

Livestock exports

Best practice use of veterinary drugs



**Tony Brightling
Colin Chapman
Phil Reeves**

2 January 2004

ISBN: 1 74036 394 9



Contents

Contents	1
Introduction	2
Responsible drug use	3
Cattle Anthelmintics	9
Cattle Antibiotics	14
Cattle Anti-inflammatory drugs	19
Cattle Appetite stimulants/tonics	21
Cattle Calcium/magnesium	22
Cattle External parasites	24
Cattle Fluke	29
Cattle Hormonal growth promotants	31
Cattle Pinkeye	33
Cattle Prostaglandins	35
Cattle Ringworm	36
Cattle Sedation	38
Cattle Vaccines	40
Sheep and goats Anthelmintics	44
Sheep and goats Antibiotics	49
Sheep and goats External parasites	54
Sheep and goats Fluke	58
Sheep and goats Pinkeye	60
Sheep and goats Vaccines	61
Appendix A: Acronyms and abbreviations	65
Appendix B: Drug Schedules	66
Appendix C: Injection techniques	67

Introduction

The cattle, sheep and goats exported from Australia are food animals that are killed after arrival overseas and go directly into the human food chain.

When using veterinary medicines and pesticides, we must be careful to ensure that treatment will not cause unacceptable residues in the carcass at the time of slaughter. Our markets are becoming more sophisticated, with chemical residue testing of meat randomly carried out in some of our customer countries. Food safety is a sensitive issue. The live export trade does not need the bad publicity and market damage that occurs with a drug residue incident.

For the health and well-being of the animals under our care, it is important that treatment is given where necessary, using the most appropriate drug, dose rate and method of application. Treatments required under the export protocol must also be done with a suitable drug, applied appropriately. However, it is also important that veterinary drugs are not used unnecessarily, so export preparation and delivery costs and the risk of adverse side effects are kept to a minimum.

This manual is a 'glove-box' guide for exporters, managers of live export assembly depots, Masters and Chief Officers of livestock ships, and stockmen working with cattle, sheep or goats exported live from Australia. The manual has four separate parts:

- A description of 'best-practice' use of veterinary drugs and chemicals – storage, record keeping, off-label use, inventory control, disposal of unwanted drugs and the like.
- A listing of common veterinary drug uses for live export cattle.
- A listing of common veterinary drug uses for live export sheep and goats.
- A description of recommended injection techniques.

The array of veterinary medicines and pesticides available is constantly changing as new products come onto the market and old ones disappear. We expect this manual to be a living document, which is updated on a regular basis.

We want the manual to be a practical, user-friendly guide. Feedback about the technical content and format of the manual is most welcome.

Responsible drug use

Legislation controlling the use of veterinary medicines and pesticides is State legislation. Requirements vary from one State to another.

The exporter's veterinarian must be familiar with the relevant legislation in the State(s) in which export preparation occurs and be able to provide professional advice about responsible use of veterinary drugs.

Although legal responsibility may cease once a livestock vessel leaves Australian waters, the live export industry has committed to best-practice standards, assuming the duty of care that applies to veterinary drug use in Australia extends to arrival at the destination port overseas. The recommendations throughout this manual are therefore based on best-practice in Australia.

National registration of veterinary drugs

All proprietary veterinary medicines and pesticides used to treat livestock in Australia must be registered by the Australian Pesticides and Veterinary Medicines Authority (APVMA).

On registration, products are classified into a drug Schedule, which determines the legal requirements for possession, storage, handling and use. The Australian drug Schedules are listed in Appendix B of this manual.

Before registering a veterinary medicine, the APVMA must be satisfied that the product does not pose an undue hazard to public health or the environment, it is safe and effective when used according to approved recommendations, and it will not unduly prejudice trade between Australia and its trading partners. Companies submitting a veterinary medicine or pesticide for registration must provide the results of detailed safety and efficacy studies to support their registration claims. Directions for use, dose rates and any necessary safety precautions and warnings must be provided. The company must also demonstrate that the product will be produced using good manufacturing practice. This ensures that each pack meets the approved quality standards and contains what it is supposed to, without contaminants that might cause adverse effects.

The APVMA registration process is onerous, but it ensures that the veterinary medicines and pesticides available in Australia, when used as directed, are safe and effective. All registered products contain an APVMA number on the label. It is illegal to sell unregistered veterinary drugs in Australia.

Veterinary medicines and pesticides that are not registered for use in Australia must not be used to treat export livestock. This does not present a problem for animals treated in Australia, but it can be an issue at sea. Many of the veterinary drugs used at sea can be purchased more cheaply overseas than in Australia, and can be found in the veterinary stores on some ships. However, product quality is often suspect and/or the directions for use, withholding period or expiry date are inadequate. There is too much at stake to use such products.

Storage

The veterinary drugs used to treat export livestock must be stored in accordance with the manufacturer's recommendations.

Some products must be stored in a refrigerator. Others do not need to be refrigerated, but must be kept below a specified temperature, eg. less than 30°C. Such drugs can be kept in an air conditioned room, but not in an outside shed or deck locker on a ship where the temperature will exceed the recommended maximum.

Some veterinary medicines and pesticides must be protected from direct sunlight. They must be stored in a drug cabinet that excludes light when closed.

All veterinary medicines and pesticides used to treat export livestock must be stored in an impervious secondary container, or above a drip tray that will effectively contain any leakage.

Schedule 4 drugs must be stored in a locked area (room, cupboard, drawer or refrigerator), with access restricted to authorised persons only. Schedule 4 drugs are veterinary prescription only medicines that have the words 'PRESCRIPTION ANIMAL REMEDY' or 'PRESCRIPTION ONLY MEDICINE' on the label. They are commonly used for treating livestock. Examples are antibiotics, non-steroidal anti-inflammatories, corticosteroids, local anaesthetics and tranquilizers.

Schedule 8 drugs must be stored in a locked drug cabinet or safe, with access restricted to veterinarians only. The drugs in Schedule 8 are medicines liable to misuse, causing physical or psychological harm or dependence. An example is the drug pethidine. Schedule 8 drugs are not commonly used to treat export livestock, though there may be an occasional need.

Authority to use

Export livestock should only be treated with Schedule 2, 3, 5 and 6 drugs by a veterinarian, the exporter, the manager of an export assembly depot, the Master of a vessel at sea, or a person directly authorised by one of the above.

Schedule 4 drugs must only be used by a veterinarian or person directly authorised by a veterinarian. Schedule 8 drugs must only be used by a veterinarian.

At sea, the authority to treat export livestock should not be delegated to a person other than the Master, Chief Officer, Bosun or a Stockperson accredited by LiveCorp.

A veterinarian, exporter, manager of an export assembly depot or Master of a vessel carrying livestock, must not authorise another person to treat export livestock unless satisfied that the person giving the treatment:

- is able to recognise when treatment is required;
- is able to recognise when treatment is not appropriate;
- understands any instructions that go with the treatment, including compliance with the recommended dose rate, method of application, withholding period and any safety warnings;
- is able to give the treatment competently; and
- is able to keep appropriate treatment records.

Product quality and spoilage

Export livestock must not be treated with any veterinary medicine or pesticide that is not in its original container, is contaminated or spoilt in any way, or has passed the product expiry date.

Withholding period

In general, slaughter and feeder animals should not be treated with a veterinary drug if the withholding period exceeds the expected date of arrival overseas. However, there are two exceptions:

- where treatment is specified in the importing country's protocol; or
- where an animal has already been loaded for export, treatment is necessary for animal welfare reasons, and there are no drugs available with comparable efficacy and a shorter withholding period.

If treatment is carried out to comply with protocol requirements, the importing country, having set the treatment requirements, is an informed buyer. It is not necessary to individually identify treated animals or advise the consignee.

If treatment is necessary for animal welfare reasons, the withholding period exceeds the expected date of arrival overseas, and the animal has yet to be loaded for export, it must be excluded from the export consignment.

After loading, if treatment of slaughter or feeder animals is necessary for animal welfare reasons and the withholding period exceeds the date of arrival overseas, the treated animal(s) must be clearly identified and the consignee advised.

Where treatment involves individual animals, (eg an injured animal treated with antibiotics) the consignee may be given prior written advice that animals identified in a particular manner have been treated at sea and slaughter is not recommended until the relevant withholding period has expired. No further advice is necessary at the time of discharge.

Ear tagging as shown in table 1 is the preferred method for identifying treated animals. If the handling required for ear tagging cattle at sea would involve significant stress on the treated animal or undue occupational health and safety risks, alternative methods of animal identification, such as spray raddle, are acceptable. The required outcome is that all slaughter and feeder animals that may contain drug residues at the time of discharge can be identified, and that they are delivered to an informed buyer.

Table 1. Tagging for individual animals treated at sea

Eartag	Meaning
Orange eartag T ₇	Slaughter not recommended within 7 days of discharge overseas.
Orange eartag T ₁₄	Slaughter not recommended within 14 days of discharge overseas.
Orange eartag T ₂₈	Slaughter not recommended within 28 days of discharge overseas.

Where treatment involves mass medication (eg oxytetracycline in the drinking water), the consignee must be advised at the time of discharge.

Off-label use

A drug is used 'off-label' if it is used other than strictly in accordance with the manufacturer's label or product insert. With a few specific exceptions, it is not illegal to use a veterinary medicine or pesticide 'off-label'. However, 'off-label' use must be prescribed by a veterinarian, who assumes full responsibility.

Whilst it is generally important to follow the manufacturer's directions for use, there are occasions when 'off-label' drug use is appropriate. 'Off-label' treatment is often necessary for minor species, such as goats or buffalo, when there is no suitable drug registered for that species, so a product registered for sheep or cattle must be used instead. It may also be necessary to use a product 'off-label' because the drug of choice is temporarily not available, and an alternative is required.

Veterinary drugs should only be used off-label if there is no suitable product registered, or the only registered products are not available.

