UNIVERSITY OF GONDAR

College of Veterinary Medicine and Animal Sciences

Department of Animal production and Extension

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For the course: Beef cattle production and Management (Anps 3104)

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TERMINOLOGY

- Bull - adult, intact male
- Cow- mature female that has had at least one calf
- Calf- young of either sex, under one year of age
- Heifer - young female that has not yet had her first calf
- Steer- castrated male over one year of age
- Beef - Meat from cattle (bovine species) other than calves.
- Meat - from calves is called veal.
- Bullock - Young bull, typically less than 20 months of age

Cont…

- **Adjusted Weaning Weight (adj 205 day wt)-** Weight of a calf at weaning, adjusted to a standard 205 days of age and adjusted for the age of the dam.
- **Adjusted Yearling Weight (adj 365 day wt) -** Weight of a calf as a yearling adjusted to a standard 365 days of age and adjusted for the age of the dam.
- **Average Daily Gain (ADG) -** Calculation of post-weaning gain, figured by dividing the weight gain by the days on feed.

Chapter- 1. The beef cattle industry

1.1 Introduction

- What is beef? What is Fattening?

- **Beef** is meat from bovines, especially domestic cattle (cows, bulls, heifers or steers)
- It is one of the principal meats used in the cuisine of many countries, considered as prestige

- Beef is considered a taboo food in some cultures, especially in Indian culture, by Hindus and Jains.

- Fattening or finishing is the laying of fat/muscle.
- **Why beef fattening is practiced**?
- ✓ Has got long history in Ethiopia for the purpose of:
  - Source of income
  - Source of food nutrients
  - Employment opportunities

Cont…

- By products (hide, bone, tallow, horn, etc) are used for making different products
- Manure for fertilizer
- Management easier compared to dairy animals
- Less facilities are required
- Fast turnover of capital
- Less initial investment compared to dairy
- Less sensitive to diseases compared to other livestock

Nutritional value of beef

- Very rich in Zinc, Selenium, Phosphorus, Potassium and Magnesium. Sodium and Copper are found in good quantities.
- Minute quantities of Calcium and Manganese are also present.
- Best source for Vitamin B12, Vitamin B6, Niacin and Riboflavin.
- It is also rich in Thiamin and Pantothenic Acid.
- Small amounts of Vitamin E, Vitamin K are present
- The calorie count of Beef per 100 gm is 155.0, higher in protein and moderate in fat.

Health Benefits of Beef:

- Good for bones and teeth
- Enhances immunity against infections
- Prevents blood vessel walls from damaging
- Moderate consumption of lean beef is all together good for cardiovascular health and to prevent cancer risks.

1.2 Scientific classification and origin of cattle

- Broad groups of animals are classified together in categories of common characteristics

✓ **Binomial nomenclature:**

- Giving two names in Latin
- System developed by Swedish Botonist named Linnaeus
- Orderly and systematic approach to identification
- Genus: First name, the first letter should be always capitalized
- Species: Second name, always lowercase
- Both are <u>underlined</u>!

- Latin- Was used because at the time, it was the international language of scholars
- Many languages of the world were based on Latin.
- Example
- Cattle: *Bos taurus*
- Pigs: *Sus scrofa*
- Equine: *Equus caballus*
- Sheep: *Ovis aries*
- Dogs: *Canis familiaris*

Zoological classification of cattle

✓ **Scientific classification**

- Kingdom: Animalia
- Phylum: Chordata
- Class: Mammalia
- Order: Artiodactyla
- Family: Bovidae
- Genus: *Bos*
- Species: *taurus*

Cont…

- Common Names

- Are often confusing
- Different organisms can have similar or the same common name
- Different parts of the country may have different common names for the same animal.

❖ Origin of cattle

➢ Cattle were originally identified as three separate species:

1. Bos taurus - the European or "taurine" cattle (including similar types from Africa and Asia);
2. Bos indicus - the zebu and
3. Bos primigenius (the extinct one) - the aurochs.

- The aurochs is ancestral to both zebu and taurine cattle.

1.3 World Cattle population

- The world has 1.468 billion head of cattle(FAO, 2015).

✓ Ethiopia has the 5th largest cattle inventory in the world.

Rank	Country	Head	% of total	
1	Brazil	211,764,292	14.43%	
2	India	189,000,000	12.88%	
3	China	113,500,000	7.73%	Source: FAO, 2015
4	United state	89,299,600	6.08%	
5	Ethiopia	54,000,000	3.68%	

Annual meat production in tonnes Source: OECD-FAO Agricultural Outlook (Edition 2016)				
Country	Beef and veal	Pork meat	Poultry meat	Shoat meat
World	67 451.9	117 567.9	112 538.9	14 256.9
Ethiopia	358.5	1.9	62.3	148.8
Argentina	2 506.6	458.8	1 799.3	57.9
Russia	2 484.7	3 363.5	4 301.4	185.4
Mexico	1 587.8	1 876.1	3 798.2	74.0
Egypt	1 319.8	0.5	975.4	133.3
Japan	1 210.4	2 428.0	1 960.8	22.0
India	958.1	356.8	2 537.1	710.5
Turkey	930.4	4.5	1 476.1	366.7
South Africa	831.3	237.3	1 894.2	190.1
Australia	780.7	622.3	1 144.2	202.2
Sudan	359.5	0.2	51.2	478.0
Uruguay	227.4	62.7	53.2	22.1
Saudi Arabia	176.1	9.9	1 476.7	198.8

1.4 Meat consumption pattern:

- Per capita meat consumption in kilogram in;

➢ Ethiopia:

✓Beef and veal=2.5

➢ Argentina:

✓Beef and veal = 40.4

➢ Uruguay: = 46.4

Source: OECD-FAO Agricultural Outlook (Edition 2016)

1.5 Challenges and Opportunities for Beef Production

- **Challenges**

- Low production levels
- Cattle sector is highly dualistic:
  - communal, subsistence & small scale farmers co-existing with large commercial farmers
- Off-take from the commercial sector is high, while it is still low in other sectors as a result of low fertility, high mortality, etc.

- **Global warming**
- Climate change will have a more extreme effect on southern than on northern hemisphere

- **Effect of global warming on livestock production**:

- ✓ reduce feed intake in order to reduce digestive heat production
- ✓ reduce grazing time as animals do not graze in hot midday
- ✓ increase sweating and water intake
- ✓ Nutrition stress

- Largest indirect effect

- natural pasture has lower nutritional value and lower tiller density (Tropically adapted C4 grasses)-in comparison to C3 grasses,
- C4 has high fiber content, reduced digestibility & higher methane production

- Diseases

- Global warming altered disease patterns that will put even more pressure on production

- Recent outbreaks of COVID -19 in China
- Climate determines distribution of ticks & vectors (Red water, Gall sickness, Heart water, Corridor disease)

- Heat stress may affect livestock health by causing metabolic disruptions, oxidative stress, and immune suppression causing infections and death.

➢ Enteric methane (CH_4) production

•Methane facts:

– makes up 16% of total world gas emissions,

– 2nd most important greenhouse gas (GHG)

– Atmospheric warming activity 23 times higher than CO_2

• Animal digestive tract is main source of methane (28% of global CH_4 emissions)

❖ **GHG emissions redaction**

1. With diet

- Most research is focusing on manipulating the diet to combat CH4emission:
  - Use of feed additives and Genetic engineering of rumen flora

2: Genetics

- Genetic improvement results in permanent and cumulative changes in performance(selection and cross breeding).
- Will mitigate GHG in two ways:

– Enhancing higher productivity - leads to higher gross efficiency

–With keeping fewer higher yielding animals.

3: Residual Feed Intake

- RFI = Actual FI Production-Expected FI Maintenance
- Cattle with low RFI produce up to 28% less methane
- Attributed to different rumen microbial populations
- May be heritable

Opportunities of beef production

1. Increase in demand

- Increasing population, urbanization & economic development in developing countries -significant rise in demand for livestock products
- World demand for meat expected to rise by more than 200% –229 million ton (1999) → 465 million ton (2050)
- Much bigger market opportunities for livestock producers in developing countries.

2. Description of production environment

- By describing production environments in more detail it would be possible to identify breeds or genotypes that may be adapted to specific environments
- Necessary to link animal performance with the production environment

3. Environmental data

- Good quality environmental data describing production environments already exist
- Variables on
  - temperature
  - relative humidity
  - precipitation (including variation in rainfall), – day length and
  - radiation are available through Geo-referenced Information Systems (GIS) layers
- Important to record GPS way points

4. Recording and improvement

- Animal recording forms the backbone of any improvement programmed
- If traits are not measured and recorded improvement is not possible
- Argentina, Brazil, Namibia and South Africa have very well organized recording and improvement programs

❖ Therefore, what will be your suggestion about the future prospects of beef production in Ethiopia???

Chapter 2. Beef production systems in the tropics

- Production of quality beef:
- ✓ is usually achieved through the feeding of high-energy rations to young animals (6 to 30 months old)
- But the bulk of the beef produced in the developing countries still comes from extensive systems

- **Present situation in developing countries**

- There is no significant specialized growing-finishing beef industry
- low internal demand for meat
- high demands of a significant export market
- They generally inhabit areas where the climate precludes cropping

- The main systems of production, and various combinations of them, can be identified as follows

1. Extensive systems

- Specialization operation is not practices
- The breeding, raising, growing and finishing activities are operated by the same stockman
- This occurs in most of the pastoralist areas of Africa
- Is also adopted by some ranchers in Latin America
- Meat is often a by-product of milk production, and
- Beef output may be low

Cont…

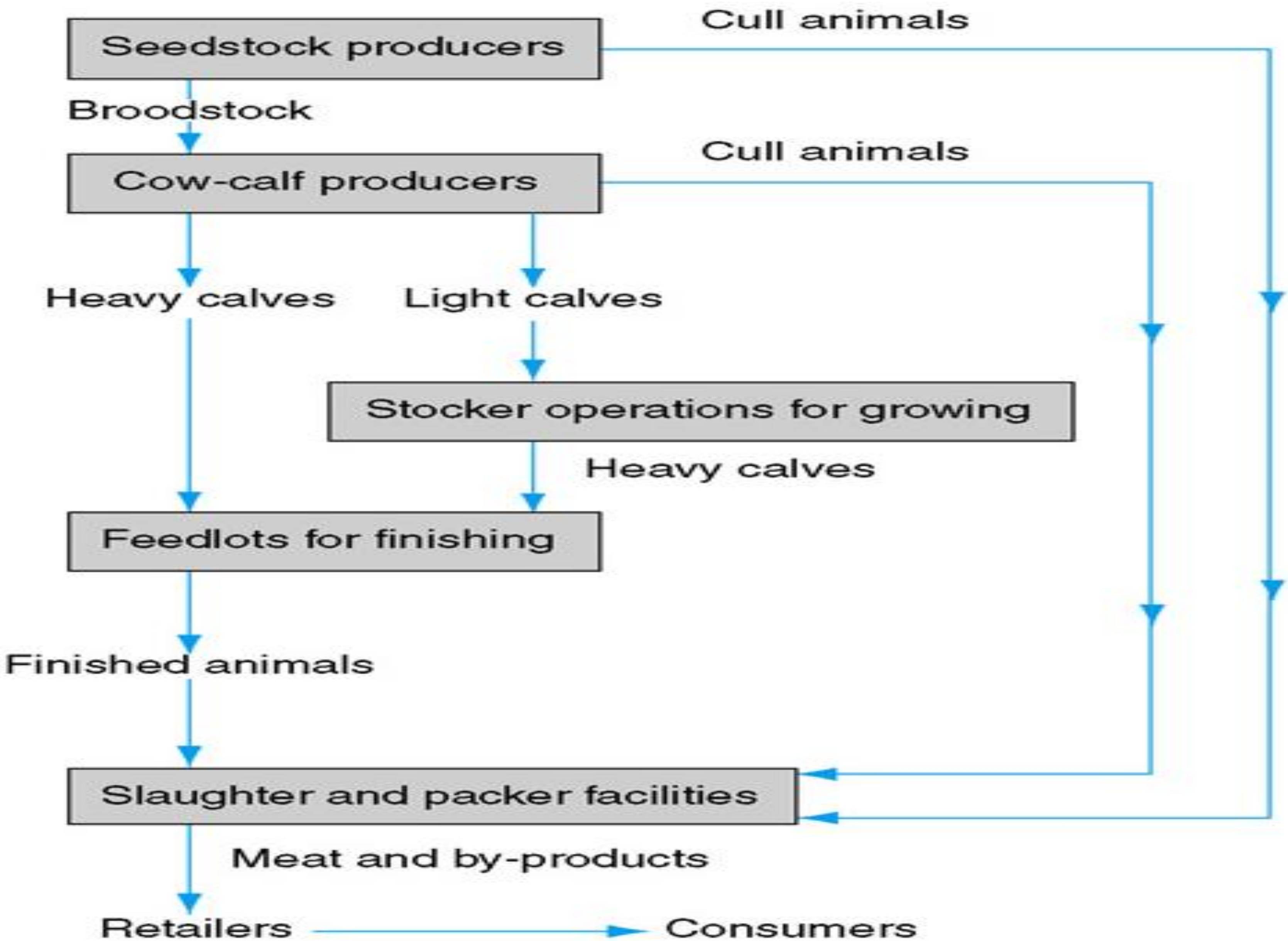
- Acceptable carcass weights (equal to or above 150 kg) can only be achieved when steers are 5 years or older
- The animals body condition is season.
- Need low production cost

2. **Mixed production systems**

- Small farmers kept young males and some culled heifers for feeding and finishing, and fed them on home-grown fodder
- Fattening and finishing of work oxen was also an important source of beef
- The feeder cattle are usually produced on specialized breeding and raising farms

3. Specialized feeding and finishing systems

- Not necessarily farmers, undertake the last phases of the beef production chain-feeding and finishing.
- The systems vary according to the principal feed ingredient used: grass, fodder, silage, grain, or industrial by-products
- The operation of growing, finishing activities are independently of breeding and rearing
  - leads to job specialization
- The breeding-rearing phase may be linked to dairy production.


Seedstock producers
Cull animals
Broodstock
Cow-calf producers
Cull animals
Heavy calves
Light calves
Stocker operations for growing
Heavy calves
Feedlots for finishing
Finished animals
Slaughter and packer facilities
Meat and by-products
Retailers
Consumers

3.1 Yearling production system /Stocker and feeder program

- Raising of calves (usually steers) until 13 – 15 months of age
- Cattle reaching a live weight of 360 - 460kg are sold for slaughter
- In poor seasons the yearling cattle can be sold at 340-380kg live weight to domestic feedlots as store steers for a further 60-100 days feeding.
- Weaned calves may be bought-in as store cattle
- Requires additional pasture and herd management and suits properties
- Improved pastures, winter forage crops or supplementary grain feeding are needed

3. 2. Vealer production system

- A similar production cycle as for weaners
- Cows joined annually in early summer and calves born the following spring
- However, sites that are slightly more productive are required to allow calves to fatten better post weaning
- Better performing calves with a live weight of 260kg -360kg at around 8 - 10 months can be sold for slaughter as “vealers”
- Lighter calves in the mix are sold as store cattle for other specialization for rapid finishing or sale as yearlings

- Feeding mgt

- Higher levels of soil phosphorus and better pastures also support higher pregnancy and survival rates
- Peak feed requirements are higher than for weaners, but calves are again sold prior to winter when feed reserves are limited
- About 20% of the calves are typically retained on farm to provide future replacement breeders

3. 3. Purebred Segment

- Provide replacement bulls and females for cow-calf operations.
- Their main goal in life is to better the genetics of the breed.
- Advantages:
  – Involved with perfecting the genetics and traits of a particular breed
  – Stock usually will sell for a higher dollar
- Disadvantages:
  – Time consuming, Costly, Takes experience

3. 4. Cow-Calf production systems

- Primary goal:
  - To produce a the heaviest calves possible at the time of weaning (205 days)

➢ Mgt practices of cow calf operation

1. Feeding mgt

✓ Feeds used in the cow-calf segment are more roughages like

- Pasture, Hay, Silage, Straw, Corncobs, Crop Residues_and Alfalfa, being the most common

- ✓ **Creep Feeding**
  - – Providing the calves with additional feed
  - – Usually grain
  - – Must introduce the grain slowly
- Advantages
  - – Produces a 30-70 lb heavier calf at weaning
  - – Better finish at weaning
  - – Already used to grain when they go to the feedlot segment

- Disadvantages
  - High cost
  - Hard to evaluate inherited feed abilities
  - Replacement heifers could be too fat
  - Calves on creep mayn't gain as well at the feedlot.

