182.20, 582.20	—	8007-46-3	aromatic
oleoresin	—	182.20, 582.20	—	—	aromatic

Chart 388 Tolu Balsam

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
extract	3069	172.510	—	9000-64-0	brown type
gum	3070	172.510	—	9000-64-0	balsamic

Chart 389 Tomato

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
essence	—	—	6505	—	vegetable
powder	—	—	6608	—	vegetable

Chart 390 Tuberose

Name	FEMA GRAS #	CFR	NAS #	CAS#	Type
oil	—	182.20, 582.20	3084	8024-5-3	floral type

Chart 391 Turkey

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
cooked meat powder	—	—	6597	—	meat

Chart 392 Turmeric

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
botanical	3085	182.10, 582.10, 73.600	—	8024-37-1	aromatic and color
extract	3086	182.20, 582.20	—	8024-37-1	aromatic and color
oleoresin	3087	182.20, 582.20	—	8024-37-1	aromatic and color

Chart 393 Turpentine

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
gum	3088	172.510	—	9005-90-7	terpene
rectified	—	172.510	8713	9005-90-7	terpene
steam distilled	3089	172.510	—	8006-64-2	terpene

Chart 394 Valerian Root

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
extract	3099	172.510	—	8008-88-6	aromatic, acid
oil	3100	172.510	—	8008-88-6	aromatic

Chart 395 Vanilla

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
beans, Madagascar	—	—	6609	—	brown
botanical	3104	163.111, 163.112, 163.113, 163.114, 163.117, 163.123, 163.130, 163.135, 163.140, 163.145, 163.150, 163.153, 163.155, 169.175, 169.176, 169.177, 169.178, 169.180, 169.181, 182.10, 582.10		8024-6-4	brown
Bourbonese Absolute	—	—	6610	—	brown
extract	3105	163.111, 163.112, 163.113, 163.114, 163.117, 163.123, 163.130, 163.135, 163.140, 163.150, 163.153, 163.155, 182.20, 582.20	—	8024-6-4	brown
oleoresin	3106	163.111, 163.112, 163.113, 163.114, 163.117, 163.123, 163.130, 163.135, 163.140, 163.150, 163.153, 163.155, 169.176, 169.177, 169.178, 169.180, 169.181, 182.20, 582.20	—	84650-63-5	brown

Chart 396 Vegetable Oil

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Vegetable Oil See Fats and Oils.					
Oil	—	—	436	8008-89-7	oil
hydrogenated	—	—	438	68334-28-1	oil
partially hydrogenated	—	—	1502	—	oil
shortening - Hydrogenated	—	—	553	—	oil

Chart 397 Vegetable Protein

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
hydrolyzed	—	—	311	68607-88-5 (Soy), or 100209-45-8, 070084-87-6, or 9004-61-9 (Wheat)	—
Vegetable Protein	—	—	6614	—	—

Chart 398 Veronica

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
	—	172.510 (alcoholic bev. only)	6163	—	bitter principle

Chart 399 Vervain

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Vervain, European (Verbena officinalis L.)		172.510 (alcoholic bev. only)	6362	8024-12-2	citrus type

Chart 400 Vetiver

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
botanical	—	172.510	6165	8016-96-4	woody
oil	—	172.510	6166	8016-96-4	woody

Chart 401 Violet

Name	FEMA GRAS #	CFR	NAS #	CAS#	Type
Viola odorata L. = Sweet Violet					
leaves absolute	3110	182.20, 582.20	—	90147-36-7	green type
flowers	—	182.20, 582.20	—	—	vegetable
leaves	—	182.20, 582.20	—	—	vegetable
V. Calcarata L. = Swiss violet					
	—	172.510 (alcoholic bev. only)	6363	—	
Violet flowers	—	food	—	—	floral

Chart 402 Walnut

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
food/nut meat					Nut
hull extract	3111	172.510	—	84012-43-1	brown type
leaves extract	—	172.510	—	—	astringent
powder	—	—	6559	—	astringent
leaves extract	—	—	6168	—	astringent

Chart 403 West Indian Sandalwood Oil

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Amyris (West Indian sandalwood) Amyris balsamifera L					
botanical	—	—	6004 (Not Food Approved)	8015-65-4	woody
oil	—	172.510	6005	8015-65-4	woody

Chart 404 Wintergreen

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
extract	3112	—	—	68917-75-9	sweet spice
oil	3113	—	—	68917-75-9	sweet spice

Chart 405 Woodruff

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
	—	172.510 (alcoholic bev. only)	6364	—	sweet type

Chart 406 Yarrow

Name	FEMA GRAS #	NAS #	CFR	CAS#	Type
3117	—	—	172.510 (alcoholic beverages only)	84082-83-7	bitter principle

Chart 407 Yeast

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Yeast, Active	—	101.4, 101.22, 102.22, 136.110, 137.235, 137.260, 137.305, 139.115, 139.122, 139.155, 160.105, 160.145, 160.185, 170.3, 172.896	—	68876-77-7	yeast
Yeast, Cell Wall	—	172.898	—	8013-1-2	yeast
Yeast Extract	—	101.4, 101.22, 102.22, 137.235, 137.260, 137.305, 139.115, 139.122, 139.155, 172.325, 172.896, 184.1983, 501.22	481	8013-1-2	yeast
Yeast Extract, Autolyzed	—	101.4, 101.22, 102.22, 137.235, 137.260, 137.305, 139.115, 139.122, 139.155, 155.120 (AYE), 155.130, 155.170, 155.200, 155.210, 172.325, 172.896, 184.1983, 501.22	1500	8013-1-2	yeast
Yeast Malt Sprout Extract	—	172.59	1187	8013-1-2	yeast
Yeast, Pischia Pastoris (use in Chicken feed only)	—	573.75	—	68876-77-7	yeast
Yeast, Whole Inactive Dry Brewers	—	101.4, 101.22, 102.22, 137.235, 137.260, 137.305, 139.115, 139.122, 139.155, 172.325, 172.896, 501.22	460	68876-77-7	yeast

Chart 408 Yerba Santa

Name	FEMA GRAS #	CFR	NAS #	CAS#	Type
fluid extract	3118	172.510	—	999999-27-9	aromatic, tonic
solid extract	—	—	6308	999999-27-9	aromatic, tonic

Chart 409 Ylang Ylang

Name	FEMA GRAS #	CFR	NAS #	CAS#	Type
oil	3119	182.20, 582.20		8006-81-3	floral, sweet
absolute	—	—	6320	8006-81-3	floral, sweet

Chart 410 Yucca

Name	FEMA GRAS #	CFR	NAS #	CAS#	Type
Yucca filamentosa (Y. Smalliana)					
botanical	3120	172.510	—	—	nutraceutical
(Mohave Yucca) (Yucca schidugera Roezl ex Ortigies (Y. mohakensis Sarg.))					
extract	3121	172.510	—	—	nutraceutical

Chart 411 Alkanet Root

Name	FEMA GRAS #	NAS #	CFR	CAS#	Type
Alkanet Root Extract (Alkanna Tinctoria Tuasch)					
	Self GRAS	8819	—	23444-65-7, or 999999-01-8	Nutraceutical and Colorant

Chart 412 Furyl Esters

Compound	Empirical Formula	FEMA	GRAS #	CAS#	
tetra hydro furfuryl alcohol	C5H10O2	3056	172.515	97-994	
methyl furoate	C6H6O	2703	—	611-131-2	
methyl thio furoate	C6H6O2S	3311	—	13679-61-3	
furfuryl formate	C6H6O3	4542	—	—	13493-97-5
ethyl furan	C6H8O	3673	172.515	3208-16-0	
methyl furfuryl disulfide	C6H8OS2	3362	—	57500-00-2	
tetra hydro furfuryl acetate	C7H12O3	3055	172.515	637-64-9	
3(2 furyl) acrolein	C7H6O2	2494	—	623-30-3	
(2 furyl) 2 propanone	C7H8O2	2496	172.515	6975-60-6	
furfuryl thio acetate	C7H8O2S	3162	—	13678-68-7	
Ethanethioic acid, S-(2-methyl-3-furanyl) ester	C7H8O2S	3973	—	55764-25-5	
furfuryl acetate	C7H8O3	2490	—	623-17-6	
furfuryl thio propionate	C8H10O2S	3347	—	59020-85-8	
alpha furfuryl propionate	C8H10O3	3346	—	623-19-8	
O-ethyl *S*-(2-furylmethyl)thiocarbonate	C8H10O3S	4043	—	376595-42-5	
tetra hydro furfuryl propionate	C8H14O3	3058	172.515	2217-33-6	
4 (2 furyl 3 butene 2 one	C8H18O2	2495	—	623-15-4	
(e)-ethyl 3-(2-furyl)acrylate	C9H10O3	4541	—	—	53282-12-5
ethyl 3 (2-furyl propionate	C9H11O3	2435	172.515	1003-90-0	
3(5 methyl 2 furyl) batanal	C9H12O2	3307	—	31704-80-0	
tetra hydro furfuryl butyrate	C9H16O3	3057	172.515	637-65-0	
furfuryl pyrrole	C9H9ON	3284	—	1438-94-4	
propyl 2 furan acrylate	C10H12O3	2945	172.515	623-22-3	
furfuryl 3 methyl butyrate (furfuryl isovalerate)	C10H14O3	3283	—	13678-27-0	
alpha furfuryl pentanoate	C10H14O3	3397	—	36701-01-6	
amyl 2 furoate	C10H14O3	2072	—	1334-82-3	
ethyl 3 (furfuryl thio) propionate	C10H24O3S	3674	—	94278-27-0	
hexyl 2 furoate	C11H1603	2571	—	39251-86-0	
iso butyl 3(2 furan) propionate	C11H16O3	2198	172.515	105-01-1	
3 (2 methyl 3 furyl) thio heptanone	C12HH18O2S	3570	—	61295-41-8	
iso amyl 3(2 furan) propionate	C12H18O3	2071	172.515	7779-67-1	
octyl 2 furoate	C13H20O3	3518	—	39251-88-2	
alpha furfuryl octanoate	C13H20O3	3396	—	39252-03-4	
iso amyl 4(2 furan) butyrate	C13H20O3	2070	172.515	7779-66-0	
tetrahydro furfuryl cinamate	C14H16O3	3320	—	65505-25-1	
4(2 methyl 3 furyl) thio 5 nonanone	C14H22O2S	3571	—	61295-50-9	
furfuryl decanoate	C15H24O3	4539	—	39252-05-6	

Chart 413 Furyl and other Oxygenated Compounds

Compound	Empirical Formula	FEMA GRAS #	NAS #	CFR	CAS#
beta-angelicalactone	C5H6O2	4438	—	—	591-11-7
tetrahydro furfuryl alcohol	C5H10O2	3056	—	172.515	97-99-4
3 methyl 3 tetrahydro furan thiol	C5H10OS	3787	—	—	57124-87-5
furfural	C5H402	2489	—	172.515	98-01-1
5-Methyl-3(2*H*)-furanone	C5H5O2	4176	—	—	3511-32-8
2-Methylfuran	C5H6O	4179	—	—	534-22-5
furfuryl alcohol	C5H6O2	2491	—	172.515	98-00-0
4 hydroxy 5 methyl 3 (2H) furanone	C5H6O3	3635	—	—	19322-27-1
2 methyl 3 furan thiol	C5H6OS	3188	—	—	28588-74-1
furfuryl mercaptan	C5H6OS	2493	—	—	98-02-2
2 methyl tetrahydro fran 3 one	C5H8O2	3373	—	—	3188-00-9
cis and *trans*-2,5-dimethyltetrahydrofuran-3-thiol	C6H12OS	3971	—	—	26486-21-5
2 furyl methyl ketone (2 acetyl furan)	C6H6O2	3163	—	172.515	1192-62-7
5 methyl furfural	C6H6O2	2702	—	—	620-06-0
furan methane thiol formate	C6H6O2S	3158	—	—	59020-16-0
methyl furoate (methyl pyromucate)	C6H6O3	2703	—	—	611-13-2
furfuryl formate	C6H6O3	4542	—	—	13493-97-5
3 ethyl furan	C6H8O	3673	—	172.515	3208-16-0
2,5-Dimethylfuran	C6H8O	4106	—	—	625-86-5
furfuryl methyl ether	C6H8O2	3159	—	—	13679-46-4
2,5-Dimethyl-3(2H)-furanone or (Mango Furanone)	C6H8O2	4101	—	—	14400-67-0
5-methylfurfuryl alcohol	C6H8O2	4544	—	—	3857-25-8
4,5 dimethyl 3 hydroxy 2,5 dihydro furan 2 one (Caramel Furanone)	C6H8O3	3643	—	—	28664-35-9
4 hydroxy 2,5 dimethyl 3(2H) furanone (pineapple ketone, Furaneol ™	C6H8O3	3174	—	—	3658-77-3
furfuryl methyl sulfide	C6H8OS	3160	—	—	1438-91-4
dimethyl furan thiol	C6H8OS	3451	—	—	55764-23-3
2 methyl 5 (methyl thio) furan	C6H8OS	3366	—	—	13678-59-6
methyl furfuryl disulfide	C6H8OS2	3362	—	—	57500-00-2
Ethyl furfuryl ether	C7H10O2	4114	—	—	6270-56-0
2 methyl 3 thio acetoxy 4,5 dihydrofuran	C7H10O2S	3636	—	—	623-17-6
5 ethyl 3 hydroxy 4 methyl 2(5H) furanone (maple furanone)	C7H10O3	3153	—	—	26486-14-8
2 ethyl 4 hydroxy 5 methyl 3 (2H) furanone	C7H10O3	3623	—	—	698-10-2
2,5 dimethyl 4 methoxy 3(2H) furanone (Strawberry furanone)	C7H10O3	3664	—	—	27538-09-6
tetrahydro furfuryl acetate	C7H12O3	3055	—	172.515	637-64-9
furfuryl acetate	C7H7O3	2490	—	—	13678-68-7
(2 furlyl) 2 propanone	C7H8O2	2496	—	—	6975-60-6
2 acetyl 5 methyl furan	C7H8O2	3609	—	—	1193-79-9
3 (2 furyl) acrolein	C7H8O2	2494	—	—	623-30-3
furfuryl thio acetate	C7H8O2S	3162	—	—	
methyl 2 methyl 2 furyl disulfide	C7H8OS2	3573	—	—	65505-17-1
furfuryl thio propionate	C8C10O2	3391	—	—	10599-70-9
furfuryl propionate	C8C10O2S	3347	—	—	59020-85-8
2 acetyl 2,5 dimethyl furan	C8C10O3	2946	—	—	615-10-1
4 (2 furyl) 3 butene 2 one	C8C8O2	2495	—	—	623-15-4

Chart 413 *Continued*

Compound	Empirical Formula	FEMA GRAS #	NAS #	CFR	CAS#
2 methyl 3 (2 furyl) acrolein	C8C8O2	2704	—	—	8874-66-8
allyl 2 furoate	C8C8O3	2030	—	—	4208-49-5
2-Acetyl-3,5-dimethylfuran	C8H10O2	4071	—	—	22940-86-9
2-Butyrylfuran	C8H10O2	4083	—	—	4208-57-5
furfuryl isopropyl sulfide	C8H10O3	3346	—	—	623-15-4
O-ethyl *S*-(2-furylmethyl)thiocarbonate	C8H10O3S	4043	—	—	376595-42-5
4-Acetyl-2,5-dimethyl-3(2*H*)-furanone	C8H11O4	4070	—	—	36871-78-0
2-Butylfuran	C8H12O	4081	—	—	4466-24-4
propyl 2 methyl 3 furyl dislufide	C8H12OS	3161	—	—	1883-78-9
tetrahydro furfuryl propionate	C8H12OS2	3058	—	172.515	61197-09-9
cis and *trans*-2,5-dimethyltetrahydro-3-furyl thioacetate	C8H14O2S	3972	—	—	252736-39-3
2,5-Dimethyl-4-ethoxy-3(2*H*)-furanone or fraision ethyl ether	C8H14O3	4104	—	—	65330-49-6
2,5 diethyl tetrahydro furan	C8H16O	3743	—	172.515	41239-48-9
benzo furan carboxaldehyde (2 formyl benzo furan)	C9H6O2	3128	—	—	4265-16-1
2-methylbenzofuran	C9H8O	4543	—	—	4265-25-2
di-2-furylmethane	C9H8O2	4540	—	—	1197-40-6
1(2 furfuryl) pyrol	C9H9ON	3284	—	—	143-93-4
2 furfurylidene butyraldehyde	C9H10O2	2492	—	—	770-27-4
(e)-ethyl 3-(2-furyl)acrylate	C9H10O3	4541	—	—	53282-12-5
3 (methyl 2 furyl butanal	C9H12O2	3307	—	—	31704-80-0
2-Pentanoylfuran	C9H12O2	4192	—	—	3194-17-0
ethyl 2,5-dimethyl-3-oxo-4(2h)-furyl carbonate	C9H12O5	4546	—	—	39156-54-2
2 pentyl furan	C9H14O	3317	—	—	3777-69-3
4-Hydroxy-3-nonenoic acid lactone or 5-Pentyl-3H-furan-2-one	C9H14O2	4323	—	—	51352-68-2
1-(2-hydroxy-4-methylcyclohexyl)ethanone	C9H16O2	4742	—	—	917750-72-2
tetrahydro furfuryl butyrate	C9Hl6O3	3075	—	172.515	637-65-0
2 methyl 3 5o r6 furfuryl thio pyrazine CIOHION2OS	C10H10N2OS	3189	—	—	65330-53-2
difurfuryl monosulfide (2, 2′ (thio dimethylene) difuran)	C10H10O2S	3238	—	—	13678-67-6
bis (2 methyl 3 furyl) disulfide	C10H10O2S2	3259	—	—	28588-75-2
2, 2 (dithio dimethylene) difuran (bis 2 furfuryl disulfide)	C10H10O2S2	3146	—	—	4437-20-1
bis (2 methyl 3 furyl) tetrasulfide	C10H10O2S4	3260	—	—	28588-76-3
difurfuryl ether	C10H10O3	3337	—	—	4437-22-3
dehydro mentho furo lactone	C10H12O2	3755	—	—	756420-26-5
propyl 2 furan acrylate	C10H12O3	2945	—	172.515	623-22-3
2,3 dimethyl benzyl furan	C10H14O	3535	—	—	3782-00-1
4,5,6,7 tetrahydro 3,6 dimethyl benzofuran (menthofuran)	C10H14O	3135	—	—	494-90-6
3-Methyl-2(3-methylbut-2-en-1-yl)furan	C10H14O	4174	—	—	15186-51-3
pentyl 2 furyl ketone	C10H14O2	3418	—	—	14360-50-0
furrfuryl 3 methyl butanoate	C10H14O3	3283	—	—	13678-60-9
alpha furfuryl pentanoate	C10H14O3	3397	—	—	36701-01-6
amyl 2 furoate	C10H14O3	2072	—	—	1334-82-3

Chart 413 *Continued*

Compound	Empirical Formula	FEMA GRAS #	NAS #	CFR	CAS#
5 isopropenyl 2 methyl 2 vinyl tetrahydro furan	C10H16O	3759	—	—	13679-86-2
Dill ether or 3,6-Dimethyl-2, 3,3a,4,5,7a-hexahydrobenzofuran	C10H18O	4315	—	—	70786-44-6
2,2 dimethyl 5(l-methyl propenyl 1 yl) tetrahydro furan	C10H18O	3665	—	—	7416-35-5
linalool oxide pyranoid	C10H18O2	4593	—	—	14049-11-7
5-(cis-3-Hexenyl)dihydro-5-methyl-2(3H) furanone or 'Lactone of cis Jasmone	C11H18O2	3937	—	—	70851-61-5
yuzunone	C11H16O	4691	—	—	1009814-14-5
2,5 dimethyl 3 thio furoyl furan	C11HI0O3S	3481	—	—	65505-16-0
2,5 dimethyl 3 thio isovaleryl furan	C11HI6O2S	3482	—	—	55764-28-8
2 heptyl furan	C11HI8O	3401	—	—	3777-71-7
1,1′-(Tetrahydro-6a-hydroxy-2,3a,5-trimethylfuro[2,3-d]-1,3-dioxole-2,5-diyl) bis-ethanone or diacetyl trimer	C12H18O6	4303	—	—	18114-49-3
cassyrane(R) (5-tert-butyl-2-methyl-5-propyl-2H-furan)	C12H22O	4731	—	—	871465-49-5
3 heptyl dlhydro 5 methyl 2 (3H) furanone	C12H22O2	3350	—	—	40923-64-6
bis (2,5 dimethyl 3 furyl) disulflde	C12HI4O2S2	3476	—	—	28588-73-0
trehalose, dihydrate {2-(hydroxymethyl)-6-[3,4, 5-trihydroxy-6-(hydroxymethyl)oxan-2-yl] oxyoxane-3,4,5-triol dihydrate}	C12H26O13	4600	—	—	6138-23-4
3(2 methyl 3 furyl) thio 4 heptanone	C12HI8O2S	3570	—		61295-41-8
2 phenyl 3 (2 furyl) prop 2 enal	C13H10O2	3586	—	—	655454-81-5
2 phenyl 3 carb ethoxy furan	C13H12O3	3486	—	—	50626-02-3
2(3 phenyl propyl) tetrahydro furan	C13H18O	2898	—	172.515	3208-40-0
octyl 2 furoate	C13H20O3	3518	—	—	39251-88-2
furfuryl octanoate	Cl3H20O3	3396	—	—	39252-03-4
(±)-6-octyltetrahydro-2h-pyran-2-one	C13H24O2	4685	—	—	7370-92-5
5-isopropyl-2,6-diethyl-2-methyltetrahydro-2h-pyran	C13H26O	4680	—	—	1120363-98-5
tetrahydro furfuryl cinnamate	C14H16O3	3320	—	—	65505-25-1
4(2 methyl 3 furyl) thio 5 nonanone	C14H22O2S	3571	—	—	61295-50-9
2,6 dimetyl 3(2 methyl 3 fuuyl) thio 4 heptanone	C14H22O2S	3538	—	—	61295-51-0
2-Decylfuran	C14H24O	4090	—	—	83469-85-6
(±)-naringenin ((2S)-5,7-dihydroxy-2-(4-hydroxyphenyl)-2,3-dihydrochromen-4-one)	C15H12O5	4797	—	—	480-41-1
nerolidol oxide	C15H26O2	4536	—	—	1424-83-5
(2r)-3′,5-dihydroxy-4′-methoxyflavanone	C16H12O5	4799	—	—	1449417-52-0
3′,7-dihydroxy-4′-methoxyflavan	C16H16O4	4708	—	—	76426-35-2
(–)-matairesinol	C20H22O6	4762	—	—	580-72-3

Chart 414 Enzyme Derived Chemicals

Flavor Type	Using	Specifically
Beer	Fermentation Cultures	Yeast – Saccharomyces cerevesiae
Bread	Fermentation Cultures	Yeast – Saccharomyces cerevesiae
Cheese flavor	Enzymes	Rennet
	Fermentation Cultures	Camembert – Pennicilium Bulgaricus Roquefort – Pennicilium Roquefortii Swiss – Propioni spp.
Cocoa	Fermentation	Endogenous Cultures
Meat	Enzymes	Protease – Ficin, Papain, Bromelain
Olives	Fermentation	Lactobacillus Saccharomyces
Pickles	Fermentation	Lactobacillus Saccharomyces
Sauer Kraut	Fermentation	Lactobacillus Saccharomyces
Soy Sauce	Fermentation	Aspergillus Oryzae
Tea	Fermentation	Endogenous Cultures
Vinegar	Fermentation	Acetobacter spp.
Wine	Fermentation	Yeast Saccharomyces Cerevesiae
Yogurt	Fermentation	Streptococcus Thermophillus Acidophillus app.
Starting Product	To Product	Using
Acetic Acid	Alcohol	Acetobacter spp.
Fusel Alcohol (Amyl Alcohol)	Amyl Esters	Lipase (mucor mehei)
Isobutanol	Isobutyric Acid	Acetobacter spp.
Dairy Cultures	Propionic Acid	Propioni spp.
Castor Oil	Lactones	Candida Lipolytica
Jalap Resin (coriolitic acid)	Delta Decalactones	Saccharomyces Cerevesiae
Jalap Resin (hydroxypalmitic acid)	Delta Octalactone	Mucor Circinelloides
Lionoleic Acid	Delta Octalactone	Soy Lipoxygenease and Cladosporium Suaveolens
Eugenol	Vanillin	Soy Lipoxygenease
Benzoin Siam (Coniferyl Benzoate)	Vanillin	Esterase, Alcohol Dehydrogenase, then soy Lipoxygenase