'Off-label' uses that are banned include:

- using a veterinary medicine or pesticide registered for oral or external use as an injection;
- using chloramphenicol, organochlorines, diethylstilboestrol or nitrofurantoin antibacterials to treat livestock;
- using sulphonamide antibacterials, except for sulphadiazine, sulphadimidine, sulphadoxine, sulphaquinoxaline or sulphatroxazole to treat livestock;
- using arsenical compounds as an external livestock treatment;
- using hormonal growth promotants (HGPs) other than precisely in accordance with label directions; or
- the use of a product in any manner if the manufacturer's label specifically states that the product is not to be used in that manner.

Human use

Veterinary drugs must not be used for human treatment unless prescribed by a medical practitioner.

Inventory control

In Australia The quantity of veterinary drugs stored for treatment of export livestock should not exceed what might reasonably be required for the consignment in question, or where multiple shipments are expected, what might reasonably be required during the subsequent six month period.

At each site where veterinary medicines and/or pesticides are stored, a drug inventory must be prepared at least once every three months, with disposal of any drug that is surplus to requirements, has reached its expiry date, or is unsuitable for use for any other reason.

At sea The quantity of veterinary drugs on board a livestock vessel should not exceed what might reasonably be required for the subsequent three month period.

A drug inventory must be prepared at the completion of each voyage, with disposal of any drug that is surplus to requirements, has reached its expiry date, or is unsuitable for use for any other reason.

Record keeping

A record must be maintained of all veterinary medicines and pesticides used to treat export livestock. This record must include:

- treatment date
- animal identification (individual or mob identification as appropriate)
- product used
- dose rate
- withholding period.

Disposal of unwanted drugs and empty containers

In Australia Unwanted drugs and empty drug containers must be disposed of in accordance with the manufacturer's recommendations and local environment protection authority requirements.

At sea Unwanted drugs and empty containers must not be thrown overboard at sea. Rather, they must be stored on the vessel, landed in port, and disposed of in accordance with the manufacturer's recommendations and local quarantine and environment protection authority requirements.

Treatment check list

It is important to think carefully before treating export livestock with any veterinary medicine or pesticide. A useful check list is as follows:

- Is treatment really necessary?
- Will treated animals get an effective dose and course of treatment?
- Are there likely to be adverse side effects?
- Is there a better treatment alternative?

Try to restrict veterinary drug use to situations where treatment is clearly necessary, treated animals will get an effective course of treatment, and there is minimal risk of adverse side effects, including carcass residues.

There are numerous anthelmintics (worm treatments) registered for use with cattle. The active ingredients in these products can be classified into three main categories, depending on their chemical structure and mode of action:

- *Macrocyclic lactones or 'mectins'* – abamectin, doramectin, eprinomectin, ivermectin and moxidectin
- *benzimidazoles* - albendazole, fenbendazole and oxfendazole
- *levamisole* - levamisole

Macrocyclic lactones These products are generally very effective against gastrointestinal worms in cattle, killing both mature worms and inhibited larvae. They are also effective against lungworm, biting and sucking lice, mange mites and cattle tick.

The 'mectin' chemicals all act a similar way – binding to invertebrate nerve and muscle cells, causing paralysis to the affected parasite. When given as directed, they have a wide safety margin. There are subtle differences between the chemicals in this group, such as their persistence and hence protective period after treatment and their impact on dung beetles and other friendly insects in the environment. However, these differences are relatively minor, with the choice of product within the group based largely on availability and cost.

The 'mectins' can be applied by injection or as a pour-on. The injectable products must be given subcutaneously – injection into the muscle causes a severe reaction at the injection site.

Ease of application, good efficacy against a broad spectrum of cattle parasites and moderate cost usually makes a 'mectin' chemical the product of choice for worm control in export cattle.

Benzimidazoles The benzimidazole or 'white' drenches are registered for use against gastrointestinal worms and lungworm in cattle, but are not effective against lice, mites or ticks. They are very safe and are generally much cheaper than the 'mectin' products. However, apart from *Systemex Rumen Injection Cattle Wormer*, they are all oral drenches. Drenching large numbers of cattle with a hook is slow and labour intensive.

Levamisole The levamisole or 'clear' drenches are registered for use against gastrointestinal worms and lungworm in cattle, but are not effective against lice, mites or ticks. The injectable levamisole products are the cheapest cattle drenches on the market. Levamisole has a small safety margin. It is quite safe when used as directed, but toxicity can occur if cattle are given more than twice the recommended dose, especially if the cattle are stressed.

Trichlorfon There is only one product registered for use in cattle - *Neguvon Soluble Powder Anthelmintic, Boticide*. It is principally used to treat bots in horses. Trichlorfon has a narrow spectrum of activity against cattle worms, and it has no obvious advantages over other products available.

Table 2. Anthelmintics for cattle – pour-ons

Class of anthelmintic	Trade name	Withholding period (meat)
Macrocyclic lactones ('mectins')	Baymec Ivermectin Pour On for Cattle	42 days
	Cydectin Pour-On for Cattle and Red Deer	nil
	Dairymec	42 days
	Dectomax Pour-On	42 days
	Ectomectin Pour-On	42 days
	Genesis Pour-On	42 days
	Ivomec Eprinex Pour-On	nil
	Ivomec Pour-On for Cattle	42 days
	Noromectin Pour-On	42 days
	Paramax Pour-On for Beef and Dairy Cattle	42 days
	Paramectin Pour-On for Cattle	35 days
	Virbamax Pour-On	42 days
	Virbamec Beefmec Pour-On	42 days
	Virbamec LV Pour-On for Cattle	42 days
	Virbamec Pour-On Endectocide	35 days
	Virbamec Pour-On for Cattle	42 days
Levamisole	Citarin Pour On	3 days
	Levamisole Pour-On	3 days
	Levipor Pour-On Anthelmintic for Cattle	3 days
	Nilverm Pour-On Cattle Wormer	3 days

Table 3. Anthelmintics for cattle – injectable preparations

Class of anthelmintic	Trade name	Withholding period (meat)
Macrocyclic lactones ('mectins')	Avomec Antiparasitic Injection for Cattle	30 days
	Cydectin Injection for Cattle	14 days
	Dectomax Injectable	42 days
	Ectomectin Injection	28 days
	Genesis Injection	42 days
	Ivomec Antiparasitic Injection for Cattle	28 days
	Ivomec Plus Antiparasitic injection for Cattle	28 days
	Noromectin Injectable	42 days
	Paramectin Injection for Cattle	30 days
	Rycomectin Antiparasitic Cattle Injection	30 days
	Virbamax Plus	28 days
	Virbamax Antiparasitic Injection for Cattle	30 days
	Virbamec LA Injection for Cattle	42 days
	Virbamec Plus Injection for Cattle	35 days
Benzimidazole	Systemex Rumen Injection Cattle Wormer	8 days
Levamisole	Nilvern Injection	3 days
	Nilverm LV	3 days
	Nilzan LV	14 days

Table 4. Anthelmintics for cattle – oral drenches

Class of anthelmintic	Trade name	Withholding period (meat)
Macrocyclic lactone	Fasimec Cattle	21 days
Benzimidazole	Farnam Worma Drench	8 days
	Fenbendazole	14 days
	Fenbendazole 100	14 days
	Fencare 25	21 days
	Fencare 100	21 days
	Flukazole C	21 days
	Mineralised Fencare	21 days
	Nuwhite CC	10 days
	Oxazole Concentrated Worming Drench for Cattle and Horses	8 days
	Oxfen C	8 days
	Oxfen LV	10 days
	Panacur 25	14 days
	Panacur 100	14 days
	Parafend LV	8 days
	Strategik Mini-dose Worming Drench for Cattle	10 days
	Systemex Concentrated Drench	8 days
	Systemex Oral	8 days
Valbazen Broad Spectrum Mini-Dose Cattle Drench	10 days	

Table 4. Anthelmintics for cattle – oral drenches cont....

Class of anthelmintic	Trade name	Withholding period (meat)
Levamisole	Levamisole	3 days
	LV Levamisole	3 days
	Mineralised Levamisole	3 days
	Nilverm Oral	3 days
	Nulev	3 days
	Nulev LV	3 days
	Rycozole Oral Anthelmintic for Sheep & Cattle	3 days
	Rycozole RV Oral Anthelmintic for Sheep & Cattle	3 days
	Rycozole RV Plus Selenium Oral Anthelmintic for Sheep & Cattle	3 days
	Sykes Big L Worm Drench for Sheep & Cattle	3 days
Trichlorfon	Neguvon Soluble Powder Anthelmintic, Boticide	3 days

Antibiotics are used to prevent and treat bacterial infections.

Antibiotic treatment is generally recommended for cattle with open wounds, abrasions on the lower legs and/or foot related lameness. At sea, a bacterial infection in the feet or lower legs, with swelling and lameness, is bad news. Many of these cattle are not suitable to discharge and end up being destroyed on the vessel.

Antibiotic treatment is also appropriate for cattle with pneumonia, and for cattle which are clinically ill, but where the cause of ill-health is uncertain – especially if rectal temperature is above 39.5°C.

Use injectable rather than oral antibiotics

If antibiotics are required, they should be given by injection rather than orally in the feed or drinking water. There are good reasons for not using oral antibiotics:

- Oral antibiotics disrupt the bacterial flora in the rumen. Apart from disrupting digestion, oral antibiotics can actually increase the risk of disease. For example; many strains of salmonella bacteria are resistant to oxytetracycline. Putting oxytetracycline in the feed or water increases the risk of salmonellosis, by knocking out competing bacteria and allowing salmonella to grow more freely.
- Cattle that are sick and in need of antibiotics often have a depressed appetite and may not drink much, so they don't get an effective dose of antibiotic. By contrast, they are certain to get a full dose of any antibiotic given by injection.
- Unless there is a header tank designed for drug administration, putting antibiotics in the drinking water can be very hit and miss. If an antibiotic powder or pre-mixed concentrate is added to individual troughs, the first cattle to drink may get many times the recommended dose, with the concentration of antibiotic getting progressively less with dilution as the trough re-fills.

Short or long acting?

If a beast requires antibiotics, it is generally desirable to maintain a therapeutic concentration of antibiotic in the animal's body for at least three days. This can be achieved with a long-acting antibiotic preparation, or with repeat doses of a short-acting antibiotic.