2. Weaning mgt

- To be done carefully, due to the stress on the calves they are susceptible to sickness
- Feeding the calves for a short period of time before they move to the feedlot.
  - Get more weight and increase your income

- Age of the calf at weaning is affected by both
  - The date of birth and
  - The date of weaning
- Time of weaning must balance the potential positive impacts on the cows with potential negative impacts on the calves or calf market weights.

➢ **Weaning Options**

✓ Many possibilities exist

- **Partial weaning**

- is when calves are separated from the dams for most of the day and allowed only one or two short periods during the day to suckle.
- The aim is reducing the length of time a cow is suckled
  - will result in shortening the postpartum interval to estrus

- The response to this management is variable and
- The practicality of such a system greatly limits its usefulness in commercial herds

- **Temporary weaning**

- is when calves are completely removed from their dams for a short period (at least 48 hours)
- It has been successfully coupled with estrus synchronization programs

- The practical application of temporary weaning is frequently limited to use only at the beginning of the breeding season and in conjunction with estrus synchronization
- A minimum of 45 days post partum interval is required to be effective.

- **Complete weaning**

- Is permanent separation of a calf from its dam.
- Treatments can occur anytime from immediately after calving up to near the time of the next calving

- Normal weaning age (180 to 240 days)

3.5 Finishing program

- Finishing/fattening- laying of fat
- Ultimate aim is to produce beef that will best answer the requirement and desire of the consumer
- This is accomplished through improvement in the flavor, tenderness, and quality of the lean meat, which results from marbling

➢ Types of Cattle finishing

A. Feedlot finishing

- Refers to feeding cattle in a restricted area with the feed conveyed to the animals

- **Finishing on feedlot**
  - Animals fattened in constructed barns
  - Feed is provided to the animals
  - Requires high capital investment for constructing different farm structures

- ***Advantages of feedlot finishing***
  - Short fattening period (3-4 months)
  - Many rounds of fattening per year (2-4)
  - Easy monitoring and disease control
  - Practiced year round
- ***Disadvantages of feedlot finishing***
  - High initial investment
  - Risk of loss due to sudden shortage of feed
  - Needs skilled manpower for implementing improved technologies and feed preparation
  - High labor requirement

B. **Pasture finishing**

- When grains are scarce and high in price, more cattle are grass finished
- But young cattle grow and do not reach market finish under usual pasture conditions
- It is impossible to finish them at early ages without either supplemental feeding on pasture and or feed lot finishing at the end of the grazing season
- Mostly advisable for older animal

- Practiced when pasture is sufficiently available
- Productivity is dependent on availability of pasture
- Animals should graze for 8 hours a day on quality and sufficient pasture

Important consideration on pasture fattening

- Comfortable and disease free grazing land
- Size of grazing land
- Availability of quality and quantity of pasture
- Availability of sufficient and clean water
- Well protected from hazards and predators

- ***Advantages of pasture finishing***
  - Fattening large number of animals at a time
  - Less capital investment
  - Less labor requirement
- ***Disadvantages of pasture finishing***
  - Long fattening period (8-10 months)
  - Monitoring is difficult
  - Transmission of diseases

- Determining factors in deciding upon the two finishing system to follow are:

1. The availability of cheap roughage pastureland and
2. The price of concentrates

- The system of pasture finishing that will be decided upon will depend on the
    - age of the cattle
    - quality of pasture
    - price of concentrate
    - rapidity of gains desired
    - market conditions

Discussion ideas

- Advantages of grain supplemented cattle on pasture compared to strictly feedlot finishing???
- Disadvantages of pasture finishing compared to strictly feedlot finishing????

Major types of beef fattening

1. Traditional fattening

- Common practice in Ethiopia and many developing nations
- Does not consider economic analysis of cost of production, not commercial/profit oriented
- It is very common in the highlands of Ethiopia
- Seasonally this type fattening also practiced in lowlands areas
- Based on grazing with occasional supplementation

cont…

- Animals for fattening comes after being used for work, milk production, and reproduction
- Long fattening period
- No access to improved technologies
- Quality and quantity of beef produced is not satisfactory

2. **Modern fattening**

- Different from traditional fattening in many aspects:
- Planned and organized
- Commercial/profit oriented
- Requires large capital investment
- Requires feasibility assessment
- Focuses on use of improved technologies

- Makes use of by products of meat industry
- Shorter fattening period (2-4 times/year)
- The two common example of modern fattening are
- ✓ Pasture finishing
- ✓ Feedlot finishing

- Fattening Systems

- In Ethiopia, there are three types of fattening systems based on the management practices

    1. Traditional
    2. By-product based and
    3. The Hararghe type of fattening

1. Traditional system

- Oxen are mainly used
- Meat yields are low
- Beef is poor quality and the farmer returns are often inadequate to buy a replacement ox
- In the lowlands, where pastoralists do not use cattle for draft, cattle are sometimes fattened on natural pasture in good condition in a good season
- In poor seasons, lowland cattle are rarely fattened and often have to be sold in poor condition at low prices

2. By-product based fattening

- Agro industrial by-products are the main sources of feed
- Which is more concentrated along the highway from Addis Ababa to Nazerate
- The market is suitable for both the fattened cattle and agro industrial products like molasses

3. Hararghe fattening system

- livestock depend more than in the central highlands upon thinning from annual crops
- During the growing season of annual crop cut and carry feeding system are practices.
- Crop stover and stubble grazing during the dry season are used
- The Hararghe highlands are close to extensive rangeland areas
- So, the working oxen in Hararghe Province come mainly from the rangelands

- Typically smallholders purchase oxen from the rangelands and use them as draught animals for some years and then fatten them prior to sale.
- Hararghe farmers to keep relatively more efficient herds (in terms of rates of conversion of animal feed into draught power and other livestock products) than is the case in the central highlands

CHAPTER - 3 BREEDS OF BEEF CATTLE

3.1 Traits of economic importance in beef cattle

- Major characteristics important in beef production include:
  - Rate and efficiency of gain
  - Muscle expression
  - Cutability
  - Marbling
  - Mature body size
  - Milk production
  - Age at puberty
  - Environmental adaptability e.t.c

❖ These characteristics differ in relative economic importance

✓ The primary concern trait of a cow-calf producer;

- Reproduction traits, such as milk production and age at puberty

✓ The most important trait to stocker and feeder operations;

- Efficiency of gain, rate of gain, and carcass traits

✓ Two characteristics having a definite effect on most production traits are

- Mature body size and milk production

➢ Mature Body Size

- Varies with breed and gender
- On average, a mature cow will weigh less than a mature bull of a given breed.??
- Is proportional to body size at all stages of growth?

✓ Larger mature size normally results in:

- Heifers being older and/or heavier at puberty;
- heavier birth weights, which are often associated with calving difficulty but it has advantage as;
  - faster rate of gain and
  - Heavier weaning weights

➢ Musculality

- The percentage of lean in slaughter cattle continues to increase, the importance of a breed's muscularity also increases.
- Most breeds that are ranked above average in muscle expression are also above average in size.
- This indicates that less difference exists among breeds on muscle-to-bone ratio than in body size.

➢ Cutability

- is the percentage of lean in a slaughter animal and is directly affected by an animal’s muscle expression.
- is evaluated in slaughter cattle as a USDA Yield Grade and is dependent upon the amount of fat, muscle, and bone.
- The relative amount of fat varies greatly in cattle, while the amount of bone is least variable.

➢ Marbling

- Marbling, or intramuscular fat, is often referred to as “taste fat.”
- Marbling is used to determine USDA Quality Grades, which are indicators of palatability of meat.

- Marbling increases with age until cattle reach physiological maturity, which normally occurs prior to 30 months of age.
- Cattle that are early maturing and have high milk yields are usually high in marbling.
- *Bos indicus* and heavily muscled, low milking types are normally low in marbling.

➢ Fertility

- A high level of fertility or reproductive performance is fundamental to an efficient beef cattle enterprise
- Fertility is commonly measured in terms of calf crop percentage
- The percentage calf crop can easily range from 70 to 95 percent
- The heritability of calving interval or fertility is low (10 percent)
- Therefore, most of the variation in calving percentage results from environmental factors such as feeding, management or herd health

➢ Maternal Ability

- The ability of a cow to wean a healthy and vigorous calf
- Increased milk production increases weaning weight per calf, and heavier weaning weights can increase efficiency of production in relation to fixed costs for the total herd.
- However, feed requirements and costs per cow are closely related to cow size and level of milk production.

3.2 Beef cattle breed

- In beef cattle production, no single breed can be considered as the best
- Because so many variations exist in
  - ✓ Climatic conditions
  - ✓ Production conditions, and
  - ✓ Market requirements

❖ So breeds have to be chosen to fit the conditions and requirements for specific areas.

- Modern beef cattle can be classified as one of two biological types
  1. Bos indicus /Zebu type
  2. Bos taurus.

3.2.1. Bos indicus

- Also referred to as Zebu-type
- Humped cattle
- Originating from South Central Asia.
- adapted to tropical and sub-tropical environments, which include the stresses of heat, humidity, parasites, and poorly digestible forages.
- The reproductive efficiency of purebred *Bos indicus* may be poor, but this can be remedied through crossbreeding.
- Hybrid *Bos indicus x Bos taurus* cattle are generally vigorous and fertile.

- The Brahman, Brangus, Beefmaster and other *Bos indicus* breeds developed in the United States are often referred to as American breeds.
- Several of these breeds are composite breeds, which means that they were developed by crossing two or more breeds, but these breeds are still classified as *Bos indicus*.

- Several *Bos indicus* breeds are common in the United States, including:

- Brahman
- Brangus
- Beefmaster
- Santa Gertrudis &
- Simbrah

1. Brahman

- Originated in the united states
- Humped cattle that were imported from India and brazil.
- Brahman cattle are a horned breed
- Vary in color, but are predominantly gray and red.
- Have large drooping ears, and loose skin in the throat and dewlap
- A very high tolerance to heat and have a natural resistance to many parasites
- They are considered as maternal breed

- Brahman

2. Brangus

- Developed in the united states
- Black in color and are polled
- A composite breed, consists of 3/8 brahman and 5/8 angus
- has combined many of the most desirable traits of the Brahman and Angus breeds.
- Some of these traits include hardiness, heat tolerance, muscularity, early maturity, and production of quality beef.

3. Beefmaster

- Developed on the lasater ranch in texas in the 1930s.
- The cattle do not have a color standard, although they are predominantly red or dun.
- A composite breed consisting of ½ brahman, ¼ hereford, and ¼ shorthorn.
- It posses many desirable reproductive traits and have high milking potential

3.2.2 Bos taurus Breeds

- Are those breeds that descended from the ancient celtic shorthorn.
- Show a closer resemblance to the aurochs, particularly scotch highland cattle, than do the *bos indicus* breeds.
- Classified into two sub-categories:

1. British breeds – also known as English breeds and
2. Continental breeds – also called exotics.

- Continental /Exotic Breeds

- That are originated in Europe
- They are known for weight gain and cutability
- They are generally large in size, lean and muscular

Charolais

- Developed in france, was introduced into the united states in 1936.
- Ranges from white to light straw in color
- Can be either horned or polled.
- This large, heavily muscled breed’s traits include a fast growth rate and feed efficiency

➢ Chianina

- Originated in central Italy.
- Range in color from white to steel gray and have black pigmented skin.
- The largest breed, with some bulls weighing more than three thousand pounds.
- Characterized by good feed efficiency, increased rate of gain, and calving ease, which is uncommon in larger breeds
- This large, well-muscled breed is most often identified as a terminal breed

➢ Gelbvieh

- Originated in Germany and was introduced in the United States in 1971.
- No color restrictions
- Can be either horned or polled
- This breed stresses both maternal and carcass traits, including
  - ✓ increased fertility
  - ✓ high milk ability
  - ✓ excellent growth rate and
  - ✓ good muscling

➢ Limousin

- Originally from France, was introduced in the United States in 1969.
- Can be polled or horned
- Range in color from golden red to black.
- These are large muscular cattle
- are known for increased rate of gain and feed efficiency
- Have the natural genetic ability to produce lean, flavorful beef in a variety of settings

- Limousin

➢ Maine-Anjou

- Developed in france
- These cattle were introduced in the u. S. In 1969.
- Very dark red in color with white markings on the head, belly, rear legs, and tail.
- White color on other parts of the body is also common.
- Can be horned or polled.
- Maine-Anjou cattle yield extremely lean, muscular carcasses.

➢ Simmental

- Originated in the Simme Valley of Switzerland.
- The color patterns vary from red and white spotted, to fawn or straw colored, to dark red, or to black.
- are acknowledged for both growth traits and maternal traits.
- The heaviest milking of the Continental breeds

➢ Texas Longhorn

- Is a descendant of the spanish cattle brought to the americas by explorer christopher columbus.
- These cattle lived as feral cattle for over 300 years.
- Are known for their distinctive long horns and have various colors and color patterns, including spotted color patterns.
- Longhorn traits include longevity, hardiness, and adaptability.
- Longhorn cattle are light muscled and produce calves with low birth weights.

✓ Texas Longhorn

British breeds

- Also known as English breeds
- Originated in the British isles
- Smaller in size than the continental breeds, but
- They have increased fleshing and marbling abilities

➢ Angus

- Originated in the highlands of northern scot land, in the shires of aberdeen and angus.
- Were first imported to the united states in 1873.
- Naturally polled cattle with black hair and skin.
- Angus are moderate in size and are considered a maternal breed.
- characterized by
  - ✓ Early sexual and compositional maturity
  - ✓ Ease of fleshing
  - ✓ Good milking ability and
  - ✓ Excellent marbling.

➢ Hereford

- Consists of both horned and polled cattle
- Which are registered with the american hereford association.
- Originated in England and was imported into the united states in 1817.
- Herefords are brownish red in color with a white face, chest, underline, and switch.
- Is a docile breed that is known for longevity, early maturity, and milking ability

➢ <u>Shorthorn</u>

- originated in England and was imported to the United States in 1783.
- Can be either horned or polled.
- can be red, white, or roan in color.
- These cattle are early maturing, excellent milkers, and are known for their good disposition

CHAPTER -4

REPRODUCTION AND PRINCIPLE OF BREEDING OF BEEF CATTLE

➢ *The Male Reproductive System*

- The male reproductive system has several interconnected working parts that must function together for successful mating to occur

✓ The male reproductive tract consists;

- ✓ the testes, scrotum
- ✓ epididymis, vas deferens, urethra and penis
- ✓ **Accessory sex organs like,**
  - ✓ seminal vesicles
  - ✓ prostate gland & Cowper's gland

Embryonic dev’t of male reproductive system

- The foetal reproductive system consists of:
  - two sexually non-differentiated gonads (medulla, cortex),
  - two pairs of ducts (wolffian and mullerian duct),
  - urogenital sinus, a genital tubercle, and vestibular folds
- In mammals, the hormones Androgens (mainly testosterone), that influence sexual differentiation and development

- In sexually undifferentiated embryo, testosterone stimulates the development of the Wolffian duct system, the forerunner of the male genital tract

✓ Mullerian duct develop into female gonaductal system with out hormonal stimulus

Testis

- Develops predominantly from the medulla of the sexually undifferentiated gonad
  - The wolffian ducts differentiate into the efferent ducts, epididymis, vas deferens and vesicular ducts
  - The prostate and bulbourethral glands form from the embryonic urogenital sinus and
  - The penis formed by tubulation and elongation of a tubercle that develops at the orifice of the urogenital sinus

✓ Function of male reproductive organs

a) The testis

- Every male animal has two testicles
- Play a major role by producing sperm, or the male sex cells called spermatozoa
- Also produce a hormone, testosterone (which causes the appearance and behaviour of the animal to have masculine traits)

Descent of testis

- In many animals the testes descend into the scrotal sacs at birth but in some animals they do not descend until sexual maturity and
- in others they only descend temporarily during the breeding season

✓ In mature animal in which if one or both testes have not descended is called a **cryptorchism**

✓ Males show more or less normal sexual desire but are infertile

b) the scrotum

- is a two-lobed sac that contains and protects the two testicles
- regulates the temperature of the testicles, (which must be maintained below body temperature)

Ex

- when the environmental temperature is lower than the desired temperature, the scrotum contracts, pulling the testicles toward the body for warmth, visa verse is true (the scrotum relaxes, permitting the testicles to drop away from the body)

- this temperature regulation is greatly important to the reproductive process
  - because of its effect on the production and vitality of sperm

Cont….,

c) The epididymis

Three parts:-

- ✓ the caput epididymis (head)
- ✓ corpus epididymis (body)
- ✓ cauda epididymis (tail)