Chart 415 Floral Terpene Esters and Ethers

Compound	Empirical Formula	FEMA GRAS #	NAS #	CFR	CAS#
geranyl formate	C11H18O2	2514	—	172.515	105-86-2
terpinyl formate	C11H18O2	3052	—	172.515	2153-26-6
linalyl formate	C11H18O2	2642	—	172.515	115-99-1
neryl formate	C11H18O2	2776	—	172.515	2142-94-1
citronellyl formate	C11H20O2	2314	—	172.515	105-85-l
rhodinyl formate	C11H20O2	2984	—	172.515	141-09-3
cis- and trans-p-1(7),8-menthadien-2-yl acetate	C12H18O2	3848	—	—	71660-03-2
linalyl acetate	C12H20O2	2636	—	182.650, 582.60	115-95-7
neryl aetate	C12H20O2	2773	—	172.515	141-12-8
terpinyl aetate	C12H20O2	3047	—	172.515	8007-35-0
l-bornyl acetate	C12H20O2	4080	—	—	5655-61-8
8-Ocimenyl acetate, or 2,6-Dimethyl-2, 5,7-octatriene-1-yl acetate	C12H20O2	3886	—	—	999999-91-4
geranyl acetate	C12H20O2	2509	—	182.60, 582.60	105-87-3
ethyl linalyl ether	C12H22O	4591	—	—	72845-33-1
citronellyl acetate	C12H22O2	2311	—	172.515	150-84-5
rhodinyl aetate	C12H22O2	2981	—	172.515	141-11-7
myrcenyl methyl ether	C12H22O2	4592	—	—	24202-00-4
geranyl propionate	C13H22O2	2517	—	172.515	105-90-8
linalyl propionate	C13H22O2	2645	—	172.515	114-39-8
neryl propionate	C13H22O2	2777	—	172.515	105-89-5
terpinyl propionate	C13H22O2	3053	—	172.515	80-27-3
citronellyl propionate	C13H24O2	2316	—	172.515	141-14-0
rhodinyl propionate	C13H24O2	2986	—	172.515	105-89-5
geranyl acetoacetate	C14H22O3	2510	—	172.515	10032-00-5
geranyl butyrate	C14H24O2	2512	—	172.515	106-29-6
geranyl isobutyrate	C14H24O2	2513	—	172.515	2345-26-8
linalyl butyrate	C14H24O2	2639	—	172.5I5	78-36-4
linalyl isobutyrate	C14H24O2	2640	—	172.515	78-35-3
neryl isobutyrate	C14H24O2	2775	—	172.515	2345-24-6
terpinyl butyrate	C14H24O2	3049	—	172.515	2153-28-8
terpinyl isobutyrate	C14H24O2	2050	—	172.515	7774-64-4
neryl butyrate	C14H24O2	2774	—	172.515	999-40-6
Bornyl butyrate	C14H24O2	3907	—	—	13109-70-1
isobornyl isobutyrate	C14H24O2	4146	—	—	85586-67-0
citronellyl butyrate	C14H26O2	2312	—	172.515	141-16-2
rhodinyl butyrate	C14H26O2	2982	—	172.515	141-15-1
rhodinyl isobutyrate	C14H26O2	2983	—	172.515	138-23-8
citronellyl isobutyrate	C14H26O2	2313	—	172.515	97-89-2
vetiveryl acetate or 6-azulenol, 1,2,3,3a,4,5,6,8a-octahydro-4,8-dimethyl-2-(1-methylethylidene)-, acetate	C14H27O2	4218	—	—	117-98-6
geranyl tiglate	C15H24O2	4044	—	—	7785-33-3
geranyl isovalerate	C15H26O2	2518	—	172.515	109-20-6
linalyl isovalerate	C15H26O2	2646	—	172.515	1118-27-0
neryl isovalerate	C15H26O2	2778	—	172.515	3915-83-1
geranyl 2-methylbutyrate	C15H26O2	4122	—	—	68705-63-5

Chart 415 *Continued*

Compound	Empirical Formula	FEMA GRAS #	NAS #	CFR	CAS#
geranyl valerate	C15H26O2	4123	—	—	10402-47-8
isobornyl 2-methylbutyrate	C15H26O2	4147	—	—	94200-10-9
rhodinyl isovalerate	C15H28O2	2987	—	172.515	7778-96-3
terpinyl isovalerate	C15H28O2	3054	—	172.515	1142-85-4
citronellyl valerate	C15H28O2	2317	—	172.515	7540-53-6
geranyl hexanoate	C16H28O2	2515	—	I72.515	10032-02-7
linalyl hexanoate	C16H28O2	2643	—	171.515	7779-23-9
geranyl benzoate	C17H22O2	2511	—	172.515	94-48-4
linalyl benzoate	C17H22O2	2638	—	171.515	12-64-7
terpinyl anthranilate	C17H23O2	3048	—	172.515	14481-52-8
linalyl phenyl acetate	C18H24O2	3501	—	—	7143-69-3
geranyl phenyl acetate	C18H24O2	2516	—	172.515	102-22-7
rhodinyl phenyl acetate	C18H2602	2985	—	172.515	10486-14-3
citronellyl phenyl acetate	C18H26O2	2315	—	I7Z.5I5	139-70-8
linalyl anthranilate	C18H28NO2	2637	—	172.515	7149-26-0
linalyl octanoate	C18H32O2	2644	—	172.515	10024-64-7
terpinyl cinnamate	C19H24NO2	3051	—	172.515	10024-56-3
linalyl cinnamate	C19H24O2	2641	—	172.515	78-37-5
digeranyl ether	C20H34O	4664	—	—	31147-36-1
phytyl acetate	C22H39O2	4197	—	—	10236-16-5
caryophyllene acetate	Cl7H2802	—	7624	172.515	32214-91-8

Note: rhodinol is a mixture of alcohols derived from geranium oil, chiefly citronellol. Therefore empirical formulae are calculated as citronellyl esters.

Chart 416 Edible Flowers

Baby's Breath
Carnation
Chrysanthemum
Cornflowers
Daylily (Hemerocallis)
Elderflowers
Freesia
Geranium
Geranium (Variegated)
Gladiola
Honeysuckle Borage
Lavender
Lilacs
Marigold
Nasturtiums
Orange Blossoms
Pansies
Primroses
Roses
Violets

Chart 417 Fruit Juice Concentrates

NAME	NAS#
Apple Juice Concentrate	6624+
Apricot Juice Concentrate	6626+
Black Currant Juice Concentrate	6562+
Blackberry Juice Concentrate	6618+
Blueberry Juice Concentrate	6629+
Boysenberry Juice Concentrate	6631+
Cherry Concentrate	6503+
Chestnut Concentrate	6577+
Cranberry Juice. Concentrate	6578+
Cucumber Concentrate	6642+
Cucumber Juice Concentrate	6579+
Elderberry Juice Concentrate	6580+
Grape Juice Concentrate	6549+
Grape, White Concentrate	6648+
Grapefruit Juice Concentrate	6651+
Guava Juice Concentrate	6581+
Lemon Juice Concentrate	6582+
Lime Juice Concentrate	6655+
Maple Concentrate	6427+
Orange Juice Concentrate	6620+
Papaya Juice Concentrate	6664+
Passionfruit Juice Concentrate	6666+
Peach Juice Concentrate	6667+
Pear Juice Concentrate	6590+
Pineapple Juice Concentrate	6594+
Plum Concentrate	6595+
Plum Juice Concentrate	6668+
Prune Juice Concentrate	6598+
Raisin Concentrate	6599+
Raisin Juice Concentrate	6669+
Raspberry Juice Concentrate	6524+
Raspberry Juice Red, Concentrate	6670+
Red Raspberry Concentrate	6600+
Strawberry Juice Concentrate	6525+
Strawberry Juice Concentrate	6675+
others of note are:	
cocoa bean concentrate	6531+
sauterne wine concentrate	6673+

Chart 418 Flavor Reactions

Acetal formation
Aging
Aldol Condensation
Amadori Rearrangement
Chelation
Condensation
Cross Esterification
Cyclization
Deaminaization
Enzymolysis
Esterification
Fermentation
Interaction
Interesterification
Maillard Reaction
Metalo-Ion Complexation
Microbial Degradation
Neutralization
Oxidation
Partitioning
Polymerization
Precipitation
Recrystallization
Reduction
Salting Out
Saponification
Schiff Base
Sedimentation

Chart 419 Foaming Agents

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Glycyrrhiza	2630	84.1408	—	8008-94-4	foaming agent, flavoring
Quillaia	—	72.510	—	68990-67-0, 977002-27-9 and 8047-15-2	foaming agent
Gellan Gum	—	72.665	—	71010-52-1	foaming agent, gum
Ethylene Oxide Copolymer	—	72.770 Malt Beverages	—	977083-02-5	foaming agent
Xanthan Gum	—	72.695	—	11138-66-2	foaming agent, gum
Yucca	—	72.510	—	—	foaming agent

Chart 420 Angola Weed

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
	—	172.510 (alcoholic beverages only)	6006	977038-44-0	coloring

Chart 422 Butter Derivatives

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
butter acids	—	2171	172.515	—	91745-88-9
butter esters	—	2172	172.515	—	97926-23-3
butter sturter distillate	—	2173	184.1848	—	91745-88-9
lipolized butter	—	6633	1O1.22 (natural flavor)	—	—

Chart 423 Pepeppermint by Regions

Peppermint Source	Description
Idaho	clean, crisp, bright, light, caramel, airy, slight green, slight hay
Madras	cool, bright, clean, sharp, powerful, high menthol
Midwest	earthy, powerful, deep, complex, green hay, cocoa, slightly smoky, slight plum
Montana	clean, warm, airy, smooth, sweet hay
Willamette	warm, rich, smooth, sweet, creamy, airy, sweet, hay, slight, cocoa
Yakima	pungent, sweet, candy, herbaceous, slight, medicinal, slight, green, tarry, coconut

Chart 424 Casein Caseinates

Form	FEMA GRAS #	CFR	NAS #	CAS #	Descriptor
Casein	—	—	422	900-71-9	milk product
Enzyme Hydrolisate	—	—	—	65072-00-6	milk product
Potassium Salt	—	24.243 (Clarifying wine)	—		milk product
Sodium Salt	—	182.1748	—	9005-46-3	milk product
Ammonium, Calcium Potassium and Sodium Salts	—	135.110 (c) Optional caseinates. The optional caseinates referred to in paragraph (a) of this section that may be added to ice cream mix containing not less than 20 percent total milk solids are: Casein prepared by precipitation with gums, ammonium caseinate, calcium caseinate, potassium caseinate, and sodium caseinate. Caseinate may be added in liquid or dry form, but must be free of excess alkali. Ice cream and frozen custard	—	—	milk product

Chart 425 Chemical Diversion Act List – DEA List

List I Chemicals (formerly precursor chemicals)
benzaldehyde
methylamine (trimethyl amine)
phenyl acetic acid
phenyl acetates
piperidine
piperonal

List II Chemicals (formerly essential chemicals)
acetone
methyl ethyl ketone

Chart 426 Cinnamyl Anthranilate

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
cinnamyl anthranilate has been delisted formerly FEMA GRAS	C16H15NO2	formerly 2295	—	—	87-29-6

Chart 427 Cork Oak

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
	—	172.510 (alcoholic beverages only)	6042	—	woody

Chart 428 Masa Harina

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Corn – (Masa Harina)	—	—	6682	—	Corn

Chart 429 Crab Extract

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
	—	—	6640	—	Crustacean – Shellfish

Chart 430 Deertongue Extract

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Solid Extract	NOT FOOD GRADE	NOT FOOD GRADE	8811	68606-82-6	NOT FOOD GRADE

Chart 431 Dimethyl Poly Siloxane

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
PDMS or Silicone	$(CH_3)_3SiO[SiO(CH_3)_2]_nSi(CH_3)_3$	—	1065	175.105 (indirect additive)	63148-62-9 or 90006-65-9

Chart 432 Enzyme Modified Milk

Name	FEMA GRAS #	NAS #	CFR	CAS#	Type
Enzyme Modified Milk	—	293	—	—	dairy
Enzyme Modified Swiss Cheese	—	6676	—	—	dairy

Chart 433 Glucose Pentaacetate

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Glucose Pentaacetate	2524	—	172.515	3891-59-6	Adjuvant

Chart 434 Enocianinna

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
	1310	73.169, 73.170	—	—	Coloring

Chart 435 Ho Oil

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
cinnamomum camphora ho-sho	—	not food approved	6704	8022-91-1	floral, camphoraceous

Chart 437 Persic Oil

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Apricot kernel (persic oil) Prunus armeniaca L. Peach kernel (persic oil) Prunus persica Sieb. et Zucc.	—	—	182.40, 582.40	72869-69-3	oil

Chart 438 Prune Juice Concentrate

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Prune Juice Concentrate	—	—	6598	—	fruit

Chart 439 Listing of Industries within the Food Industry

Alcoholic, Isotonic,
Baking Industry, Toppings, Fillings, Breads
Beverage Industry
Beverage Industry, Syrups
Candies and Confectionery Industry
Carbonated, Still Drinks
Cereal Products
Cheese Products
Chewing Gums
Chips, Nuts, Crackers, Pretzels, Popcorn, etc.
Coffee, Cocoa, Tea, etc.
Dairy Industry
Desserts
Frozen Products, Yogurts, Creams, Creamers, etc.
Health Care, Health Food and Pharmaceutical Industry
Meat Products Industry
Pet Food and Animal Feed Industry
Prepared Foods, Instant Meals, Salad Dressings, Dips, Pickles
Sauces, Marinades, Gravies, Soups, Tenderizers
Savory Industry
Snack Food Industry
Sweet Goods Industry

Chart 440 Internet Sites of Interest

Gopher Search Engine Sites	
gopher - //cyfer.esuda.gov - 70/11/ace/ hot.topic.links/gatt	General Agreement on Tariffs and Trade
gopher - //ftp.senate.gov//11	U.S. Senate
gopher - //ginfo.cs.fit.edu - 70/1	gopher - //ginfo.cs.fit.edu - 70/1
gopher - //gopher.census.gov	Bureau of the Census
gopher - //gopher.cpsc.gov	Consumer Product Safety Commission
gopher - //gopher.esa.doc.gov	
gopher - //gopher.house.gov/1	Gopher search Engine
gopher - //gopher.nsf.gov	National Science Foundation Gopher Search Engine
gopher - //gopher.osdhhs.gov	HHS Office of the Assistant Secretary for Management & Budget
gopher - //gopher-server.nist.gov	National Institute of Standard and Technology
gopher - //gopher.stolaf.edu	State Department Travel Advisories
gopher - //peg.cwis.uci.edu/politics and	gopher - //peg.cwis.uci.edu/politics and
gopher - //usda.mannlib.cornell.edu/1	USDA Agricultural Economics and Statistics
gopher - //zeus.esuda.gov/11/feds/usda-info	USDA Agency Information
Telnet Search Engine Sites	
Telnet - //fdabbs.fda.govlogin - bbs	FDA
Telnet - //fedworld.gov lgon and enter "D" at main menu	FEDWORLD
Internet Links	
thomas.loc.gov/	
www.aaaai.org	Asthma and Immunology society http://www.aaaai.org
www.access.gpo.gov/su_docs	Government Printing Office
www.ACS.org/jokes.html	Jokes of the Amercian Chemical Society
www.agmrc.org/agmrc/markets/Food/ foodconsumptiontrends.htm	Foods and Trends Information
www.cbp.gov	Customs and Border Protection
www.cbp.gov/xp/cgov/travel	Customs Transport of Items
www.cdc.gov	Center for Disease Control
www.census.gov	SIC Codes
www.cfsan.fda.gov	"Bad Bug Book"
www.cfta.org	CFTA
www.cia.gov	World Fact Book
www.cnet.com	General Information and News About Technology
www.congress.org	Congress
www.cspinet.org	Guide to Food Additives
www.doc.gov	Department of Commerce
www.dot.gov	Department of Transportation
www.eaaci.org/welcome.html	The European Academy of Allergology and Clinical Immunology http://www.eaaci.org/welcome.html
www.esa.gov	Economics and Statistics Administration
www.fao.org	Food and Agricultural Organization
www.fda.gov	U.S. Food and Drug Administration
www.flavordynamics.com	Flavor Dynamics, Inc. Coffee and Tea Flavor Wheels
www.foodallergy.org.	The Food Allergy & Anaphylaxis Network http://www.foodallergy.org.
www.foodprocessing.com	Food Companies Report

Chart 440 *Continued*

www.georgetown.edu	Georgetown University Site
www.gpo.gov/nara/cfr/	Code of Federal Regulations
www.house.gov	U.S. House of Reps
www.ita.doc.gov	International Trade Administration
www.news.com	News and Information
www.nist.gov	National Institute of Standard and Technology
www.nist.gov/srd/	National Environmental Technology Gateway Catalog
www.njlawnet.com/njlaw2nd.html	New Jersey Law Network
www.nsf.org	National Science Foundation
www.ntis.gov	National Technical Information Service
www.oehha.ca.gov/prop65.html	Proposition 65
www.orst.edu/food-resource/food.html	The Food Resource
www.os.dhhs.gov	Department of Health and Human Resources
www.osha.gov	Occupational Safety and Health Administration
www.pointcast.com	Information on Demand
www.pueblo.gsa.gov	Consumer Information Center Online
www.usitc.gov	International Trade Commission
www.uspto.gov	Patent and Trademark Office
www.webmed.com	Medical Information
www.webtrack.com/adverts/category/fl-html	Listing of Companies and Resources
www.wffc.org	Women in the Flavor and Frangrances Trade
www.whitehouse.gov	White House, Executive Office of The President
www.whitehouse.gov/White_House/EOP/html/couples.html	White House In Focus Features
www.whitehouse.gov/White_house/EOP/OSTP/html/OSTP_home.html	Office of Science & Technology Policy
www.whitehouse.gov/White_House/html/Publications/Publications.html	White House, Public Documents
www.who.int	World Health Organization
www.cfsan.fda.gov/~rdb/opa-gras.html	Summary of all GRAS Notices
www.culinology.org	Research Chefs Association
http://foodsafety.ifas.ufl.edu/	National Food Safety Database (Managed by the University of Florida)
www.fpa-food.org/	Food Producers Association (National Food Producers Association)
www.goa-online.org	Global Organic Alliance
www.ciaprochef.com	The Culinary Institute of America
www.medindia.net/	General News about medicine and herbs from India and Worldwide
www.botanical.com/botanical/mgmh/mgmh.html	A botanical and herb index and reference
www.herbslides.com/index.cfm	An index of herbal pictures
www.incb.org/incb/red_list.html	Chemical Diversion Trafficking Act of 1988 Drug Precursor List
http://www.nutritiondata.com/facts-C00001-01c20eL.html	Nutritional Database Website
http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&rgn=div5&view=text&node=49:2.1.1.3.7&idno=49	USDA CFR 49

Chart 441 IUPAC

Carbon	Acid	Acid	Alcohol	Alcohol
	new	old	new	old
1	form-	form-	methyl	methyl
2	acet-	acet-	ethyl	ethyl
3	propan-	propan	propyl	propyl
4	butan-	butan-	butyl	butyl
5	pentan-	valeric	valeryl	amyl
6	hexan-	caproic	hexyl	hexyl
7	heptan-	oenanthic	heptyl	heptyl
8	octan-	caprylic	octyl	octyl
9	nonan-	pelargonic	nonyl	nonyl
10	decan-	capric	decyl	decyl
11	undecan-	undecanoic	undecyl	undecyl
12	dodecan-	lauric	dodecyl	lauryl
14	tetradecan-	myristic	tetradecyl	myristic(yl)
16	hexadecan-	palmitic	hexadecyl	palamitic(yl)
18	octadecan-	stearic	octadecyl	stearyl

Chart 442 Leaves and Wrappings

Wrappings

Banana Leaves
Corn Husks
Grape Leaves
Lettuce Leaves
Lotus Leaves
Paan Leaves
Seaweeds
White Cabbage Leaves

Leaves for Salads

Batavia lettuce-loose leaf green lettuce similar to iceberg but packed very thin
Belgian Endive-yellowish flat long leaf version of chicory (See chicory - forced)
Chicory-the lacy green, yellow and white leaves of the chickory plant
Crisphead Lettuce-(Iceberg Lettuce or Webb's Wonder Lettuce)-common green and white lettuce.
Lollo Biondo-a curly loose leaf green lettuce.
Lollo Rosso-a loose curly leaf reddish purple lettuce.
Radicchio-a red cup leafed lettuce.
Red Oak Leaf Lettuce-a loose flat leaf green and red letuce
Romaine Lettuce-a long flat leaf green lettuce.

Salad Herbs

Arugala (Rocket)-sharp flavored relative to mustard.
Dandelions-slightly bitter, best tasting when young.
Garden Cress-often used sprouted.
Mache (Corn Salad).
Nasturtium-peppery flavor.
Nettle-best when young.
Purslane-succulent in taste.

Sorrel-Acidic and sharp, high in Vitamin C.
Watercress-must be grown in cleanest water to provide for best flavor.

Chart 443 Lettuce

Lettuce Types	
Butterhead Lettuce	
Iceberg Lettuce	
L. sativa Var. angustana	Celtuce
L. sativa Var. capitata	Head Lettuce
L. sativa Var. crispa	Leaf Lettuce (Hazelnut Flavor)
Romaine Lettuce (Cos)	

Chart 444 Linseed

Form	FEMA GRAS #	CFR	NAS #	CAS #	Descriptor
Linseed Oil – Linum usitatissimum, Linaceae – Cold pressed non-solvent extracted is also called flaxseed oil	—	GRAS exemption claim (proposed 21 CFR 170.36(c)(1))	6519	8001-26-1	Oil

Chart 445 GM Products

A Partial List of the Date of Publication of Gentically Modified Crops and Foodstuffs

Corn – Insect Resistance, Herbicide Resistance, Antibiotic Resistance: '95,'96,'97,'98,'00,'01
Rice – Herbicide Resistance: '00
Canola – Herbicide Resistance: '95,'97,'98,'99 (Rapeseed Oil)
Cantaloupe – Delayed fruit ripening: '99
Sugar Beet – Herbicide Resistance: '98
Soybean – Herbicide Resistance: '95'97'98,
Tomato – Insect Resistance: '94,'95,'96,'98
Flax - Herbicide Resistance: '98 (Seed Oil)
Potato – Insect Resistance: '95,'96,'98
Cotton - Insect Resistance, Herbicide Resistance: '95,'96,'98
Radicchio - Herbicide Resistance: '97
Squash – Virus Resistance: '95, '97
Papaya - Virus Resistance: '97

Chart 446 Lipolyzed Butter Oil and Cream

Name	FEMA GRAS #	NAS #	CFR	CAS#	Type
Lipolyzed Butter Oil	—	1329	—	—	Butter
Lipolyzed Cream	—	1328	—	—	Butter

Chart 447 Lobster

Form	FEMA GRAS #	CFR	NAS #	CAS #	Descriptor
	—	—	6454	—	Crustacean Shellfish

Chart 448 Longoza

Form	FEMA GRAS #	CFR	NAS #	CAS #	Descriptor
Absolute	—	6318	—	—	—

Chart 449 Mango

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Extract	—	—	6455	—	fruit

Chart 450 Maltodextrin

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
	—	184.1443a, 184.1444	412	9050-36-6	bulking agent, dry diluent, carbohydrate

Chart 451 Masking Flavors

Item	Masks	Off Odor
mace oil		sulfur
anethole		sulfur
vanilla		acid

Chart 452 Melon

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
extract	—	—	6456	—	fruit

Chart 453 Millet

Common Name	Botanical Name
Common Millet	Panicum miliaceum
Foxtail Millet	Setaria italica
Pearl Millet	Panicum miliare
Sorghum	Sorghum vulgare (also known as Milo)
Teff	Eragrostis abyssinica

Chart 454 Modified Food Starch

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
	—	172.892	1079	—	starch
Modification	Chemical	Limitation			
acid	hydrochloric acid or sulfuric acid or both	none			
bleached	Active oxygen obtained from hydrogen peroxide and/or peracetic acid	not to exceed 0.45 percent of active oxygen			
	ammonium persulfate	not to exceed 0.05 percent.			
	chlorine as calcium hypochlorite	not to exceed 0.036 percent of dry starch limited to use only as a component of batter for commercially processed foods			
	chlorine as calcium hypochlorite	not to exceed 0.0082 pound of chlorine per pound of dry starch			
	Potassium permanganate	not to exceed 0.2 percent, residual manganese (calculated as Mn), not to exceed 50 parts per million in food starch modified			
	Sodium chlorite	not to exceed 0.5 percent			
oxidized	sodium hypochlorite	not to exceed 0.055 pound of chlorine per pound of dry starch			
esterified	Acetic anhydride	Acetyl groups in food starch-modified not to exceed 2.5 percent			
	Adipic anhydride	not to exceed 0.12 percent, and acetic anhydride			
	Monosodium orthophosphate	Residual phosphate in food starch-modified not to exceed 0.4 percent calculated as phosphorus			
	1–Octenyl succinic anhydride	not to exceed 3 percent			
	1–Octenyl succinic anhydride and aluminum sulfate	neither to exceed 2 percent each			
	1-Octenyl succinic anhydride with subsequent beta amylase enzyme treatment	Limited to use as a stabilizer or emulsifier in beverages and beverage bases as defined in § 170.3(n)(3) of this chapter			
	Phosphorus oxychloride	to exceed 0.1 percent			
	Phosphorus oxychloride folowed by either acetic anhydride or vinyl acetate	not to exceed 0.1 percent, followed by either acetic anhydride, not to exceed 8 percent, or vinyl acetate, not to exceed 7.5 percent. Acetyl groups in food starch-modified not to exceed 2.5 percent			
	Sodium trimetaphosphate	Residual phosphate in food starch-modified not to exceed 0.04 percent, calculated as phosphorus			

Chart 454 *Continued*

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
	Sodium tripolyphosphate and sodium trimetaphosphate	Residual phosphate in food starch-modified not to exceed 0.4 percent calculated as phosphorus			
	Succinic anhydride	not to exceed 4 percent			
	Vinyl acetate	Acetyl groups in food starch-modified not to exceed 2.5 percent			
etherified	Acrolein	not to exceed 0.6 percent			
	Sodium trimetaphosphate	Residual phosphate in food starch-modified not to exceed 0.04 percent, calculated as phosphorus			
	Sodium tripolyphosphate and sodium trimetaphosphate	Residual phosphate in food starch-modified not to exceed 0.4 percent calculated as phosphorus			
	Succinic anhydride	not to exceed 4 percent			
	Vinyl acetate	Acetyl groups in food starch-modified not to exceed 2.5 percent			
	Epichlorohydrin	not to exceed 0.3 percent			
	Epichlorohydrin and propylene oxide	not to exceed 0.1 percent, followed by propylene oxide, not to exceed 25 percent			
	Propylene oxide	not to exceed 25 percent			
esterified and etherified	Acrolein and Vinyl Acetate	Acrolein, not to exceed 0.6 percent and vinyl acetate, not to exceed 7.5 percent. Acetyl groups in food starch-modified not to exceed 2.5 percent			
	Epichlorohydrin and Acetic Anhydride	Epichlorohydrin, not to exceed 0.3 percent, and acetic anhydride. Acetyl groups in food starch-modified not to exceed 2.5 percent			
	Epichlorohydrin and succinic anhydride	Epichlorohydrin, not to exceed 0.3 percent, and succinic anhydride, not to exceed 4 percent.			
	Phosphorus oxychloride and propylene oxide	Phosphorus oxychloride, not to exceed 0.1 percent, and propylene oxide, not to exceed 10 percent. Residual propylene chlorohydrin not more than 5 parts per million in food starch-modified.			
general	Chlorine, as sodium hypochlorite	not to exceed 0.055 pound of chlorine per pound of dry starch; 0.45 percent of active oxygen obtained from hydrogen peroxide; and propylene oxide, not to exceed 25 percent. Residual propylene chlorohydrin not more than 5 parts per million in food starch-modified.			
combinations	see all above				

Chart 454 *Continued*

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
enzymatic	Alpha-amylase	Generally recognized as safe. The resulting nonsweet nutritive saccharide polymer has a dextrose equivalent of less than 20.			
	Beta-amylase	Generally recognized as safe. The resulting nonsweet nutritive saccharide polymer has a dextrose equivalent of less than 20.			
	Glucoamylase	Generally recognized as safe. The resulting nonsweet nutritive saccharide polymer has a dextrose equivalent of less than 20.			
	Isoamylase	Generally recognized as safe. The resulting nonsweet nutritive saccharide polymer has a dextrose equivalent of less than 20.			
	Pullulanase	Generally recognized as safe. The resulting nonsweet nutritive saccharide polymer has a dextrose equivalent of less than 20.			