There is no benefit in giving antibiotics at a dose above that recommended by the manufacturer. 'Twice-as-much' is never 'twice-as-good', but may have an adverse side effect or cause unacceptable residues in the carcase.

When deciding whether to use a short or long-acting injectable antibiotic, you need to consider:

- The residue risk – avoid using a product if the animal is likely to be slaughtered during the withholding period.
- Ease of treatment - if the animal is quiet and the facilities allow repeat handling that is safe and without undue stress, a short-acting antibiotic is generally preferred. However, if the animal is not quiet, or the facilities do not allow daily treatment that is safe and involves minimal stress, a long-acting preparation is generally better.

Narrow or broad spectrum?

When selecting an antibiotic, the spectrum of antibacterial activity required must also be considered. Antibiotics used as wound treatments need to have a broad-spectrum of activity against the array of bacterial contaminants that occur in open wounds. If the cause of infection can be narrowed down, for example with pneumonia, an antibiotic that has a narrower spectrum of activity, but is highly effective against the target organism, may be more appropriate.

Which antibiotic?

Injectable antibiotics registered for use in cattle are listed in Table 5. They are all Schedule 4 veterinary drugs. Injectable neomycin is not recommended for the treatment of export livestock, and as a result products containing neomycin are not listed in the table.

Although there are a number of antibiotics registered for use as a feed or water medicant for cattle, they are not listed in this manual. This is because there are no obvious circumstances where oral antibiotics are the treatment of choice for live export cattle.

Key features of the different classes of antibiotic are described below.

Tetracyclines These are broad-spectrum antibiotics suitable for general purpose use, such as wound treatment. The most commonly used is oxytetracycline. All are relatively cheap and widely used. The longer acting preparations often cause irritation and pain at the injection site. To minimise injection site reactions, deep intramuscular injection is recommended, with no more than 10 ml injected at any one site. The long withholding periods may present a problem with slaughter and feeder animals.

Penicillins The penicillin group of antibiotics are broad-spectrum antibiotics suitable for general purpose use, such as wound treatment. They are the cheapest antibiotics available and are widely used. The products on the market contain a number of different forms of penicillin. Amoxicillin, benzathine penicillin and procaine penicillin are the most common. These have the same basic mode of action, but different absorption and other characteristics.

Products containing procaine penicillin and/or benzathine penicillin are typically sold as a thick liquid that settles out in the bottle and must be shaken well before use. These forms of penicillin are relatively insoluble and are only absorbed slowly from the injection site.

The concentration of procaine penicillin in the bloodstream peaks a few hours after treatment, then steadily declines. Daily treatment is required to maintain an effective dose. With benzathine penicillin there is a lower peak concentration in the bloodstream, but the drug persists longer. A therapeutic concentration is maintained for up to 72 hours after treatment. Products that contain both procaine penicillin and benzathine penicillin combine the two effects, with antibacterial activity initially provided by the more rapid but shorter acting procaine penicillin and sustained activity from the benzathine penicillin.

Erythromycin This is a broad-spectrum antibiotic suitable for general purpose use, such as wound treatment. Products that contain erythromycin are not widely used to treat cattle, mainly because of cost – erythromycin is about five times the cost of oxytetracycline. Daily treatment is required.

Streptomycin Streptomycin binds to the tubules in the kidney, persisting there for an extended time. Because of residue concerns, streptomycin treatment of food animals is now banned in Australia. However, streptomycin may still be used, under special permit, to treat animals for export. Streptomycin is a traditional treatment for leptospirosis and is a requirement in many export protocols, especially for breeding animals. Animals treated with streptomycin have a 90 day withholding period for meat and a lifetime withholding period for offal. This presents a problem for any cattle treated with streptomycin but not subsequently exported, as they cannot be slaughtered for 90 days after treatment and must be identified and tracked for the remainder of their lives.

Sulphonamides These products have an intermediate spectrum of antibacterial activity. They are mainly used to treat bacterial infections in the gut, respiratory tract and urinary system. Daily treatment is generally required.

Tilmicosin There is only one product registered for cattle use – *Micotil 300*. It is a narrow-spectrum antibiotic used specifically to treat respiratory disease caused by *Pasteurella sp.* bacteria. It is the antibiotic of choice for pasteurella pneumonia. *Micotil 300* must be injected subcutaneously, not into the muscle like most other antibiotics. It is a very expensive antibiotic that should only be used for cattle with respiratory disease.

Ceftiofur This is a narrow-spectrum cephalosporin antibiotic which is used in cattle specifically to treat respiratory disease caused by *Pasteurella haemolytica*, *Pasteurella multocida* and *Haemophilus somnus* bacteria. It is a very expensive antibiotic that should only be used for cattle with respiratory disease. Daily treatment is required.

Tylosin Products that contain tylosin have a narrow-spectrum of antibacterial activity, and are mainly used where mycoplasma infection is a concern. There is little to recommend their use with live export cattle, as mycoplasmal infections are not a major concern, and tylosin has a narrower spectrum of antibacterial activity and is generally more expensive than oxytetracycline.

Neomycin Neomycin offers no real advantage over the other antibiotics available, but is a serious residue concern. Neomycin binds to the tubules in the kidney, persisting there for an extended time. It is the antibiotic most commonly detected in cattle residue testing in Australia. Neomycin can also cause deafness and kidney failure, and its use as an injectable antibiotic is not recommended.

Table 5. Injectable antibiotics for cattle

Class of antibiotic	Trade name	Withholding period (meat)
Ceftiofur	Accent Powder for Injection	24 hours
	Excenel Powder for Injection	24 hours
	Excenel RTU	3 days
Erthromycin	Erymicin 200 Injection	14 days
	Gallimycin 200	14 days
Tetracyclines	Alamycin 10 Injection	14 days
	Alamycin LA Injection	42 days
	Alamycin LA 300	28 days
	Bivatop 200 Long Acting Injectable	21 days
	Engemycin 100	14 days
	Oxytet 200 LA	42 days
	Roscocycline 100	22 days
	Terramycin /LA	42 days
	Terramycin 100 Injectable	14 days
	Tetravet 10 Injection	15 days
	Tetravet 200 LA	42 days
	Tetravet Flexi-Dose Injection	14 days
	Tetroxy LA	42 days

Table 5. Injectable antibiotics for cattle cont....

Class of antibiotic	Trade name	Withholding period (meat)
Penicillins	Aquacaine G Injectable Suspension	5 days
	Benacillin	30 days
	Betamox Injection	28 days
	Bimoxyl LA	30 days
	Bomacillin LA	30 days
	Bomacillin SA	5 days
	Depocillin	5 days
	Duplocillin	30 days
	Mamyzin	5 days
	Moxylan LA Injection	28 days
	Moxylan Ready-to-Use Injection	14 days
	Norocillin LA	30 days
	Norocillin SA Injection	5 days
	Propen	5 days
Streptomycin	Jurox Streptomycin Injection	90 days
	Streptomycin Sulphate (Powder)	90 days
Sulphonamides	Amphoprims S	15 days
	Leotrox Injection	16 days
	Norodine 24 Solution	28 days
	Tribacterial Injection	28 days
	Tribactral S	14 days
	Tribrissen Injection	28 days
	Tridox Injection	14 days
	Triprim	15 days
	Trisoprim 480	14 days
	Trivetrim Injection	14 days
Tilmicosin	Micotil 300 Injection	28 days
Tylosin	Bilosin 200	21 days
	Tylan Injection 200	21 days

Anti-inflammatory drugs are used to provide stress relief and reduce the muscular pain and inflammatory response that occurs with injury and disease.

Which anti-inflammatory?

Key features of the anti-inflammatory drugs used in cattle are listed below. They are all Schedule 4 veterinary drugs.

Corticosteroids Corticosteroids are used principally to provide stress relief and damp down the inflammatory response that occurs with disease. They help treated animals mobilise the body's energy reserves and act as an appetite stimulant. However, they also delay wound healing and are less effective than flunixin at controlling muscular pain.

Corticosteroids slow down the immune response, which makes an animal more vulnerable to bacterial infection. As a general rule, corticosteroids should not be used without concurrent antibiotic cover.

Unless specifically prescribed by a veterinarian, corticosteroids should not be given to pregnant cattle. This is because corticosteroid treatment can induce premature calving.

Flunixin Flunixin is the anti-inflammatory drug of choice for cattle that are lame and/or have muscular injuries. It provides good pain relief, without increasing susceptibility to infection.

Tolfenamic acid Tolfenamic acid is an anti-inflammatory drug that also provides pain relief. It is principally used, in conjunction with antibiotics, to treat cattle with pneumonia or acute mastitis.

Ketoprofen Ketoprofen is an anti-inflammatory drug that is used widely in the horse industry. None of the products available in Australia is registered for use in cattle. Although ketoprofen is sometimes used 'off-label' in cattle, this cannot be recommended because there are registered alternatives available.

Phenylbutazone Phenylbutazone is an anti-inflammatory drug that is used widely in the horse industry, and is sometimes, though inappropriately, used in cattle. None of the products available in Australia is registered for use in cattle. Phenylbutazone is associated with blood disorders in humans and its use in food producing animals is specifically contraindicated.

Table 6. Anti-inflammatory agents for cattle

Anti-inflammatory	Trade name	Withholding period (meat)
Corticosteroids	Colvasone Injection	Nil
	Dexadreson	28 days
	Dexafort	7 days
	Dexapent	14 days
	Dexason	10 days
	Dexol-5	10 days
	Dexone-5	28 days
	Trimedexil	28 days
	Voren	28 days
	Voren Depot	28 days
Flunixin	Finadyne Solution	7 days
	Flumav	28 days
	Flunix	28 days
	Flunixil	28 days
	Flunixon	7 days
	Fluximine Injection	28 days
Tolfenamic acid	Tolfedine CS Injection	10 days (IM) 6 days (IV)

Appetite stimulants and tonics are sometimes used to treat cattle that are recovering from injury or disease, or have not adapted well to their shipboard environment and are not eating well.

There is a wide range of products on the market. However, most are registered for use in horses, dogs and/or cats, and cannot be recommended for cattle.