❖ The first two segments are concerned with sperm maturation, whereas the terminal segment is for sperm storage

❑ Sperm cells stored there while they mature

Cont,..

d) the vas deferens

- which serves as a transportation tube that carries the sperm-containing fluid from epididymis to the urethra

e) the urethra

- is single, large, muscular canal / tubule leading sperm from vas deferens through penis to exit

f) The penis

- penis is surrounded by spongy tissue with numerous small spaces, that fills with blood when the male is sexually aroused
- This causes an erection, which is necessary for copulation, or mating
  - deposits the semen within the female reproductive system
- The sigmoid flexure, (commonly found in ruminants and boars) and the retractor penis muscle extend the penis from the sheath (a tubular fold of
- The glans penis at the tip of the penis acts as a sensory organ

Accessory sex glands

- these different glands involved in producing the secretions in which sperm are suspended

a) the seminal vesicles

- produce thick liquid secretions that make up much of the volume of the semen and
- transport and provide nutrients for the sperm

b) the prostate gland

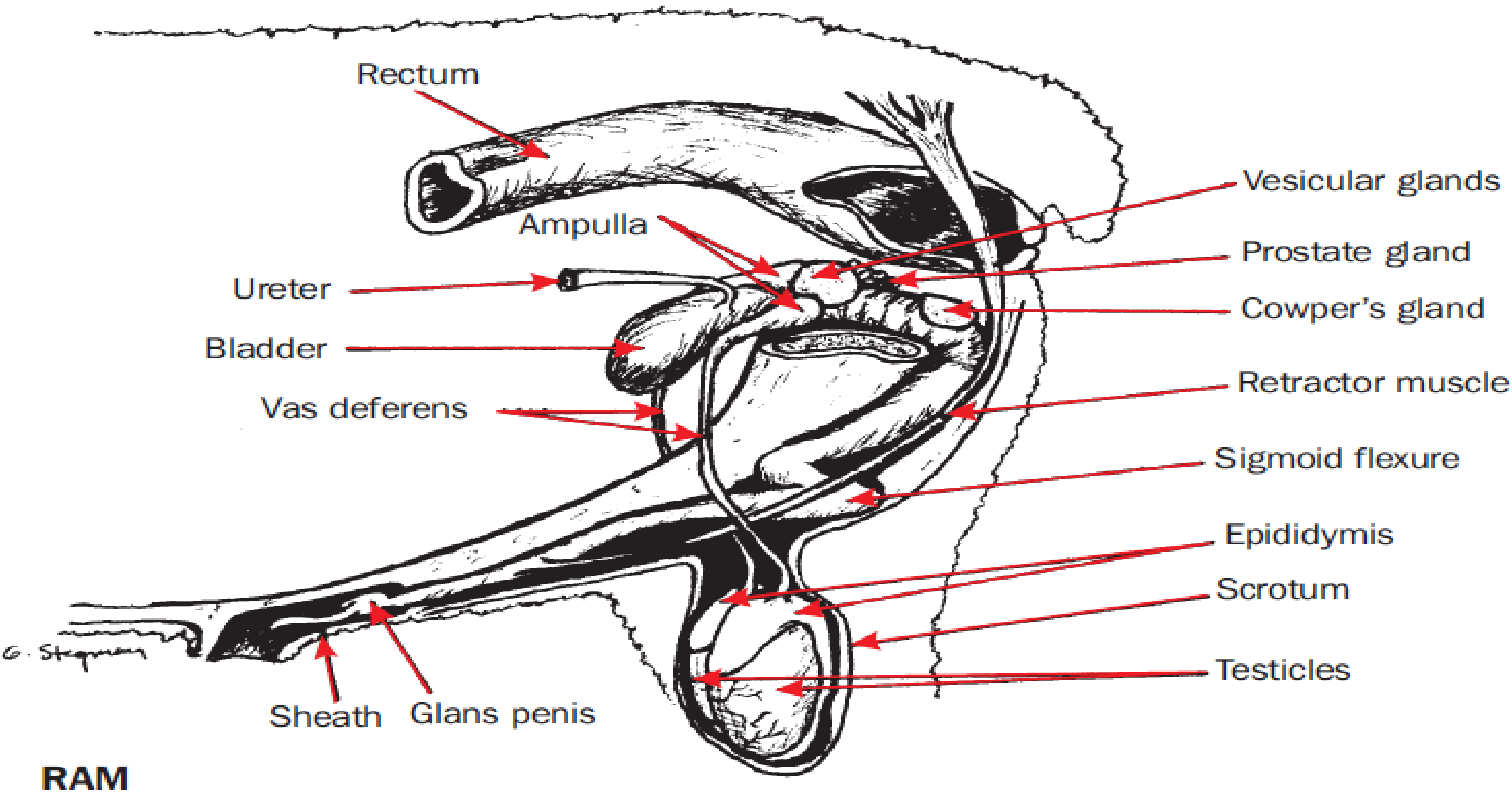
- produces an alkaline secretion that neutralizes the acidity of the male urethra and female vagina, which helps given semen its characteristic odour

c) The Cowper’s gland/ bulbourethral gland

- the secretions may lubricate, flush out urine or form a gelatinous plug that traps the semen in the female reproductive system after copulation and
- prevents other males of the same species fertilizing an already mated female

❖ mixture of seminal fluids, prostate fluids and sperm is called **semen**

Figure of male reproductive organs



The Female Reproductive System

- ❖ the female mammal has a complex system of organs that compose the reproductive system
- ✓ producers must be familiar with these various organs and their functions to
  - – ensure successful reproductive development of their livestock

some major organs of the female reproductive tract are:-

- ✓ the ovaries, oviducts, uterus,
- ✓ vulva, cervix and vagina

Cont,.....

- the ovaries, oviducts and the uterus are supported by the broad ligament (suspensory ligament)

- this ligament consists of

  - The meso-ovarium which supports the ovary;

  - The meso salphinx which supports the oviducts;

  - The meso metrium which supports uterus

Embryo dev’t of female reproductive system

Ovary

- ❖ arises primarily from the cortex of the sexually undifferentiated gonad

- In the female the Mullerian ducts develop into a gonaductal system
  - uterus, a cervix and the anterior part of a vagina
  - the urogenital sinus gives rise to the vestibule
  - the folds of skin that border the sinus form the lips of the vulva

Cont,....

❑ Ovary

- remains in a abdominal position throughout life
- are paired glands or organs (left and right)
- Function: gametogenic (produces ova) and
    - an endocrine (produces hormones): the female sex hormones, oestrogen and progesterone

✓ the shape and size of the ovary vary:-

- ✓ both with the species and
- ✓ the stage of the oestrus cycle

✓ Ovary consists of inner region (medulla)& outer region (cortex)

- Cortex is predominant tissue of ovary
- ✓ which is surrounded by superficial epithelium known as Germinal epithelium
- ✓ just beneath the germinal epithelium dense fibrous connective tissue which covers the whole ovary called Tunica albuginea
- ✓ Cortex confines a cluster of cells called Follicles and Corpus-luteum at various stage of development

Ovarian follicles:-

- Primary follicles- Oocyte surrounded by a single layer of follicular cells called granulosa cells
- Secondary follicles- Oocyte with a tough membrane called Zone Pellucida
- Tertiary (graffian) follicles- follicles with in a fluid filled cavity called Antrum

- Development or maturation of follicles stimulated by the hormone Follicle stimulating Hormone (FSH), secreted from anterior lobe of pituitary gland
  - The cell of matured follicles secret the hormone oestrogen
- Development of corpus luteum influenced by Luteinising Hormone (LH) secreted from anterior pituitary gland
  - The corpus luteum produces a hormone progesterone

❑ Fallopian tubes / oviduct

- ✓ Are the two tubes carry the ova / fertilised egg from the ovaries to the uterus
- ✓ Fertilization of the ovum occurs

- It divided into four functional segments:-

- ➢ The finger like **fimbriae**
- ➢ The funnel-shaped end of each oviduct opening near the ovary- **the infundibulum (**caught released ovum **)**
- ➢ The more distal dilated segment- **ampulla**
- ➢ The narrow proximal portion of the oviduct connecting the oviduct with the uterine horns- **the isthmus**

The uterus

- Hollow muscular organ

Consisting of

- The body (corpus)
- Two uterine horns (cornua) and
- The cervix (neck)

- Thickness and vascularity of the uterus vary with the hormonal change and pregnancy

Uterus has three layers:-

- Perimetirium- outer most layer, support
- Myometrium- thick inner circular layer
- Endometrium- inner most layer

The uterus serves a number of functions:-

- Is the site where the foetus grows until parturition, or birth
- Regulation of the function of the corpus luteum

- Cervix

- Known as neck which forms a barrier between external and internal uterine environment
- Composed of connective tissue

Important in :- sperm transportation

» Maintenance of pregnancy & parturition

- Vagina
- Is the passage between the cervix and the vulva
- Serves as the female organ of copulation at mating and
- As the birth canal at parturition
- Vulva
- Is the external opening of the reproductive and urinary systems
- The exterior, or the visible parts of the vulva, consists of two folds called the labia major and labia minor

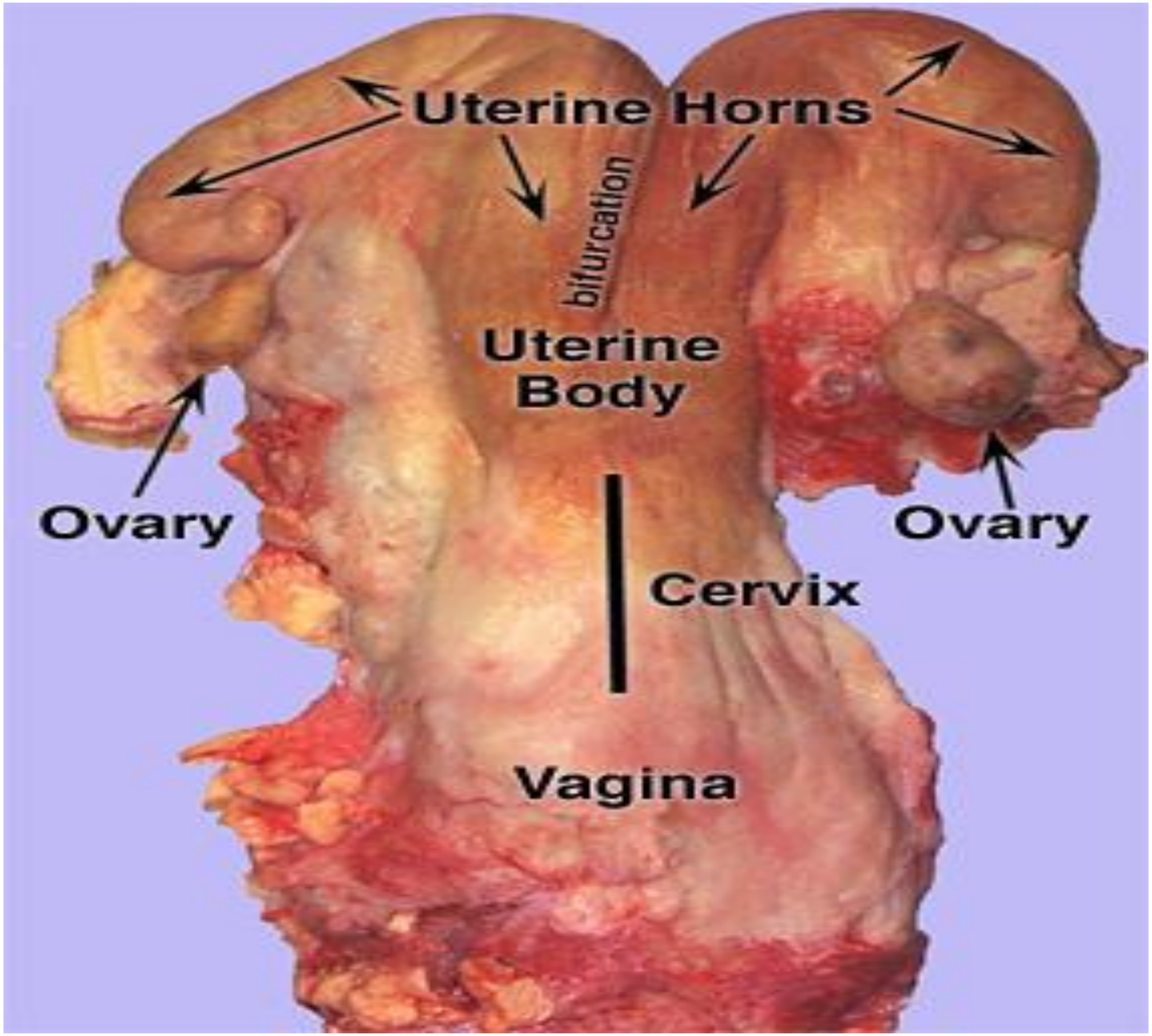
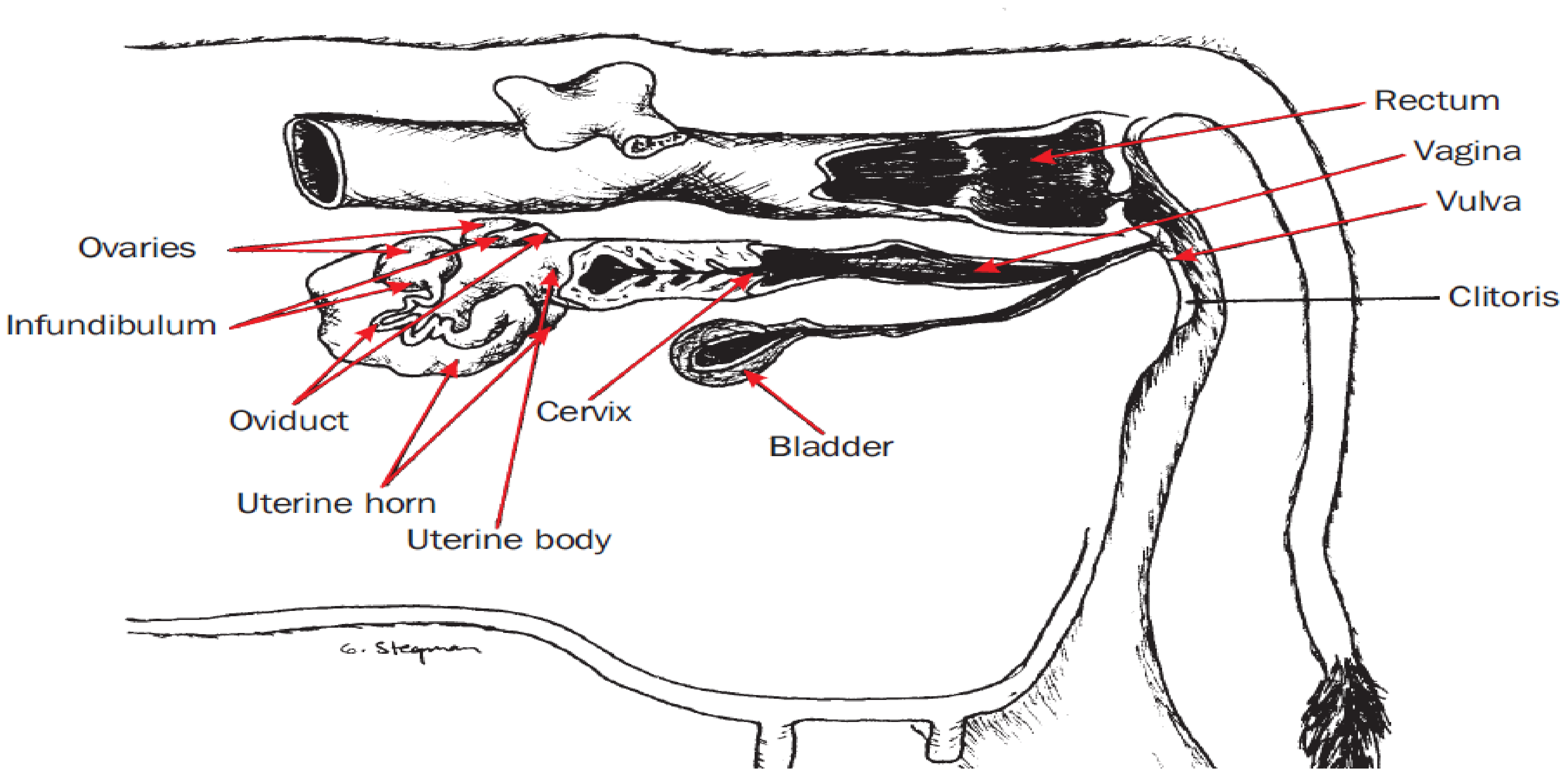