Chart 455 Mollusks

Bivalves	
	Abalone (Haliotis spp.)-Also known as seas ears called ormer.
	Clam (Venus spp.)-Including the quahog (Venus mercenaria), surf clam (Spissula solidisima), razor-shells or jackknife clams (Ensis spp.), little neck clam (mercenaria-mercenaria), long necked clam (Mya mercenaria).
	Cockle shells (Cardium spp.)-Including European cockle (C. edule).
	Mussel (Muscullus spp. and Mytilus spp.)-Including the blue mussel (mytilus edulis).
	Oyster (Ostrea spp. and Crassostrea spp.)
	Scallop (Pecten spp.)-Including great scallop (P. maximus or P. jacobeus), queen scallop or quin (Chlamys opercularis), Atlantic deep-sea scallop (Placopecten magellanicus), bay scallop (Aequipecten irradians), Iceland scallop (Chlamys islandicus).
Cephalopods	
	Cuttlefish (Sepia officinalis)
	Octopus (Octopus spp.)
	Squid (Loligo spp.)-Also known as a calamari.
	Gastropods (Snails)
	Periwinkle (Littornia spp.)
	Snail (Helix spp.)-Including the white burgundy snail, also known as the vineyard snail (Helix pomatia), garden snail (Helix aspersa).
	Whelk (Buccinum spp.)
Echinoderms	
	Stongylocentrotus spp.-Contains spines which are occasionally venomous. The inside contains the edible matter.

Chart 456 Mono and Diglycerides

Form	FEMA GRAS #	CFR	CFR	NAS#	CAS #	Descriptor
	—	—	184.1101 Diacetyl tartaric acid esters of mono- and diglycerides, 184.1323 Glyceryl monooleate, 184.1324 Glyceryl monostearate, 184.1328 Glyceryl behenate, 184.1329 Glyceryl palmitostearate, 184.1505 Mono- and diglycerides	130	67254-73-3	fat, solvent

Chart 457 Mushroom Extract

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
	—	6557	—	—	vegetable, earthy
mushroom oil, distilled		4487	—	946156-68-9	vegetable, earthy

Chart 458 Non-Potability

Chemical	Amount
citric acid	(1) If the ethanol is less than 30%, then the percentage of citric acid should be 0.1 × % alcohol + 0.5.
citric acid	(2) If the ethanol is greater than 30%, then the percentage of citric acid should be 0.1 × % ethanol.
essential oils	most essential oils are unfit at a level of 3% in 90% ethanol.
essential oils	Anise oil is an exception, needing 4.2%. Many 1% solutions of
ethanol	90% ethanol is unfit.
ethyl vanillin	0.4 ounces per gallon at a dilution of 30% ethanol
maltol (TM)	5.0% maltol (TM) by weight in a volume of 90% ethanol
propylene glycol	equal amounts by volume of PG and ethanol
salt	3.21 grams of salt per 100 mL at a dilution of 45% alcohol
vanillin	1 ounce per gallon at a dilution of 30% ethanol

Chart 459 Nutrient Content

CFR	Nutrient claim
101.54	“good source”, “high”, and “more”
101.56	“light” or “lite”,
101.60	the calorie content of foods
101.61	the sodium content of foods,
101.62	fat, fatty acid, and cholesterol content of foods, and Subpart F.
101.95	“fresh”, “freshly frozen”, “fresh frozen”, “frozen fresh”

Chart 460 Ethyl Oenenthate

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
Oenanthic Ether	C9H184O2	2437	172.515	8768	106-30-9

Chart 461 Pineapple

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
	—	—	6594	—	fruit

Chart 462 Polycyclic Heterocyclic Amines

Code	Chemical Name
DiMeIQx	2 amino 3,4,8 trimethyl imidazo [4,5-f] quinoxiline
MeIQx	2 amino 3,4 or 8 dimethyl imidazo [4,5-f] quinoxiline
PhIP	2 amino 1 methyl 6 phenyl imidazo [4,5-b] pyridine
IQ	2 amino 3 methyl imidazo [4,5-f] quinoxiline
MeIQ	2 amino 3,4 dimethyl 3 H imidazo [4,5-f] quinoxiline
TrpP1	3 amino 1,4 dimethyl 5H pyrido [4,3-b] indole
TrpP2	3 amino 1 methyl 5H pyrido [4,3-b] indole
GluP1	2 amino 6-methyl dipyrido [1,2a:3′2′d] imidazole
GluP2	2 amino dipyrido [1,2a:3′2′d] imidazole
A alpha C	2 amino 9H pyrido [2,3b] indole A alpha C
MeA alpha C	2 amino 3 methyl 9H pyrido [2,3b] indole
	These are NOT GRAS, but potent carcinogens under study

Chart 463 Rosin

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
tall oil (pine sap)	—	—	1035	8050-9-7 and 8052-10-6	resinous
Glycerol Ester of Rosin	4226	—	7723	8050-31-5	weighting agent
tall oil (rosin) phytosterols	self GRAS	170.36(f) (Self GRAS)	—	—	—
distilled	—		—	8002-26-4	resinous
oleic acid from tall oil	—	172.862	—	—	acid

Chart 465 Tea Tree

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Tea tree oil	3902	oil	—	68647-73-4	Camphoraceous

Chart 466 Perilla Oil

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Perilla leaf oil or Shiso Oil	4013	—	—	68132-21-8	Green

Chart 467 Litsea Cubeba

Form	FEMA GRAS #	CFR	NAS #	CAS #	Descriptor
Litsea cubeba oil	3846	—	—	68855-99-2	Lemon Citral

Chart 468 Grape Seed Extract

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Grape seed extract	4045	—	—	Pending	Nutraceutical

Chart 469 Daidai Peel Oil

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Daidai peel oil (Citrus aurantium L. subspecies cyathifera Y.)	3823	—	—	999999-91-0	citrus

Chart 470 Mentha Arvensis

Name	FEMA GRAS #	NAS #	CFR	CAS#	Type
Cornmint oil, Mentha arvensis L.	4219	6452	—	68917-18-0	mint

Chart 471 Tomato Lycopene

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Tomato Lycopene or (Lycopersicon esculentum)	4110	—	—	502-65-8	nutraceutical

Chart 472 Ester Gum

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Glycerol Ester of Rosin	4226	7723	—	8050-31-5	weighting agent

Chart 473 Sodium Diacetate

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Sodium diacetate	3900	184.1754	—	126-96-5	acidulant, precursor

Chart 474 Sarcodactylus Oil

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Sarcodactylis oil (Citrus medica L. var. Sarcodactylis swingle) or Fingered Citron, or Buddha's Hands	3899	—	—	85085-28-5	citrus

Chart 475 Heliopsis

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Heliopsis longipes extract	4220	—	—	792933-14-3	nutraceutical

Chart 476 Mesquite Wood Extract

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Mesquite wood extract (Prosopis spicigera, extract)	3942	—	—	93165-66-3	woody

Chart 477 Isoquercitrin Enzymatically Modified

Name	Chemical Information	Empirical Formula	FEMA GRAS #	NAS #	CFR	CAS#	Type
Isoquercitrin, enzymatically modified (extracted from buckwheat, rutin , japanese pagoda tree extract Sophora japonica)	Isoquercitrin or 2-(3,4-dihydroxyphenyl)-4,5-dihydroxy-3-[3,4,5-trihydroxy-6-(hydroxymethyl) oxan-2-yl]oxy-chromen-7-one	C21H20O12	4225	—	—	21637-25-2 – isoquercitrin G1 52844-41-4 – isoquercitrin G2 143672-59-7 – isoquercitrin G3 280748-30-3 – isoquercitrin G4 280748-31-4 – isoquercitrin G5 280748-32-5 – isoquercitrin G6 280748-33-6 – isoquercitrin G7 280748-34-7 – isoquercitrin G8	

Chart 478 Adenosine Derivatives

Name	Empirical Formula	FEMA GRAS #	NAS #	CFR	CAS#
Adenosine monophosphate; monosodium, or disodium adenylate	C10H14N5O7P (Acid)	4224	—	—	61-19-8 (acid form); 18422-05-4; 149022-20-8 - (monosodium salt); 4578-31-8 (disodium salt)

Chart 479 Piperitenone Oxide

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Piperitenone oxide	C10H14O2	4199	—	—	35178-55-3

Chart 480 Succinamides – Dimethyl Menthyl Succinamide

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
(+/−)-*N*,*N*-Dimethyl menthyl succinamide	C16H28NO2	4230	—	—	544714-08-1

Chart 481 Food Doneness Chart

Protein	Reccomended Degree Range
Beef, pork, lamb, ground products	160 Degrees F
Beef, pork, lamb, roasts or steaks	160 Degrees F
Poultry products	170–180 Degrees F
Ground poultry products	165 Degrees F
Seafood	145–160 Degrees F

Chart 482 Mint Varieties

Mint Varieties		Edible?
Spearmint – Native	Mentha Spicata 'Native'	yes
Spearmint – Scotch	Mentha Spicata 'Scotch'	yes
Horse Mint	Many varieities???	
Chocolate Mint	Mentha Piperita f. citrata 'Chocolate'	
Pineapple Mint	Mentha Suaveolens Variegata	
Peppermint	Mentha Piperita	yes
Corn Mint	Mentha Arvensis	yes
Banana Mint	Mentha Arvensis var. 'Banana'	
Moroccan Mint	Mentha Piperita f. citrata 'Moroccan'	
Egyptian Mint	Mentha Niliaca	
Orange Bergamot Mint	Mentha Piperita citrata 'Orange Bergamot'	
Lavender Mint	Mentha Piperita 'Lavender'	
Curly Spearment	Mentha Spicata Crispa	
Kentucky Colonel Mint	Mentha Spicata 'Kentucky Colonel'	yes
Basil Mint	Mentha var. 'Basil Mint'	
Habek Mint (Horse Mint?)	Mentha Longifolia	
Lemon Bergamot Mint	Mentha Piperita citrata 'Lemon Bergamot'	
Pennyroyal Oil	Mentha Pulegonium	
Apple Mint	Mentha Suaveolens	
Lemon Mint / Horse Mint / Lemon Bee Balm	Monarda Citriodoria and Monarda Puntata (err. Punctuata)	yes
Agastache urticifolia		
Asian Mint	Mentha Asiatica	
Australian Mint	Mentha Australis	
Watermint wild wind	Mentha Aquatica	
	Mentha Cervina	
	Mentha Cunninghama	
	Mentha Diemenica	
Corsican Mint	Mentha Requienii	
	Mentha Saturiodes	
Bushy Mint	Mentha Gentilis	
Tall Mint	Mentha Smithiana	
Whorled Mint	Menta Verticilata	

Chart 483 Wine Varieties

WHITE WINES	
Aligoté	Uncommon white grape being replaced by the Chardonnay
Chardonnay	Vanilla less acidty than Sauvignon Blanc Malolactic Fermentation adds a buttery taste and reduces crispness.
Chenin Blanc	Fragrant high in acid used to make sparkling wines South African called Steen.
Columbard	Second highest planting in CAL fresh and high in acid
Folle Blanche	Originally planted for Armagnac, now for early maturing Ugni Blanc Tart and thin, some planting in Califirnia
Gewurztraminer	Floral and Spicy, Alsace Cal & OR, bette in cooler climates Completely dry to semi dry. Later harvest wine with a lot of sugar very delicious.
Grüner Veltliner	Bright spicy aroma grown only in Australia most of wine in Australia >1/3
Malvasia	Nera and Bianca sub variety. Dry to very sweet pear and spice and fruity Italy and other parts of world. Best in Sunlight and good drainage. Ages well only as dessert wine.
Marsanne	This grape comes from the Rhone river valley. It is a little used variety. It is often blended with Rousanne. Wines made from it are somewhat dry, rich in flavor with spicy fruity notes.
Melon de Bourgogne	This is the primary grape grown in the lower Loire valley region of France. It is used to produce Muscadet.
Muller-Thrugau	This wine is usually dry to semi-dry and is lightly aromatic. Muller-Thurgau is a cross between Riesling and Sylvaner. Muller-Thurgau is grown primarily in Germany (where it is planted more than any other grape). It also grows in Austria, New Zealand and Oregon. It is matures early and grows well in cool climates.
Muscadelle	It is one of the three grapes used in making white Bordeaux. The other two are Sauvignon Blanc and Semillon. It develops a fruity and a floral wine. It is planted in small quantities in California and in Australia.
Muscat	This grape includes many varieties. Most of the wines it produces are sweet and floral. In Italy it is called Moscato and in Spain it is kinown as Moscatel. It is used to produce Asti Spumante, an Italian sparkling wine.
Palomino	Palomino grapes are native to Spain and are used in sherry. Also grown in Australia, South Africa and California
Pedro Ximénez	A sweeter white grape used to increase sugar content for sherries. Grown in Spain and Australia.
Pinot Blanc	Also known as a poor man's Chardonnay. The Pinot Blanc looks similar to that variety. It is planted in California, Austria, Germany, France and Italy. It yields a dry white wine.
Pinot Gris / Pinot Grigio	An average tasting grape, usually well balanced and slightly floral.
Reisling	Produces wines of varying character from very dry to very sweet. Its versatility has given it the moniker of "noble" grape. It can survive very well in very cool climates. It has a distinctive flavor of peach and honeysuckle and can be described as having a terpeny or gasoline type character upojn againg.
Rousanne	A variety grown in Northern France used in Hermitqge Blanc or blended with Marsanne.
Sauvignon Blanc	A lesser expensive grape to grow. Sauvignon blanc has a melon like character, but takes on a grassy note when grown in colder climates. It has a pretty good heat tolerance.Because of its subtle flavor it is oftentimes not aged in oak.
Scheurebe	Developed in Germany as a cross between the Reisling and a Sylvaner varieties, Scheurebe is typically high in acid with berry notes.

Chart 483 *Continued*

Semillon	Due to its tendency to ripen early it can be a sensitive variety to frost and excess rain. It is usually blended with Sauvignon Blanc. It is one of the three grapes used in making white Bordeaux. It ages well and produces a wine with full aromatic flavor.
Sylvaner	Growns in cool climates and has more body and is sweeter than a Reisling.
Trebbiano (Ugni Blanc)	Grown in France, Australia and in Italy, this grape is usually high in acidity. It is used for making not only wines, but brandy and cognac as well.
Verdicchio	Verdicchio comes from central Italy where wine was believed to have originated. It produces a high acid wine that does not age more than 2 years. It is often blended with other wines and produces a yellowish green wine.
Viognier	It is planted in Southwestern France and some in California. It has a peach/apricot flavor with a spicy background.
RED WINES	
Barbera	It usually has a high acid and is therefore used as a blender.
Brunello	Used for Brunello di Montalcino. Makes dark fruity wines that age well.
Cabernet Franc	Adds acidity and aroma to wines. It is the genetic precursor to Carbernet Sauvignon. But it's wines are lighter and fruitier.
Cabernet Sauvignon	Wines produced from this grape are often the finest wines. It's wines are tannic and age well. It is often blended to increase complexity. It descended from Carbernet Franc and Sauvignon Blanc. Flavor notes include; dark cherry, cedar, tobacco, black currant, and in cool climates green pepper or olive.
Carignane	One of the most widely planted varieties. It has a tannic, fruity character, with a high amounbt of sugar. Sometimes it has a peppery flavor like the Sirah grape.
Carmenere	One of the wines allowed in Bordeaux. But it is not a hardy grape so it is not grown as much as in the past. It is grown in Chile where it is often mislabeled as Merlot,
Cinsault	It was bred with Pinot Noir to produce South African's Pinotage. It yeields moderate wines and is often blended. It is a very old variety.
Dolcetto	A soft fruity wine that ripens early.
Durif / Petit Sirah	A hybrid of Peloursin and Sirah to avoid powdery mildew disease. Created by Dr. Durif in the laste 1800's. It did not do too well in Europe but did quite well in California. The problem is it grows in tight bunches and is susceptible to rot.
Gamay	Light, low in alcohol and fruity often cherry like, the Gamay grape grows in the Beaujolais region of France. Gamay Beaujolais does not hold well and is meant to be consumed within 2 years.
Grenache	This sweet grape is one of the most widely produced in the world. Fruity and spicy this variety resists light rain and heat.
Grignolino	A red grape that is grown in northern Italy. Wines are dry and perfumy with a fruity rosey nose and slight tannin.
Malbec	One of the wines allowed in Bordeaux. Malbec is often blended with other grapes. It is being grown in Argentina.
Merlot	Closely related to the Cabernet Sauvignon grape. Most merlots are dry rich and smooth while some are lacking and are blended with C. Sauvignon.
Montepulciano	Medium flavor and somewhat tannic.
Mourvedre / Mourvèdre	Grows along the Mediterreanean coasts of France and Spain. It is medium fruity and ages well. It is blended in Chateauneuf du Pape.
Nebbiolo	Grown in Piedmont Italy. Used in Barbaresco and Barolo.
Petit Sirah	See Durif Grape.
Petit Verdot	One of the six grape varieties allowed in the Bourdeaux region of France. Late ripening variety fairly strong in tannin is used as a blending grape.
Pinotage	Cross between Pinot Noir and Cinsault, it is grown in South Africa. It is mildly light and fruity.
Pinot Meunier	Along with Chardonnay and Pinot Noir it is one of the three grapes allowed to make Champagne. This light and fruity wine w\as a mutation of the Pinot Noir Grape.
Pinot Noir	One of the most difficult grapes to grow, but has one of the most pleasant flavors when done well. Low tannin and high acidity it is often dark berry like.

Chart 483 *Continued*

Sangiovese	Used to make Chianti, the wine produced from these grapes are smooth, with good acid and full bodied. It is blended with Cabernet Sauvignon to make "Super Tuscan" blends.
Syrah / Shiraz	In France, U.S. and Australia, the Shiraz grape probably originated from Shiraz, Persia. It is often blended with Grenache and is an essential grape in the production of Chateauneuf du Pape. It is also probably the source of Petit Sirah (also confused with Durif) grapes in California. It has a fruity berry character and low tannin and reasonable acidity. It can be drunk early and ages reasonably.
Tempranillo	Grown in Spain and Portugal, it is the grape that is used to produce Rioja in Spain. Medium body with a flavor of plum and currants with a high acid character.
Tinta Barroca	The grape matures early and does well in cooler climates. It has a delicate fragrant flavor and blends well.
Tinta Cao	It produces a low alcohol, somewhat fruity floral wine.
Touriga Francesa	The grape matures early and does well in cooler climates. It is grown in Protugal and is used to add a floral character to Port.
Touriga Nacional	It is the best grape for Port. It matures early and has an intense fruity aroma and tannin. Has excellent aging characteristics.
Tinta Roriz	The only key "Port" variety planted outside Portugal. Has light to heavy fruity character and is heavy in tannins.
Zinfandel	DNA studies have shown that it is derived from the Primitivo grape found in Italy. This grape is also proven to have descended from Croatian stock. It is most important to California.

Chart 484 Worldwide GM Labeling Status In Progress

Country	Label
China	None at this Time
Hong Kong	Voluntary – 5% tolerance
India	None at this Time
Indonesia	Law enacted but not implemented
Israel	Law enacted but not implemented
Japan	Mandatory labeling
Malaysia	None at this Time
Philippines	Voluntary labeling
Russia	Required 0.9% tolerance
Saudi Arabia	Mandatory Labeling of imports 1% tolerance
South Korea	Mandatory Labeling 3% Tolerance
Taiwan	Mandatory Labeling 5% Tolerance
Sri Lanka	Mandatory labeling
Thailand	Mandatory labeling
United Araba Emerites	None at this Time
Vietnam	Mandatory labeling
Africa	Mostly Banned
Europe	Mandatory banned in Albania and Austria
European Union	Mandatory labeling
South America	Brazil, Chile, Mexico Mandatory Labeling
Mexico	Mandatory labeling
United States	Voluntary labeling
Canada	5% Tolerance
Australia and New Zealand	Mandatory labeling

Chart 485 Cheeses

Category	Description	Name
Fresh, Whey and Stretched Curd		
	Curdled and Drained	Cottage Cheese
		Cream Cheese
		Curd Cheese
		Farmer Cheese
		Caş
		Fromage Blanc
		Queso Fresco (Mexcio)
		Paneer
		Chèvre
		Asadero (Mexico - Used in Chilli Relleno)
		Panela (Mexico)
	Made from Whey	Brocciu (Corsican)
		Ricotta (Italian)
		Urda (Romanian)
		Mizithra (Greek)
		Anari (Cyprus)
		Geitost (Norway)
		Reuesón (Mexico)
	Pasta Filata - Stretched Cheeses	Mozzarella
Hard	Typically Use Rennet or Microbial Enzymes as Coagulating Agent	Havarti
		Munster
		Port Salut (see also Smear Ripened)
		Emmental
		Asiago
		Gruyère
		Gouda
		Jarelsberg
		Cantal
		Caşcaval
		Monterrey Jack (U.S.)
		Parmesan (Italy)
		Pecorino Romano (Italy)
		Queso Blanco (Mexico)
		Oaxaca (Mexico)
		Menonita (Mexico)
		Manchego (Spain)
		Chihuahua (Mexico)
Semifirm	Typically Use Rennet or Microbial Enzymes as Coagulating Agent	Cheddar
		Colby
		Edam
		Provolone
		Swiss
Soft Ripened	Mold on the outside	Camembert
		Brie
Wash Rind	Continued Washing - Red Mold (b. linens)	Limburger (Originally Limburg)
		Appenzeller

Chart 485 *Continued*

Category	Description	Name
Smear Ripened	Red Film on outside	Munster
		Port Salut
Blue Veined	Penicillium sp.	Bleu
		Roquefort
		Gorgonzola
		Stilton
Brined		Bryndza
		Feta
		Halloumi
		Sirene
		Cotija (Mexico)

Chart 486 FEMA GRAS Lists – Numbers Included

GRAS List Number	From	To	Date Published
3	2001	3124	Feb-65
4	3125	3249	May-70
5	3250	3325	May-72
6	3326	3390	Jan-73
7	3391	3423	Nov-73
8	3424	3444	Sep-74
9	3445	3476	Aug-75
10	3477	3525	Jan-77
11	3526	3596	Feb-78
12	3597	3650	Jul-79
13	3651	3739	Oct-84
14	3740	3754	Nov-85
15	3755	3774	Feb-90
16	3775	3796	Jun-93
17	3797	3815	Oct-96
18	3816	3905	Sep-98
19	3906	3963	Jun-00
20	3964	4023	Dec-00
21	4024	4068	May-03
22	4069	4253	Aug-05
23	4254	4429	Aug-07
24	4430	4666	Jun-09
25	4667	4727	Jul-11*
26	4728	4778	Aug-13