If treatment with an appetite stimulant or tonic is considered necessary and the animal has yet to be loaded for export, it should be excluded from the export consignment.

At sea, if treatment with an appetite stimulant or tonic is considered necessary, the animal should be moved to a hospital pen, with at least three times the pen area that would otherwise apply for a beast of that weight. Feed and water should be provided ad-libitum, and if there is good quality hay on board, it should be provided as well. Simply moving a beast that is struggling to a less competitive, less stressful environment is often more beneficial than any drug treatment.

Which appetite stimulant / tonic?

Bykahepar and *Coforta 100* are appetite stimulants specifically registered for use in cattle. Either can be used. Daily treatment is required.

Corticosteroids Corticosteroids are principally used for stress relief, but they also help mobilise the body's energy reserves and stimulate appetite. Corticosteroids are the treatment of choice for cattle that are simply stressed and not coping well with their environment. Corticosteroids slow down the immune response and increase susceptibility to bacterial infection. As such, they are less suitable for animals debilitated by injury or disease. As a general rule, corticosteroids should not be used without concurrent antibiotic cover. The corticosteroids registered for use in cattle are listed and discussed in more detail under the heading 'anti-inflammatory agents'.

Vitamin B₁₂ There are numerous products on the market containing vitamin B₁₂, a recognised appetite stimulant, often with a cocktail of other supplements. They offer no obvious advantages over *Bykahepar*, *Coforta 100* and corticosteroids. Vitamin B₁₂ supplements that are not registered for use in cattle should not be used.

Table 7. Appetite stimulants for cattle

Appetite stimulant	Trade name	Withholding Period (meat)
Butaphosphan	Coforta 100 Injectable Phosphorus Solution	7 days
Clanobutin + vitamin B ₁₂	Bykahepar	3 days
Corticosteroids	See 'Anti-inflammatories'	various

Live export cattle rarely suffer from overt calcium deficiency. They can draw on stores of calcium in their bones to meet a short-term dietary deficiency. However, marginal calcium status may complicate a deficiency of magnesium.

Cattle are not able to rapidly utilise their body stores of magnesium. Much of the magnesium required is met on a day-to-day basis from the diet, which usually has more than enough magnesium. A shortfall only occurs if feeding stops and there is a high magnesium requirement (eg. late pregnancy, lactation, severe transport stress).

In practice, there are two situations where calcium and/or magnesium deficiency occur in the live export trade:

- downers - cattle that go down for another reason (such as a leg injury), stop eating and are severely stressed; and
- cows in late pregnancy or early lactation.

The calcium/magnesium infusions listed below are registered treatments. There is limited benefit in the range of 'extras' - sugars and/or phosphorus, which do no harm but do not address a critical deficiency.

When injected into the jugular vein, calcium/magnesium solutions go directly into circulation, but if infused too quickly, there is a real risk of cardiac arrest.

Intravenous treatment must be by slow infusion, with the heartbeat monitored as the solution drips into the vein.

Subcutaneous injection is much safer, and although it takes longer for the solution to reach the circulation, slower absorption gives a more prolonged effect. As there is a large volume involved, it should be injected into at least two sites, with each injection site massaged to disperse the solution. This enhances absorption and reduces the risk of a local tissue reaction.

Table 8. Calcium/magnesium infusions for cattle

Trade name	Ca	Mg	Extras	Withholding period (meat)
Calcigol Plain	•			Nil
Calcigol Plus	•	•	•	Nil
CBG 375	•			Nil
Double-Cal Milk Fever Injection	•			Nil
Flopak Plain	•			Nil
Flopak Plus (4 in 1)	•	•	•	Nil
Glucalphos 4 in 1	•	•	•	Nil
Magnesate		•		Nil
Minbal 4 in 1 Balanced Mineral Injection	•	•	•	Nil
Theracalcium	•			Nil

The products registered for treating cattle against ticks, lice and/or buffalo flies are listed in Tables 9-12. General purpose fly repellents and insecticide impregnated eartags are not listed because of their limited application to the live export industry.

Most live export protocols require freedom from external parasites. The challenge is to reliably achieve this, with large numbers of cattle sourced from multiple properties, and a treatment program that is as streamlined and low-cost as possible.

Ticks

Macrocyclic lactones or 'mectins' The treatment of choice for ticks is generally a 'mectin', either by injection or as a pour-on. This is because of high efficacy and ease of application. In addition to killing ticks on treated cattle, some of the 'mectin' products also claim protection against the development of immature cattle tick, for up to three or four weeks after treatment.

Amitraz Wet dipping with a product containing amitraz is the alternative recommended treatment. Amitraz resistance is an emerging problem. However, dipping with amitraz is generally effective at killing ticks. Good dipping technique (wetting heads, maintaining an effective concentration of active ingredient in the dip at all times etc) is essential. The major downside with wet dipping cattle for ticks is that it is so labour intensive.

Synthetic pyrethroids and organophosphates The synthetic pyrethroid (SP) and organophosphate (OP) sprays and dips are not recommended because there is widespread resistance to these chemicals and a highly effective tick kill cannot be guaranteed. Occupational health and safety is also a concern with OP dips and sprays. Human poisoning can occur with skin absorption or inhalation of OP chemicals. It is important to avoid skin contact, especially when handling the chemical concentrate.

Lice

The injectable 'mectin' preparations and pour-ons registered for treatment of cattle lice are the products of choice for sucking lice. Choice is based on ease of application, cost and likely side benefits from the broad spectrum of activity of the 'mectin' chemicals.

Injectable and pour-on preparations tend not to be as effective against biting lice, which browse on the skin surface and don't suck blood, and are therefore less exposed to drugs in the bloodstream. If biting lice are present, a pour-on 'mectin' preparation should be used in preference to an injectable product.

Table 9. Fly, lice and/or tick treatments for cattle – injectable preparations

Chemical class	Trade name	Fly	Lice	Tick	Withholding period (meat)
Macrocyclic lactone	Avomec Antiparasitic Injection for Cattle		•	•	30 days
	Cydectin Injection for Cattle		•	•	14 days
	Dectomax Injectable		•	•	42 days
	Ecomectin		•	•	28 days
	Genesis Injection		•	•	42 days
	Ivomec Antiparasitic Injection for Cattle		•	•	28 days
	Ivomec Plus Antiparasitic Injection for Cattle		•	•	28 days
	Noromectin Injectable		•	•	42 days
	Paramectin Injection for Cattle		•	•	30 days
	Rycomectin Antiparasitic Cattle Injection		•	•	30 days
	Virbamax Plus		•	•	28 days
	Virbamec Antiparasitic Injection for Cattle		•	•	30 days
	Virbamec LA Injection for Cattle		•	•	42 days
	Virbamec Plus Injection for Cattle		•	•	28 days

Table 10. Fly, lice and/or tick treatments for cattle – pour-ons

Chemical class	Trade name	Fly	Lice	Tick	Withholding period (meat)
Macrocyclic lactone	Baymec Ivermectin Pour On for Cattle	•	•	•	42 days
	Cydectin Pour-On for Cattle and Red Deer		•	•	Nil
	Dairymec	•	•	•	42 days
	Dectomax Pour-On	•	•	•	42 days
	Ecomectin Pour-On	•	•	•	42 days
	Genesis Pour-On	•	•	•	42 days
	Ivomec Eprinex Pour-On	•	•	•	Nil
	Ivomec Pour-On for Cattle	•	•	•	42 days
	Noromectin Pour-On	•	•	•	42 days
	Paramax Pour-On for Beef and Dairy Cattle	•	•	•	42 days
	Paramectin Pour-On for Cattle	•	•	•	35 days
	Virbamax Pour-On	•	•	•	42 days
	Virbamec Beefmec Pour-On	•	•	•	42 days
	Virbamec LV Pour-On for Cattle	•	•	•	42 days
	Virbamec Pour-On Endectocide	•	•	•	35 days
Virbamec Pour-On for Cattle	•	•	•	42 days	
Synthetic pyrethroid	Arrest Easy-Dose	•	•		Nil
	Bombard Pour-On	•	•		Nil
	Coopafly	•	•		Nil
	Coopers Easy-Dose	•	•		Nil
	Deltamethrin Pour-On	•	•		Nil
	Demize Pour-on for Cattle	•	•		14 days

Table 10. Fly, lice and/or tick treatments for cattle – pour-ons cont....

Chemical class	Trade name	Fly	Lice	Tick	Withholding period (meat)
Organophosphate	Poron		•		Nil
	Tiguvon Spot-On Cattle Lice Insecticide		•		10 days
	Warbex		•		14 days
Carbamate	Bovicare Pour On Louse Treatment		•		Nil
Insect growth regulator	Stampede Pour On Lousicide for Cattle		•		21 days
	Acatak Pour-On Tick Development Inhibitor			•	42 days

Table 11. Fly, lice and/or tick treatments for cattle – wet dips, sprays and washes

Chemical class	Trade name	Fly	Lice	Tick	Withholding period (meat)
Amitraz	Amitik EC			•	Nil
	Amitik WP			•	Nil
	Amitraz EC Cattle and Pig Spray			•	Nil
	Taktic EC			•	Nil
	Taktic WP			•	Nil
Synthetic pyrethroid	Bayticol Cattle Dip and Spray			•	Nil
	Cypafly Buffalo Fly Spray	•			3 days
	Sumifly Buffalo Fly Insecticide	•			Nil
Organophosphate	Diazinon		•		3 days
	Di-Jet	•	•		3 days
	Maldison 50	•	•		
	Nucidol 200 EC	•	•		3 days
	Supona Buffalo Fly Insecticide	•			Nil
	Tixafly	•		•	Nil
Synthetic pyrethroid and organophosphate	Barricade 'S' Cattle Dip and Spray	•	•	•	Nil
	Blockade-S	•	•	•	8 days

Table 12. Fly, lice and/or tick treatments for cattle – other preparations

	Trade name	Fly	Lice	Tick	Withholding period (meat)
Oral drench	Fasimec Cattle		•		21 days
Topical powder	Ficam Gold Cattle Dust	•			Nil

The drugs registered for treatment of cattle fluke can be classified into four groups, based on their active ingredient:

- triclabendazole;
- clorsulon;
- oxyclozanide and nitroxynil; and
- albendazole.