Uterine Horns
bifurcation
Uterine Body
Ovary
Ovary
Cervix
Vagina

Figure of female reproductive organs



CHAPTER 5

GROWTH AND CARCASS DEVELOPMENT

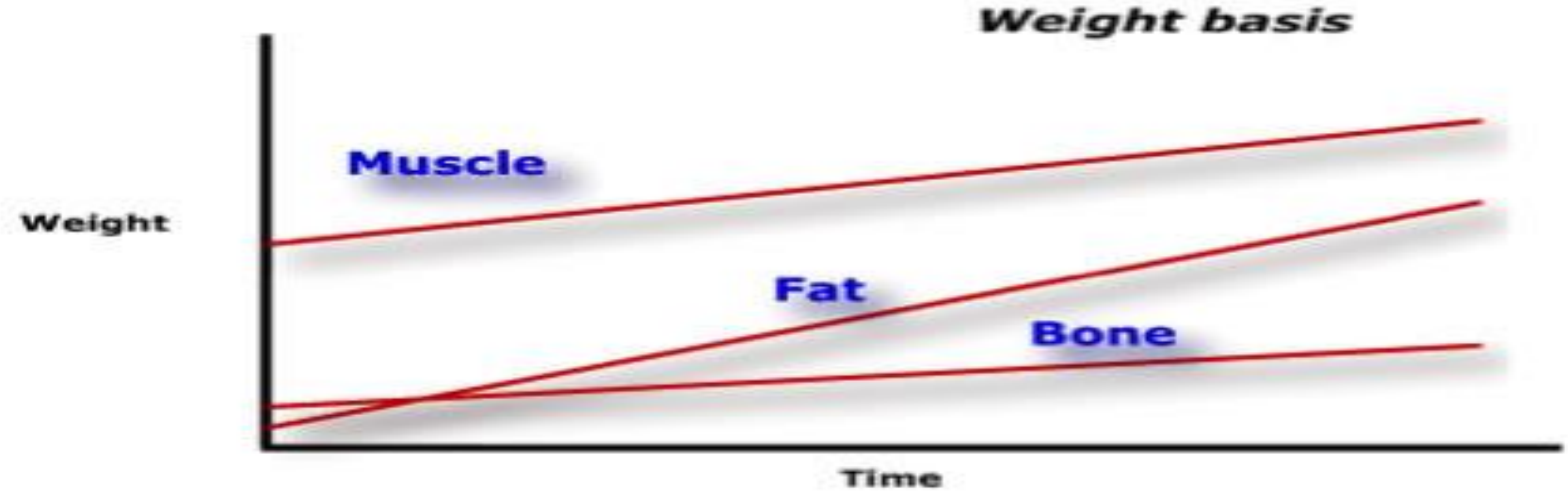
- **Growth and development of beef animals**
- **Growth** is a dynamic process, continues throughout life
- Refers to change in size and developmental changes associated with it
- **Development** is a gradual progression from a lower to a higher stage of complexity in association with a gradual expansion in size.
- **Chronological growth**
- Increase in size or body function due to an animal growing older
- **Physiological growth**
- Increase in size or body function due to increase in tissue and organ growth and development

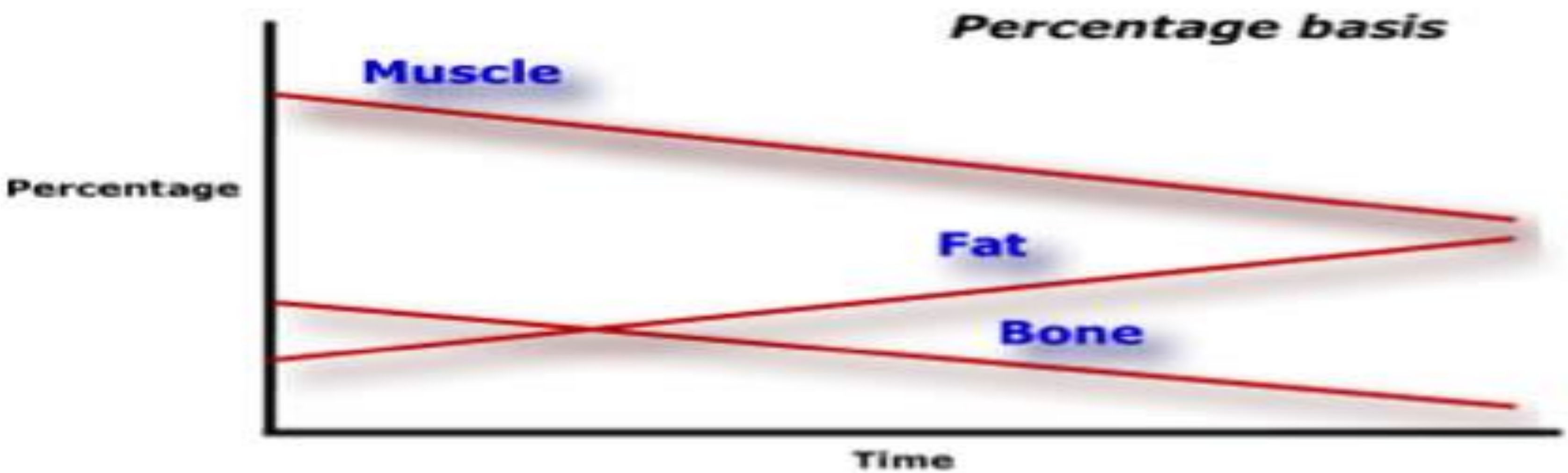
➢ Changes in shape

- Calf: short and broad head, long legs and shallow body, when it grows: long narrow head, short legs and deep body
- Changes indicate the different relative growth rates of one part compared with another part
- During growth shape is more closely related to weight than age
- Young animals held at a constant weight for long periods remain juvenile in appearance. They show a small increase in skeletal size and a limited change in shape

- Differences in shape between animals is associated with differences in quantity of saleable meat
- Beef type is associated with higher carcass yield and lower bones than dairy type
- Associated with knowledge of body weight and age shape is important for assessing meat animals.

Growth Curves





➢ **Measurement of growth**

- Measuring growth depends on the intended use of animals
- Indication of the edible portion of the carcass that meets minimum quality standards in animals intended for slaughter.

✓ Objective measurements

- such as animal weight, loin –eye area or back fat thickness are indicators of edible portion
- The weight is positively correlated with loin-eye area and the depth of back fat is negatively correlated with proportion of lean tissue in the carcass

✓ Subjective or visual appraisal of growth

- is used to estimate the nature or quality of growth and complements objective measurement of growth.
- The best single measurement of size is body weight
- The rate at which growth occurs is a better measurement of animal's ability to perform than is weight itself.

- Average daily gain (ADG) and weight per day of age (WDA) are measures growth rate
- Growth can also be expressed as relative growth rate (RGR) = gain per day per unit body weight on that day.
- Within a breed, when compared as the proportion of mature size, selection for growth rate based on average RGR is likely to be most effective than daily weight gain.

- In addition to body weight body surface measurement (length, height, width etc) have been made on cattle for recording major differences between genotypes in skeletal size and proportions. However of limited value in predicting meat production.
- Chest girth or heart girth is a better parameter for the prediction of body weight.

Group work

- If an animal increases its live weight by drinking water, do the resulting increments to live weight really constitute growth?
- If an animal increases its body weight by accumulating fat between and within its muscles, do the resulting increments true growth increments?

❖ Factors affecting growth

✓ Genetics

- create imbalances in the secretion of hormones could result in slowed growth and development.

✓ Antibiotics

- improve growth rate and feed efficiency by reducing the incidence of diseases

✓ Breed and sex

- affect rate of growth and the point at which it declines.

✓ Nutrition

- Growth rate is positively correlated with plane of nutrition.
- Excessive feeding early in life cause fattening and may inhibit bone growth and organ development.

✓ Hormonal control of growth

- Hormones collectively coordinate growth and development of body tissues, structures and organs.
- For growth to occur with ease and effectiveness, different organs and tissues must be functional at different times.
- Primary hormones that control growth include somatotrophins, thyroxin, glucocorticoids, androgens and estrogen

❖ Relative development of carcass

- Three overlapping processes govern the development of the carcass:
  - Bone achieves its maximum growth rate first followed by muscles and finally fat.
- Partition of nutrients gives preference to bone and muscle development over fat development.
- When animals are fed sub – maintenance diets fat is drawn on and used as a source of energy
- A differential growth pattern starts at the extremities of the fetal calf and ultimately converges on the abdomen.
- So, at birth the calf is bony with a big head and feet connected by long legs to a slight body.

➢ Importance of Body Condition scoring

- In order to manage a beef cow-calf operation in the most cost-efficient way
- The body condition of beef cows is related to many critical aspects of production, such as conception rate, days to estrus, calving interval, and milk production.
- When cows are extremely thin (BCS < 4), they are not only reproductively inefficient, but they are more susceptible to health problems.
- Cows at BCS 1 are in a life-threatening situation and need immediate attention.
- Cows that are over-conditioned (BCS 8-9) are the most costly to maintain. Two-year-olds with BCS 8-9 may encounter dystocia (calving difficulty) due to the excessive fat in the pelvic area.

➢ Numerical Scoring System

- BCS are indicators of the nutritional status in beef cows.
- Also, body condition can be measured in the field without gathering or working cattle.
- Estimate energy reserves in the form of fat and muscle of beef cows.
- BCS ranges from 1 to 9, with a score of 1 being extremely thin and 9 being very obese.
- Areas such as the back, tail head, pins, hooks, ribs, and brisket of beef cattle can be used to determine BCS.
- Be aware that gut fill due to rumen contents or pregnancy can change the appearance of moderately fleshy cows, especially over the ribs or in front of the hooks.

➢ When to score body condition

✓ Body condition scores of females in the breeding herd should fall within a range of 5 to 7 from the beginning of the calving season throughout the breeding season.

✓ Ideal times to body condition score beef cattle:

- 60 days prior to calving
- At calving
- When calves are weaned
- At the beginning of the breeding season

CHAPTER - 6

Feeds and Feeding of beef cattle

- **Feed resources**

- Animal feeds are derived from four sources;

- ✓ Forages/ fodder crops/natural pasture
- ✓ Crop residues
- ✓ Improved pasture
- ✓ Agro industrial by products and concentrates

Classification of animal feed

- Broadly feeds can be classified in to two groups namely roughages and concentrates

1. Concentrates

- "Feeds that are high in nitrogen-free extract and total digestible nutrients (TDN) and low in crude fibre (less than 18%)"
- Grains and agro industrial by- products

➢ NFE

- Term for organic material in a feedstuff for which there is no specific analysis
- These include carbohydrates, pigments, and water soluble vitamins

- Concentrates specifically the cereal grains play the most important role for TDN
- Provide the bulk of the energy along with a large portion of the dietary protein

2. Roughages

- are relatively large amount of less digestible material
- crude fibre over 18% in DM and
- low (about 60 %) in total digestible nutrient (T.D.N.)
- Grasses, straws, legumes, silage, fodder trees, etc
- The two major groups of roughages are:

✓ succulent roughages and

- feeds usually contain 60-90% moisture,

✓ dry roughages

- 10-15% moisture

- **Factors determining the level of nutrient requirement:**

- breed

- overall balance of nutrition

- age and sex

- stress from the environments

- level of production

- hormonal and physiological activities

- Etc

Feeding....

- Beef animals require feed nutrients for
  - Maintenance
  - Growth
  - Production/gain
  - Disease resistance, etc

Requirements for maintenance

- ✓ is the amount of feed
- to keep an animal at a particular weight without any significant change in body composition
- needed to maintain essential body functions such as respiration, heart rate, eating, keeping warm, etc
- needed to replace the nutrients that are excreted daily from the body
- are required to replace loss of tissue of the body

Requirements for production

- are met after maintenance requirement
- are the amount of feed needed for growth or milk production, draft power and meat production etc
- need large quantities of feed

Feed nutrients required by beef animals

- Energy (carbohydrates, fats, proteins)
- Protein
- Vitamins
- Minerals
- water

Energy feeds

- Grains (wheat, maize, sorghum, etc)
- agro- industrial by- products (molasses, brans, brewery by-products, etc)
- Silage, grasses, straws

- Carbohydrates and lipids are the major sources of energy in livestock rations
- Some energy is also derived from the protein in the ration
- But, carbohydrates are the most important because they are:
  - readily available
  - easily digested in great quantities
  - lower in cost

- lipids (fats and oils) are the second most important sources of energy for livestock
- lipids contain 2.5 times as much energy as carbohydrates

➢ **Disadvantage lipids as energy source:**

- in warmer climate it is difficult to store feeds that are high in fat content because they tend to become **rancid**
  - this makes the feed unpalatable
  - in some cases, rancid feed may cause digestive disturbances

Protein Feeds

- Are composed of amino acids, which contain C, H, N, and sometimes S.
- Muscle, skin, hair, hooves and many other tissues & fluids in the body contain protein
- Internal organs & soft structure of the body are composed of primarily of proteins
- plant origin protein digested by the animals provide the amino acids, which are used in the body to form animal protein
- In plant protein is mostly found in the leaves, petioles, & seeds
- in addition to proteins, plants contain simpler nitrogenous compounds called non-protein nitrogen (NPN)

- Ruminants needs protein a source of nitrogen, from which the microbes in the rumen can then construct the essential amino acids
- The total diet should average around 11% to 13% crude protein (CP) for most uses
- Younger, growing animals need more protein
- Young lightweight calves require higher levels of protein at any given energy intake due to their higher requirement for muscle development

- *Crude protein* refers to all the nitrogenous compounds found in a feed, i.e. *protein and NPN (ex. Urea & ammonium salts {nitrates, nitrite, NH3)*

- Protein sources
  - Oil industry by- products (noug seed cake, linseed cake, cottonseed cake, mustard/ rapeseed cake, etc,)
  - Legumes
  - Poultry litter, etc

❑ Mineral

- when an organic material, such as feed, is burned, the ash that is left is the mineral content
- are inorganic substances needed in very small

❖ **Macro/Major Minerals**

- needed in large amounts

- **ex**. Calcium, Phosphorus, Magnesium, Potassium, Sulphur, Salt (NA & Cl)

❖ Micro/Trace Minerals

- Necessary for the well being of the animal
- Needed in sufficient quantities to promote health & to optimize production & reproduction
- Are all toxic when fed in excessive amount

  - **ex.** Copper, Zinc, Manganese, Selenium, Iodine, Cobalt,

➢ Functions of Minerals

- provide material for the growth of bones, teeth & soft tissues
- regulate many of the vital chemical processes in the body
- aid in muscular stimulation and activity, reproduction, digestion, repair of tissue, & release of body heat for energy
- help to regulate the acid-base balance
- are essential for the utilization of some vitamins in the body

✓ **Deficiency symptoms**

- a lack of iron in the blood reduces its ability to carry oxygen to the body cells
- when Ca & P are deficient, the bones and teeth do not form properly
- inefficient feed utilization, poor gains & lower meat, milk, egg production
- physical problems such as anemia, hypocalcemia (milk fever), goiter, or death

✓ **Minerals in the ration**

- are usually added to the ration either by feeding them free choice or including them in the mixed ration
- salt, Ca & P are the minerals most likely to be needed in the rations of farm animals
- about 70% of the mineral content of an animal's body is Ca & P

Vitamins

- are organic compounds required in minute amounts by the body
- are essential to metabolism and some must be supplied in the feed
- required by cattle are A, D & E.
- B-vitamins and vitamin K are produced by rumen microorganisms

➢ Source of vitamin

- Most grains are deficient in vitamin A
- Green feeds such as alfalfa hay (or growing grass) contain high levels of vitamin A
- Other sources include vitamin A feeding concentrates and injections
- Other vitamins usually are adequate in most rations
- B-complex vitamins sometimes help when starting cattle on feed, especially drawn, stressed calves
- High quality alfalfa-grass hay will help to correct many mineral and vitamin deficiencies

Water

- is the main constitute of the animal's body, constituting 50-80% of the live weight, depending on age and degree of fatness
- an animal may lose almost all of its fat and about 50% of its body protein and can survive
- but the lose of 10% of its body water can be fatal

Water functions

- to help eliminate waste products of digestion and metabolism
- regulate blood osmotic pressure
- as a major component of secretions (milk, saliva)
- in the thermoregulation (evaporation, respiration etc.)