* 2 Hexyl 4 AcetoxyTetrahydrofuran GRAS 2566
2 Methyl 5 Vinyl Pyrazine are both Re-GRAS-ed

Chart 487 Gardenia gummifera

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Gardenia gummifera distillate	4265	—	—	853947-47-4	nutraceutical

Chart 488 Piper longum

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Piper longum Linn.					
Piper longum distillate	4266	—	—	90082-60-3	nutraceutical

Chart 489 EU Labeling Changes

Old EU Labeling System	New EU Labeling System
Nature Identical (NI)	Flavouring Substance
Artificial Flavouring	Flavouring Substance
Natural XX Flavouring	>= 95% from actual Source
Natural Flavouring	Natural Flavouring is < 95%
Smoke Flavouring	Smoke Flavouring from (ex. Wood)
—	Flavour Precursor
—	Not Otherwise Described
Natural XX Flavouring	Thermal Processed XX Flavouring

Chart 490 Gluten Free Grain Status

barley	Yes
bulgur	Yes
couscous	Yes
dinkle	Yes
durum	Yes
einkorn	Yes
faro	Yes
fu	Yes
freekeh	Yes
gliadin	Yes
gluten	Yes
glutenin	Yes
graham	Yes
khorasan	Yes
matzah	Yes
mir	Yes
rye	Yes
seitan	Yes
semolina	Yes
spelt	Yes
triticale	Yes
wheat – All Types Varieties and Products thereof	Yes
acorn flour	Probably not
almond flour	Probably not
amaranth flour	Probably not

Chart 490 *Continued*

arrowroot flour		Probably not
artichoke flour		Probably not
besan (type of chickpea flour)		Probably not
buckwheat seed flour		Probably not
canola (hybrid rapeseed flour)		Probably not
cassava flour		Probably not
chickpea (garbanzo)		
	channa (Type of Chickpea)	Probably not
	chestnut	Probably not
	garbanzo (chickpea)	Probably not
	gram flour (chickpeas)	Probably not
coconut flour		Probably not
corn		Probably not
	cornmeal	Probably not
	cornstarch	Probably not
	hominy (White or Yellow Corn Kernels)	Probably not
	modified corn starch	Probably not
	popcorn flour	Probably not
cottonseed flour		Probably not
dal (also dhal split peas from India)		Probably not
dasheen flour		Probably not
fava bean flour		Probably not
flaxseed flour		Probably not
hominy grits		Probably not
Job's tears (seed of annual grass)		Probably not
kaniwa (related to Quinoa)		Probably not
kasha (Roasted Buckwheat Groats)		Probably not
kudzu flour		Probably not
legumes flour		Probably not
lentil flour		Probably not
maize,		Probably not
manioc flour		Probably not
millet		Probably not
milo		Probably not
modified tapioca starch		Probably not
peanut flour		Probably not
potato flour		Probably not
quinoa		Probably not
rice		
	arborio rice Short-grain	Probably not
	basmati rice Very	Probably not
	black and red rice	Probably not
	brewer's rice	Probably not
	brown rice	Probably not
	calrose A (Type of Medium Grain Rice grown in California)	Probably not
	Carolina gold rice	Probably not
	della rice	Probably not
	enriched rice	Probably not
	glutinous rice	Probably not

Chart 490 *Continued*

	instant rice	Probably not
	japonica rice	Probably not
	jasmine rice	Probably not
	koshihikari rice	Probably not
	long-grain rice	Probably not
	pearl rice flour	Probably not
	polished rice flour	Probably not
	popcorn rice flour	Probably not
	red rice flour	Probably not
	rice [Oryza sativa)	Probably not
	risotto (Rice Flour)	Probably not
	rosematta (Parboiled rice from India)	Probably not
	rough rice flour	Probably not
	short-grain rice flour	Probably not
	sweet rice flour	Probably not
	Valencia rice	Probably not
	waxy rice	Probably not
	wehani rice	Probably not
	wild rice	Probably not
sago Starch		Probably not
sesame flour		Probably not
sorghum		Probably not
soy flour		Probably not
sunflower flour		Probably not
sweet potato flour		Probably not
tapioca flour		Probably not
taro flour		Probably not
tef		Probably not
texmati		Probably not
tree nut flour		Probably not
urd (Variety bean grown in India)		Probably not
water chestnut		Probably not
wild pecan		Probably not

Chart 491 DHS Chemicals of Interest

Chemicals of Interest (COI)	CAS #	GRAS #	Security Issue	
Acetaldehyde	75-07-0	2003	Release-Flammable	
Methyl Mercaptan	74-93-1	2716	Release-Flammable	Theft-Weapons of Mass Effect
Piperidine	110-89-4	2908	Release-Flammable	
Trimethylamine	75-50-3	3241	Release-Flammable	

Chart 492 Adipates

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
dimethyl adipate	C8H14O4	4472	—	—	627-93-0
dipropyl adipate	C12H22O4	4473	—	—	106-19-4
diisopropyl adipate	C12H22O4	4474	—	—	6938-94-9
diisobutyl adipate	C14H26O4	4475	—	—	141-04-8
dioctyl adipate	C22H42O4	4476	—	—	123-79-5

Chart 493 Ketals

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
acetoin propyleneglycol ketal	C7H14O3	4532	—	—	94089-23-3
ethyl acetoacetate ethyleneglycol ketal	C8H14O4	4477	—	—	6413-10-1
ethyl levulinate propyleneglycol ketal	C10H18O4	4479	—	—	57197-36-1
cyclohexanone diethyl ketal	C10H20O2	4516	—	—	1670-47-9

Chart 494 Cyclotene Derivatives

Compound	Empirical Formula	FEMA GRAS #	CFR	NAS#	CAS#
cyclotene propionate	C9H12O3	4511	—	—	87-55-8
cyclotene butyrate	C10H14O3	4648	—	—	68227-51-0

Chart 495 Stevia and Stevia Derivatives

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor	Empirical Formula
Stevia (*Stevia Rebaudiana BERTONI*)						
rebaudioside a	4601	—	—	58543-16-1	Flavor Enhancer	C44H70O23
rebaudioside c	4720	—	—	63550-99-2	Flavor Enhancer	C44H70O22
stevioside	4763	—	—	57817-89-7	Flavor Enhancer	C38H60O18
steviol glycoside extract, stevia rebaudiana, rebaudioside a 60%	4771	—	—	58543-16-1	Flavor Enhancer	
steviol glycoside extract, stevia rebaudiana, rebaudioside a 80%	4772	—	—	58543-16-1	Flavor Enhancer	
steviol glycoside extract, stevia rebaudiana, rebaudioside c 30%	4796	—	—	63550-99-2	Flavor Enhancer	C44H70O22
steviol glycoside extract, stevia rebaudiana, rebaudioside a 22%	4805	—	—	91722-21-3	Flavor Enhancer	
steviol glycoside extract, stevia rebaudiana, rebaudioside c 22%	4806	—	—	91722-21-3	Flavor Enhancer	
glucosyl steviol glycosides	4728	—	—	57817-89-7	Flavor Enhancer	

Chart 496 Acai

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
açaí palm (*Euterpe oleracea Mart*)					
acai berry extract	4547	—	—	861902-11-6	fruity

Chart 497 Chrysanthemum

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Chrysanthemum morifolium or C. indicum					
chrysanthemum extract	4689	—	—	223748-32-1	tea floral

Chart 498 Honeysuckle

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Honeysuckle – Lonicera sp.					
honeysuckle extract	4690	—	—	223749-79-9	floral tea

Chart 499 Luo Han Guo

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Siraitia grosvenorii (Swingle) C. Jeffrey ex A.M. Lu & Zhi Y. Zhang Luo Han Guo luo han fruit concentrate	4711	—	—	1042967-53-2	FMP – Sweetener Enhancer

Chart 500 Chinese Coriander

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Persicaria odorata (Lour.) Soják persicaria odorata oil	4736	—	—	444085-42-1	herbal

Chart 501 Amacha Leaves Extract

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Hydrangea macrophylla var. thunbergii. amacha leaves extract	4737	—	—	97722-03-7	Modifyer – Non Nutritive Sweetener

Chart 502 Szechuan Pepper

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Zanthoxylum sp. szechuan pepper extract	4754	—	—	97404-53-0	herbal pepper

Chart 503 Mountain Pepper

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Tasmannia lanceolata (Poir.) A.C.Sm. tasmannia lanceolata extract	4755	—	—	183815-52-3	pepper

Chart 504 Mangosteen

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Garcinia mangostana L. mangosteen distillate	4757	—	—	90045-25-3	tropical fruit

Chart 505 Chinese Sweet Leaf

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Rubus suavissimus glucosylated rubus suavissimus extract, 20–30% glucosylated rubusoside glycosides	4800	—	—	1268518-76-8	Modifyer – Non Nutritive Sweetener
glucosylated rubus suavissimus (Chinese Sweet Leaf) extract, 60% glucosylated rubusoside glycosides	4814	—	—	1268518-76-8	Modifyer – Non Nutritive Sweetener

Chart 506 Olive

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Olea europaea L. olive fruit extract	4801	—	—	8001-25-0	olive

Chart 507 Sugar Cane

Form	FEMA GRAS #	CFR	NAS#	CAS #	Descriptor
Saccharum barberi x officinarum sugar cane distillate (Aguardente (Portuguese) Aguardiente (Spanish)		4816	—	pending	fermented – Rummy

Chart 508 Enhancers and Flavors with Modifying Properties

FEMA Number		GRAS Item	CAS Number	
	Key B – Bitter Blocking K – Kokumi, Umami and Enhancer M – Mint/Cooling Mod – Modifyer S – Not to be used as sweetener only as modifyer U – Umami			
2756		mono sodium glutamate	142-47-2	U
2962		isopulegol - Coolact P ®	89-79-2	M
3285		L- glutamic acid	56-86-0	U
3455		n-ethyl-2-isopropyl-5-methylcyclohexane carboxamide (WS-3)	39711-79-0	M
3668		disodium 5′-guanylate	5550-12-9	U
3669		disodium [(2R,3S,4R,5R)-3,4-dihydroxy-5-(6-oxo-3H-purin-9-yl)oxolan-2-yl]methyl phosphate	4691-65-0	U
3669		disodium 5′-ribonucleotides	4691-65-0	U
3773		sodium 2-(4-methoxyphenoxy)propanoate	150436-68-3	E
3804		2-isopropyl-n,2,3-trimethylbutyramide (WS-23)	51115-67-4	M
3805		l-menthol ethylene glycol carbonate - Frescolat MGC ®	156324-78-6	M
3806		menthyl propylene glycol carbonate	30304-82-6	M
3806		l-menthol 1- and 2-propylene glycol carbonate - Frescolat MPC ®	30304-82-6	M
3807		L- menthone glycerol ketal	563187-91-7	M
3807		l-menthone 1,2-glycerol ketal	63187-91-7	M
3808		d,l-menthone 1,2-glycerol ketal - Frescolat MGA ®	63187-91-7	M
3810		mono-menthyl succinate (MMS)	77341-67-4	M
3849		3-(l-menthoxy)-2-methylpropane-1,2-diol	195863-84-4	M
3904		vanillin 3-(l -menthoxy)propane-1,2-diol acetal (Vanillin MPD)	180964-47-0	M

Chart 508 *Continued*

FEMA Number	GRAS Item	CAS Number	
4006	l-monomenthyl glutarate (Physcool 2, MMG)	220621-22-7	M
4053	p-menthane-3,8-diol (Coolact 38d, PMD38)	42822-86-6	M
4054	l-menthyl methylether	1565-76-0	M
4154	2-(l-menthoxy)ethanol - Coolact 5	38618-23-4	M
4230	(+/–)-n,n-dimethyl menthyl succinamide	544714-08-1	M
4267	N-3,7-dimethyl-2,6-octadienylcyclopropylcarboxamide	744251-93-2	E
4308	l-menthyl (r,s)-3-hydroxybutyrate	108766-16-1	M
4309	n-[(ethoxycarbonyl)methyl)-p-menthane-3-carboxamide (WS-5)	68489-14-5	M
4496	N-p- benzeneacetonitrilementhanecarboxamide	852379-28-3	M
4550	(+/–)-N-lactoyl tyramine	781674-18-8	E
4557	N-ethyl-2,2-diisopropylbutanamide	51115-70-9	E
4558	cyclopropanecarboxylic acid (2-isopropyl-5-methylcyclohexyl)-amide	958660-02-1	E
4602	N-(2-hydroxyethyl)-2,3-dimethyl-2-isopropylbutanamide	883215-02-9	E
4603	N-(1,1-dimethyl-2-hydroxyethyl)-2,2-diethylbutanamide	51115-77-6	E
4611	iso propylideneglyceryl 5-hydroxydecanoate	172201-58-0	
4668	(2E,6E/Z,8E)-N-(2-methylpropyl)-2,6,8-decatrienamide	25394-57-4	E
4669	4-amino-5,6-dimethylthieno[2,3-d] pyrimidin-2(1H)-one	121746-18-7	Mod
4669	4-amino-5,6-dimethylthieno[2,3-d] pyrimidin-2(1H)-one hydrochloride	1033366-59-4	Mod
4674	trilobatin ((1R,2S)-3-[(2S,3R,4S,5S)-2-(carboxymethyl)-4,5-dihydroxyoxan-3-yl] oxycarbonyl-1-(3,4-dihydroxyphenyl)-6,7-dihydroxy-1,2-dihydronaphthalene-2-carboxylic acid)	4192-90-9	B
4678	N-(2-methylcyclohexyl)-2,3,4,5,6-pentafluorobenzamide	1003050-32-5	S
4680	5-iso propyl-2,6-diethyl-2-methyltetrahydro-2H-pyran	1120363-98-5	E
4681	(1R,2S,5R)-N-(4-methoxyphenyl)-5-methyl-2-(1-methylethyl)cyclohexanecarboxamide	68489-09-8	E
4684	(2S,5R)-N-[4-(2-amino-2-oxoethyl)phenyl]-5-methyl-2-(propan-2-yl) cyclohexanecarboxamide	1119711-29-3	E
4693	N-cyclopropyl-5-methyl-2-isopropylcyclohexanecarboxamide	73435-61-7	E
4701	3-[(4-amino-2,2-dioxido-1H-2,1,3-benzothiadiazin-5-yl)oxy]-2, 2-dimethyl-N-propylpropanamide	1093200-92-0	Mod
4708	3',7-dihydroxy-4'-methoxyflavan	76426-35-2	S
4709	glutamyl-valyl-glycine	38837-70-6	E
4711	luo han fruit concentrate	1042967-53-2	S
4715	2-(3,4-dihydroxyphenyl)-5,7-dihydroxy-4-chromanone	4049-38-1	B

Chart 508 *Continued*

FEMA Number	GRAS Item	CAS Number	
4716	N-[N-[3-(3-hydroxy-4-methoxyphenyl)propyl-alpha-L-phenylalanine methyl ester, monohydrate	714229-20-6	S
4717	sweet blackberry leaves extract (rubus suavissimus s. lee)		SS
4720	rebaudioside C	63550-99-2	S
4721	1-(2-hydroxyphenyl)-3-(pyridin-4-yl) propan-1-one	1186004-10-3	S
4725	3-(1-((3,5-dimethylisoxazol-4-yl)methyl)-1H-pyrazol-4-yl)-1-(3-hydroxybenzyl) imidazolidine-2,4-dione	1119831-25-2	B
4726	3-(1-((3,5-dimethylisoxazol-4-yl)methyl)-1H-pyrazol-4-yl)-1-(3-hydroxybenzyl)-5,5-dimethylimidazolidine-2,4-dione	1217341-48-4	B
4728	glucosyl steviol glycosides		S
4737	amacha leaves extract	97722-03-7	S
4738	glutamyl-2-aminobutyric acid	16869-42-4	K
4739	glutamyl-norvalyl-glycine	38837-71-7	K
4740	glutamyl-norvaline	71133-09-0	K
4741	N1-(2,3-dimethoxybenzyl)-N2-(2-(pyridin-2-yl) ethyl)oxalamide	851670-40-1	E
4751	(R)-N-(1-methoxy-4-methylpentan-2-yl)-3,4-dimethylbenzamide	851669-60-8	E
4752	N-acetyl glutamate	1188-37-0	E
4762	(–)-matairesinol	580-72-3	B
4763	stevioside	57817-89-7	S
4764	1-(2,4-dihydroxyphenyl)-3-(3-hydroxy-4-methoxyphenyl)propan-1-one	50297-39-7	B
4767	2-iso propyl-4-methyl-3-thiazoline	67936-13-4	E
4771	stevia rebaudiana extract, rebaudioside A 60%	91722-21-3	S
4772	stevia rebaudiana extract, rebaudioside A 80%	91722-21-3	S
4773	(E)-N-[2-(1,3-benzodioxol-5-yl)ethyl]-3-(3,4-dimethoxyphenyl)prop-2-enamide	125187-30-6	E
4774	4-amino-5-(3-(isopropylamino)-2,2-dimethyl-3-oxopropoxy)-2-methylquinoline-3-carboxylic acid	1359963-68-0	S
4793	(3R,3S)-3-[[(4- amino-2,2-dioxido-1H-2,1,3-benzothiadiazin-5-yl)oxy]methyl]-N-cyclopentyl-2-oxo-3-piperidinecarboxamide	1446687-20-2	Mod
4798	2-(((3-(2,3-dimethoxyphenyl)-1H-1,2,4-triazol-5-yl)thio)methyl)pyridine	902136-79-2	E
4800	glucosylated rubus suavissimus extract, 20-30% glucosylated rubusoside glycosides	1268518-76-8	S
4802	(S)-1-(3-(((4- amino-2,2-dioxido-1H-benzo[c][1,2,6]thiadiazin-5-yl)oxy)methyl) piperidin-1-yl)-3-methylbutan-1-one	1469426-64-9	Mod
4814	glucosylated rubus suavissimus (Chinese Sweet Leaf) extract, 60% glucosylated rubusoside glycosides	—	S

Appendix I: Abbreviations and Acronyms (Regulatory Issues and Organizations)

AACC	American Association of Cereal Chemists
AAOC	American Association of Oil Chemists
ABA	American Beverage Association
ABV	Alcohol By Volume
ACC	American Chemistry Council
ACGIH	American Council of Governmental Industrial Hygienists
ACS	American Cancer Society
ACS	American Chemical Society
ACSH	American Council on Science and Health
ADA	American Dental Association
ADA	Americans with Disabilities Act
ADA	American Dietetic Association
ADI	Acceptable Daily Intake
ADS	Association for Dressings and Sauces
AECA	American-European Community Association
AEDA	Aroma Extract Dilution Analysis
AERS	Adverse Event Reporting system
AF	Acidified Food
AFDO	Association of Food and Drug Officials
AFFI	American Frozen Foods Institute
AFJC	American Fresh Fruit Juice Council
AHA	American Heart Association
AHCPR	Agency for Health Care Research and Quality, US Department of Health and Human Services
AIB	American Institute of Baking
AICHE	American Institute of Chemical Engineers
AIHC	American Industrial Health Council
AIOE	Alliance for Innovation and Operational Excellence
AIPPI	Association Internationale pour la Protection de la Propri Intellectuelle (a.k.a. IAPIP)
AMA	American Medical Association
AMI	American Meat Institute
AMP	Adenosine Mono Phosphate
ANFA	Australian and New Zealand Food Authority
ANFPA	Asociacion Nacional de Fabricantes de Productos (Mexico)
ANOVA	Analysis of Variance
ANPR	Advanced Notice of Proposed Rulemaking

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ANSI	American National Standards Institute
AOAC	Association of Official Analytical Chemists
AOCS	American Oil Chemists Society
APHIS	Animal and Plant Health Inspection Service (USDA)
AQL	Acceptance Quality Level
ARMS	Adverse Reaction Monitoring System
ARS	Agricultural Research Service
ASCN	American Society for Clinical Nutrition
ASEAN	Association of Southeast Asian Nations (Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam)
ASLT	Accelerated Shelf Life Test(ing)
ASMO	Arab Organization for Standardization and Metrology
ASTA	American Spice Trade Association
ASTM	American Society for Testing and Materials
ATSDR	Agency for Toxic Substances and Disease Registry
ATTC	Alcohol Tobacco and Trade Committee (FEMA)
BAM	Beverage Alcohol Manual (TTB)
BAM	Biological Analytical Manual (FDA)
BATF	Bureau of Alcohol, Tobacco and Firearms (Now TTB)
CA	Chemical Abstracts
CA	Codex Alimentarius
CAA	Clean Air Act
CAIR	Comprehensive Assessment Information Rule
CAP	Controlled Atmosphere Packaging
CARU	Children's Advertising Review Unit
CAS	Chemical Abstracts Service
CASRN	Chemical Abstracts Service Registry Number
CBER	Center for Biologics Evaluation and Research
CBI	Confidential Business Information
CCP	Critical Control Point
CCS	Certified Culinary Scientist
CDC	Centers for Disease Control and Prevention
CE (COE)	Council of Europe
CEPA	Canadian Environmental Protection Act
CFIA	Canadian Food Inspection Agency
CFP	Conference for Food Protection
CFR	Code of Federal Regulations
CGF	Certified Gluten Free
cGMP	Current Good Manufacturing Practices
CGMP	Cyclic Guanosine Monophosphate
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CJD	Creutzfeldt-Jakob Disease
CMA	Chocolate Manufacturers' Association of the USA
COFEPRIS	Comision Federal para la Proteccion contra Riesgos Sanitarios (Federation for the Protection against Health Risks (Mexico))
COLA	Certificate of Label Approval (TTB)
COLIPA	Cosmetic Council of Europe now Cosmetics Europe
COSTHA	Council on Safe Transportation of Hazardous Articles (Europe)
CRA	Corn Refiner's Association
CRC	Certified Research Chef
CWC	Chemical Weapons Convention
DEPE	(New Jersey) Department of Environmental Protection
DFISA	Dairy and Food Industries Supplier Association (Now IAFIS)
DISCUS	Distilled Spirits Council of the United States

DOC	Discreet Organic Chemicals
DOT	Department of Transportation
DPCC	Discharge Prevention, Containment and Countermeasure
DSA	Dietary Supplement Act (of DSHEA) (nutraceuticals)
DCP	Department of City Planning (Respective Cities of the U.S.)
DSD	Dangerous Substances Directive (EU)
DSHEA	Dietary Supplement Health and Education Act
DSL	Domestic Substances List
DT	Decision Tree
EC	European Community
EFFA	European Flavor and Fragrance Association
EFSA	European Food Safety Authority
ELISA	Enzyme-Linked Immunosorbant Assay
EPA	Environmental Protection
ETH	Swiss Federal Institute of Technology
EU	European Union
EAFUS	Everything Added to Foods in the United States (Database)
FAA	Federal etc. (TTB)
FAAN	Food Allergy and Anaphylaxis Network
FALCPA	Food Allergen Labeling and Consumer Protection Act
FAO	Food Additives Organization
FARRP	Food Allergen Research and Resource Program
FASEB	Federation of American Societies for Experimental Biology
FCC	Food Chemicals Codex
FDA	Food and Drug Administration
FEMA	Flavor and Extracts Manufacture's Association
FEXPAN	FEMA Expert Panel
FFDCA	Federal Food, Drug and Cosmetic Act
FIDS	Flavor Ingredient Data Sheets
FIM	Foundation for Information in Medicine
FMP	Flavors with Modifying Properties
FOE	Friends of the Earth
FOIA	Freedom of Information Act
FONL	Formulas Online
FPA	Food Producers Association
FSA	Food Standards Agency (Europe)
FSPCA	Food Safety Preventative Controls Alliance
FTC	Federal Trade Commission
GAIN	Global Agricultural Information Network
GFCP	Gluten Free Certification Program
GFSI	Global Food Safety Initiative (U.N.)
GHS	Global Harmonized System
GMA	The Grocery Manufacturers Association
GMO	Genetically Modified Organism (recommended by FDA to be made from genetically engineered substances (or ingredients)
GMP	Good Manufacturing Practices
GOA	Global Organic Alliance
GRAS (List)	Generally Recognized as Safe
GRL Council of Europe	Global Reference List
GSP	Generalized System of Preferences
HACCP	Hazard Analysis and Critical Control Points
HARPC	Hazard Analysis and Risk Based Preventative Controls
HCS	Hazard Communication Standard (OSHA HazCom 1994)
HLB	Huonglongbing (Citrus Greening Disease)