Triclabendazole If elimination of fluke is the only consideration, triclabendazole is the drug of choice. This is because it kills both immature fluke in the liver tissue and mature fluke in the bile duct. The other products available have little if any effect on early, immature fluke.

Unfortunately, in some areas fluke have developed resistance to triclabendazole, rendering it less effective. Another major drawback is that triclabendazole must be given as an oral drench. Drenching large numbers of cattle with a hook is slow and labour intensive.

Clorsulon Clorsulon is combined with ivermectin in *Ivomec Plus Antiparasitic Injection for Cattle* and *Virbamax Plus*. It kills mature fluke in the bile duct, but has limited effect against immature fluke. However, the advantage of these products is that they can be given by injection, with the clorsulon/ivermectin combination effective against a broad spectrum of internal parasites.

Oxyclozanide and nitroxynil These older chemicals are moderately effective against mature liver fluke and a narrow spectrum of gastrointestinal parasites in cattle. They offer no obvious advantages over products containing triclabendazole or clorsulon, and are unlikely to be the treatment of choice for export cattle.

Albendazole The cattle worm drenches that contain albendazole typically have a secondary claim to 'aid the control of liver fluke'. Few fluke are killed by albendazole. However, there is a reduction in the number of viable fluke eggs passed by infected animals. To achieve this effect cattle must receive a higher dose than is recommended for worm control. Albendazole is vastly inferior to all other registered fluke treatments and it is difficult to imagine a situation where it would be the treatment of choice. For this reason, products containing albendazole are not listed in Table 13.

Table 13. Fluke treatments for cattle

Flukicide	Trade name	Withholding period (meat)
Triclabendazole	Fasicare 120	28 days
	Fasimec Cattle	21 days
	Fasinex 100	21 days
	Flukare C	21 days
	Flukare S	21 days
	Flukazole C	21 days
	Tremacide 50 Flukicide for Sheep, Cattle and Goats	21 days
	Tremacide 120 Flukicide for Cattle and Sheep	21 days
Clorsulon	Ivomec Plus Antiparasitic injection for Cattle	28 days
	Virbamax Plus	28 days
	Virbamec Plus Injection for Cattle	28 days
Oxyclozanide	Nilzan LV	14 days
Nitroxylnil	Trodax	28 days

The hormonal growth promotants (HGP) for cattle increase both weight gain and feed conversion efficiency. The increase in bodyweight is predominantly lean meat and not fat, so the carcass is more valuable. However, to achieve this growth response there must be a plentiful supply of good quality feed available.

HGPs work well and are generally very cost effective if young cattle are to be held for any length of time and there is adequate feed available. There is no scientific evidence that cattle treated with HGPs are a human health risk. However, there is strong consumer concern about the use of HGPs in animals destined for human consumption. Meat from cattle treated with HGPs is not allowed into the European Union, and some of our live export markets have restrictions on the importation of HGP treated cattle. Food safety is an emotive issue. The Australian live export trade must be very mindful of the market sensitivities involved.

HGPs sales are subject to close inventory control and government audit. HGPs must be stored securely and used strictly in accordance with the manufacturer's recommendations.

The HGPs registered for cattle are all pellets which must be implanted under the skin of the ear. No other implantation site is acceptable. Nor is it acceptable to use an HGP registered for cattle in any other species. Treated cattle must be individually identified with an approved ear punch.

Adverse side effects include bulling, prepuce prolapse (mainly in *Bos indicus* cattle), vaginal prolapse and rectal prolapse. However, the incidence of serious problems is low. Breeding cattle should not be treated with HGPs, as they can interfere with subsequent fertility.

HGPs that have oestradiol, progesterone and/or testosterone as the active ingredient are sometimes called 'natural' HGPs, because these hormones occur in normal animals – treatment simply increases their concentration and hence metabolic effect.

Table 14. Hormonal growth promotants for cattle

Growth promotant	Trade name	Withholding period (meat)
Oestradiol	Compudose 100	Nil
	Compudose 200	Nil
	Compudose 400	Nil
Oestradiol and testosterone	Progro H Heifer Growth and Finishing Implants	Nil
Oestradiol and progesterone	Progro S Steer Growth and Finishing Implants	Nil
	Synovex C Calf Growth Promotant	Nil
	Synovex S Steer Growth and Finishing Implants	Nil
Oestradiol and trenbolone	Compudose G	Nil
	Progro TE-S	Nil
	Revalor G	Nil
	Revalor H	Nil
	Revalor S	Nil
	Synovex with Trenbolone Acetate	Nil
Trenbolone	Progro T-S	Nil
Zeranol	Ralgro	Nil

Pinkeye is an infectious disease caused by the bacterium *Moraxella bovis*. Initially there is conjunctivitis and production of clear, watery tears. The cornea then develops a blue haze, which becomes more opaque and turns white over 3-4 days. Shallow ulcers develop on the cornea, and in a small proportion of cases there is perforation through into the eyeball. Sight is lost whilst the eye is opaque. This makes affected cattle quite difficult to handle.

Most cases of pinkeye recover, without treatment, in about three weeks. However, if infection spreads deep into the eye, recovery can take months.

A grass seed lodged beneath an eyelid may abrade the surface of the eye and cause signs similar to pinkeye. Persistent abrasion from the seed rubbing across the eye can severely damage the cornea, with a high risk of perforation, infection spreading deep into the eye and a protracted recovery. If a beast has what appears to be pinkeye, it is important to check the eye for a grass seed.

Mild pinkeye The best response to treatment occurs with an eye ointment, such as *Orbenin Eye Ointment* or *Opticlox Eye Ointment*. Instil one quarter of a 5g syringe into the lower conjunctival sac, then repeat the treatment 48 hours later.

Mastitis intramammary preparations are sometimes used to treat pinkeye, but this is an unnecessary 'off-label' use that is not recommended.

Aerosol can sprays and powders are of limited value as the antibiotic soon washes out of the eye and powders are themselves irritant. Repeat treatment, three times daily, is needed to maintain an effective concentration of antibiotic in the eye.

At sea, where cattle cannot be readily put in a head bail, oxytetracycline antibiotic dissolved in water or glycerine and sprayed into the eye with a garden spray and wand has been used with apparently good effect. This is a crude method of treatment, as the dose of antibiotic delivered and persistence in the eye are uncertain. However, treatment can be done with minimal disturbance to the other cattle in the pen, and it is better than no treatment at all if stock handling facilities are not available.

Severe pinkeye An eye patch is recommended if the cornea has perforated and infection has spread into the eye, or there is a deep corneal ulcer close to perforation. With these more severe cases, recovery is greatly enhanced if, in addition to a liberal dose of eye ointment, a patch covers the eye for a few days, reducing irritation to the injured eye from direct sunlight and dust. Cattle eye patches are commercially available. Alternatively, a home-made 200mm x 200mm denim patch fixed across the eye with strong adhesive can be quite satisfactory.

Table 15. Antibiotic treatments recommended for pinkeye in cattle

Antibiotic	Trade name	Withholding period (meat)
Cloxacillin	Opticlox Eye Ointment	Nil
	Orbenin Eye Ointment	Nil

Prostaglandins are reproductive hormones that are used to manipulate reproduction in cattle. There are two main uses in the live export trade:

- to terminate unwanted pregnancies
- to synchronise oestrus prior to insemination of breeding cattle.

Termination of pregnancy Unwanted pregnancies can be terminated with prostaglandins given 7-150 days after joining. If prostaglandins are given during the period from 7-100 days after conception, abortion is reliably induced 3-5 days later, with relatively few complications.

If prostaglandins are given between 100-150 days of pregnancy, abortion is less reliable and there is a high incidence of complications. Fetal membranes that are not fully expelled and go rotten within the uterus are a particular problem.

For animal welfare reasons, cattle intended for live export should not be treated with a prostaglandin drug unless they are pregnancy tested immediately prior to prostaglandin treatment and found to be less than 100 days pregnant.

Synchronisation of oestrus This is invariably done under the direction of an AI centre or veterinarian experienced in cattle reproduction – and if the cattle are otherwise healthy and not pregnant, there are very few problems.

Table 16. Prostaglandins for cattle

Prostaglandin	Trade name	Withholding period (meat)
Cloprostenol	Estromil	1 day
	Estroplan	1 day
	Estrumate	1 day
	Juramate	1 day
Dinoprost	Lutalyse Solution	3 days

Human health There are significant human health risks associated with the use of prostaglandins. People with a history of asthma or bronchial disease and women of childbearing age must use extreme care when handling prostaglandins, as these drugs can cause acute bronchoconstriction and induce abortion in humans.

Prostaglandins are readily absorbed through human skin. Care must be taken to avoid skin contact, and if it does occur, the skin should be washed immediately.

Veterinary supervision Prostaglandins must only be used by or under the direct supervision of a veterinarian.

Treatment of affected cattle

The imidazole group of compounds are specific anti-fungal agents, with high efficacy against the fungi that cause ringworm on cattle. Iodine and chlorine based treatments are much less effective.

Unfortunately, although there are numerous imidazole preparations registered in Australia for use on cats, dogs and/or horses, there is none registered for treating cattle.

Imaverol Fungicidal Wash is the only imidazole product available that can be readily applied to cattle as a large volume spray. It is the treatment of choice. *Imaverol* is registered for use on cattle in Europe, and on horses in Australia, but the treatment of Australian cattle is an 'off-label' use.

Treatment does not induce a rapid clinical response. Regrowth of hair still takes some weeks. The most that can be expected is that established lesions develop no further, and that spread on the same animal and to others in the mob is contained.

Disinfectant of choice

Imaverol is too expensive to use as a disinfectant for cattle handling facilities, and is less effective against fungal spores in the environment than against fungal mycelia in an active ringworm lesion.

Disinfectants with a registered efficacy claim as a fungicide and suitable for use as a large volume spray are listed in Table 17. Products containing centrimide and/or chlorhexidine have been excluded from the table. Although some disinfectants containing these chemicals have anti-fungal claims registered, their mode of action is principally antibacterial, with low efficacy against fungal spores.