Feed Additives

- increase the performance of beef cattle
- There are restrictions for using most feed additives
    - ✓ Some must be withdrawn from the ration a certain number of days before the animal is slaughtered
    - ✓ Some are restricted to cattle being fed for slaughter
- reduce liver abscesses, a problem with cattle fed high grain rations
- control of founder, feedlot bloat, legume bloat, foot rot, parasites and other cattle disorders

Additives

✓ Melengestrol acetate (MGA)

- use in dry and liquid supplements fed to heifers in the feedlot or on pasture
- is a synthetic hormone similar in structure and activity to progesterone, the natural pregnancy hormone
- improves rate of gain and feed use and suppresses heat in heifers
- no significant change in carcass quality in heifers fed MGA

- A 48-hour withdrawal before slaughter is required
- MGA is approved for feeding at a level of 0.25 to 0.50 milligrams per head daily
- MGA is not effective for steers, spayed heifers or pregnant heifers

✓ **Ionophores**

e.g. Rumensin and Bovatec

- improve the efficiency of rumen fermentation by increasing the propionate-to-acetate ratio
- reduces the energy losses associated with volatile fatty acid production in the rumen

- Bovatec improve the feed efficiency of cattle fed high grain or high roughage rations
- reduce grain bloat and legume bloat and give some coccidiosis control at the level fed to beef cattle
- No withdrawal period before slaughter is necessary with Rumensin or Bovatec
- For feed efficiency improvement 5 to 30 grams per ton of complete air-dry feed are recommended

➢ Antibiotics

- inhibits the growth of other organisms
    - ✓ suppress harmful organisms in the digestive tract
- E.g. chlortetracycline (Aureomycin), oxytetracycline (Terramycin), bacitracin, tylosin (Tylan), and others
    - ✓ It vary from 35 to 100 grams per head daily for continuous feeding of antibiotics
    - ✓ It also varying from 250 milligrams to 1 gram per head daily for ranging from three days to four weeks periodical feeding

- To control disease
- To keep healthier state of the mucosal lining of the digestive tract
- improves the absorption of nutrients and prevents the passage of harmful bacteria across the digestive tract wall (a cause of liver abscesses and other cattle disorders)

Buffers

- solutions containing both weak acids, weak base and their salts
- It resist changes in pH (hydrogen ion concentration) when either acids or alkalis are added to them
- Large quantities of organic acids are produced in the rumen by microbial fermentation
- Saliva is the principal source of rumen-buffering agents

- Needed in the diet of beef cattle when they are fed high-silage or high-concentrate diets
- Silages are high in organic acids
- High-energy diets are digested quickly in the rumen and rapidly lower rumen pH
- Also, saliva flow is decreased with high moisture and high-energy, low-roughage diets

- Buffers are most likely to be useful in the ration of cattle when:
  - Starting new cattle on feed
  - Feeding high-grain, low-roughage rations
  - Using corn silage, high moisture grain or wheat rations
  - Mixing rations poorly
  - Changing cattle from a high roughage to a high grain ration

- Alkali compounds used as buffering agents in beef cattle diets include
  - Sodium bicarbonate
    - ✓ commonly used buffering agent in cattle diets
  - Magnesium oxide
  - Limestone and sodium bentonite
- Limestone is not highly soluble in the rumen and is considered a buffering agent in the small intestine rather than the rumen

Balancing ration

- is a process by which different feed ingredients are combined in a proportion necessary to provide the animal with proper amount of nutrients needed at a particular stage of production
- It requires the knowledge about nutrients, feedstuffs and animal in the development of nutritionally adequate rations that will be eaten in sufficient amounts to provide the level of production at a reasonable cost

- Important considerations in feed formulation
- Acceptability to the animal
- Digestibility
- Cost- be least-cost formulation
- Presence of anti-nutritional factors and toxins
  - anti-trypsin factor in soybean meal, affects the digestion of some nutrients
  - Some feed ingredients may also contain toxic substances, which may be detrimental to the animal when given in excessive amounts
- Other factors that should be considered in feed formulation are texture, moisture and the processing the feed has to undergo

Methods of formulating rations

Square Method

- simple and easy to follow

Disadvantage

- It satisfies only one nutrient requirement and uses only two feed ingredients
- The level of nutrient being computed should be intermediate between the nutrient concentration of the two feed ingredients being used

Simultaneous Equation Method

- An alternative method for the square method using a simple algebraic equation
- A particular nutrient requirement is satisfied using a combination of two feed ingredients

Two-by-two Matrix Method

- solves two nutrient requirements using two different feed ingredients
- A 2 x 2 matrix is set and a series of equations are done to come up with the solution to the problem

➢ Trial-and-error Method

- This is the most popular method of formulating rations for swine and poultry
- The formulation is manipulated until the nutrient requirements of the animal are met
- This method makes possible the formulation of a ration that meets all the nutrient requirements of the animal

- **Linear Programming (LP)**
- determining the least-cost combination of ingredients using a series of mathematical equations
- There are many possible solutions to each series of equations, but when the factor of cost is applied, there can only be one least cost combination
- An electronic computer is capable of making thousands of calculations in a very short time
  - ✓ the machine is incapable of correcting errors resulting from incorrect data and errors in setting up of the program
- The resultant rations obtained from linear programming will be no better than the information and values which are entered into the programming

Pearson's square

- **Procedures:-**
  - Balance first for protein or energy (Mix 1)
  - Balance the other protein/ energy (Mix 2)
  - Balance for both energy and protein(Mix 3)
  - Calculate the ingredient composition
  - Test for adequacy of Ca, P, and vitamin A
  - Check /test for protein and energy

✓ Formulating Diets Using Pearson Square and Algebraic Equation Methods

- Formulating diets by hand is complicated
- it is difficult to solve for more than one nutrient at a time
- it also is difficult to solve equations with more than two unknowns
- Hence, the process is often simplified by fixing certain ingredients in the diet, thereby allowing one to work with only two unknowns

- The nutrient most likely to be deficient (often protein) is chosen to be solved for
- The two unknowns ingredients are
    - usually the major ingredient in the diet
    - Supplies the nutrient of interest
- The fixed ingredients are designed to supply other nutrients examples
    - ✓ minerals like ca and P
    - ✓ Vitamins, or a certain level of roughage

Example: Balance a diet for a finishing beef steer to contain 12.75% CP (DM basis).

- ❖ Procedures
- ➢ **Step 1**. **Fixed ingredients**
- ✓ To be considered for most feedlot diets:
  - o Approximately 10% roughage, so we can fix that level of roughage in the diet
  - o Require supplemental ca because grains are low in ca, so we can fix a certain level of limestone and dicalcium phosphate to supply ca and some additional P
  - o Contain added molasses to improve palatability and structure
  - o Fat to boost the energy content
  - o A certain level of salt
  - o Urea, supply 10 to 12% of the total CP, which would be approximately 0.5% of the diet
  - o Finally, contain a fixed level of custom premix that supplies trace minerals, vitamins, and feed additives

1.1. Given this background, we can now set up the following list of fixed ingredients:

Ingredient	% fixed in dietary DM
Alfalfa hay, mid bloom	5
Cottonseed hulls	5
Cane molasses	4
Fat	2
Premix	4
Limestone	0.7
Dicalcium phosphate	0.4
Salt	0.3
Urea	0.5

1.2. Now, assume that we have **steam-flaked corn and cottonseed meal** as the two unknown ingredients

- Then the question becomes - “**What combination** of flaked corn and cottonseed meal do we need to mix together, so that when combined with the fixed ingredients, the final diet will supply 12.75% CP?”

➢ **Step 2**.

- ✓ determine the percentage of CP that will be supplied in the diet by the fixed ingredients

- So, multiplying the %CP supplied by each fixed ingredient by the fraction of the diet made up by each fixed ingredient

- The CP values for each ingredient can be obtained from an Ingredient Composition Table or by chemical analysis of each ingredient (assume the premix has 10% CP). This process is illustrated in the following table:

Ingredient	%CP (DM basis) in ingredient	Fraction in diet	Result
Alfalfa hay, mid bloom	17	5/100	0.85
Cottonseed hulls	5	5/100	0.25
Cane molasses	5	4/100	0.20
Fat	0	2/100	0
Premix	10	4/100	0.40
Limestone	0	0.7/100	0
Dicalcium phosphate	0	0.4/100	0
Salt	0	0.3/100	0
Urea	288	0.5/100	1.44
Total		**21.9/100**	**3.14**

- Thus, the fixed ingredients (21.9% of the diet) will supply 3.14% CP in the final diet
- So, we need **12.75 - 3.14 = 9.61% CP** to be supplied by a combination of the other two ingredients, steam-flaked corn and cottonseed meal
- However, because of the fixed ingredients, steam-flaked corn and cottonseed meal will comprise only **100 - 21.9 = 78.1%** of the final diet
- Thus, we must get 9.61% CP from 78.1% of the diet, so we need to determine what combination of steam-flaked corn and cottonseed meal will provide **9.61/0.781 = 12.3% CP**

- **Step 3**. Two methods can be used to determine the combination of steam-flaked corn and cottonseed meal that we need

3.1 **Pearson Square**

- From an Ingredient Composition Table, we can determine that steam-flaked corn contains 9% CP, and cottonseed meal (solvent extracted) contains 46% CP.

- Corn = 9

33.7

12.3

- Cottonseed meal = 46

3.3

37

- The proportions from the square indicate that we need 33.7 out of 37 parts as steam-flaked corn and 3.3 out of 37 parts as cottonseed meal to achieve a mixture with a CP of 12.3%
- Expressed as percent, that would equal (33.7/37) x 100 = 91.08% corn and (3.3/37) x 100 = 8.92% cottonseed meal
- Remember, however, that steam-flaked corn and cottonseed meal will only make up 78.1% of the final diet, so we need to multiply each of these proportions by 78.1/100, which would yield **71.12% for steam-flaked corn** and **6.98% for cottonseed meal**, with a total of the needed 78.1%

- **Step 4**. We need to make sure that it really is balanced for 12.75% CP

- ✓ To do this, multiply the percentage of CP in steam-flaked corn by its fraction in the final diet (9 x 71.12/100 = 6.40) and the percentage of CP in cottonseed meal by its fraction in the final diet (46 x 6.98/100 = 3.21)

- ✓ We know that the fixed ingredients supplied 3.14% CP, so 3.14 + 6.40 + 3.21 = 12.75% CP. Thus, our diet is balanced for CP

- **Step 5**. Calculate the concentration of other nutrients in the diet and check the nutrient requirement tables

- ✓ we will illustrate this process for nem, by doing exactly the same thing we did in step 2 to determine the CP supplied by the fixed ingredients
- ✓ We will be using all the ingredients in the diet. For this calculation, we will assume that the premix contains 1.76 mcal/kg of NEM.

Ingredient	NEm (Mcal/kg) in ingredient	Fraction in diet	Result
Steam-flaked corn	2.21	71.12/100	1.57
Cottonseed meal	1.79	6.98/100	0.13
Alfalfa hay, mid bloom	1.28	5/100	0.06
Cottonseed hulls	0.99	5/100	0.05
Cane molasses	1.74	4/100	0.07
Fat	5.88	2/100	0.12
Premix	1.76	4/100	0.07
Limestone	0	0.7/100	0
Dicalcium phosphate	0	0.4/100	0
Salt	0	0.3/100	0
Urea	0	0.5/100	0
Total		**100/100**	**2.07**

- Thus, this diet contains 2.07 Mcal/kg of NEm. If we go through the same process for NEg, Ca, and P, we would find that the diet contains (on a DM basis) 1.41 Mcal/kg of NEg, 0.48% Ca, and 0.43% P (assuming the premix contains 1.17 Mcal/kg of NEg, 0.14% Ca, and 0.92% P)
- These values for Ca and P are above the levels required for finishing beef cattle, so our diet does not have any obvious deficiencies
- With knowledge of the NEm and NEg values, one can then proceed to determine the quantity of this diet would need to be fed to produce a certain rate of gain
- Finally, this basic process can be applied to formulation of diets for all livestock

❖ Providing supplementary feeds to the animals:

- Estimation of air dry feed requirement per animal per day based on the weight of the animal i.e. DM based.
- The animal can feed 2.6—3 % of their body weight
- 2.6%*weight of animal. i.e. $X_{wit} = \frac{\text{initial wt+expected wt}}{2}$

✓ Ex. A 300kg weighing animal requires

2.6%*300kg =7.8kg air dry feed

- **Determine the proportion of concentrate and roughages**

✓ for fattening animal from the total daily consumption

  - 80% should be high energy feed (energy rich concentrate or grain)

  such as wheat, maize, sorghum, etc and

  - 20 % must be roughages
  - Therefore according to the above given example

  7.8kg X 80 % = 6.24kg of grain and 7.8kg X 20 % = 1.56 kg of roughages (hay)

- **determination of the quantity of protein supplement:**

✓ The amount of protein supplement is determined

- As the ratio of the quantity of energy concentrate
- Age of animal
  - ✓ provide young animals with more protein
- Type of roughages being provided and feeding period

Ration type	**Feeding period**	**Age of the animal and protein energy ratio(P:E)**		
		≥2years old steer	Yearling steer	Calves<one year
Energy concentrate	1st, (1-50days)	1:6	1:5	1:4
Corn + none legume roughages	2nd, (50-100days)	1:8	1:7	1:6
Grass hay	3rd , (101-150days)	1:7	1:6	1:5

- **Length of feeding period depends upon:-**

- **Age:** the period of feeding for calves is 8-9months, the period of feeding for mature animal is 3-4 month and the period of feeding for yearling is 6-7 months.
- **Sex :**
  - ✓ bull for 6-7 months, if it is yearling bull
  - ✓ Yearling steers 4-5 months and
  - ✓ Yearling heifers for 3-4months
- **Breed:** either indigenous or exotic
- The efficiency of feed conversion is higher for bulls and at the same time feeding length is also higher in bull i.e.

- Bulls
- Steers
- Heifers
- Cows

feed conversion efficiency and feeding length increase in the direction of arrows

CHAPTER - 7

ROUTINE OPERATIONS IN BEEF FARMS

➢ Bull management

✓ Maintenance of young bull calf requires:

- Good feeding
- Good housing
- Regular exercise in each day
- Good general management

- The future performance of the herd depends on the type of the bull used
- ➢ The bull is allowed to mat:
- At the age of 18 months and
- Live weight of about 350 kg
- ➢ The ratio of female to bull depends on the age of the bull
- ➢ The major factors that should be evaluated in a breeding soundness exam include;
- Testicular development
- Ability to physically breed females
- Semen quality and
- Libido characteristics

➢ Cow management

- The management should be geared to have 1 calf/cow/year
- Adequate feed supply must be provided throughout the season
- The length of lactation should also be controlled for the health of the lactating cows
- In adequate feeding leads to

✓ Lower fertility

✓ Possibility of emaciation and weight loss

❖ So, supplementary feeding especially during the dry seasons may offset the problem

- Disease that affect reproductive efficiency directly include;

- Brucellosis
- Vibriosis
- Leptospirosis
- IBR/BVD complex, and trichomoniasis.
- Developing and following a complete health program for the herd can easily accomplish control of these and other diseases

Weaners management

- Weaning of calves is normally done at 6-7 months of age
- The decision to weaning months will affect the productivity of the calf and the dam
- For the dam, late weaning will limit the second mating for giving another calf
- The roughages for weaner include
  - crop residues and
  - natural pastures
- Protein and energy rich feeds supplementation are important
- Dry season supplementation of 1kg dry matter/day
- Provide 20-30 liters of water/day

- Vaccination against
  - Anthrax
  - Brucellosis
  - FMD and
  - Rinder pest disease is of vital importance between 6-9 months of age
- Deworming of the weaners is done twice to three a year
- Must be housed in good ventilated shed and space and separate from the aged stocks

➢ Management of Growing Heifers

❖ Heifer

- from the period of weaning to its first calving

✓ Selection of heifers form the calf herd is based on;

- The history of the animal
- Plane of nutrition and
- Environmental factors like diseases and climate

▪ Management of heifers through better feeding regimes, determines the future performance of the cow. E.g. severe underfeeding during an early life can permanently reduce size and weigh

- Mating of heifers is done between 15 to 20 months so as to have its first calving at 24 to 29 months of age for most of the conventional beef breeds
- should not be lower than 200 kg live weight at first mating
- Weight is important for the heifers to avoid pregnancy complications

➢ Steer management

- The weight for steers range between 250 to 350 kg live weights, and
- Aged between 3-3 1/2 years old

✓ **Bullocks**

- After 3 and ½ years old the steer
- These are oldest
- The slowest growing and
- The most inferior from a carcass point of view of any of the recognized commercial lines of male cattle
- The bullocks are safest in drought compared to other classes of stock

➢ Calf Management

- 1/2 the calf loss will occurs at calving
- Size and weight is important, not age
- Breed to easy calving bulls
- Immunization
- Giving the growth promotants- ralgro, synovex, compudose, etc.