HLB	Hydrophylic Lypophylic Balance
HNOC	Hazard Not Otherwise Classified
HTS	Harmonized Tariff System
IAFIS	International Association of Food Industry Suppliers
IAFP	International Association of Food Protection
IFEAT	International Federation of Essential Oils and Aroma Traders
IFR	Institute of Food Research
IFRA	International Fragrance Association
IFS&H	Institute of Food Safety and Health
IFT	Institute of Food Technologists
IHPC	International Hydrolyzed Protein Council
IL	Information Letter (Regulatory)
ILO	International Labor Organization
IOFI	International Organization of the Flavour Industry
IRAC	International Regulatory Affairs Committee (of FEMA)
ISO	International Standards Organization
ITPS	Institute for Thermal Processing Specialists
JECFA	Joint Expert Committee on Food Additives (for FAO)
LACF	Low Acid Canned Food
Lm	*Listeria Monocytogenes*
MAP	Modified Atmosphere Packaging
MCP	Mono Chloropropanol
MCS	Multiple Chemical Sensitivity
MERCOSUR	Trade Organization Made of Argentina, Brazil, Uruguay, and Paraguay (Mercado Común del Sur)
MFN	Most Favored Nation
MIS	Material Ingredient Sheet
MNBP	Manufacturer of Non-Beverage Products
MPID	Meat and Poultry Inspection Division
MPDS	Meat and Poultry Data Sheet
MSDS (Now SDS)	Material Safety Data Sheet
MVA	Multivariate Analysis
MWG	Materials Working Group (of the National Organics Standards Board)
NAC	Natural Aroma Chemicals
NAFFS	National Association of Fruits Flavors and Syrups
NAFTA	North Atlantic Free Trade Agreement
NACGM	National Association of Chewing Gum Manufacturers
NACMCF	National Advisory Committee on Microbiological Criteria for Foods
NAICS	North American Industry Standard Classification System
NAS	National Academy of Science
NCA	National Confectioners Association
NCS	Natural Complex Substances
NDSL	Non-Domestic Substances List
NFCA	National Foundation for Celiac Awareness
NFPA	National Food Processors Association (Now Called FPA)
NHLBI	National Heart Lung and Blood Institute
NIH	National Institute of Health
NLEA	Nutritional Education and Labeling Act
NOAA	National Oceanic and Atmospheric Administration
NOC	Notice of Commencement
NOAEL	No Adverse Effect Level
NPRM	Notice of Proposed Rulemaking
NRA	National Restaurant Association
NREA	Nutraceutical Research and Education Act
NSF	National Science Foundation

NSSP	National Shellfish Sanitation Program
NRC	National Research Council
NTIS	National Technical Information Service
OMB	Office of Management and Budget
ORAC	Oxygen Radical Absorption Capacity
OSHA	Occupational Safety and Health Administration
OT	Oregon Tilth
OTC	Over The Counter
QAI	Quality Assurance International
QSAR	Quantitative Structural Activity Relationship
PEL	Permissible Exposure Limit
PLMA	Private Label Manufacturers Association
PMC	Proprietary Mix Committee
PMN	Pre-manufacture Notification
PMO	Pasteurized Milk Ordinance
PMP	Pathogen Modeling Program
POP	Persistant Organic Pollutants
QAI	Quality Assurance International
RCA	Research Chefs Association
REM	Rapid Eye Movement
RIFM	Research Institute on Fragrance Materials
ROP	Reduced Oxygen Packaging
RTK	Right To Know Law
SAFSR	Society for the Advancement of Food Service Research
SCOGS	Select Committee on GRAS Substances
SDA	Salad Dressing Association
SDA	Specially Denatured Alcohol
SDS	Safety Data Sheet (GHS)
SFA	Specialty Food Association
SIC	Standard Industrial Classification System
SLR	Scientific Literature Review
SME	Subject Matter Expert
SPI	Science in the Public Interest
SPME	Solid Phase Micro Extraction
SSOP	Standard Sanitary Operating Procedures
SSP	Society of Sensory Professionals
SSP	Standard Operating Procedures
STEL	Short Term Exposure Limit
TF	Task Force
TGD	Transportation of Dangerous Goods (U.N.)
TRI	Toxic Release Inventory
TSCA	Toxic Substances Control Act
TTB	Alcohol and Tobacco Tax and Trade Bureau (Old BATF)
TTC	Toxicological Threshold of Concern
UNCED	United Nations Conference on Environment and Development
USDA/FSIS	United States Department of Agriculture/Food Safety & Inspection Service
USP/FCC	United States Pharmacopoeia / Food Chemicals Codex
USTR	U.S. Trade Representative
VOC	Volatile Organic Compound
WGMA	Working Group in Methods of Analysis (IOFI)
WTO	World Trade Organization

Appendix II: Nutraceuticals Overview

Nutraceutical	Effect
The following are effects purported in the industry. Although many of these results have been verified, others may be the result of hearsay and tradition. Furthermore, there are issues in the nutraceutical field regarding purity authenticity and possible contamination. Lastly, many of these substances have potent chemicals that might in fact do good, but little is known about other potentially potent substances are contained therein. Physician guidance is necessary in all instances. Furthermore, all the following should certainly not be used by pregnant women without consultation by a physician.	
Acai	The fruit of the acai is used to lower LDL cholesterol due to the presence of omega fatty acids. It is also considered an antioxidant.
Acerola (Malpighia punicifolia L.) or Barbados Cherry and Wild Crape myrtle	A fruit native to the West Indies and Northern South America. It is unusually high in Vitamin C. It has been reported that one drop of acerola juice has as much vitamin C as a glass of orange juice.
Adenosine monophosphate; monosodium, or disodium adenylate	Promotes wound healing, and diabetes mellitus. Also has been seen to slow tachycardia. Adenosine is used to improve wound healing deficiencies and treat diabetes mellitus. It also has been seen to slow tachycardia. (Rapid heartbeat)
Afa or (aphanizomenon flos aquae)	A cyano bacteria or blue-green algae. Although some cyanobacteria produce neurotoxins, one scientist claims the use of this extract helps children with learning disabilities. Others claim it assists in mental clarity, boosting of the immune system, and having a restorative effect on health.
Agaricus Blazei Murrell or Hime-Matsutake Mushroom	Carcinostatic properties along with immunology enhancement (according to Japanese University research). One theory is its high content of beta glucan.
Alfalfa or Medicago sativa	Cited by many as one of the best for overall health benefits. It has been claimed to have positive effects as a diuretic and overall tonic, anti-inflammatory, a phytoestrogenic, a detoxifier for the liver and bloodstream, treatment for high fevers, as an enhancer for pituitary gland issues, help reduce inflamed prostate, reduce severity of allergic reactions, containing saponins, phytoestrogens, macro and micro nutrients, isoflavones, coumarins, betaine, alkaloids (stachydrine), phytoestrogens, and an antioxidant (tricin).
Algae, Green Blue - See AFA	

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Nutraceutical	Effect
Alisma plantago aquatica	Used mostly in China although similar species are found in many parts of the world all with the same purported benefits. Root extracts promote kidney, bladder and urinary health, is a diuretic and is used as an expectorant, help abdominal cramps and the leaves are used to help bruising and swelling.
Alkanet Root Extract (Alkanna Tinctoria Tuasch or Anchusa officinalis)	Colorant, contains pyrrolizidine alkaloids so should only be used externally, not on open wounds or in products used by pregnant women. Contains rosmarinic acid and omega 3 fatty acids. Used for coughs and colds, and as an antibacterial, anti-inflammatory and antiviral. Some claim it is similar in effect to St. John's Wort.
Allicin	A powerful antifungal antibacterial found in garlic. It has been shown to be an antioxidant and has been used to treat arteriosclerosis. It is also purported to help reduce serum cholesterol.
Allspice or pimenta officinalis or pimenta dioica	Used as a stomach calming agent, help diarrhea, flatulence and as a "pick me up". Contains many antioxidants, as well as eugenol which can deaden pain and has antiseptic properties as well.
Almond or (Prunus amygdalu var. dulcis) sweet and (Prunus amygdalu var. amara) bitter	Used for its content of monounsaturated fats, users of almonds for nutraceutical benefits claim it can help prevent gallstones and reduce cholesterol. Although, due to the presence of oxlates the use of almonds can cause oxalate based kidney stones.
Aloe Vera	Used by some as a food preservative for its antibacterial and antifungal components. Used for hundreds of years for its skin healing affects and to reduce inflammation.
Aloe, Cape or (Cape Aloe Ferox)	Extracts of the plant and the resinous sap is used as a laxative and to treat arthritis.
Althea Root - See Marshmallow	
Amla or Emblica officinalis	A fruit that has been used as a diuretic and a laxative. It has also been used to treat diarrhea and dysentery as well. It has antibacterial properties and is used to help healing of skin lesions and to treat arteriosclerosis. The ancient name is Amalaki and has reference to anti-aging properties.
Andrographis paniculata (Burm. F.) Nees or Kalmegh	Kalmegh has been used since ancient times in traditional Indian medicine. It has been proven so useful that it is often considered a wonder drug. It has been used in the treatment of Typhoid fever, Blood Poisoning, Malaria, Snake Bites, Hepatitis, Thrombosis, Inflammation, an antibiotic and a fever reducer. Recently it has been showing interest in the treatment of HIV from one of its components known as andrographolide.
Angelica or angelica pubescens or angelica archangelica	Used for its anti-inflammatory and calming effects, reducing pain, dilation of blood vessels, prevention of blood clots and positive effects for women, angelica contains columbianetin, columbianetin acetate, osthol or osthole, isoangelol, anpubesol, alpha angelica lactone and coumarin related compounds.
Anise or Pimpinella anisum	Anise has an extremely wide as a nutraceutical. It has been used as an expectorant, as having pro-estrogenic properties, has been cited in ancient manuscripts as an aphrodisiac, helping with gastrointestinal issues, mental acuity, bronchial matters and diseases of the lung nose and sinuses, as having a calming affect, breath freshener, digestion promoter, and enhancement of vision. Topically it has been used as an anti-inflammatory, aromatic antiseptic and as a treatment for skin parasites.
Apple	"An apple a day" is an accurate phrase according to many as many components in apples including; flavonoids, fiber, phytochemicals, and other have been shown to have positive affects on blood cholesterol, bowel function, heart health, stroke, prostate cancer, type II diabetes and asthma and overall cellular health.

Nutraceutical	Effect
Apricot Kernels, Apricot Kernel Oil or Prunus Armeniaca (LINN.)	Contains amygdalin or Vitamin B17 claimed by some to reduce the risk of cancer. Amygdalin was used tro make the drug Leatrile ® that held promise but In 1982, the U.S. National Cancer Institute concluded that laetrile was not effective for cancer therapy. The oil is used for hair and skin treatments. It must also be remembered that amygdalin is the precursor for benzaldehyde and cyanide. There is a content of about 1200–1600 mg/kg of cyanide present in apricot kernels.
Arjuna or Terminalia arjuna	The bark of the arjuna plant has been used in ancient Indian culture for most heart ailments. It has been seen to reduce serum cholesterol and promote overall heart health.
Arnica Montana L. or Leopards bane, Wolfsbane	Arnica has been used by doctors to reduce bruising and swelling, help reduce lower back pain,
Ashwagandha - Withania somnifera or Indian Winter Cherry	It has been used for many years in traditional Indian and African cures. It has been seen as having anti-inflammatory, energy boosting, anti-tumor, anti-stress, antioxidant, mind-boosting, and overall health and rejuvenating properties. One study shows the inhibition of production of leukotrienes.
Asparagus racemosus or Shataveri-kalp	Contains the active ingredient shatavarin, along with saponins, and alkaloids. It is viewed by some to be beneficial for pre and postpartum health.
Astragalus Membranaceous	One of the most used food supplements in China used as an immunity booster. It contains flavonoids, polysaccharides, triterpene glycosides, amino acids and trace minerals.
Atractylodes microcephela	A spleen tonic, mild diuretic and digestive aid. The essential oil contains atractylon, atractylodin, eudesmol, hinesol, and sesquiterpenes lactones
Avocado Oil	Containing monounsaturated fatty acid moieties, it has the same benefits as olive oil to reduce serum cholesterol. It also has skin benefits as well.
Bacopa monnieri or Water Hyssop	Used to enhance mental function.
Banba (Banaba) Leaf or Lagerstroemia speciosa	Used as an overall relaxant and health stimulant. Also used to control blood sugar.
Barberry or Berberis vulgaris	Barberry has been used for gastrointestinal disorders, cough, infections and fevers. It has been thought to have antioxidant properties as well.
Barley Grass	Is used to prevent ulcers, has antioxidants to prevent cellular damage, and contains both antioxidant superoxide dismutase (SOD) and the substance P4D1 both showing an ability to slow cellular damage.
Basil	Basil is seen as a mild sedative, relieving high blood pressure. It has also been shown to alleviate the symptoms of peptic ulcers, colitis and asthma. Various species of basil are also used to treat colds, flus, fevers, joint pain, stomach cramps, nausea and headaches. Two water-soluble flavonoids; Orientin and vicenin are found in basil.
Basil or Ocimum basilium (LINN.)	Used extensively in cooking, some use it for treatment of insect stings and as an insect repellant, headaches, coughs, diarrhea and constipation.
Bay Leaf or Laurus nobilis	Used to treat migraines, ulcers, high blood sugar, rheumatism, stress and indigestion.
Bayberry or Myrica cerifera (LINN.)	Used to treat diarrhrea, jaundice, ulcers, inflammation and bleeding.
Belleric myrobalan (a.k.a. Bulu) or Terminalia belerica	Bahera, or Bibitaki are other names. It is used for heart health, as a laxative, and antiflatulant. It also shows antibacterial properties.
Benzoin or Styrax Benzoin	Used as a skin treatment for its antibacterial properties, reducing itching, promotion of healing, and internally for coughs, and respiratory illness.
Bergamot or Monarda didyma	Consumed mostly as a flavor in Earl Grey Tea, Bergamot is used for its calmative effects. It is also thought to reduce nausea, digestive and breathing disorders and diseases, vomiting, as a nasal decongestant and to clear up sinuses.

Nutraceutical	Effect
Betaine (Trimethyl Glycine)	Reduces toxic buildup of homocysteine
Bilberry or Vaccinium myrtillus	Bilberry can act as an anticoagulant. It is used to treat sore throats and diarrhea, to maintain kidney and urinary health, treat arthritis, gout, scurvy, varicose veins, skin problems, an aid with vision, as an anti-bacterial, anti-ulcer, and an anti-spasmodic.
Birch or Betula alba (LINN.)	Used as a laxative, a diuretic and to reduce fevers.
Bitter Melon or (Karela) Momordica Charantia	Bitter melon has been recently researched in the repression of the AIDS virus. IT is also useful in maintaining sugar levels in Type II diabetes.
Bitter Orange or (Citrus Aurantium) Bigarade Orange or Neroli	Bitter Orange Peel has been used to cure digestive problems, nervousness, insomnia, gout, constipation, and dysenteric diarrhea, sore throat and as an antispasmodic. The flower has been used for poor appetite, chest and stomach pain, and vomiting and headaches. It is thought by some to stimulate the metabolism and is therefore used as a weight loss enhancer due to natural alkaloids contained within.
Black Cohosh or Cimicifuga racemosa	Used in the treatment of symptoms of menopause.
Black Currant Seed or Ribes nigrum	Black Currant Seed Oil is high in essential fatty acids. These provide energy, regulate body temperature and metabolism, protect tissues, and insulate nerves. The oil is made up of omega-6 fatty acids (~17%), gamma-linolenic acid (GLA), omega-3 fatty acids (13%), alpha-linolenic acid, and prostaglandins. It is an anti-inflammatory, aids in cramps, and boosts the immune system. Black currant seed oil is also used to treat skin disorders.
Black Pepper or Piper nigrum (LINN.)	Used for constipation, and to promote kidney health, black pepper is the most widely used spice in cooking. It is considered to have antioxidant and antibacterial properties.
Black Walnut or Juglans nigra	Used by the Asians and American Indians as an antihelminic, wart remover, eczema herpes, psoriasis and skin parasites.
Blackberry or Rubus fruiticosus	Blackberries have been cited as good for women's health having a significant amount of phytoestrogens. They also have shown by some studies to retard tumor growth, protect eyesight and aid in heart health due to the presence of tannins lycopene, ellagic acid, phytochemicals.
Bladderwrack or Fucus vesiculosis	It is a seaweed that grows in colder climates. It is Used to treat arteriosclerosis, constipation, heartburn and hypothyroidism as it is a good source of Iodine. Also used as a generalized immune enhancer.
Bloodroot or Sanguinaria canadensis	Used mainly by the Native Americans for a variety of maladies including; sore throats, fevers, and joint pain. It has been used by some to treat skin and breast cancer, respiratory infections, asthma, joint pain, warts, as a drawing salve, ringworm and nasal polyps. Bloodroot also contains sanguinarine which has been researched as a possible antibiotic.
Blue Cohosh or Actaea racemosa, Cimicifuga racemosa	Blue and Black cohosh has been used for rheumatism, and various ailments of menopause and menstruation.
Blueberry or Vaccinium angustifolium	According to the USDA Human Nutrition Research Center on Aging (Boston, MA), blueberries have one of the most highest antioxidant activity of the fruits.
Boldo or Peumus boldus	Used for indigestion, constipation, stomach cramps, improve overall immunity due to its anti-microbial properties and for digestive tract, gall bladder and liver health.
Boneset or Eupatorium perfoliatum	Boneset contains sesquiterpene lactones, such as euperfolin, euperfolitin, and eufoliatin, as well as polysaccharides and flavonoids. Its was used by Native Americans for fevers. Later Europeans brought the herb home to treat Malaria.
Borage or Borago officinalis)	A source of Omega 6 fatty acid gamma linoleic acid, it lends itself to use as an anti-inflammatory.

Nutraceutical	Effect
Boswellia or Shallaki or Boswellia serrata, or Frankincense	Recent results point to benefits regarding rheumatoid arthritis, chronic colitis, ulcerative colitis, Crohn's disease, bronchial asthma and peritumoral brain edemas
Brewer's Yeast or Saccharomyces cerevisiae	Used to regulate blood sugar, provide a source of vitamins and chromium, and aid in sleep, reduce stress and regulate cholesterol.
Broccoli or Brassica oleracea italica	Broccoli contains the phytonutrients sulforaphane and indole-3-carbinol which seem to prevent tumor growth.
Bromelain or pineapple protease enzyme	Used to prevent heart disease, reduce the effects of aging, imrpove the immune system, and to reduce arthritis and inflammation.
Buchu or Barosma betulina	Extracts of the leaf have been used to treat urinary tract infections.
Buckthorn or Sea Buckthorn or Hippophae Rhamnoides	Used to reduce skin damage, and help in regeneration, and to improve heart and stomach health.
Bupleurum or Bupleurum chinense	Used in China and Japan, the plant contains saikosaponins seem to inhibit growth of liver cancer cells, and are anti-inflammatory.
Burdock or Arctium lappa L. or Gobo	Used in Japan, Europe, India and China to treat respiratory disorders, as a diuretic, for abscesses, joint pain, to promote urinary health, for gastrointestinal problems, and joint and bone issues.
Butcher's Broom or Suscus aculaetus	Used to improve circulation, relieve constipation, as a diuretic, to reduce the effects of hemmorhoids and varicose veins by strengthening the blood vessels. Contains flavonoids like rutin which enhance blood flow, thereby potentially improving memory loss.
Butterbur or Petasites hybridus	Butterbur was used in Europe in the Middle Ages to treat plague and fevers. It is also used to treat coughs, asthma, headaches, and stomach ulcers. The scientific name for butterbur is *Petasites hybridus*. It shows antihistamine properties as well.
Cajuput or Melaleuca leucadendra	Used internally for chest, nasal and gastric conditions, arthritis, gout, as an expectorant and exterally for skin conditions, as an anti-inflammatory, and antibacterial, and anti-dandruff. The herb contains ursolic acid, piceatannol and oxyresveratrol.
Calendula or Calendula officinalis, or Garden marigold, Pot Marigold	Widely used for many years throughout Europe, for many ailments. It was used to induce menstruation, aid in the healing of burns, bruises, and cuts, as well as minor infections, to produce sweat during fevers, cure jaundice, treat stomach ulcers, for liver ailments, to treat pink eye, to reduce inflammation and to control bleeding.
California Poppy Eschscholzia californica	Extracts of this plant have been used as a sedative and for its antispasmodic properties. It is not addictive as is its relative, the red poppy.
Camphor or Cinnamomum camphora (L.) Siebold [Fam. Lauraceae]	Used as an inhalant to treat cold and flu symptoms however, overuse has been seen to cause health problems if ingested.
Camu camu or Myrciaria dubia	Found in the Rainforest of South America, Camu-camu was used to enhance the immune system, promote eye health, to help with skin problems, and support circulatory and nervous system health.
Canola Oil or Brassica napus	Canola comes from Canada Oil and is a low Erucic Acid version of Rapeseed Oil. One research states rapeseed Oil is a cutting oil and has been found to cause health problems either directly or by components developed through cooking. Others say the low Erucic acid variety called Canola Oil is not only safe but extremely healthy due to its omega fatty acid profile. A third health study attempting to get to the bottom of the debate claims to have found heart lesions in rats that were exposed to Canola oil for a long time.

Nutraceutical	Effect
Capsaicin or trans-8-methyl-N-vanillyl-5 nonenamide	Used for pain relief topically and as a digestive aid when taken internally. It is also seen as a possible antioxidant for the body. It can pose a risk of allergic reactions and the severe damage to the eyes or skin if used in higher doses.
Caralluma fimbriata	An appetite suppressant and fat reducer similar to hoodia
Caraway or Carum carvi	Used to improve appetite loss, respiratory ailments, fever, sore throat, and liver and gallbladder issues. It is seen by some to be especially useful in curing irritable bowel syndrome in accompaniment with peppermint.
Cardamom or Elletaria cardamomum	Has been used to treat colic and bedwetting.
Carnitine or L-Carnitine	Responsible for the transportation of long-chain fatty acids groups into the mitochondria. Here the chemicals are converted into energy thereby aiding in enhanced fat metabolism.
Carnitine or L-carnitine, L-acetylcarnitine, acetyl-L-carnitine, and L-propionyl carnitine	Carnite is a collectively a group of chemicals that are classified as antioxidants, and that benefit brain function. It is claimed that Acetyl L-Carnitine or ALCAR improved the efficiency of the mitochondria, the structure that supplies cellular energy by promoting the synthesis of acetylcholine, a neurotransmitter. Acetyl L -Carnitine has been used to improve cognitive ability, memory and mood and to help burn fat. The chemical was originally isolated in meat, hence the name carnitine, derived from the Latin root "carnus" or meat.
Carrot or Daucus carota (LINN.)	Used for its pectin fibre to reduce cholesterol, and contains many carotenoids which are believed to be antioxidants and anticarcinogenic.
Cascara sagrada or Sacred Bark	Used originally by North American Natives and brought to Europe by the Spaniards, it was thought to improve bowel health and help with constipation.
Cassia or Cinnamomum aromaticum, synonym C. cassia	Helps with diabetes type II and blood pressure.
Castor Oil or Ricinus communis (LINN.)	Contains ricinoleic acid the active ingredient. Castor oil is used both externally (multiple skin problems) and internally (constipation, upper respiratory problems, and liver and kidney issues).
Catauba or Erythroxylum Catuaba	Originally found in the Brazilian rainforest, it is used as a male aphrodisiac and as a sleep enhancer. It also has shown interesting results as an antibacterial and antiviral.
Catmint or Nepeta cataria (LINN.) or catnep - See catnip	
Catnip or Nepeta cataria	Catnip has been used as stimulant and mild sedative. It has been used to cure insomnia, stress, and cramps.
Cat's Claw or Uncaria Tomentosa	Purported to help cure arthritis, Aids, cancer and to help fight against premature aging. Seen to have anti-microbial, antioxidant, anti-viral, anti-inflammatory and anti-tumor effects.
Cayenne or Capsicum anuum	It was first discovered in South America. Cayenne is viewed by some herbalists as being one of the most valuable herb as they feel it promotes heart, circulatory and digestive health. It has also been cited to cure herpes, diabetes, psoriasis, and arthritis.
Cedarwood, Red or Juniperus virginiana or American Cedar Cedrus atlantica	Used to treat repiratory ailments, to treat stress and externally for dandruff and skin diseases.
Celery or Apium graveolens	Used to lower cholesterol (phthalides) and to prevent cancer (coumarins).
Centella or Centella asiatica Urban See Gotu Cola	

Nutraceutical	Effect
Cereal Grasses	Cereal grasses include the green leaves of wheat, barley, kamut, rye and oats. They are nutritionally potent and seen to promote healthy blood and decrease inflammation.
Chamomile See German Chamomile	
Chanca piedra or Phyllanthus nirui	Used to promote kidneys, liver, and gall bladder health.
Chaste Tree or Agnus castus	Used for treatment of paralysis, joint pain, and muscular health, relieve PMS symptoms and overall female health. Its use reduces male hormones and should not be used by men reducing libido, hence the name "Monk's Pepper"
Chickweed or Stellaric media	Used to cure eczema, psoriasis, boils, ulcers, and a variety of rashes. Taken internally to treat blood disorders, gout, fevers, asthma, arthritis, constipation, lung disease, and aid in weight control.
Chicory or Cichorium intybus	Used as a non-caffeine coffee substitute. It was used by Greeks, Romans and Egyptians as a diuretic, stimulant and a mild laxative, helps the liver and gall bladder, eye health, is a natural laxative, very helpful in anemia, helps with liver disorders, and enlargement of the spleen, helpful in asthma and hay fever and in chronic bronchitis and is useful in treating obstructed menstruation.
Chives or Allium schoenoprasum (LINN.)	Chives are used to aid in circulatory system and to lower cholesterol.
Chlorella or Chlorella pyrensoida	Often used in conjunction with spirulina, another single celled alga; it is claimed to have twelve times more digestible protein than beef, rebuilds nerve tissue in the brain and throughout the body, and kills breast cancer tumors outright. It is thought to detoxify the body and to strengthen the immune system.
Chocolate (originally from the Aztec word Chocolatl, a mixture of cocoa and vanilla.)	Studies have shown to have positive effects on the heart and blood pressure due to the flavonoids in chocolate. One study shows chocolate helps the body process nitric oxide. Chocolate also contains antioxidants which scavenge free radicals and retard cellular damage and possible aging. Chocolate also contains a neurotransmitter, serotonin, that acts as an anti-depressant, and other substances, such as theobromine and phenylethylamine. These have a stimulating effect. Chocolate is one of the more complex chemical factories in nature and so far over three-hundred chemicals have been identified. When I wrote this I was actually eating some chocolate so I can attest to the fact that it makes us feel good.
Chondroitin	One report cites that the Food and Drug Administration support findings that Chondroitin appears to reduce the affects of osteoarthritis. Chondroitin and glucosamine are part of normal cartilage and acts as a cushion between the joints.
Cinnamon or Cinnamomum zeylanicum (NEES.)	Has been used to treat high blood pressure and type II diabetes. One claim is a mixture of cinnamon and honey cures most diseases. This is of course a bit of a stretch.
Citronella or Cymbopogon nardus	Used by many as an insect repellant, but other uses are to alleviate excessive perspiration, fatigue, headache, and to cure oily skin, as an antiseptic, stimulant, headache reliever and for nervous system health.
Clary Sage or Salvia sclarea	Used to treat nausea and vomiting, to treat anxiety and to stimulate the appetite.
Clove or Eugenia caryophyllata (THUMB.)	Has been used to aid in digestive tract issues, joint inflammation, as an anesthetic, and it also has antibacterial properties. Clove contains flavonoids such as kaempferol and rhamnetin.
Clover or red clover, cow clover, meadow clover, wild clover - Trifolium pratense	Clover has been used for cancer and respiratory ailments. It is also used for femnale issues including problems with menstruation and menopause, as well as male issues of prostate enlargement.