There are practical difficulties with chloramine. The powder is quite irritant, so care must be taken to avoid contact with the skin or eyes, and to avoid inhalation of chloramine dust.

The cationic alkyl dimethylbenzyl ammonium halides are the fungal disinfectants of choice. As concentrates, they may irritate sensitive skin, but at wash strength they are very safe. These chemicals are also used as surgical and obstetrical disinfectants, udder washes and wound cleansing agents.

The choice between the cationic alkyl dimethylbenzyl ammonium halide disinfectants is one of availability and price. They are all suitable for disinfecting cattle handling facilities to minimise the spread of ringworm spores.

Table 17. Disinfectants with a registered efficacy claim as a fungicide and suitable for use as a large volume spray.

Anti-fungal	Trade name
Cationic alkyl dimethylbenzyl ammonium halides	Benzalkonium Chloride Solution
	Clinikill Concentrate
	Fido's Hydrobath Flush & Kennel Disinfectant
	Sporekill
Chloramine powder	Halasept
	Nycex Disinfectant Powder

Sedation is required at times to allow quiet, safe handling; for example with wound treatment, calving assistance or removal of an animal with its head or leg trapped. It should be noted that not all sedatives reduce pain. Great care is required when sedating cattle to ensure that sedation is only as mild as necessary. Where possible, it is better if the animal remains standing. With heavy sedation, cattle are likely to go down, with the possibility of rumen reflux causing aspiration pneumonia, bloat, cardiac irregularities and/or musculoskeletal injuries.

There are two different sedatives available for cattle – acepromazine and xylazine. The products available are all Schedule 4 drugs.

Acepromazine Acepromazine provides mild sedation. At recommended dose rates, it does not normally cause cattle to go down. However, acepromazine causes a fall in blood pressure, which may cause some animals to collapse. Another side effect is relaxation of the penis with prolapse of the prepuce. This is particularly a problem for *Bos indicus* cattle, which have a pendulant prepuce anyway, that is easily traumatised if it prolapses any further.

Xylazine Xylazine is generally the sedative of choice. In addition to being a sedative, it also reduces pain and causes muscle relaxation. If required, deeper sedation can be achieved with xylazine than with acepromazine; there are not the same problems with low blood pressure or prepuce prolapse; and the effects of xylazine can be reversed with the xylazine antidote *Yohimbine*.

There are a number of products containing xylazine on the market, but *Xylazil-20* is the product of choice because it is registered for use in cattle and the concentration of xylazil in the bottle (20 mg/mL) is most appropriate for cattle. The horse preparations typically contain 100 mg/mL xylazine. With these more concentrated preparations the volume required to sedate cattle is so small that it is difficult to calibrate the dose accurately.

Table 18. Sedatives for cattle

Sedative	Trade name	Withholding period (meat)
Acepromazine	Acemav Injection	2 days
	Acepril 10	2 days
	ACP 10 Injection	2 days
	Calmivet	2 days
	Sedazine-ACP Paste	3 days
Xylazine	Xylazil-20	28 days
Yohimbine (xylazine antidote)	Reverzine	28 days

The recommended dose rate for xylazine is shown in the table below. If the dose given is above that for moderate sedation, the animal is likely to go down, heavily sedated.

Table 19. Dose rate for *Xylazil-20* in cattle

Injection method	Sedation required	Dose (mL)		
		Bodyweight		
		300 kg	400 kg	500 kg
Intravenous	Mild	0.5	0.6	0.8
	Moderate	1.0	1.4	1.8
Intramuscular	Mild	1.5	2.0	2.5
	Moderate	2.8	3.6	4.5

Vaccine effectiveness can be greatly reduced by improper storage and handling. This is especially so for vaccines which contain a live modified agent. It is critically important that vaccines are stored and handled according to the manufacturer's recommendations. Keeping the vaccine within the correct temperature range is particularly important.

When taken out in the field, vaccines should be kept in an esky with frozen cooler blocks. During meal breaks, smoko, and at any other time when the vaccine is not actually being used, such as during a change of mobs, the vaccine and vaccine applicator should go back in the esky – where it is cool and out of direct sunlight.

Anthrax There is currently only one anthrax vaccine for cattle available in Australia. It is produced by the Colorado Serum Company in the USA and distributed in Australia by Fort Dodge. The vaccine is subject to a special permit from APVMA.

A condition of the APVMA permit is that the vaccine may only be used by persons authorised by the State Chief Veterinary Officer. Another requirement is that the vaccine may only be used as directed by the State Chief Veterinary Officer. In practice, what this means is that specific approval must be obtained from the State Chief Veterinary Officer before an export consignment is vaccinated against anthrax.

The vaccine is a live non-encapsulated spore vaccine that must be stored at 2-7°C (refrigerated). It should be given by subcutaneous injection high on the neck. The vaccine is quite irritant, producing a local reaction at the injection site in a significant proportion of animals.

The immune response to anthrax vaccination includes development of a mild fever and transient loss of appetite.

The meat withholding period after anthrax vaccination is 42 days.

Clostridial diseases and leptospirosis Vaccination against black disease, blackleg, enterotoxaemia, malignant oedema and tetanus (the 'clostridial diseases') and against leptospirosis are considered together because the vaccines available are similar. There are also combination vaccines on the market that cover both the clostridial diseases and leptospirosis.

Vaccination against the clostridial diseases and/or leptospirosis is a common requirement in breeder cattle export protocols.

The vaccines listed in Table 20 are all killed vaccines that must be stored at 2-8°C (refrigerated). Two doses of vaccine, at least four weeks apart, are needed to develop strong immunity. The first vaccination primes the animal's immune system, with antibody production stimulated in earnest by the second dose.

There are almost no adverse side effects and little if any difference in efficacy between the vaccines available for each disease. Choice of product is based largely on availability and cost.

Table 20. Clostridial and leptospirosis vaccines for cattle

Disease	Vaccine	Withholding period (meat)
Clostridial diseases	Tasvax 5-in-1	Nil
	Ultravac 5 in 1 Vaccine	Nil
	Websters 5 in 1 Vaccine for Cattle and Sheep	Nil
	Websters 5 in 1 Vaccine with Vitamin B ₁₂ for Cattle and Sheep	Nil
	Websters Low Volume 5 in 1 Vaccine for Cattle and Sheep	Nil
Leptospirosis	Leptoshield Vaccine	Nil
	Websters Lepto HP Vaccine for Cattle	Nil
Clostridial diseases <u>and</u> leptospirosis	Coopers Cattlevac LC 7 in 1	Nil
	Ultravac 7 in 1	Nil
	Websters Clepto-7	Nil

Respiratory diseases There are two respiratory disease vaccines available in Australia:

- *Rhinogard*
- *Triangle 3 + Type II BVD* vaccine

Both are used to comply with export protocol requirements. There may also be merit in giving respiratory disease vaccines to cattle on long-haul voyages. *Rhinogard* has been shown to enhance growth rate and feed conversion efficiency in feedlot cattle in Australia, by suppressing the subclinical effects of respiratory disease.

Rhinogard is a live attenuated infectious bovine rhinotracheitis (IBR) virus vaccine, which is applied as an intra-nasal spray. Mild, transient clinical signs of IBR typically develop 3-4 days after vaccination. However, the vaccine is quite safe, including use in pregnant animals. Vaccinal virus may be shed for up to seven days. A single vaccination with *Rhinogard* produces strong, long-term immunity.

Triangle 3 + Type II BVD is a killed vaccine against IBR, bovine pestivirus (BVD) and parainfluenza 3 (PI3) virus. The vaccine is given by subcutaneous or intramuscular injection, with two doses 14-28 days apart required to develop strong immunity.

Triangle 3 + Type II BVD vaccine is produced in the USA and distributed in Australia by Fort Dodge. The vaccine is subject to a special permit from APVMA. A condition of the APVMA permit is that the vaccine may only be used to treat export cattle, under the direction of the State Chief Quarantine Officer.

Cattle vaccinated with *Triangle 3 + Type II BVD* vaccine must remain isolated from other Australian cattle until exported. Any cattle that are vaccinated but rejected from export are not allowed to return to an Australian cattle herd. The vaccine has a meat withholding period of 21 days.

Ticks *TickGARD Plus* is a vaccine used to help control the population of cattle tick (*Boophilus microplus*) larvae on the pasture. The vaccine stimulates an immune response against cattle tick, with engorged female ticks having reduced fertility and reduced egg viability.

TickGARD Plus is more directly relevant to the strategic management of ticks on pastoral properties, than to the live export trade. However, there may be occasions when *TickGARD Plus* has a role in reducing the population of cattle ticks on the pasture at an assembly depot.

TickGARD Plus is given as a subcutaneous injection. Reactions at the injection site are common. The vaccine is not recommended if there is concurrent use of tick fever vaccine.

Tick Fever The tick fever vaccines commercially available are listed in Table 21. They are all produced at the Tick Research Centre at Wacol in Queensland.

The chilled tick fever vaccines have a very short shelf life, only four days, so they need to be ordered specially and used as soon as they arrive.

The frozen vaccine has a shelf-life of up to four years. It comes as cryotubes of vaccine concentrate (which must be stored in liquid nitrogen at minus 196°C), together with diluent packs (which must be stored refrigerated at 2-8°C). The Tick Research Centre dispatches the vaccine in liquid nitrogen canisters. Just prior to use, the vaccine concentrate must be thawed in a waterbath and mixed with the vaccine diluent. A thaw temperature of 37-40°C is critical. It is important to precisely follow the manufacturer's directions for storage and handling.

The tick fever vaccines are all given as a subcutaneous or intramuscular injection. Immunity develops 4-8 weeks after vaccination.

There are relatively few adverse reactions to tick fever vaccination in cattle less than nine months of age. With adult cattle, the immune response includes development of a mild fever and transient loss of appetite, with a small risk that tick fever might develop. The vaccines are not recommended for use in cattle during late pregnancy, as the risk of abortion is significantly increased.

Approval from the State Chief Veterinary Officer is required before tick fever vaccine may be used within NSW or Victoria.