➢ Dehorning

- What is dehorning?
  - process of removing or preventing the growth of horns
- Why?
  - improve appearance
  - reduce injuries
  - Minimize feeder, shad and brand space
  - easier to handle
  - improve value
- Two methods
  - non-invasive
  - invasive

➢ Choice of Dehorning Methods

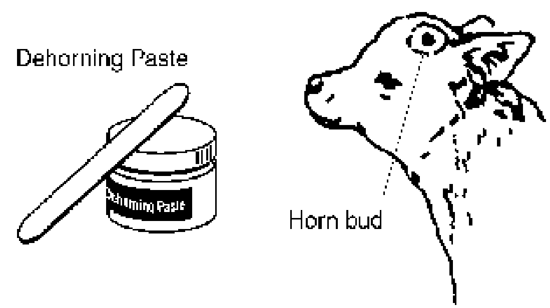
- The choices of dehorning techniques range from genetic to surgical.
- The risks to the calf and the operator vary with each technique.

o Many producers choose to dehorn new-born calves

- Because the techniques are easier for the operator, less stressful on the calves and they demonstrate concern for the animals' welfare.

1. **Non-Invasive methods**

- It includes polled bulls, Chemicals like KOH or NaOH, bell irons, tube, spoon, barnes
- It is bloodless
- Mostly applicable for young animals
- Types
  - Chemical paste
  - Hot iron



➢ Chemical Dehorning

- Caustic chemicals will prevent the growth of horns when properly applied to the horn buds of new-born (less than one to three weeks of age) calves.
- The chemical destroys the horn-producing cells around the horn bud.
- The chemicals are available as sticks or pastes
- To protect yourself, wear gloves and to protect the calf, avoid application near its eyes is mandatory.
- Do not use caustics in rainy weather.

➢ Hot Iron Dehorning

- Hot iron dehorners are available in versions heated by a furnace or fire, 12-volt battery, 120-volt electricity, power packs (e.g., Buddex™) or LP gas
- The head of the iron is a hollow circle and it fits over the horn bud.
- Proper application of the hot iron will destroy the horn-producing skin at the base of the horn.
- This technique works well for calves up to 12 weeks old.

2. Invasive methods

- Blood flow
- For older animals
- Involves cutting or scooping the horn off of the animals skull.
- Types
  - Barnes dehorner
  - Scoop dehorner
  - Keystone dehorner

- **Disadvantages**

- Sets the animal back due to stress
- Cost and labor as well as equipment
- Death loss due to bleeding
- Disease spreading
- Scurrs may occur if not properly done

- **Time to dehorn**

- Genetically vary
- Calves, early as possible
- Older cattle, colder weather

➢Dehorning yearlings or older

❖ clippers, saw or surgical wire

✓ **Clippers**

  – remove 1/4 “of the hide and tissue below the base of the horn

- Advantages
  - Fast
  - Neat job
- Disadvantages
  - Severe bleeding
  - Danger of cracking the skull

✓ **Saw**

- Advantages
  - smooth job
  - less bleeding than clippers
- Disadvantages
  - much slower

Castration

- Castration of a bull (male) calf is the process of removal or destruction of the testicles.

❖ **Reasons for Castration**

- Reasons given for castrating beef calves include to:
- stop the production of male hormones and semen
- historically, tame oxen for draught purposes
- prevent mating and reproduction after the age of puberty

- produce docile cattle that are easier to handle compared to bulls
- decrease aggressiveness, mounting activity, injuries, frequency of dark-cutting carcasses
- enhance on-farm safety for animals, producers and employees
- decrease costs associated with fencing and handling facilities compared to bulls
- avoid discounted price that packers pay for bull carcasses
- provide meat products of the quality consumers demand

Castration Age

- Castration at a young age minimizes hazards and stress condition to the calf,
- It is preferred to perform in between 2 and 3 month of age

✓ Many producers choose to castrate new-born calves because:

- techniques are easier for the operator
- castration is less stressful on newborn calves
- concerns for animal welfare related to castrating older calves

➢ Choice of Castration Methods

- Castration may be accomplished by physical, chemical or hormonal techniques.
- Physical methods are most common.
- Testicles may be removed surgically or killed by obstructing the blood supply.
- Young calves may be castrated with rubber rings, Burdizzo or by surgery.
- **Surgical castration** may be more appropriate for calves that are not handled until weaning

- Two Methods
  - Non-invasive
  - Invasive

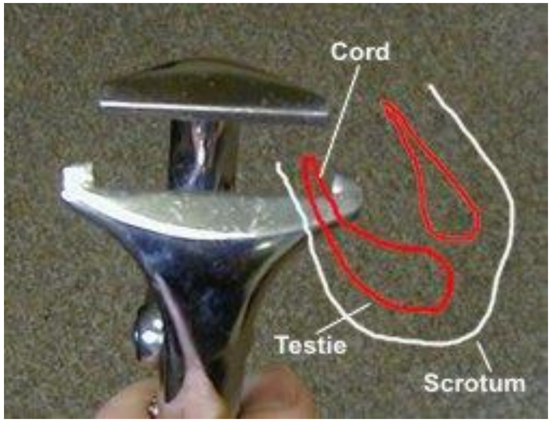
❖ **Non-invasive**

- Bloodless
- Tetanus antitoxin
- Crimps or contracts the blood vessels and spermatic cord resulting in loss of blood supply.
- Young calves or weanlings

- Types:
  - Burdizzo
  - Elastrator
  - Calicrate bander
  - Short-scrotumed
  - Chemical castration

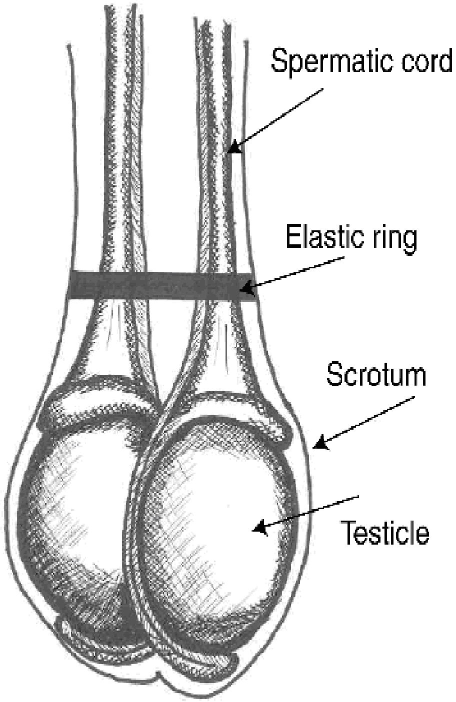
✓ Burdizzo

- It crushes the blood vessels, interrupts the blood supply to the testicle and thus kills the testicle.
- Good restraint is essential because the Burdizzo must be in place about 10 seconds to crush the artery.



➢ Elastrators

- The equipment for banding calves less than three weeks of age is called an elastrator.
- Elastic band castration cuts off blood supply to the testicles.
- A lack of blood supply kills the testicles.
- It is Bloodless castration method.



❖ Invasive/Surgical Castration

- Surgical castration is the most certain method of castration because the testicles are removed completely.
- It is best performed before or after fly season and when calves can be turned into a dry area after the surgery.
- Surgical castration can be performed on any age calf.
- It is easier to learn on calves with larger testicles.
- However, larger and older calves experience more stress and usually bleed more than younger calves.

- Blood flow
- Do not reach into the wound because it could cause infection
- Types:
  - Knife

  - Scalpel

  - Emasculator

✓ Technique

- Wash and clean your hands and surgical equipment using an antiseptic solution.
- Position yourself at the side or rear of the calf and reach forward between the hind legs.
- Make sure the scrotum is clean. You may use a mild surface disinfectant (such as iodine) to prepare the incision sites.
- Make an incision to open the skin of the scrotum
- Incision might be done either on the side of scrotum or below testicles

Identification Systems

❖ Importance of identification systems

- For keeping accurate production records of the herd.
- To keep records on an animal's parentage, birth date, production records, health history, and a host of other important management information.
- Provide the producer with enough information to make individual or whole herd management decisions.
- To be able to quickly identify an animal

Cont…

- Makes this task more efficient
- It is also important to indicate ownership of a particular animal, or to indicate the herd of origin

➢ Branding

- Used mainly for cattle
- Two types
  - Freeze branding
  - Hot iron branding
- Uses a metal instrument to burn or freeze a mark on the animal's hide
- used to show ownership

✓Fluid Branding

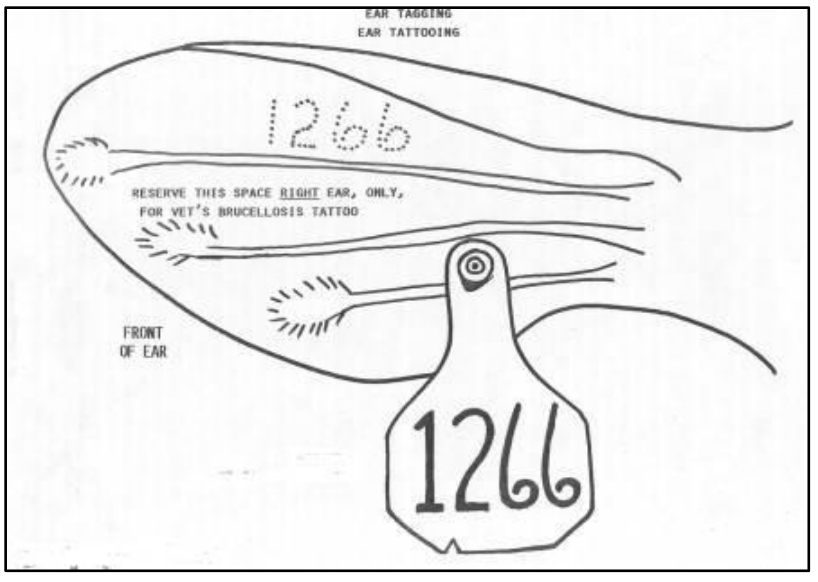
- Uses potash or acids
- Kills the hair follicles
- Must be more careful because their is more room for accidents and error to animals and humans

✓Freeze Branding

- Super cold iron will burn
- Dry ice and alcohol or liquid nitrogen or spray can clean the area and place irons to get cold
- Place iron firmly until the area is harden
  - Usually 50 seconds for dry ice /alcohol method
  - 25-30 seconds for liquid nitrogen
- 3-4 weeks hair will grow back

➢ Ear Tagging

- Use special pliers to attach pieces with numbers on them
  - Easy to read from the front view
  - Not permanent
  - Can be lost or removed



➢ Tattooing

- Uses a special tool to put numbers in an animal's skin
- Most commonly found in the ear
- Can be used on the lips or other locations
- Permanent
- Simple and relatively painless
- Hard to read from a distance

➢ Body weight measurements

❑ How to Calculate Cattle Weight

- By a livestock scale
- By measuring girth and length of animals

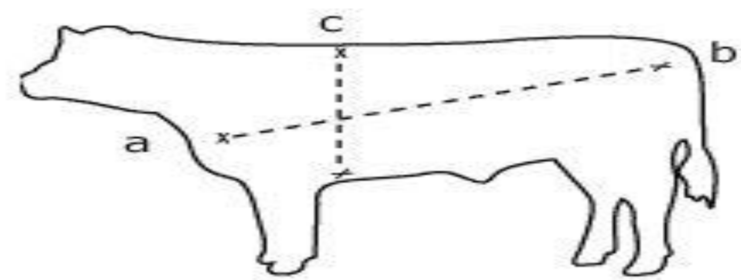
❖ Using the formula;

- Heart Girth X Heart Girth X Body Length / 300 = Animal Weight

In Pounds or

- Body weight = 2.126 * heart girth (cm) – 87.39 in kg

Measuring a dairy heifer.



Measuring beef cattle.

➢ Estimate Cattle Age

✓ Cattle age estimate by their teeth

- In cattle, age is often estimated by examining their lower incisor teeth
- Estimating cattle age by their teeth involves;
- Noting how many incisor teeth there are
- What type of teeth they are ("baby" or "milk" teeth, or permanent teeth)
- Their degree of wear and overall appearance

- **Age: Two**

- The first permanent incisors come in from about the time a cow is 1 1/2 years old to two years
- By approximately age two years they are typically fully developed
- They often come in at an angle and then straighten

- **Age: Three**

- The second pair of permanent incisors appear somewhere around age 2 1/2 years, and are typically fully developed by age three years

- **Age: Four**

- At approximately age 3 1/2 years the third pair of permanent incisors are appear and are typically fully developed by age four years

✓ Age: Five

- At approximately age 4 1/2 years the last of the cow's permanent incisor teeth (the "corner" incisors) are appears, and are typically fully developed by age five years
- Therefore, at age five years, cows typically have all eight of their permanent incisors erupted and in use
- At this age the incisors are tall, relatively flat across the front (when compared to older ages), sharp at the top, and close together

✓ Age: Six

- From age six forward, estimating cattle age by their teeth is based on the degree of wear of the teeth
  - Estimating the age of cattle from this point forward becomes more difficult
- At age six years the cow's eight permanent incisor teeth will begin to show various degrees of wear

✓ Age: Seven

- The cow's eight permanent incisor teeth will continue to show various degrees of wear
- The tops of the teeth will show additional loss of sharpness, and the teeth will continue to appear slightly more rounded from side-to-side
- Commonly a separation, from subtle to definitely noticeable, between at least some of the teeth from top to bottom
- The roots of the teeth may begin to be visible at the gum line

✓ Age: Short and Solid

- The term "short and solid" might be used after the age of seven years
- Uncommon for a more general description of age
- "solid" can mean there is no tooth loss, and/or it can mean that there are not any wide gaps between the teeth (although there may be narrower gaps)
- Exactly what "solid" means (no tooth loss and/or no very large gaps) can vary from region to region, sale barn to sale barn, or person to person

✓ Age: Short

- Not all areas/persons recognize the age "short"
- a cow aged as "short" will have very short teeth with large gaps between most or all of them, often particularly at the bottom
- Roots may be quite visible

✓ Age: Broken Mouth

- The age "broken mouth" is older than the age "short." Commonly, a broken mouth cow is a cow that has lost one tooth due to age
- In some areas, a cow is not a "broken mouth" until she has lost two teeth due to age

✓ age: gummer

- The oldest age description given to a cow
- Lost several teeth due to age, or has worn them down until they are of little or no practical use

Horn method of age determination

- The rings on the horns are less useful as guides
- At ten or twelve months the first ring appears
- At twenty months - two years the second
- At thirty to thirty-two months the third ring
- At forty to forty-six months the fourth ring
- At fifty four - sixty months the fifth ring, and so on. But,
- At the fifth year, the three first rings are indistinguishable, and
- At the eight year all the rings are indistinguishable

➢ Tail brush method of age determination

- The brush of the tail is only useful as a guide when assessing small, stunted or young cattle
- A brush that is about fetlock length or longer is an indication for twelve months old or older

CHAPTER 8

BEEF CATTLE HOUSING AND HANDLING FACILITIES

- The type of housing provided for beef fattening will depend on

- The geographic location
- Availability of straw
- Size of the fattening unit and on the traditional methods of fattening.

- In designing houses for fattening cattle most consideration has been given to
- labor availability
- Feeding systems
- Type of diet
- Group size
- Drinking systems, and systems for handling and storage of the manure.

Housing of beef animals

- In general, building requirement for animal production in the tropics should be minimal and less expensive than are requirements in temperate areas.
- A satisfactory shelter for beef cattle is one that furnishes adequate protection from wind, rain, and solar radiation.
- **For maximum productivity of animals,**
  - Consider behavioral needs of animals in housing, feeding and all aspects of management
  - Basic requirements for welfare of livestock are :
    - The provision of readily accessible fresh water and nutritionally adequate as required;

- Adequate freedom of movement and food ability to stretch limbs;
- Sufficient light for satisfactory inspection;
- Rapid diagnosis and treatment of injury and disease;
- Emergency provision in the event of a breakdown of essential mechanical equipment;
- Flooring which neither harms nor causes undue strain;
- The avoidance of unnecessary mutilation
- In many modern beef units animals are kept indoors all the year round.
- Therefore, it is important to ensure that, what ever housing system is provided, behavioral needs (e.g. resting, feeding and drinking) are properly met.

Housing…

- In loose housing systems, the freedom of movement of the animals means that both individual and group behaviors must be satisfied.