Nutraceutical	Effect
Club Moss or Lycopodium clavatum	Some studies have indicated possible use for Chinese club moss as a treatment for Alzheimer's disease. The potential active ingredient found in this extract Huperzine A. Traditionally Club Moss has been used for ailments of the bladder, stomach, and the kidney. It has also been used as a diuretic, for fever and for inflammation.
Cnidium monnieri	Traditional uses are for skin ailments, as an anti-fungal, anti-bacterial, and anti-histamine, and possibly as an anticancer treatment. The herb contains glucides, osthol, coumarins, hepatoprotective sesquiterpenes, and imperatorin. Cnidium has been mixed with Catuaba, Muirapauma, Passion Flower, Maca, Horny Goat Weed, Tribulis Terrestris, and Yohimbe Bark for overall libido enhancement, although studies have not proven their efficacy.
Cocoa - See Chocolate	
Codonopsis or Dangshen (Codonopsis pilosula)	Codonopsis has been used in China to improve energy and endurance and as an aid to the immune system. It has been called the "poor man's ginseng" because of its general overall boost to the immune system. Active ingredients include; 8beta-hydroxyasterolid, perlolyrine, tangshenoside I, friedelin, taraxerol, alpha-spinasterol, alpha-spinasterol-beta-D-glucopyranoside, n-butyl-alpha-D-fructofuranoside and n-butyl-beta-D-fructopyranoside.
Cola Nute - See Kola Nut	
Coleus forskohlii	Grown originally in Nepal, Sri Lanka, Thailand, and India, Coleus has been traditionally used for cardiovascular disease, allergies, asthma, bladder infections (pain relief), eczema, glaucoma, hypertension, irritable bowel syndrome (Spastic Colon), menstrual cramps; weight loss eczema, abdominal colic, respiratory disorders, painful urination, insomnia, and convulsions. Forskolin is the active constituent.
Coltsfoot or Tussilago farfara L. (Compositae)	Used for bronchitis, cough, sore throat, asthma, as an anti-inflammatory and an antioxidant.
Comfrey or Symphytum officinale or Knitbone	Comfrey has traditionally been used to treat wounds, reduce inflammation and help with sprains and broken bones. Comfrey contain allantoin, a substance which some have seen promotes healing and tissue regeneration. However pyrrolizidine alkaloids contained in this plant have been seen to do liver damage.
Coral	As a source of calcium, some claim calcium from coral is more readily absorbed into the body than from other sources.
Cordyceps Sinesis	Cordyceps has been used in the treatment of hepatitis and liver cirrhosis, to strengthen the immune system, relax the bronchia and strengthen the adrenal glands. It has been used as an aid to help strengthening the fortitude of cancer patients and others in general. Active ingredients are; cordycepic acid, and cordycepin. Cordyceps also contains glutamic acid.
Coriander or Coriandrum sativum (LINN.)	Used to control blood sugar, for digestive issues and as a disinfectant / anti-microbial.
Corn Silk or Zea mays	Used as a diuretic, for kidney, bladder and prostate function and to treat some venereal diseases, jaundice and swelling due to water retention (edema).
Cornflower or Centaurea Cyanus (LINN.)	Used as an eyewash, to help regulate menstrual flow, to counteract poisonous bites, cure infectious diseases and reduce fever.
Corydalis or Rhizoma Corydalis (Yanhusuo)	Used in traditional medicine to alleviate pain. Active ingredients are potentially dangerous alkaloids. These include; tetrahydropalmatine (THP) - the most toxic, corydaline, protopine, tetrahydrocoptisine, tetrahydrocolumbamine, and corybulbine.
Cramp Bark or Viburnum opulus	Used for relief of menstrual cramping, cramp bark is a general muscle and nervous relaxant. One claim many women have used cramp bark to help avoid a threatened miscarriage

Nutraceutical	Effect
Cranberry, Cranberry Seed Extract, Cranberry Seed Oil	Cranberries contain proanthocyanidins (PACs) that are seen to prevent urinary tract infections. Similarly it is this anti-adhesion feature for bacterial infections which provide a benefit in the mouth as well. Furthermore, cranberries contain antioxidants and other phytonutrients that may help protect against heart disease, cancer and other diseases. Studies recently indicate that cranberries might help inhibit blood clotting, promote increased blood vessel diameter and help prevent clogged arteries as seen with red wine.
Curcumin	The colorant in turmeric a fraction of which has been shown by studies done at the University of California in Los Angeles to clear brain plaque caused by Alzheimer's disease.
Cyperius or Cyperius alternifolius or Zhi Xiang Fu (Wine treated Cyperius rhizome	Used to promote menstrual health.
Damiana or Turnera aphrodisiaca	Damiana was used by the Mayans and Aztecs as a sexual stimulant. It was also burned ceremoniously to enable participants to "see visions". More recently is used to treat respiratory disorders, as an anti-depressant, to relieve constipation, soothe headaches especially those caused by menstruation, to relieve congestions from asthma, colds and flu. Damiana contains anti-microbial substance called arbutin.
Dandelion or Taraxacum officinale	Dandelion is claimed to help joint and bone ailments. Its leaves are used as a salad green and the flowers are used to make wine. It has been used as a diuretic, tonic, and to help with kidney and liver disorders and as a laxative.
Decalepis hamiltonii Wight & Arn extract	Also known as swallow root. It is used to control insects (as an acaricide) and as an antioxidant. It has been made recently GRAS (#4238) CAS# 853947-36-1.
Devil's Claw or Harpagophytum procumbens	Devil's claw originally came from Africa. It was subsequently brought to Europe where it was used to treat fever, rheumatoid arthritis, skin conditions, to help with conditions of the gallbladder, pancreas, stomach and kidneys. The plant contains harpagoside which seems to inhibit production of leukotriene in the body associated with inflammation response.
Dill or Peucedanum graveolens (BENTH.) or Anethum gravelans	Contains flavonoids, including kaempferol and vicenin, dill has antibacterial properties.
Doggrass, a.k.a. Couchgrass, Twitchgrass, Quickgrass, Agropyron repens	Used as a diuretic, for urinary infections, as an antimicrobial and for skin ailments. Active ingredients include; triticin, and agropyrene.
Dong Quai or Angelica sinensis	Used traditionally to treat female disorders such as menstrual cramps and regulation, PMS and the hot flashes of menopause.
Dulse or Palmaria palmata or Rhodymenia palmata	Dulse has been used as both a food and a medicine. It is a red seaweed that grows on rocks in the North Atlantic coastal areas. It is a good source of dietary vitamins. Dulse is claimed to help with the treatment of irritated gums, and to help maintain the blood, adrenal glands, kidneys and to help cure herpes.
Echinacea or Echinacea purpurea, Echinacea angustifolia, Echinacea pallida	Echinacea is used as an overall immune system builder. It has been used to prevent colds, the flu, and other infections. It has also been used with wounds and skin problems, such as acne or boils.
Elderberry or Sambucus nigra	Traditionally used in Europe to cure arthritis, asthma, influenza, cold sores, colds, sore throat, general infections and inflammation. It is also used to make wine.
Elderflower or Sambucus nigra	Used to treat respiratory ailments, treat herpes sores and help with arthritis.

Nutraceutical	Effect
Elecampane Inula Helenium (LINN.)	One of the richest sources of Inulin, elecampane has been used since before Roman times. It has been used as a diuretic, tonic, diaphoretic, expectorant, alterative, antiseptic, astringent and gentle stimulant. It is also used as a remedy for coughs, and general issues of the lungs. It was also used on livestock in the middle ages as a cure for various disorders.
Eleuthero or Eleutherococcus senticosus or Siberian Ginseng or Acanthopanax senticosus	It is an ancient herb that was used in China for over 2000 years. It has been used by Russian cosmonauts and Russian Olympic team members as a general tonic to reduce physical and mental stress. The herb contains phytochemicals, classified as eleutherosides. It also has triterpene saponins (eleutherosides I-M), lignans and their glycosides (sesamin and syringa-resinol), coumarins (isofraxidin), b-sitosterol, daucosterol, liriodendrin and polysaccharides.
Emblic or Phyllanthus emblica or Emblic Myrobalan - See Amla	
Ephedra or Ephedra vulgaris (RICH.)	Ephedra is a sympathetic nerve stimulant resembling adrenaline. It reduces swelling of the mucous membrane, is an antispasmodic, helps with asthma, hay fever and rheumatism.
Eucalyptus globulus	Used to treat respiratory ailments, sinusitus, as a soothing inhalant, has antibacterial, antifungal and antiviral capabilities, heals wounds, treats dandruff, herpes, to boost energy and to aid in urinary health. It is also used as an insect repellant.
Eucommia or Eucommia ulmoides Oliv.	The bark of Eucommia ulmoides has been used as an analgesic, an aphrodisiac, to help with arthritis, as a diuretic, a sedative, to aid in impotence, with lumbago, rheumatism and back strain.
Evening Primrose or Oenothera biennis (LINN.)	Evening Primrose has been used to help with gastro-intestinal disorders, coughs, asthma, whooping cough, dyspepsia, liver spleen and digestive system ailments, allergies, asthma, atopic eczema, hay fever, inflammation, and help to lower cholesterol. Native Americans used a poultice rubbed on their muscles to give them strength. It was also known as "King's Cure-All" for at least 500 years. The latter two are due to the presence of prostaglandins in the extract, especially PGE1. The primary chemical constituents of this herb include gamma linolenic acid (GLA), essential fatty acids (oleic, palmitic, stearic)
Ewodia rutaecarpa or Euodia ruticarpa - (A.Juss.)Benth. Or (Wu Zhu Yu)	Ewodia or Eudia has been used traditionally for headaches, digestive problems, as an analgesic, anthelmintic, appetite enhancer, and in the treatment of gastritis, nausea, headaches, edema, beriberi and post-partum pains. Recent studies show possible antiviral, antitumor and anti-inflammatory traits. It was also used in China as a birth control preparation.
Eyebright or Euphrasia officinalis (LINN.)	Used for all ailments of the eye. It also contains acubin an anti-inflammatory, caffeic acid an antiviral, and ferulic acid an antiallergenic.
False Unicorn or Chamaelirium luteum (A. GRAY)	Originally used by Native Americans, the herb contains the fatty acid Chamaelirin. It has been used to promote health in the liver, kidney and heart. It helps in the regulation of albumin and also with female disorders including painful menstruation and prevention of miscarriage. In higher doses however it is toxic.
Fennel or Foeniculum vulgare	It has been used as a traditional remedy for issues with the spleen, liver, and kidneys, to treat shortness of breath, wheezing, with jaundice, gout and cramps. One citation claimed it can be used for weight reduction.
Fenugreek or Trigonella foenum graecum	Used as a calmative agent in skin preparations, for the treatment of fever and type II diabetes, reduction of cholesterols and aid in the prevention of arteriosclerosis.
Feverfew or Tanacetum parthenium	Used topically for pain and swelling and internally as a calmative. It helps with migraines as well. However there have been some adverse findings to exposure to feverfew.

Nutraceutical	Effect
Flaxseed or Linum usitatissimum - See Also Linseed Oil	An good source of the omega 3 fatty acid alpha-linolenic acid (ALA). Fatty acids are important in the production of necessary prostaglandins in the body.
Flower Pollen	Pollen is a good source for the following nutrients; antioxidants, unsaturated fatty acids, prostaglandin, vitamins and minerals and amino acids, RNA and DNA building factors, and phytosterols.
Fo-Ti or Polygonum Multiforum	Fo-Ti contains flavonoids which help lower cholesterol and help support a healthy heart. Some use it to help memory, to fight depression and aid in cancer prevention, as a sedative and to help in fertility.
Frankincense or Boswellia Thurifera	Frankincense is an ancient herb whose resinous substance was used in biblical times. According to the Roman Pliny it was sometimes used as an antidote to hemlock poisoning. Other classical Roman uses were for tumors, ulcers, to prevent vomiting, to cure dysentery and fevers and in China it is used for the treatment of leprosy. Recent studies have indicated interest for the prevention of chronic inflammatory diseases.
Ganoderma lucidum or Lingzhi or Reishi	The Chinese called it the "Miraculous King of Herbs". Ganoderma is a mushroom that has been used for overall body healing and immune system support and anti-aging. Some use it to lower cholesterol. Recent studies show interest as a cancer curing agent. The active constituents are triterpenoids called ganoderic acids. Ganoderic acids may lower blood pressure as well as decrease LDL cholesterol.
Garcinia cambogia or Malabar Tamarind	Contains Hydroxycitric acid (HCA) which some see as having an effect on weight loss and metabolism regulation.
Gardenia gummifera (Nadihingu)	An ancient herb mentioned in the Ayurvedic medicines of India. Mostly used for gastrointestinal ailments. The gum powder is sometimes mixed with honey and then used to sooth teething in infants. It has also been used as a painkiller, antiseptic and to fight infections.See Nutraceuticals - **Chart 487** - Approved as GRAS.
Garlic or Allium sativum (LINN.)	Garlic has had a long history of use. It was thought to cure the common cold, the flu and even the Bubonic Plague. Garlic has been used to treat acne, cure stomach ulcers, lower cholesterol levels and even act as a natural insect repellent. It has been associated with preventing colon, stomach, throat and prostate cancers. It does show some allergic responses in some people however.
Gentian or Yellow Gentian, Cross-Leaved Gentian, Five-Flowered Gentian	An aid to the digestive system, an anthelmintic, an antiseptic, and a fever reducer (Yellow), cure for sore throat (Cross-Leaved), and a tonic, aid to stomach ailments and fever reducer (Five-Flowered).
Geranium or Pelargonium odorantissimum (Apple Geranium)	Used to stop bleeding, help with gastroenteritis, and nervous disorders, as an insect repellant, and for treatment of shingles (varicella-zoster virus).
German chamomile (*Matricaria retutica*) and Roman (or English) chamomile (*Chamaemelum nobile*).	Used to cure colds, wounds, gum inflammation, colic, and skin conditions such as psoriasis, eczema, chickenpox, and diaper rash.
Ginger or Zingiber officinale	Ginger root inhibits production of prostaglandins and leukotrienes associated with pain and inflammation. Also used to cure gastritis, gastrointestinal problems, and to aid in menstrual flow.
Ginkgo Biloba	The gingko tree is one of the oldest living tree species dating back to the Cretaceous Era. It has been used in China as a sexual stimulant, to aid in blood flow, as an anti-inflammatory, as a decongestant, improve brain function (Alzheimer's), fight fatigue, control tinnitus, asthma and allergies in general, and to extend lifespan.

Nutraceutical	Effect
Ginseng, Oriental Ginseng, Panax, sp. American ginseng, Panax quinquefolius).	Ginseng is used as an overall health booster, cancer preventative, lowering cholesterol and blood pressure, and for pulmonary health. Other claims are for the treatment of cancer, erectile dysfunction, hepatitis and problems during menopause. A herb called Siberian ginseng or eleuthero (Eleutherococcus senticosus) is not a true ginseng. The active ingredients in ginseng are called ginsenosides.
Glucosamine	One report cites that the Food and Drug Administration support findings that Chondroitin appears to reduce the affects of osteoarthritis. Chondroitin and glucosamine are part of normal cartilage and acts as a cushion between the joints.
Glutathione (GSH), whose IUPAC name is 2-amino-5-{[2-[(carboxymethyl)amino]-1-(mercaptomethyl)-2-oxoethyl] amino}-5-oxopentanoic acid	A tripeptide which provides antioxidant properties thereby protecting the cells against damage by free radicals.
Goji or Lycium Barbarum	Goji has traditionally been used by people in Tibet and India going as far back as 800 A.D. There it is used for high pressure, prevention of cancer, diabetes, treatment of pain of arthritis and fibromyalgia, weight control, and promotion of heart health. The juice of this berry is thought also to extend longevity. The fact that there is a higher ratio of centenarians in the area might lend credence to this. Studies continue. Treatment of pain of arthritis and fibromyalgia, diabetes, weight control, and promotion of heart health.
Goldenrod or Solidago virgaurea	Goldenrod is used to treat kidney, bladder issues, arthritis, and respiratory issues and externally for insect bites and wounds. Compounds found in Goldenrod are saponins (polygalic acid derived), diterpenes (clerodane types) including agolactones and elongatolides, phenolic glucosides such as leicarposide and flavonoids (rutin and quercitin, isoquercetrin and kaempferol)
Goldenseal or Hydrastis canadensis	Found in the United States, the American Natives used the herb for an eye wash and for skin problems, as a digestive, an antibiotic, for lowering blood sugar, and prevent infections. The herb was used as a dye due to hystrastine and berberine. These compounds are effective in soothing mouth sores.
Gotu Kola or Centella asiatica	This herb has been used in India, China and Indonesia for thousands of years. Users claim it helps heal a variety of conditions including; the healing of wounds, improving mental clarity, treatment of leprosy, psoriasis, syphilis, hepatitis, stomach ulcers, mental fatigue, epilepsy, diarrhea, fever, asthma, arthritis, high blood pressure, memory loss, and anxiety. It has also been claimed to improve intelligence.
Grape Seed Extract	Grape seed extract contains oligomeric proanthocyanidins (OPC). OPCs are anti-oxidants. The extract is also rich in polyphenols.
Grape Skin Extract	Grape skin extract contains a number of anthocyanins and resveratrol which has shown to have antioxidant properties. One claim says it can reduce the risk of stroke.
Grapefruit Seed Extract	It has been claimed to help cure digestive problems, diarrhea, is an antiparasitic, anti-bacterial, anti-viral and anti-fungal, especially with colds, flu, sore throats and other infections. It is also claimed to help reduce tooth plaque, gum disorders, and to aid as a breath freshener.
Grapes	Grapes contain resveratrol was first isolated from Cassia quinquangulata, a Peruvian legume. Later it was also identified in red grapes, peanuts, and mulberries. It has been cited by some to be one of the compounds responsible for wine's proven ability to protect against arteriosclerosis and coronary heart disease.

Nutraceutical	Effect
Graviola (Annona Muricata) Soursop	The small upright tree is found in the warmer climates of the Americas. It has been used to alleviate muscle and joint pain, the fruit and seeds to promote intestinal health, and eliminate intestinal parasites, to aid in overall feeling of well-being and to help lower the blood pressure. The fruit contains a serotonin uptake inhibitor involved in the experience of joy. There has been some evidence that the herb has anti-viral, anti-parasitic and potent anti-cancer effects on lab animals, but this is not necessarily translated to humans.
Green Algae - See Chlorella and Spirulina	
Green Tea - See Tea	
Guacatonga Casearia sylvestris	Grown in the Brazilian Rainforest, it has been used to cure snakebites, as an antiseptic, for skin issues as an anti-inflammatory, to treat burns, wounds and rashes, and an antiviral, to treat rheumatism, syphilis, herpes, stomach and skin ulcers, edema, fevers of all kinds, diarrhea and as an anesthetic.
Guarana or Paullinia Cupana	Guarana is mainly used by some for its caffeine content as an aid in dieting and as an energy supplement, for nervous tension, headaches, hangovers, and even menstrual pain.
Guggul or mukul myrrh tree (Commiphora mukul)	Used to lower cholesterol, as a weight control agent, topically as a wrinkle cream, to control inflammation, arthritis, and to help heal bone fractures.
Gymnema sylvestre	Gymnema is an ancient climbing plant used to help with diabetes, to treat stomach upsets and as a diuretic.
Hawthorn or Crataegus oxyacantha (LINN.)	Used by some to treat high blood pressure and moderate to congestive heart failure.
Heliopsis Longipes Extract	Heliopsis shows to have fungistatic and bacteriostatic properties. It is also used to prevent dry mouth and in other medicinal preparations.
Hemp (Cannibus sativa)	Hemp has been used to treat stress, arthritis, topically as an antibiotic, for the treatment of migraine headaches (CBDs or cannabidiols), glaucoma, the reduction of pain in cancer patients, epilepsy, asthma, and as a laxative.
Hesperetin or 5,7-Dihydroxy-2-(3-hydroxy-4-methoxy-phenyl)-chroman-4-one	Hesperitin is a GRAS ingredient that shows interest as a potential anti-inflammtory. See Also Aromatic Alcohols, Aromatic Ketones, Hesperidin.
Hesperidin	The glucoside made up of hesperitin and glucose. In recent studies, this compound has shown potential interest in reducing blood pressure and serum cholesterol. See Also Hesperitin
Hibiscus sp.	Hibiscus is thought to lower blood pressure and cholesterol, and to help with nausea, constipation and bladder infections.
Honey	Honey has been used to help treat allergies, and in the fight against cancer. The anti-cancer substances found in honey include: caffeic acid methyl caffeate, phenylethyl caffeate, and phenylethyl dimethylcaffeate.
Honey Bush or Rooibos (Aspalathus linearis (N.L.Burm.) R.Dahlgr.)	Found in South Africa, Rooibos has been used to treat hay fever, asthma and eczema.
Hoodia Gordonii	A rare cactus like plant that grows in South Africa. Hoodia purportedly contains several nutraceutical components that helps suppress the appetite. One of them has been designated as P57 and has a DE rating of approximately 10,000.
Hops or Humulus lupulus L. [Cannabaceae]	Used to treat insomnia, as an anti-inflammatory, anxiety, appetite loss, digestive issues, gastrointestinal disturbances, menopause, skin abrasions, and to support urinary health.
Horehound or Marrubium vulgare (LINN.)	Used for the treatment of whooping cough, bronchitis, as an expectorant and to lower blood pressure. It has been used for ailments of the gall bladder. It contains alkaloids, flavonoids and diterpenes (e.g., marrubiin).

Nutraceutical	Effect
Horny Goat Weed or (Epimedium)	Used as a libido enhancer and to aid in the cure of kidney disease.
Horse Chestnut or Aesculus hippocastanum	Used internally for fevers and externally for wounds.
Horseradish or Armoracia rusticana	Used to treat arthritis, kidney stones, worms, sinus congestion, water retention, coughs and sore throats and to improve pulmonary health.
Horsetail or Equisetum hyemale	Used to promote healing from infection. The horsetail is a relative of trees that grew during the carboniferous period about 270 Million years ago.
Hydroxycitric Acid	Hydroxy Citric Acid found in Garcinia Cambogia is a different substance than either citric acid or isocitric acid, which are key intermediates in the tricarboxylic acid or Krebs cycle. HCA is known to block the conversion of carbohydrates into fat by inhibiting an enzyme called ATP-Citrate Lyase by competing with adenosine triphosphate-citrate. HCA seems to delay postprandial (after-meal) blood sugar (glucose) levels thereby indicating a positive effect towards weight loss.
Hyssop or Hyssopus officinalis (LINN.)	It has been used since biblical times for cleansing sacred sites, and recently for respiratory problems, including: coughs, chest congestion, sore throat, and bronchitis, but also for diabetes, and weight loss, digestive problems, stomach pain, and intestinal gas.
Iceland Moss or Cetraria islandica	A lichen that grows in the Arctic, believed by some to have some anti-microbial effect, used for upper respiratory problems, including colds, digestive and gastric problems, and inflammation of the throat.
Immortelle or Everlasting or Helichrysum arenarium	Used as an anti-allergenic and an anti-inflammatory, a diuretic, to boost lung, liver and skin health, to reduce anxiety, boost the immune system and help against allergic reactions, It is thought by some to have regenerative properties.
Irish Moss or Chondrus crispus, Carrageen or Pearl Moss	A seaweed used when dried as a stabilizer thickener in ice cream and other dairy products, sherbets etc, and also as a laxative. The herb has been used as an anti-inflammatory, an expectorant, to boost the immune system, as a laxative and for its general nutritional profile.
Isoquercitin (Enzyme Modified)	Increases blood flow for varicose veins, B224 and possible use for arterial flow as well. Also has been shown to have anti-irritation properties as well. Recent studies have shown possibilities in increased brain functions and might be useful in the treatment of progressive Alzheimer's disease. Increases cyclic GMP levels in the brain, (cGMP) which is a second messenger in the biological response to a hormone. There are cGMP dependent kinases, some of which trigger lipid hydrolysis in the body, while others enhance immuno response.
Ivy (Poison) or Rhus Toxicodendron (LINN.) or Poison Ivy	Care must be taken with this herb as it is very potent and can cause significant allergic reactions. Some have used it as an aid in incontinence, and as a sedative, but significant gastric and intestinal irritation might be side effects. Other effects are drowsiness, stupor and delirium.
Ivy or Hedera helix	Ivy contains saponins. It also contains emetine which induces both vomiting and an increase in lung mucus, thereby allowing its use as an expectorant. It is also used to treat asthma and chronic bronchitis.
Jasmine or Jasminum grandiflorum Linn.	Used as a tea and in many fragrances and flavors, jasmine is considered by some to prevent cancerous tumors, to reduce cholesterol, aid in gastrointestinal health by accentuating the good flora in the intestines and act as an anti-oxidant.
Jiaogulan or Gynostemma Pentaphyllum	A herb which boasts the use for thousands of years, one claim is that it is an adaptogen and brings the body into homeostasis. It has been described as being like ginseng only much better.
Jojoba or Simmondsia chinensis	Used for skin health and hair thickness.