Table 21. Tick fever vaccines for cattle

Disease	Vaccine	Withholding period (meat)
Babesia bovis Anaplasma centrale	Bivalent Tick Fever Vaccine (Chilled)	Nil
Babesia bovis Babesia bigemina Anaplasma centrale	Trivalent Tick Fever Vaccine (Chilled)	Nil
	Combavac 3 in 1 Live Tick Fever Vaccine (Frozen)	Nil

Other vaccines The vaccines listed below are rarely used to treat export livestock, but are included here for the sake of completeness. Veterinary advice should be obtained if use of these vaccines is being considered.

Table 22. Other vaccines for cattle

Disease	Vaccine	Withholding period (meat)
Botulism	CSL Botulism vaccine	Nil
	Longrange Botulism Vaccine	Nil
	SinVac Bivalent Botulinum Vaccine	Nil
	Websters Low Volume Bivalent Botulinum Vaccine for Sheep and Cattle	Nil
Colibacillosis	BOvac Vaccine for Cattle	Nil
Ephemeral fever	Websters Bovine Ephemeral Fever Vaccine (Living)	Nil
Pestivirus	Pestigard	Nil
Salmonellosis	Bovilis S	Nil
Vibriosis	Vibrovax	Nil

There are numerous anthelmintics (worm treatments) registered for treating sheep or goats. The active ingredients in these products can be classified into groups, depending on their chemical structure and mode of action:

- *macrocyclic lactones* or 'mectins' – abamectin, ivermectin and moxidectin;
- *benzimidazoles* - albendazole, fenbendazole, mebendazole and oxfendazole;
- *levamisole* – levamisole, morantel; and
- *organophosphate* – naphthalophos.

The various products available are listed in Tables 23 and 24, with key features of the active ingredients described below. The tables do not include products with closantel or nitroxylnil as the principal active – these are fluke treatments with a narrow spectrum of activity against gastrointestinal worms. Nor do the tables include vaccine/mectin combinations, which are listed under the vaccine section of this manual. Slow release rumen capsules are not included either, as they have limited use in the live export trade.

Goats generally metabolise drenches more rapidly than do sheep. As a result, anthelmintics tend to persist in goats for a shorter period of time, and are less effective at killing worms. The dose rate recommended for sheep may not be adequate for goats. However, if an increased dose rate is given, there is a greater risk of toxicity in goats than in sheep. Caution is needed before a drench registered for use with sheep is given to goats.

Macrocyclic lactones These products are generally very effective against the broad spectrum of gastrointestinal worms in sheep and goats. They are also effective against lungworm, itchmite and nasal bots.

The 'mectin' chemicals all act in a similar way – binding to invertebrate nerve and muscle cells, causing paralysis to the affected parasite. When given as directed, they have a wide safety margin. There are subtle differences between the chemicals in this group, such as their persistence and hence protective period after treatment. However, these differences are relatively minor for the live export trade, with the choice of product within the group based largely on availability and cost.

Unfortunately, on some properties sheep and goat worms have developed resistance to the 'mectin' drenches, rendering them less effective. However, high-level resistance is uncommon.

The *Cydectin* products have a specific contraindication or warning registered – not for use in goats.

Good efficacy against a broad spectrum of worms, safety and moderate cost usually makes a 'mectin' chemical the product of choice for treatment of worms in export sheep.

Benzimidazoles The benzimidazole (BZ) or ‘white’ drenches have been extensively used by sheep and goat producers over the last thirty years. Such widespread resistance has developed that it is now very difficult to find a property where BZ drenches are highly effective. The use of a BZ drench by itself is not recommended. Similarly, the use of a BZ additive to the feed, for worm control purposes, is largely a waste of time. A BZ is only recommended if it is used as a drench in combination with another class of drench.

Levamisole The levamisole or ‘clear’ drenches are the cheapest sheep drenches on the market. However, there are two major problems with levamisole. The first is that levamisole resistance is widespread, so a high level of efficacy cannot be assured. Levamisole is only recommended if used in combination with another class of drench. The second problem is that levamisole has a small safety margin. It is quite safe when used as directed, but toxicity can occur if sheep are given more than twice the recommended dose, especially if they are stressed.

Organophosphate There is only one product on the market – *Rametin Sheep Drench*. It is a moderately toxic drench that must not be used on stressed, exhausted or thirsty animals. *Rametin Sheep Drench* is principally used on-farm to manage worms resistant to other drenches. For the live export trade, it offers no obvious advantages over treatment with either a ‘mectin’ or BZ/LVS combination drench, and is unlikely to ever be the treatment of choice.

Table 23. Injectable anthelmintics for sheep and goats

Class of anthelmintic	Trade name	Sheep	Goats	Withholding period (meat)
Macrocyclic lactone	Genesis Injection	•		35 days
Levamisole	Nilverm Injection	•		3 days

Table 24. Oral anthelmintics for sheep and goats

Class of anthelmintic	Trade name	Sheep	Goats	Withholding period (meat)
Macrocyclic lactone ('mectins')	Abamectin	•		14 days
	Cydectin LV Drench for Sheep	•	X	7 days
	Cydectin LV Se Low Volume Drench for Sheep with Selenium	•	X	7 days
	Cydectin Oral Drench for Sheep	•	X	7 days
	Cydectin Plus Tape Oral Drench and Tapeworm Treatment for Sheep and Lambs	•	X	7 days
	Cydectin Se Oral Drench for Sheep	•	X	7 days
	Fasimec Sheep	•		28 days
	First Mectindrench	•		14 days
	First Mectindrench Plus Selenium	•		14 days
	Flukamec	•		21 days
	Flukamec Plus Selenium	•		21 days
	Genesis Drench	•		14 days
	Genesis Tape	•		14 days
	Ivomec Liquid for Sheep	•		10 days
	Ivomec RV for Sheep	•		10 days
	Noromectin Liquid	•		10 days
	Paramax-F	•		21 days
	Paramax Multi-purpose Concentrate for Sheep	•		14 days
	Paramectin Broad Spectrum Oral Antiparasitic Solution for Sheep	•		14 days
	Rycomectin Oral Drench for Sheep and Lambs	•		14 days
	Rycomectin RV Plus Selenium Oral Drench for Sheep	•		14 days
Virbac Firstmectin Se	•		14 days	
Virbamax Oral Drench for Sheep	•		10 days	

Table 24. Oral anthelmintics for sheep and goats cont....

Class of anthelmintic	Trade name	Sheep	Goats	Withholding period (meat)
'Mectins' cont...	Virbamec Gold Plus Selenium	•		14 days
	Virbamec Oral for Sheep	•		14 days
	Virbamec Oral LV for Sheep	•		14 days
	Virbamec Oral Plus Selenium for Sheep	•		14 days
Benzimidazole (BZ)	Alben	•	•	10 days
	All Farm Benzicare	•		7 days
	Closal	•		28 days
	Fenbendazole	•	•	14 days
	Fencare 25	•		21 days
	Flukazole S	•		21 days
	Mineralised Fencare	•		21 days
	Nuwhite	•	•	10 days
	Oxfen	•	•	10 days
	Oxfen LV	•	•	10 days
	Panacur 25	•	•	14 days
	Parafend 2.265% Drench	•	•	10 days
	Rotafluke	•		28 days
	Rycoben Drench for Sheep and Lambs	•		10 days
	Strategik Broad Spectrum Lamb, Weaner and Sheep Drench	•		10 days
Valbazen Broad Spectrum Sheep, Lamb and Goat Drench	•	•	10 days	
Levamisole (LVS)	Goat and sheep wormer	•	•	7 days
	Levamisole	•		3 days
	Levamisole Gold	•		3 days
	Levamisole Gold Low Volume	•		3 days
	LV Levamisole	•		3 days
	Mineralised Levamisole	•		3 days
	Nilverm LV	•		3 days

Table 24. Oral anthelmintics for sheep and goats cont....

Class of anthelmintic	Trade name	Sheep	Goats	Withholding period (meat)
Levamisole (LVS) cont...	Nilverm Oral	•		3 days
	Nilzan LV	•		14 days
	Nulev	•		3 days
	Nulev LV	•		3 days
	Ripercol Soluble Powder	•		3 days
	Rycozole Oral Anthelmintic for Sheep and Cattle	•		3 days
	Rycozole RV Oral Anthelmintic for Sheep and Cattle	•		3 days
	Rycozole RV Plus Selenium Oral Anthelmintic for Sheep and Cattle	•		3 days
	Sykes Big L Worm Drench for Sheep and Cattle	•		3 days
	Virbac First Drench	•		3 days
Combination BZ + LVS	Combi Oral Drench for Sheep and Lambs	•		10 days
	Combi Plus Selenium Oral Drench for Sheep and Lambs	•		10 days
	Combination	•		14 days
	First Duodrench	•		14 days
	Leviben Oral Drench for Sheep & Lambs	•		10 days
	NuCombo	•		14 days
	Rotate Oral Drench for Sheep and Lambs	•		10 days
	Salvo	•		14 days
	Scanda	•		10 days
	Scanda Mineralised	•		10 days
Organophosphate	Rametin Sheep Drench	•		7 days
Combination Mectin + BZ + LVS	Triton	•		14 days

Antibiotics are used to prevent and treat bacterial infections.

Antibiotic treatment is generally recommended for sheep and goats with an open wound, foot abscess or symptoms of pneumonia. Antibiotic treatment is also appropriate for animals which are clinically ill, but where the cause of ill-health is uncertain – especially if rectal temperature is above 39°C.

Oral antibiotics

As a general rule, if antibiotics are required, they should be given by injection rather than orally in the feed or drinking water. There are good reasons for avoiding oral antibiotics:

- Oral antibiotics disrupt the bacterial flora in the rumen. Apart from disrupting digestion, oral antibiotics can actually increase the risk of disease. For example, many strains of salmonella bacteria are resistant to oxytetracycline. Putting oxytetracycline in the feed or water increases the risk of salmonellosis, by knocking out competing bacteria and allowing salmonella to grow more freely.
- Animals that are sick and in need of antibiotics often have a depressed appetite and may not eat or drink much, so they don't get an effective dose of antibiotic. By contrast, they are certain to get a full dose of any antibiotic given by injection.
- Unless there is a header tank designed for drug administration, putting antibiotics in the drinking water can be very hit and miss. If an antibiotic powder or pre-mixed concentrate is added to individual troughs, the first animals to drink may get many times the recommended dose, with the concentration of antibiotic getting progressively less with dilution as the trough re-fills.