Feeding condition

- Cattle spend many hours per day eating.
- If the feed is fed restrictively,
  - There should be sufficient feeding places
  - For all animals to feed at the same time
  - To avoid competition, frustration and aggression.
- Any restriction in number of places may result
  - In low-ranking animals receiving insufficient feed
  - And, as a consequence, their daily weight gain will be too low or they may lose excessive weight

- If the feed is fed adlibitum
  - And if there is one eating place per two or three animals,
  - Each animal will have enough time to eat all the feed it needs.
- If roughage is fed adlibitum and concentrates restrictively,
  - There should be sufficient feeding places to feed the concentrates to all animals at the same time

Drinking facility in the house

- Drinkers/water troughs should be located where they are easily accessible.
- They should not be located where it is impossible for submissive animals to leave when a dominant animal approaches,
  - e.g. in corners or at the end of a passage.
- There should be enough room around the drinkers to avoid difficulties for animals to drink.

Locomotion

- should not be slippery when beef cattle walk or move on them.
- Any slips that occur during, or as a result of, confrontations can bring the animals into a state of chronic stress.
- Slippery floors can also cause beef cattle to reduce their movement,
- Movement difficulties can cause irregular hoof wearing and lameness.

➢ Group size

- In buildings the groups are made on basis of
  - Sex (no males with females except for reproductive purposes)
  - Age of animals (bulls of the same age and weight, calves or heifers of the same age and weight),

- Reproductive purposes (mother cows with their calves with or with-out a bull),
- Diet, future of the animals (fattening, breeding, ..), physiology status (pregnant cows, cull cows)
- To prevent disturbances with fattening bulls, it is recommended to house the bulls in a building without females.

Hygiene

- Prevent animals from becoming dirty.
  - Can be achieved by correct design and by sufficient use of bedding material.
  - If animals are dirty, they will be uncomfortable, development of (ekto-)parasites in their coat could be increased, heat losses could be increased and their market value could be decreased.
- The use of bedding and the frequency of cleaning are important

- Space requirements for basic behaviors of young stock e.g. lying, feed intake or walking depends on body dimensions of animals.
- Size of animals is defined by the basic measurements H = height at withers, L = diagonal body length and W = width of chest

➢ Loose Housing

- Open shade, minimum of building, can be constructed from local materials
- Very suitable for tropical climate
- Loose housing systems provide more comfort free movement for both stockmen and animals.
- Thus improve productivity and welfare.
- In loose housing usually animals of equal line of production and similar age are kept in groups of at least four to five, usually up to twenty or, in large enterprises, even much more.

➢ Cubicle housing

- Animals kept in constructed houses, penned individually.
- Common in developed nations and temperate climate
- The space requirements of the animals with respect to lying and rising consists of :
  - The space from the rear of the animal to the front of its fore knees;
  - Space in front of the animal occupied by its head
  - The additional space necessary for the thrust of the animal's head as it lunges forward during rising. About the same space will be needed for the movement of the head during standing up.

Cubicle housing

Group size and space allowance

- Group size has an important bearing on the internal design of a building.
- Small groups of cattle are easier to manage and probably perform better and with less variability.
- Animals with different performance characteristics due to breed, sex or age can be penned separately and rationed accurately.
- In general, the smaller the pen size the greater the cost for pen divisions, gates, and water supply, but the better will be the ease of handing and managing the animals.

Guide lines of space allowance (Sq. m)

Live weight (kg)	Straw bedding	Slated floor
50 - 250	1 - 2	Not suitable
250 - 450	2 - 3	1.5 - 2
450 - 600	3 – 4.5	2 -2.5
Suckler cows	5 - 6	3 – 3.5

➢ Water tanks and troughs

- Water tanks may be constructed from various materials.
- The critical tank wall may be constructed from brick or stone, to increase the strength. It could also be of strong metallic material.
- Circular troughs give a considerable volume of water rapidly refilled from a tank and have a long drinking face.

Estimated space requirements for watering and feeding troughs

Live weight (kg)	Space at feeder and waterer (cm)
Up to 250	40
250 - 450	50
Over 450	60
Suckler cows and calf	75

Animal handling facilities

- Corrals or animal handing facilities are required for ease of handling of stock of various age groups.
- The major uses of handling facilities are
  - To direct and control animal movement,
  - To reduce cost and labor requirements for handling animals,
  - To promote safety of animals and workers and
  - To promote humane treatment of animals on the farm.

Design consideration for handling facilities

- The following points may be used as guidelines when designing cattle facilities.
  - Safety of both animals and operator.
  - Economical, convenience in sorting and handling animals.
  - Locate the facility in a well-drained area.
  - Build all components strongly and solidly enough to hold the animals.

Cont…

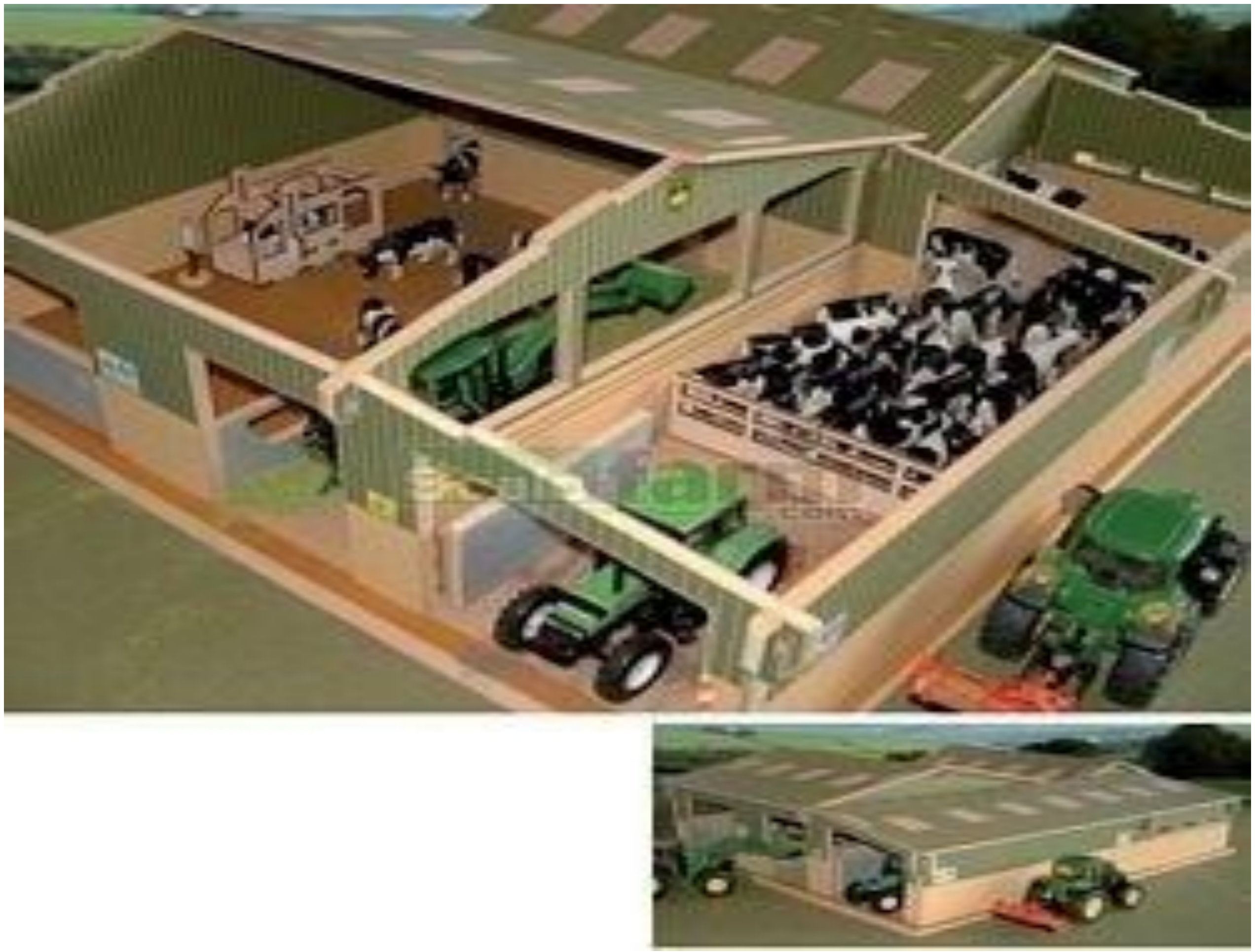
- Use decay resistant materials paint with wood preservative solution every 3 – 5 years.
- Avoid constructing any corners or projections that could bruise or cripple animals.
- Locate head gate at the highest elevation, that is, make cattle walk slightly uphill through the handling facility.
- Ensure that head gate and other equipment work quietly. Loud noises frighten cattle and make them difficult to control.

Components of handling facilities / corrals

1. Collecting yards

- Collecting yards are farm facilities to which animals from field or pasture are brought to undergo through some farm routines.
- The collecting yard must have adequate size.
- It should provide 1.5 m^2 of space for finishing cattle
- Should not be large and costly
- Circular collecting pens are easiest to control and best movement of cattle
- Entrance and exit preferably be located uphill, since cattle move uphill readily.

Collection yard



2. Funnel or forcing yard

- Is used to direct animals easily from the collecting yard to a crush.
- Corners should be blocked off to stop cattle from refusing to turn by standing head up in the corner.

3. Crushes

- Crushes are facilities used to provide veterinary diagnosis and treatment of sick animals or passages to other yards where some routine daily activities may be performed.
- Vet crush need to have a catwalk on its sides for ease of vaccination team and also to make driving cattle easier to where they are needed to go.
- The crush may also have man gates associated with it to enable stock workers enter into the crush and assist obstructed animals in the crush.
- The crush may be fitted with a sliding or dropping gate wherever possible.

Cont…

- Such facilities simplify the restraining of animals for veterinary attention, pregnancy diagnosis, artificial insemination or branding.
- Design of a cattle crush is important, especially with respect to width .
- If it is too wide, cattle, especially yearlings can turn round and seriously slow up proceedings.
- The most common width is 600 – 680 mm
- Crushes could have vertical sides or sloping sides, with the bottom measuring 450 mm wide and the top 600 – 680 mm.
- The latter design has lost popularity because cattle easily get their legs between horizontals, rarely breaking them, but slowing up crush work.

4. Weigh bridges (scales)

- These are very valuable to measure growth rates accurately and so help in the selection on most rapidly growing breeding stock, as well as to assist in record keeping and determine the moment to sell.
- The alternative way to estimate live weight is by means of heart girth measurement, but it is less satisfactory.
- Weighbridges are best placed at the end of the crush, so that cattle become familiar with them, by regularly passing through them, even when not being weighed.

5. Cattle dips and sprays

- These facilities are preferably built at the end of a race and are used to facilitate the treatment of animals against ecto – parasites.
- Animals are commonly dipped in a plunge tank where the animals is driven into the bath and is completely immersed momentarily, swimming the length of the bath, with the excess liquid draining back into the tank as the animal walks out

6. Head gate or yoke

- Head gate or yokes are located at the exit of a veterinary crush and their use is to completely immobilize an animal for various veterinary examination and treatments.
- Head gates should be sturdy, safe and easy to operate and should have a quite action.

Head gate

7. Sorting gates (Classing gates)

- These facilities help in sorting cattle as they come out of the veterinary crush and guiding or directing them to the dip, weighing ramp or any other holding yards as required.
- The classing gates are of extreme importance when weaning calves and separating cattle meant for market.

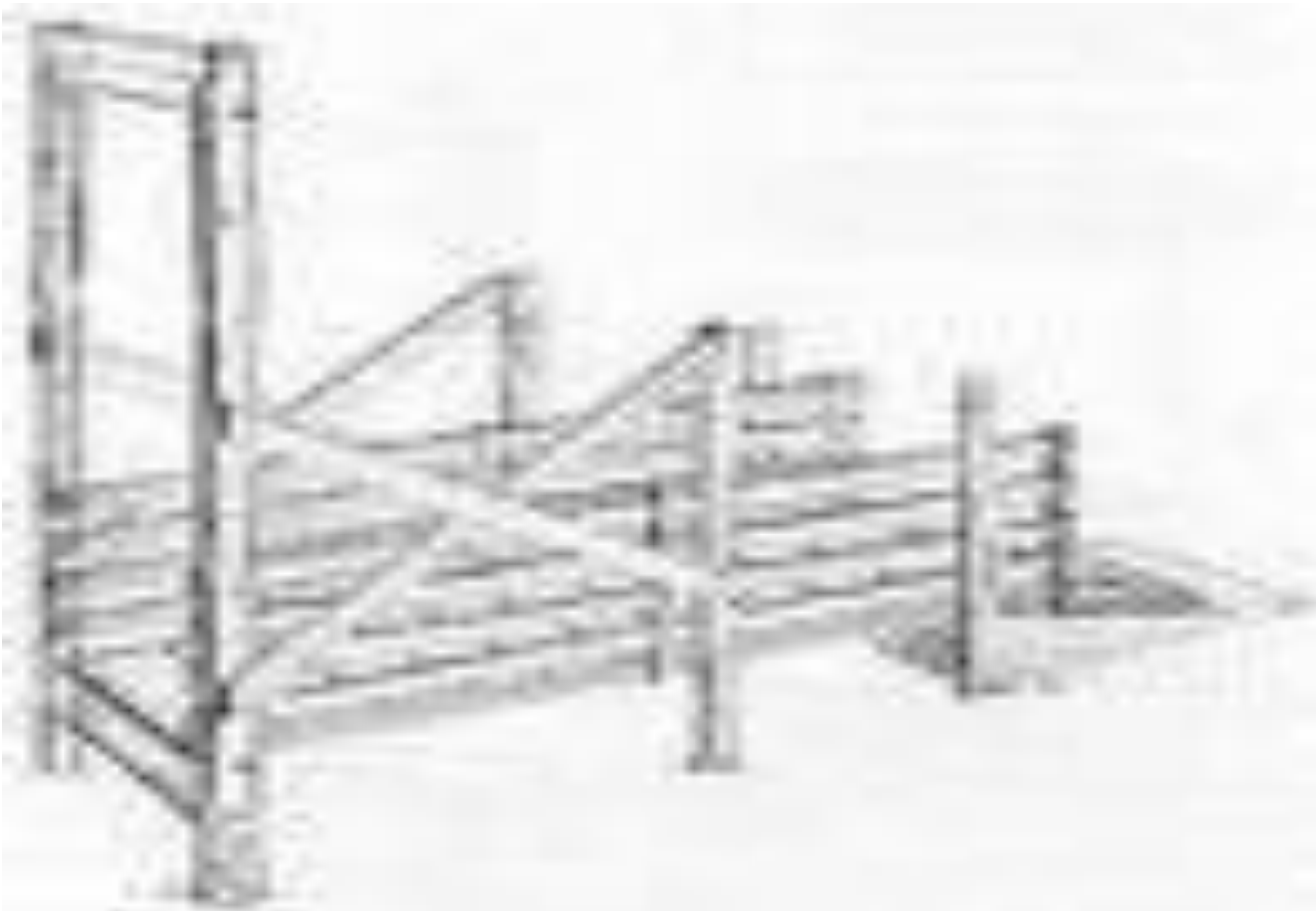
8. Holding yards

- These are facilities in which animals coming out of the veterinary crush or any of the facilities are held for a while before being moved into the pasture.
- Are preferred to be larger than collecting yards, so that cattle can calm down after handling.

9. Loading chute

- Loading chute must be located outside the corrals and to an all weather road.
- Maximum incline should be 30%
- Total chute length should be 3.5-5 meter to accommodate 2-3 cattle.

Loading Chute



CHAPTER - 9
HEARD HEALTH MANAGEMENTS

- Local/indigenous breeds of beef cattle (in comparison with exotic /high production breeds) have higher level of resistance to:

➢ Infections diseases
  - Contact diseases
  - Soil-borne diseases

➢ Vector borne diseases

➢ Plant poisoning

- Effective beef cattle health management requires understanding of the host defence mechanism.

➢ Host Defence Mechanism against Infection

✓ Resistance

- is a congenital (inborn) and hereditary trait of the organism used for defending itself against infections, toxic, and allergic antigens.
- This potential or variation among animals can be exploited by selecting for disease resistance.

✓ Immunity

- is a defence mechanism acquired either actively or passively which can combat only that particular antigen against which it was formed.

- Disease of the feed-lot can be grouped into six:

1. Vector-borne diseases:

  - Trypanosomosis, babesiosis, theleriosis, anaplasmosis, heart water, rabies, *etc.*

2. Soil-borne diseases:

  - Enterotoxaemia (complex infection caused by a number of clostridium species), anthrax, and botulism (complex toxication of *C. botulinum*)
  - Gas gangrene (*C. chauvoei*), and tetanus (*C.tetani*) are rare.