Nutraceutical	Effect
Juniper or Juniperus communis (LINN.)	Juniper has been used since the middle ages. It was thought to be a cure against the plague. It is believed to show some antibacterial characteristics as well as aiding in arthritis, for promotion of kidney, stomach, bladder and as a diuretic. The berries were thought to be a potency enhancer. It was originally added to gin for that reason. Today, some believe it can alleviate cellulite tissue.
Kava or piper methysticum	Kava was used for insomnia and nervousness and as an overall calmifyer, pain relief, prevention of spasms and relaxation of muscles. However, adverse reactions of the heart and blood pressure and potential liver issues led to its disuse. Ingredients found in kava kava are: demethoxyyangonin, dihydrokawin, dihydromethysticin, flavorawin A, kawain, methysticin, and yangon.
Kelp or Laminaria digitata Lmx. Or Fucus vesiculosis	Kelp is a good source of vitamins especially iodine. Alginates are derived from kelp and are used as thickeners, for its antibacterial, antioxidant, diuretic, emollient, endocrine tonic, expectorant, and nutritive properties, and is generally available in the forms of a tea, tincture, or capsules. Topical applications have been used for relief of arthritis, reduction of cellulite tissue, overall skin softening. It is used as a bulking agent for the feeling of fullness in weight loss programs. It has been eaten raw or cooked. One citation claims that Kelp improves the digestibility of beans.
Kola Nut or Cola nitida or Cola acuminata	Kola nut contains caffeine and phenols and anthocyanin which act as antioxidants. It is therefore used as a stimulant, for the suppression of hunger, nervous diarrhea, depression, anxiety, and sea sickness, as a digestive aid and as a diuretic, to treat asthma, migraine and depression. Some use it as an aphrodisiac.
Kudzu variety Pueraria thomsonii	This kudzu is not the variety that has claimed much of the Southern United States landscape, but another used in herbal medicationas in China. The herb contains two active ingredients; daidzin and daidzein. It has been used for migraine headaches, stiff neck, influenza, cough, colds, bronchitis, pneumonia, tonsilitis, measles, fevers, snake and insect bites, diarrhea, dysentery, intestinal ailments, enteritis, constipation, as a diuretic, for digestive disorders, bad breath, headaches, migraines, hangovers, sinus problems, anemia, internal bleeding, thirst, hunger, lack of energy, sexual apathy, impotence, infertility, asthma, dizziness, for the spleen, stomach and intestines, as an immunity booster, angina, for alleviating pain due to high blood pressure and to treat alcoholism by reducing the cravings for alcohol. It has also been used to treat diabetes but in larger quantities might result in hypoglycemia.
Kukui Nut or aleurites moluccans	Kukui nut is a nut prevalent in the Pacific. It is rich in fat and has been used as a source of oil for lightning, for skin rubs, and hair glossifyers.
Lady's Mantle or Alchemilla vulgaris (A. xanthochlora)	Used in the treatment for diarrhea, increase blood circulation and menstrual and menopausal issues.
Lavender or Lavendula angustifolia	Lavender has been used as an antiseptic, an antiparasitic, antispasmodic, diuretic, sedative, stimulant, for depression, nausea, vomiting and headaches, as an antiseptic, and for stomach and intestinal disorders. Lavender oil seems to be both a stimulant and to lower blood pressure. It has also been used in mouthwash preparations, for toothaches, cold sores, acne and sore joints, as an anti-scarring, to promote healing and to prevent infection. It has been used a natural bug repellent, and to alleviate stings from bees, mosquitoes, spiders, wasps and snakes. Lavender essential oil has been used as an aroma in a baby's room to calm a teething baby down. It has also been used topically as a massage oil for sore muscles, edema, rheumatism and cellulite. Lavender is used in cooking. It is one of the classical 'Herbes de Provence' of the French cooking style.

Nutraceutical	Effect
Lemon	Used to aid in digestive lung and gastrointestinal health and as a skin treatment for bites, stings and skin problems. Other claims are for menstrual issues, and asthma, although other reports claim it is a trigger for certain asthmatic people.
Lemon Balm or Melissa officinalis	Used to help stomach distress including gas cramps and nausea, nervousness, anxiety and insomnia.
Lemon Thyme or Thymus x citriodorus	Used to fight respiratory ailments, especially asthma, as an antiseptic, expectorant and to relieve muscle spasms.
Lemon Verbena or Aloysia triphylla	Used for reducing fevers, supporting digestive track and overall immune system, treat asthma, fever, and colds.
Lemongrass Cymbopogon citratus	Used to treat muscle spasms, as a boost for overall energy, for nervousness and for stomach ailments.
Licorice or Glycyrrhiza glabra	Licorice has been used as early as Roman and Greek times as a decongestant, anti-inflammatory, to treat stomach ulcers. Adverse reactions for extended use may include electrolyte imbalance, water retention, increased blood pressure, and heart and circulatory problems.
Lignan	Lignans are one of the two major classes of phytoestrogens. Phytoestrogens are antioxidants and have been viewed as reducing ill affects in the body as cellular destruction, aging, etc. Lignans have been found in a many plants including the seeds of flax, pumpkin and sesame, and also in rye, soy, beans, berries and broccoli.
Lily of the Valley or White Calla Lily Convallaria magalis (LINN.)	Used for heart health and as a diuretic.
Lime or Tilia Europoea (LINN.) or Citrus acida (ROXB.)	Used to help in digestion, as a calmative, and to help with nausea.
Linden Flowers or Lime Flower or Tilia sp. See Lime	
Linseed Oil - Linum usitatissimum, Linaceae - Cold pressed non-solvent extracted is also called flaxseed oil. A low linolenic acid oil is called Solin Oil.	Rich in omega-3 fatty acids, especially alpha-linolenic acid, which has shown to be beneficial for heart health. Also used in the prevention of inflammatory bowel disease and arthritis. Flaxseed oil contains lignans that might be cancer preventatives.
Lobelia or Lobelia inflata or Indian Tobacco	Used to treat coughs, improve kidney and bladder function, and with its active ingredient, lobelline, helps stops people from smoking.
Loofah or Luffa aegyptiaca	Used to reduce pain, promote healing, stop internal bleeding, help with backache, hemorrhoids, boost circulation and aids in lactation. The internal structure can be used as an exfoliant sponge for skin health.
Luo Han Guo or Momordica Grosvenori (also spelled Lo han guo, Luo han kuo, or lo han kuo)	In China luo han guo was used as a natural sweetener the active ingredients; siamenoside and neomogroside are about 300 times the sweetness of sucrose.
Lutein and Letein Esters	Extracted from marigold seeds, and also found in spinach and kale, it is a carotenoid which shows healthful eye benefits.
Maca or Peruvian Ginseng Lepidium meyenii,	A radish like fruit grown in Peru that has a positive affect on the Libido.
Magnolia officinalis	Has been used as a weight control agent, an anti-aging supplement, a calming agent, and for improved kidney health.

Nutraceutical	Effect
Maitake or Grifola frondosa	Mushrooms have been used to provide protein, fiber, B vitamins, and vitamin C, calcium and other minerals. Maitake as well as shiitake and reishi all boost immune function, improve cardiovascular health, and show interesting results in the treatment of cancer. Maitake has been also used for stomach and intestines disorders as well as to regulate blood sugar and contains potential antiviral compounds.
Mangosteen or Garcinia mangostana	Used in China originally for its healing powers, and reduction of migraine pain. The natural ingredients in mangosteens, Xanthones, have also been credited by some for improved cardiovascular health, as a natural antibiotic, antiviral, and anti-inflammatory, and as a powerful antioxidant.
Manuka, Tea Tree or Leptospermum scoparium	Grown in New Zealand, some credit the positive effects of this herb as a topical cure for acne, cold sores, corns, cuts, athlete's foot, insect bites, ringworm, oily skin and itching. Internally it was used for chicken pox, colds, flu, migraine, sinusitis and whooping cough.
Marjoram or Origanum majorana	Used as a natural disinfectant, anti-bacterial, anti-fungal, for stomach and gastrointestinal problems, reduce anxiety and help with menstrual problems.
Marshmallow or Althaea officinalis (LINN.)	An ancient herb and food used by the Chinese, Romans, Egyptians and marshmallow extracts have been used for the treatment of inflammation, sore throat, chapped skin, irritation digestive canal, treatment of minor wounds, the urinary tract and respiratory organs.
Mate see Yerba Mate	
Meadowsweet (Filipendula ulmaria)	An ancient herb reportedly used by the druids. IT was used to cure the common cold, the flu and to heal arthritis. Main ingredients are salicin, salicylaldehyde, and methyl salicylate. These ingredients form salicylic acid in the body and have a similar effect to aspirin.
Melaleuca - See Tea Tree	
Melilotus officinalis or Sweet clover	Melilotus contains coumarins which as the leaves dry can be converted into dicoumarol. Dicoumarol is a powerful anticoagulant and can yield harmful results if ingested. Internally the plant has been used as an antispasmodic, diuretic, expectorant, sedative, insomnia, nervousness, heart palpitations, varicose veins, flatulence and intestinal disorders. Externally, the plant has been used treat inflammation, bruising, and general eye infections.
Melissa See Melissa	
Menthol - See Peppermint	
Milk Thistle or Silybum marianum	Used to promote liver health, but it does show some minor side affects and allergic responses as well.
Monarda Punctuata Horse Mint	Monarda has been used treat nausea and vomiting, and to encourage perspiration during colds. It was also applied externally as a poultice to treat swellings and rheumatic pains. Nowadays it is used primarily to treat digestive and upper respiratory tract problems.
Motherwort or Leonurus cardiaca	Motherwort has been used for conditions of the thyroid, constipation, arteriosclerosis, liver, heart, and general female ailments.
MSM - Methyl Sulfonyl Methane	Similar in structure to DMSO or Dimethyl Sulfoxide, whose anti-inflammatory characteristics are widely accepted, MSM is found in many natural products and is a naturally occurring organic sulphur compound found in all living plant and animal tissues. It is destroyed by most cooking processes and is constantly being used by the body in normal bodily functions. It is therefore thought by many that the anti-inflammatory positive circulation contribution that MSM has should be augmented by supplementation. It is believed by some that MSM helps support the immune system and overall nervous and muscular health.
Mucuna pruriens or velvet bean or cowhage	Used in the treatment of Parkinson's disease, for mood and sexuality, sexuality, and for its antioxidant properties. Contains L-dopa used by the body to make dopamine.

Nutraceutical	Effect
Muira puama	Found in Brazil, the bark of this bush or small tree is generally used as a Libido enhancer, although claims also include treatment of nervous disorders, neuralgia, baldness, gastrointestinal issues, neuromuscular problems and rheumatism.
Mullein or Verbascum sp. (V. thapsus, V. phlomides, and V. densiflorum)	Used as an expectorant, to soothe irritated mucous membranes, for coughs and congestion, to treat pneumonia and asthma. Also used as a topical treatment for inflammation and burns.
Muscadine	A variety of grape that has a much higher percentage of reservatrol the natural antioxidant found in grapes. These grapes are grown in South Carolina and are claimed to have the highest ORAC (Oxygen Radical Absorbing Capacity) of any natural substance they have yet to test.
Mustard or Erysimum Cheirantholdes	Mustard seed extract has been used as an anti-inflammatory, to help cure asthma, arthritis and to lower blood pressure, help with menopausal symptoms, help prevent heart attack, migraine headaches, and diabetes. It was used as a mustard plaster to reduce inflammation and pain.
Myrrh or Commiphora myrrha also Commiphora erythraea (sometimes called East Indian myrrh), Commiphora opobalsamum and Balsamodendron kua.	Grown originally in Africa and the Middle east, myrrh has been used for sore throats, as a mouth wash and to cure bad breath, to help with cold sores and as an antiseptic skin wash, asthma, rickets and even the treat the bubonic plague.
Nattokinase	Natto is fermented soy beans. Nattokinase is the enzyme produced by bacillus natto used in the fermentation. Another microorganism isolated from natto is Bacillus firmus NA-1 producing fibrinolytic enzyme. Some believe these enzymes have blood clot dissolving abilities.
Neem or Azadirachta Indica	Neem is an ancient herb and is mentioned in Sanskrit texts. Indian poets called it "Sarva Roga Nivarini" or The One That Can Cure All Ailments. It was used to treat leprosy, skin problems, hemorrhoids, heat-rash, boils, wounds, jaundice, leprosy, skin disorders, tiredness, illnesses of the eye, fever, loss of appetite, insect bites, skin diseases, excessive thirst, and diabetes, general debilitation and skin diseases. The bark gum is used for respiratory diseases and other infections, the leaves are used for digestive problems, intestinal parasites, and viral infections and the fruit has been used for the treatment of malaria and chicken pox, fevers and in general an anti-inflammatory, anti-fungal, ant-viral and antibacterial. The bark of the neem is used to manufacture certain pesticides.
Neroli - See Bitter Orange Citrus Aurantium	
Nettles or Urtica dioica or Piscidia erythrina	Used as an astringent, antiseptic, diuretic, to treat anemia, diarrhea, and arthritis and to support good prostate health.
Niaouli or gomenol or Melaleuca viridiflora	Niaouli is used for pulmonary and sinus health, gastrointestinal issues and topically and an antibacterial.
Noni or Morinda Citrifolia	The juice of the fruit Noni has many antioxidants and has been used to treat diabetes, chronic fatigue syndrome, arthritis, digestive disorders, pre-menstrual Syndrome (PMS), Noni is antibiotic, anti- inflammatory, anti-congestive and analgesic. It can help to restore and regulate the body's pH balance, help assimilate nutrients, to regulate blood pressure, and balance the endocrine system, to treat allergies, respiratory problems, skin infections and inflammations, high blood pressure, headaches and gout. It is claimed that Proxeronine a component found in noni, combines with Proxeronase and Serotonin to produce Xeronine which aids in healing damaged and sick cells.

Nutraceutical	Effect
Nopal Cactus or Nopal Verde (opuntia-indica)	The green nopal is the only Nopal Cactus felt to be edible. It is used to treat diabetes and regulate LDL Cholesterol, to heal the circulation, digestion and heart health.
Nori or Porphyra yezoensis	Closely related to Laver which has a more purplish black color and is found in the North Atlantic, nori is a Pacific Ocean seaweed. Nori is claimed to help with fatty cysts, beriberi, urinary tract problems, goiter, edema, warts, coughs, high blood pressure, nervous disorders, kidney disorders, indigestion, and ailments of the lungs and kidneys.
Nutmeg or Myristica fragrans or Mace	Used for relaxation and to prevent nausea, other uses are for kidney health, digestion, inflammation, gastrointestinal disorders and some claim even as an aphrodisiac.
Oak Bark or quercus alba	Oak Bark contains tannins such as ellagitannin and thus is considered an anti-inflammatory and and antioxidant. It has been used to treat internal hemorrhage, diarrhea, dysentery, cancer, and pneumonia.
Oat Bran or Avena sativa	Oat bran is the edible outermost layer of the oat kernel. Oatbran is rich in beta glucan a soluble fibre which helps lower serum cholesterol.
Oat ß-Glucan	Has been seen to reduce LDL serum cholesterol in rodents.
Oatstraw or Avena sativa or groats (unripe oat straw)	Used for stronger nails and healthy hair, fighting osteoporosis, arthritis and other bone and neurological ailments, for pain, anxiety, hyperactivity, and for boosting the immune and nervous system.
Olive Oil, Olive Leaf	Olive oil is high in monounsaturated fat and is a healthy oil in maintaining good cholesterol levels. The leaf extract is an antibacterial, antiviral and antiparasitic perhaps due to the phytochemical oleuropein that breaks down into elenolic acid.
Omega 3 Fatty Acids	Among other positive effects see rest of chart; omega 3 fatty acids have been associated with positive eye health.
Onion or Allium cepa	To promote appetite and to treat colds, reduce blood sugar, lower cholesterol, for bacterial infections, as an insect repellant, and treat pulmonary disorders and arteriosclerosis. Onions contain flavonoids like quercitin.
Orange, Sweet and other citrus products	Oranges contain phytonutrients like *flavanones; hesperetin, naringenin, and* herperidin the latter of which is being studied to lower blood sugar and cholesterol.
Oregano or Origanum vulgare	Oregano contains thymol and carvacrol which act as antibacterials and the phytonutrients thymol and rosmarinic acid - that have also been shown to function as potent antioxidants. It has also been used to combat fever, vomiting, diarrhea, jaundice, itchy skin, relieve sores and to soothe aching muscles.
Oregon Grape or Berberis vulgaris	Not really a grape, this botanical is more closely related to the barberry. It is found in the Northwest and was used originally by Native Americans to treat poor appetite. Extracts of the root was used for treatment of jaundice, arthritis, diarrhea (especially E. coli based), fever, and infections in the throat, intestines and urinary tract, for moderate psoriasis, gall bladder and liver function, constipation, diverticulosis and irritable bowel syndrome, and hemorrhoids. It has also been used as an ointment for reducing skin irritation, inflammation, and itching.
Palmarosa or East Indian Geranium, or Cymbopogon martinii	Used as an antiseptic, to promote healing, as a healing agent, as an antiviral, to reduce fevers and as a stimulant.
Pansy - Viola tricolor	A highly variably colored flower. Pansy has been used as a bitter principle in alcoholic beverages. It also contains the following pohytochemicals; Violutoside, Rutin, Violanthin, Scoparin, Orientin, Violaxnathin, Triterpene Saponins, Methyl-Salicylic Acid, Flavonoids, Tanninsand Coumarin. The triterpenes, salicylates and flavonoids are probably the components in the botanical responsible for its anti-inflammatory action. It has been used to treat skin disease, epilepsy and asthma.

Nutraceutical	Effect
Papaya or Carica papaya	Contains a high amount of beta carotene, an antioxidant and the proteolytic enzyme papain, which aids in digestion. The fruit has also been used in the treatment of arteriosclerosis and diabetes. Papain can also help celiac disease patients, who cannot digest the wheat protein gliandin, by first using papain treated wheat. The seeds are not very safe to eat in large quantities as they contain the substance carpine which adversely effects the heart rate and nervous system. Papaya contains arginine believed to be essential for male fertility, carpain, an enzyme thought to be good for the heart and fibrin an uncommon substance helpful in the process of blood clotting.
Parsley or Petroselinum crispum (Mill.) Nym. ex A. W. Hill	Parsley contains antioxidant flavonoids, including apiin, apigenin, crisoeriol and luteolin. Parsley also contains myristicin which has been shown to inhibit tumor formation in animal studies. Myristicin, the active ingredient in nutmeg which when taken in larger quantities has adverse health effects on the liver as well as hallucinogenic effects, is believed to activate glutathione-S-transferase destroying the activity of glutathione that would otherwise damage the body.
Passion Flower or Passiflora incarnata (LINN.)	First used in the Americas to improve the libido and reduce anxiety, passionflower contains at least one flavonoid found called chrysin, which lowers anxiety and reduces the blood pressure.
Patchouli or Pogostemon cablin	Patchouli is used as an antidepressant, a stimulant, an anti-inflammatory, to fight colds, fever, nausea, headaches, vomiting and diarrhea, as an anti-microbial, antiseptic, antiviral, aphrodisiac, to aid in digestion and a diuretic.
Pau D'Arco (inner bark of Tabebuia avellanedae)	Pau D'Arco has been used as a diuretic, to treat inflammation, infections, psoriasis, and pain, skin problems, hemorrhoids, ulcers, digestive disorders, arthritis, rheumatism, fever, cardiovascular disease and high blood pressure. Recently it has been reviewed as a possible anti-cancer treatment.
Peony or Paeonia suffruticosa, Paeonia lactiflora, Paeonia veitchii	Peony has been used for the treatment of hypertension, chest pain, muscle cramping, spasms, excessive bleeding and fever. Peony contains a unique glycoside called paeoniflorin. Paeoniflorin's major effect seems to be to calm nerves and alleviate spasm. It also contains proanthocyanidins and flavonoids useful as antioxidants.
Peppermint or Mentha piperita	Peppermint has been used in the treatment of liver and gallbladder disorders, appetite loss, nausea and vomiting, respiratory ailments and general infections, menstrual cramps, toothache and fever. Peppermint is also used for pain reduction and as an antiseptic.
Perilla or Perilla frutescens or shisu	Perilla was used to aid in heart health, to help prevent cancer, arthritis, colitis, arteriosclerosis, to fight auto-immune diseases, inhibit cardiac arrhythmia, blood clots, inflammation, obesity and allergic reactions. It also has a high Omega-3 content (antioxidant).
Periwinkle or Vinca major, Linn	Used to stop bleeding, as a laxative, a gargle to treat hemorrhoids, skin disorders and inflammation. It has also been used in the treatment of Alzheimer's disease, herpes sores, diarrhea, glaucoma, hearing disorders, and stroke.
Petitgrain - See Bitter Orange - Citrus Aurantium	
Phloretin or 3-(4-Hydroxy-phenyl)-1-(2,4,6-trihydroxy-phenyl)-propan-1-one	Obtained from the decomposition of phloridzin and used in the treatment of malaria as a quinine replacer. Studies have shown it inhibits protein kinase C and affects the Sodium / Potassium transfer across membranes. It is found in the root bark of apple trees as a glucoside called phloridzin. One study concerned its effect and treatment of the disease cystic fibrosis, others pointed to its uses as an antagonist of prostoglandins in the reduction of inflammation and general skin disorders. See Also Aromatic Alcohols and Aromatic Ketones

Nutraceutical	Effect
Phytosterol	Chemicals found naturally in foods which has the ability to lower cholesterol absorption in the digestive tract thereby lowering overall cholesterol levels in the bloodstream.
Picrorhiza kurrua or kurroa	An ayurvedic herbal treatment for varicose veins, arthritis, gangrene, asthma, cholesterol and clogged arteries, thyroid health, heart, liver and prostate health, fibroid tumors and as a dietary aid.
Pine Bark Extract or Pinus sp.	Used as an antioxidant and to treat varicose veins, swelling, leg sores and blood clots. Pycnogenol found in Pine Bark extract has been patented for use in the treatment of Attention Deficit Disorder (ADD).
Piper Longum or Indian Long Pepper or Catkins	Piper longum has been used as an analgesic for pains and inflammation, it is also used for respiratory ailments, asthma and bronchitis, and issues of the nerves. It is GRAS - 4266.
Piperitenone Oxide (Extract of Mentha spicata L. variety viridis)	
Pipsissewa - Chimaphila umbellata (LINN.)	
Plantain or Broadleaf plantain, Lanceleaf plantain, Ribwort or Plantago lanceolata, Plantago major	Used to treat bronchitis, and topically to treat poison oak and ivy skin rashes. Other claims are for urinary tract health.
Polygonum cuspidatum or Japanese Knotweed	Also called hu zhang in Chinese it is used mainly for prevention of blood clots.
Polygonum multiflorum	Used in Chinese herbal medicine as a tonic and to stimulate hair growth, where it is often combined with other herbs, such as ginseng (Panax sp.).
Pomegranate or Punica granatum	Pomegranate contains polyphenols such as punicalagins. These compounds have shown interest as potent antioxidants and as anticancer treatments.
Poplar or Populus tremuloides (MICHX.)	Contains salicin and populin, used for diarrhea and fever.
Poria cocos	Historically this mushroom has been used in China as a sedative and a diuretic. However recent interest is in its effect in preventing psoriasis and certain tumors.
Poterium sanguisorba or Sanguisorba minor	Has been used for over 2000 years. The Latin scientific name, Poterium sanguisorba or Sanguisorba minor, translates as “drink up blood” referring to its astringent qualities. It has been used to prevent hemorrhages and internal bleeding. Knowing this, soldiers of old would drink tea made from the herb before going into battle in hopes that any wounds they received would be less severe. It was also used as an anti-Plague tonic, one of 21 herbs combined and dissolved in wine.
Prickly Ash or Toothache tree, American prickly ash, Zanthoxylum clava-herculis, Zanthoxylum americanum	Used by the Native Americans as a treatment for sore throats, skin infections, as an antiparasitic, to soothe aching muscles and for the treatment of upset stomach.
Prickly Pear Cactus - See Nopal Cactus	
Proanthocyanins	Help with urinary tract infections by inhibiting adhesion of microorganisms like E. coli to the urinary tract wall.