3. Contact diseases:

- CBPP, FMD, pasteurellosis, rinderpest, etc

4. Diseases caused by spoiled or poisoned feed:

- Mycotoxicosis and poisoning caused by poisonous principles from oil cakes.

5. Endoparasitoses

- Roundworms, liver flukes etc.

6. Deficiency diseases

- Vitamin deficiency (E,K,B,C)
- Mineral deficiency

❖ Sodium and chlorine are the only minerals not found in grass or hay.

Causes of diseases in the feed-lot

- Introduction of latently infected animals
- Insufficient vector control in the feed-lot
- Abrupt change in feeding
- Contamination of soil of the pen with *b. Anthracis* spores
- Use of contaminated or toxic feed

  - FMD, Brucellosis

- Transportation and adaptation stress /"crowding"

    - Pasturellosis, FMD

- Inadequate selection and diagnostics

  - Tuberculosis, CBPP, etc

- Inadequate immune and chemoprophylaxis

- Mouldy concentrates, straw and silage with high aflatoxin *(Asprigillus species); s*ugar can tops with mycotoxins (fungi).

- The main targets of animal health management in a feed-lot are:

- ✓ Cleaning up and isolation of the site of the feed-lot from vectors and other disease reservoirs
- ✓ Prevention of the introduction of diseases
- ✓ Control of vector borne and infections diseases during the fattening cycles
- ✓ Prevention of diseases caused by management and feeding errors.
- ✓ Properly setting/site of feed lot like slop, accommodation, infrastructure, designed and partition.

Animal Health Scheme for a feed-lot operation

- The animal health scheme of the feed-lot is an animal health management system that is carried out at three different stages, i.e. during
- Purchase/selection
- Delivery/arrival and
- Fattening of animals

➢ The scheme requires a minimum of personnel and complicated technical procedures and is highly applicable in the Ethiopian context.

- **Conclusion:** the success of the three-stage animal health scheme for depends on three points:

- The complete and better elimination of carriers and vectors of pathogens;
- An effective immunity against the infectious diseases which occur in a given location; and
- Additional chemoprophylatic control of potential disease carriers.

- Success stories indicate that even in tropical countries, losses of less than 0.1% can be reached with animals of 5,000 or more in number!

CHAPTER 10
RECORD KEEPING IN BEEF FARM

- ✓ Keeping records is an important part of any livestock operation/project.
- ✓ Accurate records enables to:
- Identify specific animals for medication
- Analyze your efficiency and
- Find changes you could make to improve your operation/project.

❖ Any records kept are better than no records at all.

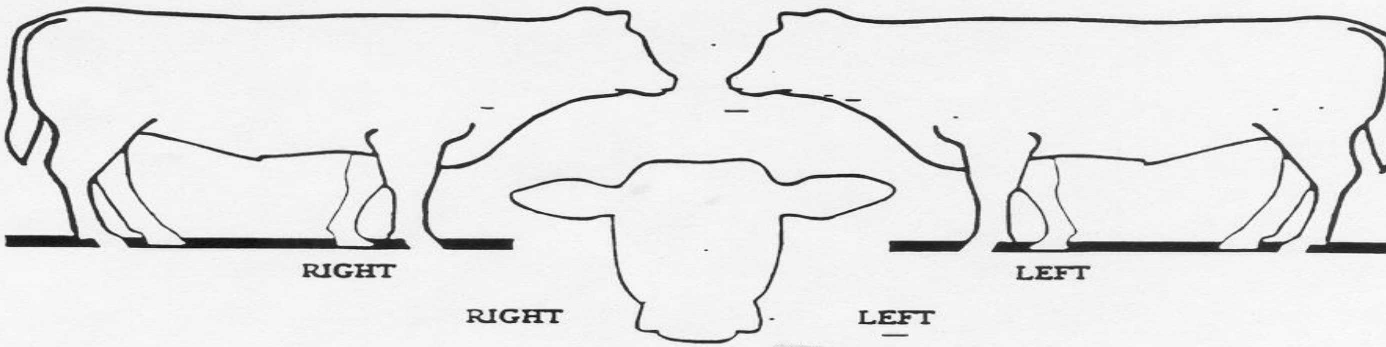
- Main areas of record keeping

1. Individual Animal Records

- ✓ Lets you know which animal belongs to whom.
- ✓ Allows to compare performance of individual animals:
    - ✓ Selecting replacement females and bull
    - ✓ Determining rate of gain
    - ✓ To cull poor productive animals
    - ✓ E.t.c

2. Health record

Cattle Processing Map



Date	Pen/ Pasture	Number	Product	Company	Lot and Exp. Date	Dose	Route of Admin.	Initials

Comments:

____

____

____

____

____

____

Signed: ______________________ Date: ______________

Hospital Record and Movement

Animal ID# ______________________________

Location ______________________________

Approx. Wt. __________

Treatment Record

Date	Temp.	Diagnosis	Treatment	Withdrawal	Treated by:

Returned to Herd

Date	Location	Comments
Cleared for Shipment on:		

Check One:

Bull ☐ Open Cow ☐ Bred Cow ☐ Wet Cow ☐ Calf ☐

Replacement Heifer ☐ Steer ☐

Diagnosis Codes:

Abs: Abscess
Blt: Bloat
Cir: Circulatory
CP: Calving/Prolapse
DL: Downer/Lameness

Eye: Pink Eye
FR: Foot Rot
NS: Nervous System
Res: Respiratory
Other:

3. Feed Records

- ✓ It is very important to read your feed labels and keep copies of your feed labels.
- ✓ Keep records on how much you feed an individual animal.

4. **Production Records**

- ✓ Production records let you measure animal and business performance.

Examples:

- ✓ Average daily gain
- ✓ Weaning weights
- ✓ Milk yield in dairy cattle
- ✓ Yearling weight
- ✓ Birth weight

5. Business records

- ✓ Can show how profitable the operation is.
- ✓ Records from different years can be compared to see how your livestock project has progressed.

CHAPTER - 11
Carcass evaluation and grading

- **Meat**
- The flesh of animals used as food

- **MEAT QUALITY PARAMETERS**:

- Color
- Water holding capacity/Juiciness
- Texture/tenderness
  - the primary essential quality index of meat, and if meat is not tender it may be considered unacceptable, despite other characteristics such as color, flavor, and juiciness
- Intramuscular fat and fatty acid composition
- Flavor
- Odor and
- PH =5.4—5.5 for most mammalian carcass

❖ Quality Indices of Carcass Meat

- The word carcass means the whole body of the animal after stunning, bleeding, plucking, and eviscerating
- Cattle and pig carcasses are split along the mid ventral axis into two sides
- Carcasses may be “dressed,” where the head, feet, and hide (in the case of sheep, cattle, and pigs) are separated

➢ **Factors for meat quality**

✓ Species

- Is the most general factor affecting tenderness
- A reflection of texture (the size and condition of the meat fibers within the muscle
- The relationship between the amounts of muscle fiber and connective tissue
- Large-size cattle, in relation to pigs or sheep, are generally associated with a greater coarseness of musculature
-

- ✓ The connective tissue content
- It vary in individual cattle within a breed
- There are distinct differences in tenderness between muscles
  - ❖ Elastin (a type of connective tissue protein)
  - ❖ Collagen
    - As animals mature cross linkages increase resulting in more stability, yet tougher and stronger collagen bonds thus decreases solubility and reduces gelatinization

- ✓ Growth and development of the animal
- ✓ Nutrition
- ✓ Ante-mortem and post- mortem handling
- ✓ Methods of cooling, processing, retailing, and cooking

- ✓ Myo fibrillar Protein Interactions
  - – Degree of overlapping structures within actinomyosin formation resulting in varying sarcomere length
  - – Proteolytic activity
    - Calpain enzyme system are responsible for destruction of myofibrils
- ✓ Sex/gender variations within growth and development-biological maturity

- Male animal
- Less fat as well as less firmness of fat
- Increased protein, myoglobin, red color
- Increased off-odors due to increased steroid metabolism synthesized by the gonads, stored in the salivary glands, released by the saliva ingested and deposited in the fatty tissue
- Skatole is a fat-soluble cmpd from tryptophan metabolism in the hind gut especially in swine and is correlated to the off-odor

✓ Rigor Mortis

- Physiology is similar to muscle contractions in live animals
- Carcass muscles do not relax
- As enzymes and microorganisms begin to break down the muscle tissue, rigor mortis is partially relaxed
- Onset usually takes 6 - 12 hours for beef and lamb
- 30 minutes - 3 hours for pork

➢ Carcass quality grading

- Quality grades indicate expected palatability or eating satisfaction of the meat.
- A quality grade is a composite evaluation of factors that affect palatability of meat (tenderness, juiciness, and flavor).

✓ The major factors for quality grading consideration include;

- ❖ Carcass maturity
- ❖ The amount and distribution of marbling within the lean.

✓ Other factor for quality grade

- ❖ Firmness
- ❖ Texture
- ❖ Color of lean, and

❑ Generally beef carcass quality grading is based on

(1) Degree of marbling and

(2) Degree of maturity

1. Marbling

- Dispersion of fat within the lean
- Graders evaluate the amount and distribution of marbling in the rib eye muscle at the cut surface after the carcass has been ribbed between the 12th and 13th ribs
- Degree of marbling is the primary determination of quality grade
- The greater the amount of marbling, the higher the quality grade.

➢ Desirable rib eyes will exhibit an adequate amount of finely dispersed marbling in a firm, fine textured, bright, cherry-red colored lean

- As an animal matures, the characteristics of muscle change, and muscle color becomes darker and muscle texture becomes coarser.

➢ There are nine degrees of marbling:

- Abundant (most), moderately abundant, slightly abundant, moderate, modest, small, slight, traces and practically devoid (least).

2. Maturity

- Refers to the physiological age of the animal rather than the chronological age
- Because the chronological age is virtually never known

✓ Physiological maturity is determined by;

- The ossification (cartilage turning to bone) pattern of the backbone
- Lean color, and
- Rib bone shape and color.

❖ Cartilage becomes bone, lean color darkens and texture becomes coarser with increasing age.

➢ Cartilage and bone maturity receives more emphasis because lean color and texture can be affected by other postmortem factors.

- The most important factor is the ossification pattern of the dorsal tip (button) of the thoracic vertebrae.
- The thoracic vertebrae is the section of the backbone that has the ribs attached.
- In **A** maturity cattle, the buttons will have;
  - ✓ No to very little ossification
  - ✓ The ribs are red and round
  - ✓ The lean color is light red and
  - ✓ The lean texture is fine.

❖ As cattle mature:

- ✓ The buttons contain greater ossification
- ✓ The ribs become whiter and flatter
- ✓ The lean color becomes darker and
- ✓ The meat texture becomes more coarse (grainy)

- There are five classifications for beef carcass maturity: A, B, C, D and E.
- A maturity cattle tend to be 9-30 months of age
- B is 30-42 months
- C is 42-72 months
- D is 72-96 and
- E is greater than 96 months of age.
- Determine age using thoracic buttons
- When the percentage ossification of the cartilage reaches 10, 35, 70, and 90 percent, the maturity is B, C, D, and E, respectively.

Carcass Yield grade

- Yield grades estimate the amount of boneless, closely trimmed retail cuts from the high-value parts of the carcass– the round, loin, rib, and chuck.
- However, they also show differences in the total yield of retail cuts
- The USDA yield grades are rated numerically and are 1, 2, 3, 4, and 5. Yield grade 1 denotes the highest yielding carcass and yield grade 5, the lowest.
- A YG 1 carcass to have the highest percentage of boneless, closely trimmed retail cuts, or higher cutability
- A YG 5 carcass would have the lowest percentage of boneless, closely trimmed retail cuts, or the lowest cutability.

- Meat graders assign a yield grade to a carcass by evaluating:

1.The amount of external fat

- evaluate the amount of external fat at the 12th rib by measuring the thickness of fat three-fourths the length of the ribeye from the chine.

2. The hot carcass weight

- Carcass weight is the “hot” or un chilled weight in pounds (taken on the slaughter-dressing floor shortly after slaughter).

3. The amount of kidney, pelvic, and heart fat and

- The amount of kidney, pelvic, and heart (KPH) fat is evaluated subjectively and is expressed as a percentage of the carcass weight (this usually will be from 2 to 4 percent of carcass weight).

4. The area of the rib eye muscle

- The area of the rib eye is determined by measuring the size (in inches, using a dot-grid) of the rib eye muscle at the 12th rib.

❖The USDA Yield Grades

Yield Grade	% Trimmed Retail Cuts / % BCTRC/
1	> 52.32
2	52.3 – 50.0
3	50.0 – 47.7
4	47.7 – 45.4
5	< 45.4

CHAPTER - 12

Potential , Constraint and Future Prospects of Beef Production in Ethiopia

➢ Beef production potential

- The Livestock Marketing Authority (LMA, 2004) estimated the annual potential for export at 72,000 metric tons of meat.
- Based on Workneh (2006), the estimated national offtake rates of 10% for cattle, pastoral areas of the country alone, could produce 734 000 heads of beef cattle per annual.
- When these are compared to the current demand in the Middle East Africa, they meet only 42% for beef.
- However, the live beef cattle supplies are well over the demand (144%), thus requiring new market outlets

- The exports of meat and live animals have dramatically increased in 2010-2011 Ethiopian fiscal.
- Ethiopia exported 16,877 tons of meat and 472,041 head of live animals, recording a 69 % increment from last year's export revenue.
- Ethiopian revenue and customs authority reported that live animal export in 2010 contributed 70% of the earnings while 30% was obtained from meat export (Trade bulletin, 2011).
- The same bulletin also revealed that chilled sheep and goat carcass accounted for 80%, beef 9% and offal 11% of the exported meat.
- Of the number of exported live animals, cattle accounted for 46%, sheep 35%, camels 13% and goats 6%.
- In terms of revenue, cattle contributed 67%, camels 25% and sheep and goats 8% to the revenue generated.

❖ *Official annual average quantities of live animal and meat exports from Ethiopia (1998–2003)*

Item	Quantity
➢ Live animals (numbers)	
• Cattle	12,934
• Sheep	13,554
• Goats	1247
➢ Meat (t)	
• Beef	81
• Mutton	27
• Goat meat	1560
• Total	1668

✓ Source: Unpublished data from the Livestock Marketing Authority.

- The quantity of official meat export increased dramatically after 2003.

➢ In 2005–06

✓ 163,380 animals (75% of which were cattle) were officially exported to

  - Egypt, Yemen, the United Arab Emirates (UAE) and Saudi Arabia.

✓ 8000 t of meat (primarily shoat carcasses) worth USD 18.5million was exported to Saudi Arabia, UAE and Egypt by air flight (Belachew Hurissa, personal communication).

- **Current export market outlets**

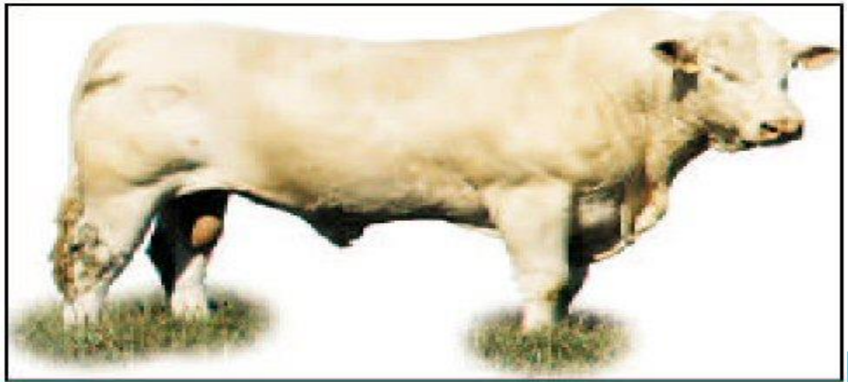
- Meat is exported mainly by air and
- Live animals through three main routes
  - Via Somalia and Somali land to the gulf states
  - The southern border to Kenya and
  - The northwestern border to Sudan

- Opportunity of beef production

- *High demand of animals by the local abattoirs*
- Official exports expansion
- Domestic Consumption

- **The main challenges** faced beef cattle production, value chain and marketing:-

1. Lack of well defined breeding program and production systems.
2. Lack of an integral connection between the stakeholders involved in the production chain.
3. Inadequate market promotion and study tours to potential importing countries
4. Lack of efficient air transport for export of fresh and chilled meat.
5. Some markets are also dominated by influential personalities and illegal exporters.
6. Limited access to market-related information (e.g. on prices, value chains, competitors, consumer preferences).
7. Lack of capital to invest in assets, equipment and inputs that would improve quality (Daniel, 2008).



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