Nutraceutical	Effect
Psyllium	On Tuesday, Feb. 17, 1998, the Food and Drug Administration gave permission to allow Kellogg and other food manufactures to make a health claim on the packaging of food products using psyllium. The claim reads: "Eating soluble fiber from foods such as psyllium as part of a diet low in saturated fat and cholesterol may reduce the risk of heart disease." It is also used to relieve constipation.
Pumpkin Seed or Pepitas, and Pumpkin Seed Oil	Used in prostate health, as a healing aid, to help reduce cholesterol. The oil is used to balance cholesterol.
Pygeum or Prunus africanum	Pygeum is an African tree whose bark extract is used for prostate issues. (Benign prostatic hyperplasia (BPH), a nonmalignant enlargement of the prostate)
Raspberry Leaf or Rubus idaeus	Originally used by Native American to resolve many female issues. Raspberry leaf has been also used to treat diarrhea, relieve sore throats, as a laxative and to reduce fever, heal sore throat, wounds and burns.
Red Clover or Trifolium pratense	Red clover has been used to treat diabetes, cardiovascular blood flow, prostate cancer, to lower cholesterol, to treat Osteoporosis (bone loss), Menopausal symptoms, and as a hormone replacement. It contains isoflavones (phytoestrogens) which are responsible for a number of positive results including antioxidation.
Rehmannia or Rehmannia Glutinosa or Chinese Foxglove	Rehmannis has been used to treat diabetes, anemia, dizziness, constipation, ulcers and general digestive disorders, anemia, urinary tract problems, dizziness, hypoglycemia, regulation of menstrual flow, as an anti-inflammatory, antifungal, to reduce capillary fragility, and to boost adrenal glands and liver function.
Reishi or Red Reishi (Ganoderma Lucidum) or Linghzi	Reishi is the oldest mushroom used in medicine. It has been used in Japan and China for over 2,000 years. Reishi contains triterpenes called ganoderic acids. These among other ingredients found in the fungus are thought to help enhance the immune system, improve blood circulation, lower cholesterol, treat anxiety, high blood pressure, hepatitis, altitude sickness, fatigue, bronchitis, insomnia, asthma, reduce tumors, allergic reactions, inflammation, and as an antiviral, anti-parasitic and anti-fungal, to moderate blood sugar levels, to prevent blood clots, to promote kidney health, as a sexual potentiator, for chemotherapy support, and HIV support as well.
Rhodiola or Rhodiola rosea	Rhodiola comes from Eastern Siberia. It has been used to boost overall energy levels. Others claim it can be used to fight depression, impotence, overall female health, anemia, gastrointestinal ailments, infections, life expectancy and even cancer. It is claimed that the Vikings even used it to increase their strength and endurance.
Rhubarb or Rheum Officinale)	Rhubarb has been used as a purgative and laxative but with high levels of calcium oxalate, may be harmful if ingested in great quantities. Also, it is dangerous for people who develop Oxalic acid kidney stones. Other claims benefits for overall female health.
Rice and Rice Bran	Rice is a good alternative for those who are allergic to wheat gluten. When in the 19th century, rice producers began milling the rice, it was found that Vitamin B1, or thiamine contained in the hull or husks was missing causing some to get the deficiency disease beriberi. Polished rice is almost entirely starch. People who eat relatively high amounts of whole grains were reported to have low risks of lymphomas and cancers of the pancreas, stomach, colon, rectum, breast, uterus, mouth, throat, liver, and thyroid as well as low risk for constipation and other similar gastrointestinal disorders.

Nutraceutical	Effect
Roibos - See Honey Bush	
Rooibos see Honey Bush	
Rose Geranium - See Geranium	
Rose Hips or Rosa canina	Rose hips are high in Vitamin C and flavonoids. It has been used to treat urinary bladder infections, headaches and dizziness.
Roselle (Hibiscus sabdariffa l.)	Rich in Vitamin C. It has been used in Africa to reduce blood pressure. Known as a good source of flavonoids. The extract has been purported to provide excellent antioxidant protection for the cardiovascular system and the brain. One study showed existing drug resistant strains of harmful bacteria.
Rosemary or Rosmarinus officinalis	Rosemary contains caffeic acid and rosemarinic acid - both are potent antioxidant and anti-inflammatory agents. Rosemary has been used to prevent cancer, asthma, liver and heart disease, skin color relating to age, as an overall circulatory booster to the organs, a mild diuretic and to help reduce swelling.
Rosewood or Bois de Rose or Aniba rosaeaodora	Used to relive headaches, as an antiseptic, and insect repellant, to boost the immune system and help regenerate damaged tissue and general skin treatment. Some claim the herb can be used as an aphrodisiac.
S-adenosylmethionine or SAM-e	Used for depression, liver disease and osteoarthritis.
Safflower and Safflower Oil or Carthamus tinctorius L. [Fam. Compositae] or American Saffron	A vegetable oil with linoleic acid (omega-6 Essential Fatty Acids (EFAs), 13% oleic acid (omega-9s - monosaturates) and the balance of saturated fats. It has been used to improve hair health, and to improve blood circulation, soothe the stomach and reduce flatulence.
Sage or Mexican sage (Salvia leucantha), pineapple sage (Salvia elegans), or common sage (Salvia officinalis)	Sage is used to heal inflammation, and help stop bleeding, and as a gargle for its anti-microbial properties. It has a long history of use and was used by the Romans and Greeks to cure snake bites, eye problems, fever and infection, epilepsy, memory loss, and parasites. Other references claim it has aphrodisiac properties as well.
Salvia Root or Acanthopanacis Radicis	Salvia root contains a psychoactive chemical known as salvinorin A (a diterpene). Specific health benefits are unknown at this time.
Sandalwood or Santalum album	Sandalwood has been used for millennia to reduce fevers, decrease thirst, treat headaches, scorpion stings and snake bites, as a diuretic, expectorant, to treat digestive disorders, as an overall body relaxer, as a mouthwash and as an analgesic (relieves pain and spasms). Externally, Sandalwood's antibacterial qualities makes it useful to fight skin conditions, such as dermatitis, and acne, as well as to treat other external concerns such as psoriasis, stings, reduce inflammation, and as a component in deodorants.
Sangre de Drago, Sangre de Grado or Croton Lechleri	Found in the Amazon of South America, the name literally means dragon's blood owing to the color of the sap when the bark is damaged. It has been used for pain, inflammation, and scarring, for gastrointestinal disorders including gastritis, gastric ulcer, intestinal infections, colitis and digestive parasites. It is believed that this curative property is by virtue of its ability to reduce inflammation in the intestinal mucosa. Its healing properties have been linked to the chemical taspine. It also contains one of the most potent antioxidants; proanthocyanidin.
Sarcodactylis oil (Citrus medica L. var. Sarcodactylis swingle) or Fingered Citron	Was used in older times to cure seasickness, pulmonary troubles and intestinal ailments especially aboard ship.

Nutraceutical	Effect
Sarsaparilla or Smilax medica, Smilax oficinalis	Sarsaparilla was first used in the Americas and then brought to Europe. It was used to cure sexual impotence, rheumatism, skin ailments like psoriasis, and as a strength booster, for headaches, joint pain and arthritis, and to treat the cold, gout, sexually transmitted diseases, wounds, fever, cough, hypertension, digestive disorders and cancer. The plant's chemistry has been studied well. Compounds include: steroids such as sarsasapogenin, smilagenin, sitosterol, stigmasterol, and pollinastanol and saponins such as sarsasaponin, smilasaponin, sarsaparilloside, and sitosterol glucoside. It is sitosterol that is probably responsible for the anti-inflammatory effects.
Saw Palmetto or Serenoa repens, Sabal serrulata	Saw palmetto has been used for a variety of male issues including prostate health, strength, urinary tract health, and reproductive stamina and prowess. Some claim that taking saw palmetto might interfere with PSA assays, the test for prostate health and potential cancer. Other doctors agree that saw palmetto has no effect on the test results.
Schizandra or Schisandra chinensis	Considered an adaptogenic medication Schizandra is used to improve overall immune system health. Similarly treated herbs are astragalus, bupleurum, ginseng, and ligusticum. It is also used as an aphrodisiac and to enhance longevity.
Sea Buckthorn or Hippophae rhamnoides L.	Used as a tonic and laxative, for skin health, for the heart, and to reduce cholesterol.
Senna (Senna acutifolia Nect. = Alexandria Senna, Senna medicinalis Bischoff = Tinnevelly Senna).	Used mainly as a purgative. Active ingredients are sennosides. The leaves are sometimes used to cure skin diseases like acne.
Serrapeptase	Another enzyme similar to nattokinase that is believed to dissolve and prevent blood clots.
Sesame Oil, Seeds or Sesamun indicum	Sesame contains substances called lignans, specifically sesamin and sesamolin. Ligans are thought to be both cholesterol-lowering, to prevent high blood pressure, and to help fight against cancer. It was used to increase longevity, ease pain, help in digestion, and have antibacterial and anti-inflammatory effects.
Shea Nut or Vitellaria paradoxa	Of African origin, a butter is made of the Shea nuts from the Shea Tree. This butter is used as a soap for various skin treatments.
Shepard's Purse or Sheperd's (Shepherd's) Purse (Capsella bursa-pastoris)	Although pregnant women must avoid using this herb as it might cause miscarriage, it has been used for overall menstrual health.
Shiitake Mushroom or Lentinula edodes)	Used to lower blood pressure and as an antiviral, hepatitis B and some types of cancer. Lentinan, a (1-3) β-D-glucan, is the ingredient found in Shiitake that might be responsible for its anti-tumor properties.
Silymarin see Milk Thistle	
Simaruba amara (D. C.), Simaruba officinalis	Extracts of the bark are used to cure later stages of dysentery.
Skullcap or Scutellaria galericulata L.	Used originally by the Native American for treatment of anxiety, it has been recently explored for its anti-seizure potential. It used to be thought of as a cure for rabies and was dubbed "Mad Dog Weed".
Slippery Elm or Ulmus rubra Muhl., Ulmus fulva Muhl.	Used as an anti-inflammatory, and for the treatment of breathing disorders, constipation, diarrhea, gastrointestinal and digestive disorders, sore throat, hemorrhoids, and as a poultice externally. It is being studied for its antioxidant effects as well as its ability to balance female hormones and reduce LDL cholesterol.

Nutraceutical	Effect
Soy, Soy Oil or Glycine soja	During the Chou Dynasty (1134-246 BC) the soybean was designated one of the five sacred grains; barley, wheat, millet, soy and rice. Products made from soy include tempeh (cooked, acidified, cultured), natto, miso and soy sauce (all fermented). The benefits of soy have been touted in the marketplace, however the presence of haemagglutinin, a red blood cell clot-promoting substance found in soy might be a health issue for those exposed to a high soy diet for too long a time. Soy also contains goitrogens that depress thyroid function and phytic acid that blocks certain nutrient absorption. On the other hand, soy is believed to help maintain hormonal balance, especially for postmenopausal women, to reduce cholesterol, lower the risk of heart disease, prevent osteoporosis, promote healing, and promote overall good health.
Spearmint or Mentha spicata	Spearmint has been used to make a tea for the benefit of overall relaxation. It has also been used to treat indigestion, colic, headache and itching, in many mouth and dental preparations, sore throat, diarrhea, wrinkles, antiseptic, antispasmodic, diuretic, restorative, stimulant, in the treatment of fevers, bronchitis, chills, cramps, chronic gastritis, common cold, headaches, indigestion, morning sickness, motion sickness, nasal congestion, and nausea.
Spikenard (Nardostachys grandiflora D.C.)	Used as a sedative, and to treat insomnia, flatulence, difficulties during childbirth and other minor maladies.
Spirulina or Sirulina Platensis	Spirulina is believed to raise three cytokines responsible for the production of immune system lymphocytes. It is thought to prevent cancer, be a powerful antioxidant, improve heart health, lower cholesterol and be an antiviral agent.
Squaw Vine or Mitchella repens	Used by Native Americans for overall female health and diuretic properties.
St. John's Wort or Hypericum perforatum	Used for mental disorders, especially depression, nerve pains, wounds, burns and insect bites.
Stevia - About 150 species, including: S. eupatoria, S.ovata, S. Plummerae, S. Rebaudiana, S. salicifolia S. serrata	Used as a dietary aid and to lower blood pressure. Stevioside and rebaudioside are the active sweetening compounds and have a D.E. of about 25000-30000.
Stinging Nettle or Urtica dioica	Used for treatment of minor allergies, to help in healing of skin, as a diuretic, and to help with prostate and kidney health, menstrual bleeding and hemorrhoids.
Strawberry or Fragaria vesca (LINN.)	Strawberries contain ellagic acid and anthocyanins both of which are antioxidants. Strawberries are thought to lower cholesterol and improve heart health, reduce the risk of cancer (ellagitannin), enhance memory and reduce the effects of arthritis.
Suma or Brazilian ginseng (mistaken identification)	Used by South American people to fight cancer, diabetes, and various skin conditions. It is also popular as an aphrodisiac and as a means to enhance energy, and to relieve stress.
Sunflower Oil or Helianthus annus, Sunflower Seed	Used for skin and hair care, levels of monounsaturated fats are usually around 80% making it a relatively healthy oil to maintain serum lipid health, lower cholesterol and aid against heart disease.
Superoxide Dismutase	An enzyme present in human tissue that promotes the removal of superoxide (O2-1), a potent and destructive free radical. Unfortunately it is both destroyed in the stomach and poorly absorbed in the cells. Some formulations address this disadvantage.
Tagettes or Tagetes Minuta or Calendula, Khaki Weed, Marigold, or Pot Marigold	Used externally for conditions of the skin, eyes, for its antibacterial properties, to aid in menstrual health and as an antifungal. It can be used internally to treat gastritis, indigestion and intestinal worms (antihelminic), fevers, as a gargle for sore throats, for indigestion and for menstrual problems.

Nutraceutical	Effect
Tall oil : Derived phytosterols	Has been seen to reduce arteriosclerosis, and plasma cholesterol in rodents.
Tamanu Oil or Calophyllum tacamahaca	Found in the South Pacific, Tamanu Oil has been used for healing of cuts and burns to helping to clear up acne and psoriasis, and soothe muscles, boils, open sores and wounds, arthritis, chapped lips, diaper rash, sciatica, rheumatism, insect bites and stings, sunburn, cold sores, gout, ringworm, post-surgical wounds, skin allergies, athlete's foot and infected nails. It is considered by some to be antibacterial and antifungal .
Tangerine - See Orange, Sweet and other Citrus Products	
Tea, Black or Camellia sinensis	Green tea contains the antioxidant epigallocatechin gallate (EGCg) as well as theaflavins and thearubigens. The EGCg is consumed in the fermentation from green to black tea but the latter two seem not to be. These might be associated with the use of black tea to reduce the risk of stroke, lower cholesterol, and heart attack, arthritis, osteoporosis, cancer, flu, and Parkinson's disease.
Tea, Green or Camellia sinensis	Some studies have shown that drinking green tea reduces the risk of cancer, particularly esophageal cancer and slows the growth of cancer cells in general. It has also been used to reduce LDL cholesterol, arthritis and cardiovascular disease. Green tea contains antioxidants four primary called catechins (-)-epigallocatechin gallate (EGCG), (-)-epicatechin gallate (ECG), (-)-epigallocatechin (EGC) and (-)-epicatechin (EC). Catechins are classified as polyphenolics and belong to the flavan-3-ol class of flavonoids. Catechins are believed also to fight viruses, slow aging, and improve the immune system.
Tee Tree Oil (Melaleuca alternifolia Chell.) and oil	Used for skin and hair care as well as oral care. Also used for hair parasites, as an antiseptic, acne and vaginal infections. The oil should not be used internally as it can be toxic. It is used as an antiseptic, germicide, antibacterial and fungicide.
Thyme or Thymus vulgaris	Thyme has long been used for respiratory problems. It's original Greek meaning is "to fumigate". It is often used in decongestant inhalers, aromatic chest rubs, and similar cold products designed to alleviate symptoms. It contains flavonoids such as: apigenin, naringenin, luteolin, and thymonin. It is also considered an anti-microbial and as a spice it has been used to preserve foods.
Tomato Lycopene or Lycopersicon lycopersicum, and tomato fibre	The red coloration predominantly in tomatoes and other vegetables. Lycopene has been shown to be both an antioxidant preventing damage to lipids, proteins, and DNA. Lycopene shows to be potent as an inhibitor of cancer cell proliferation.
Tongkat Ali or eurycoma longifolia jack	An extremely rare and hard to cultivate herb found in Southeastern Asia, Tongkat Ali is used to raise testosterone levels. Eeurycomanone, 13alpha(21)-epoxyeurycomanone, eurycomalactone, and 14,15 beta-dihydroxyklaineanone are the eurypeptides responsible for the herbs activity. It is also being explored for anti-cancer properties.
Tribulus terrestris	It has been used as a libido enhancer as it is believed to raise testosterone levels. It is not a hormone itself but increases the amount of luteinizing hormones (LH) thereby stimulating sex hormones in both sexes.
Triphala	Triphala is an ancient herbal blend of equal parts Amalaki (Emblica officinalis), Bibhitaki (Terminalia belerica), and Haritaki (Terminalia chebula) and has been used for digestion, constipation, cholesterol, circulation and heart, liver and kidney health, as an expectorant, for high blood pressure, liver function, as an anti-inflammatory and an anti-viral.

Nutraceutical	Effect
Tulsi or (Holy Basil) or Ocimum sanctum	Tulsi is an antioxidant rich ancient Ayurvedic herb used for stress management. It is named "Queen of the herbs or Incomparable One" and is revered by India since about 3000 B.C. It was considered the most effective for health promoting, disease prevention and life extending of all the ancient herbs.
Turmeric or Curcuma longa	Inhibits prostaglandin production and stimulates the production of cortisol which relieves inflammation.
Usnea or Usnea barbata or Old Man's Beard or (oak moss) Evernia prunastri	Usnea is a lichen found in North America and Europe hanging from trees that resembles an old man's beard, hence the nickname. Usnea contains usnic acid which has been the object of antibacterial study. Specifically it has been seen to inhibit bacteria such as streptococcus, staphylococcus, and mycobacteria and the treatment of strep throat and pneumonia.
Uva Ursi or Arctostaphylos uva-ursi Ericaceae or bearberry	Used for urinary health, it contains the glycosides arbutin and methyl arbutin. These chemicals go from the liver where they are metabolized into hydroquinone. This then goes to the kidneys then to the bladder. In the bladder hydroquinone does seem to have bacteriostatic properties but has also been seen as a liver toxin and potential carcinogen.
Valerian or valerian officinalis	Used for the treatment of anxiety and sleep disorders, heart palpitations, nervousness and headaches.
Vanilla or vanilla planifolia	Vanillin, the active constituent in vanilla is believed to have antioxidant and anti-tumor properties. Vanilla has been long used in folk medicine and in aromatherapy. Venomous bites, mixed with chocolate to cure flatulence, respiratory and stomach ailments, aches, chills and fever. Vanilla contains heliotropine which was seen by Sloan Kettering to reduce anxiety in some patients. Some claim smelling vanilla reduces cravings for food.
Vervain or Verbena officinalis	Used to cure colic, this herb smells much like lemon and is reminiscent of lemongrass. It was also used to treat depression, improve digestion, reduce pain, and possibly increase the flow of breast milk.
Vetiver, or Vetivert Vetiveria zizanoides or Khus Khus	Used for its calmative effects, as an insect repellant, its antiseptic properties and by some as an aphrodisiac.
Vinca Minor or Lesser Periwinkle - See Also Periwinkle	Used mostly in the treatment of Alzheimer's Disease and arteriosclerosis. Vinpocetine is the active ingredient which some believe improves short term memory, tinnitus, glaucoma and debilitation from strokes.
Vinegar	Used to improve bladder, kidney and liver health, vinegar especially apple cider vinegar is touted as beneficial for skin conditions, and as a natural cleanser for skin and surfaces.
Violet or Viola odorata	The violet family contains over 900 species. It has been used as for the treatment of allergies, asthma, to soothe inflammation and irritation, as a cancer preventative, to cure dizziness and headaches, for pulmonary, bladder and gastrointestinal health, and for its calmative effect. Violets contain eugenol, ferulic-acid, kaempferol, quercetin and scopoletin.
Walnut, black or Juglans nigra (LINN.), English Walnut (juglans regia)	Used as a purgative internally and to promote gall bladder, liver and lung health, and for diseases of the skin.
Wasabia Japonica	Used to promote liver and general immune health, an antioxidant, anti-microbial and helpful in maintaining balanced blood sugar. It has been used to fight cancer and respiratory illnesses.
Watercress or Nasturtium officinale R. Br.	Used as an antioxidant, for arthritis, pulmonary health, for healing, as a diuretic, for gastrointestinal disorders, gingivitis, goiter and scurvy due to its vitamin C content.
Wheat Germ or Triticum vulgare (Vill.), Triticum sativum (Lam.)	Used for its ability to enhance endurance and its nutrition, to lower cholesterol, prevent cancer, constipation, strokes, heart disease, and to aid in digestion.

Nutraceutical	Effect
White Kidney Bean or Phaseolus vulgaris	Used as a source of cholesterol lowering fiber, for heart health, blood sugar balance and memory enhancement, to aid in weight loss and strength building. It contains amylase inhibitors which block the absorption of starches into the body.
White Willlow Bark or Hyssopus officinalis	Contains salicin which is converted into salicylic acid in the body, a chemical relative of acetyl salicylic acid (Aspirin). It is therefore a good anti-inflammatory, pain and fever reliever.
Wild Cherry or Prunus serotina	Wild cherry contains the glucoside prunasin which is thought to relieve bronchial spasms.
Wild Yam or Dioscorea villosa	Used by some as a natural source of a progesterone enhancer, while others claim it increases estrogen content. In fact the product contains saponins which are converted both to progesterone and estrogen.
Willow, white or Salix alba (LINN.)	Used for diarrhea, and digestive disorders, white willow was used by Native Americans for the relief of pain, fever and inflammation. It is the salicylates that are present which are effective in this regard and the basis from which aspirin was eventually derived.
Witch Hazel or Hamamelis virginiana	Used as a antibacterial and topical disinfectant, to treat cold sores, eczema and hemorrhoids.
Wolfberry (Lycium barbartum L.)	It is an extremely nutritious plant having an equivalent macronutrient content to soy, with omega 3 and 6 fatty oils, and a high concentration of micronutrients as well.
Wormwood or Artemisia absinthum	Used originally in absinthe, wormwood is used an anti-insect rub, to improve digestion, and liver health. However the active ingredients thujone and isothujone also bring on hallucinations and caused brain damage and death. Bitter agents contained therein are absinthin and anabsinthin which aid in gall bladder performance. Artemisinin is used for cancer and malaria.
Yacon or Polymnia edulis	Yacon is found in South America and is used to improve digestion, lower blood sugar, as an anti-microbial and to enhance liver function. Yacon also contains antioxidants.
Yarrow or Achillea millefolium (LINN.)	Used to treat colds, fever, hemorrhoids, and aid in kidney and liver health. Some even claim it helps cure baldness, as an anti-inflammatory, to stop bleeding, reduce blood clots, lower blood pressure and balance blood sugar, to aid in digestion, treat gastritis, slow heart rate, as an insect repellant, to lessen varicose veins and improve vision.
Yellow Dock or Rumex crispus	Used for digestive disorders, liver health and for skin conditions. Yellow dock contains the glycoside anthraquinone which might contribute to the herb's laxative properties.
Yerba Mate or Ilex paraguariensis	Yerba mate is felt to be a generally effective herb due to its many polyphenols (phytochemicals = antioxidants, possible cancer prevention) and saponins (immune health boosters). Other claims are as a weight management herb, as a stimulant with less caffeine, to retard aging, to help with insomnia and as a relaxant. The presence of xanthines (the class of compounds in which caffeine is included), namely mateine is believed to be the reason for the caffeine like effects.
Yerba Santa or Eriodictyon californicum or Eriodictyon glutinosum (BENTH.)	Used for the treatment of colds and other respiratory issues, fevers, hemorrhoids, and bladder health.
Ylang Ylang or Cananga odorata	Used as an aromatherapy and massage to reduce nervousness and calm breathing and reduce blood pressure. Some believe it is useful in curing skin problems, aid in fertility and enhance libido.

Nutraceutical	Effect
Yohimbe or Corynanthe Yohimbe	Used as a male libido enhancer, however studies show it might have adverse effects on the kidneys.
Yucca filamentosa (Y. Smalliana)	Contains yuccagenin a saponin used for skin care and arthritis, migraine headaches, colitis, gout, bursitis, ulcers and other wounds, hypertension, and to lower high LDL cholesterol.
Zeaxanthin	A carotenoid, used as an antioxidant, zeaxanthin is the coloring agent in marigolds and is extracted from them. It is used for eye health and some claim will retard the effect of "aging eyesight" or Age-Related Macular Degeneration (AMD). Lutein is also used for similar effects. Some believe it has libido enhancing effects as well.
Zizyphus or Zizyphus vulgaris or Jujube Berries or Zizyphus spinosa	Used for anxiety and insomnia, ulcers, increasing appetite, inflammation, diarrhea and dry skin.

Appendix III: List of Chemicals

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Appendix IV: Natural Flavoring Complexes and other Miscellaneous Charts

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Appendix V: List of Figures

Please log on to www.flavordynamics.com to view the figures in full color.

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