There are only two circumstances where mass oral medication with antibiotics is the treatment of choice. The first is with an outbreak of pneumonia, where antibiotic treatment can make the difference between death and survival, but individual treatment of a large number of animals presents logistical difficulties and may be stressful for the animals involved. Mass medication should not be undertaken unless a firm diagnosis of pneumonia has been established and the affected group has been clearly defined. Oxytetracycline is the drug of choice. Treatment should be limited to the sheep and goats at risk.

The second situation where mass oral medication is appropriate is with an outbreak of coccidiosis in goats, where sulphonamides in the water can be used to good effect.

There are lots of antibiotic powders registered for mass medication of pigs and/or poultry. A few are registered for treating cattle, but only two products are registered for treating sheep. They are listed in Table 25. There are none registered for the treatment of goats.

Which injectable antibiotic?

The injectable antibiotics registered for treating sheep and goats are listed in Table 26. They are all Schedule 4 drugs. Injectable neomycin is not recommended for the treatment of export livestock, and as a result products containing neomycin are not listed in the table.

Key features of the different classes of antibiotic are described below.

Tetracyclines These are broad-spectrum antibiotics suitable for general purpose use, such as wound treatment. They are relatively cheap and widely used. The longer acting preparations often cause irritation and pain at the injection site. To minimise injection site reactions, deep intramuscular injection is recommended, with no more than 10 ml injected at any one site. The long withholding periods may present a problem for slaughter animals.

Penicillins The penicillin group of antibiotics are broad-spectrum antibiotics suitable for general purpose use, such as wound treatment. They are the cheapest antibiotics available and are widely used. The products on the market contain a number of different forms of penicillin. Amoxicillin, benzathine penicillin and procaine penicillin are the most common. They have the same basic mode of action, but different absorption and other characteristics.

Products containing procaine penicillin and/or benzathine penicillin are typically sold as a thick liquid that settles out in the bottle and must be shaken well before use. These forms of penicillin are relatively insoluble and are only absorbed slowly from the injection site.

The concentration of procaine penicillin in the bloodstream peaks a few hours after treatment, then steadily declines. Daily treatment is required to maintain an effective dose. With benzathine penicillin there is a lower peak concentration in the bloodstream, but the drug persists longer. A therapeutic concentration is maintained for up to 72 hours after treatment. Products that contain both procaine penicillin and benzathine penicillin combine the two effects, with antibacterial activity initially provided by the more rapid but shorter acting procaine penicillin and sustained activity from the benzathine penicillin.

Erythromycin This is a broad-spectrum antibiotic suitable for general purpose use, such as wound treatment. Products that contain erythromycin are not widely used, mainly because of cost – erythromycin is about five times the cost of oxytetracycline. Daily treatment is required.

Streptomycin Streptomycin binds to the tubules in the kidney, persisting there for an extended time. Because of residue concerns, streptomycin treatment of food animals is now banned in Australia. However, streptomycin may still be used, under special permit, to treat animals for export.

Streptomycin is a traditional treatment for leptospirosis and is a requirement in many export protocols, especially for breeding animals. Animals treated with streptomycin have a 90-day withholding period for meat and a lifetime withholding period for offal. This presents a problem for any animal treated with streptomycin but not subsequently exported, as it must not be slaughtered for 90 days after treatment and must be identified and tracked for the remainder of its life.

Sulphonamides These products have an intermediate spectrum of antibacterial activity. They are mainly used to treat bacterial infections in the gut, respiratory tract and urinary system. Daily treatment is generally required.

Neomycin Neomycin offers no real advantage over the other antibiotics available, but is a serious residue concern. Neomycin binds to the tubules in the kidney, persisting there for an extended time. It is the antibiotic most commonly detected in meat residue testing in Australia. Neomycin can also cause deafness and kidney failure. Its use as an injectable antibiotic is not recommended.

Short or long acting?

If an animal requires antibiotics, it is generally desirable to maintain a therapeutic concentration of antibiotic in the animal's body for at least three days. This can be achieved with a long-acting injectable antibiotic, or with repeat doses of a short-acting preparation.

When deciding whether to use a short or long-acting injectable antibiotic, you need to consider both ease of treatment and residue risk.

There is no benefit in giving antibiotics at a dose above that recommended by the manufacturer. 'Twice-as-much' is never 'twice-as-good', but may have an adverse side effect or cause unacceptable residues in the carcass.

Table 25. Oral antibiotics for sheep and goats

Antibiotic	Trade name	Sheep	Goats	Withholding Period (meat)
Oxytetracycline	Terramycin 200	•		5 days
Sulphonamides	Sulphatrim	•		14 days

Table 26. Injectable antibiotics for sheep and goats

Class of antibiotic	Trade name	Sheep	Goats	Withholding Period (meat)
Erythromycin	Erythromycin 200	•		3 days
	Gallimycin-200	•		3 days
Tetracyclines	Alamycin 10 Injection	•		14 days
	Alamycin LA Injection	•		42 days
	Alamycin LA 300	•		28 days
	Bivatop 200 Long Acting Injectable	•		42 days
	Engemycin 100	•		14 days
	Oxytet-200 LA	•		42 days
	Roscocycline-100	•	•	22 days
	Terramycin /LA	•		42 days
	Terramycin 100 Injectable	•		14 days
	Tetravet 10 Injection	•		15 days
	Tetravet 200 LA	•		42 days
	Tetravet Flexi-Dose Injection	•		10 days
	Tetroxy LA	•		42 days
Penicillins	Aquacaine G Injectable Suspension	•		5 days
	Benacillin	•		30 days
	Betamox Injection	•		28 days
	Bimoxyl LA	•		30 days
	Bomacillin LA	•		30 days
	Bomacillin SA	•		5 days
	Depocillin	•		5 days
	Duplocillin	•		30 days
	Mamyzin	•		5 days
	Moxylan LA Injection	•		28 days
	Norocillin LA	•		30 days
	Norocillin SA	•		5 days
	Propen	•		5 days

Table 26. Injectable antibiotics for sheep and goats cont

Class of antibiotic	Trade name	Sheep	Goats	Withholding Period (meat)
Streptomycin	Jurox Streptomycin Injection	*	*	90 days
	Streptomycin Sulphate (Powder)	*	*	90 days
Sulphonamides	Amphroprim S	•		15 days
	Leotrox Injection	•		16 days
	Norodine 24 Solution	•		28 days
	Tribacterial Injection	•		28 days
	Tribactral S	•		14 days
	Tribrissen Injection	•		28 days
	Tridox Injection	•		14 days
	Triprim	•		15 days
	Trisoprim-480	•		14 days
	Trivettrin Injection	•		14 days

* Streptomycin may only be used under APVMA Permit to treat animals for export.

Flystrike

Products registered for the prevention or treatment of flystrike on sheep are listed in Table 27. Those that require plunge or shower dipping have been excluded as this is a much more labour intensive and costly method of pesticide application, and is never the treatment method of choice for live export sheep.

Products with a synthetic pyrethroid active are not listed either. These are essentially lice treatments with minimal effect against flies.

Flystrike prevention Products containing cyromazine, dicyclanil, ivermectin or spinosad are the treatments of choice for flystrike prevention. When applied as recommended, these products are all highly effective, protecting treated sheep for several weeks. They are also very safe chemicals to use.

Products containing organophosphate (OP) group chemicals are not recommended. Resistance to OP pesticides is widespread. Strong protection against flystrike cannot be guaranteed after OP jetting. Occupational health and safety is also of concern. Human poisoning can occur with skin absorption or inhalation of OP chemicals. It is important to avoid skin contact, especially when handling the chemical concentrate.

The products that contain diflubenzuron are generally effective against flies, though some strains of flies that are resistant to the OP chemicals are also resistant to diflubenzuron.

Flystrike treatment With breech or body strike, it is important to clip the area around the strike, removing all moist wool and dags. Exposing the strike wound and allowing it to dry out makes the struck area less attractive to further strikes from other secondary flies.

Products containing ivermectin or spinosad are the treatments of choice for flystrike wounds. These treatments are effective and safe, but are much more expensive than organophosphate wound dressings and jetting fluids.

Cyromazine and diflubenzuron are not recommended as flystrike dressings because they do not cause an immediate maggot kill.

Resistance is a problem with the organophosphate chemicals. Some strains of blowfly maggots are susceptible to OPs, but others can survive contact with OP pesticides. For this reason, organophosphate products are not treatments of choice.

Table 27. Fly dressings, jetting solutions, sprays and pour-ons for sheep

Active chemical	Trade name	Dress	Jet	Pour/ Spray	Withholding period (meat)
Cyromazine	Cyro-Fly 500		•		7 days
	Jetrite		•		7 days
	Sprayrite			•	7 days
	Vetrazin Liquid		•		7 days
	Vetrazin Spray-On			•	7 days
	Virbazine Liquid		•		7 days
	Virbazine Spray-On			•	7 days
Dicyclanil	Clik Spray-On Sheep Blowfly Treatment			•	28 days
Spinosad	Extinosad		•		Nil
Ivermectin	Jetamec		•		7 days
	Paramax Multi-purpose Concentrate for Sheep	•	•		7 days
Organophosphate (OP)	Aerosol Sheep Dressing	•			14 days
	Defiance 'S'	•			3 days
	Diazinon			•	3 days
	Di-Jet		•		14 days
	Ectomort Plus Lanolin Sheep Dip		•		14 days
	Fly-Strike Powder	•			14 days
	Flystrike Powder	•			14 days
	Jetdip	•	•		14 days
	KFM Blowfly Dressing	•			14 days
	Mulesing and Fly Strike Powder	•			14 days
	Mulesing Powder	•			14 days
	Mules 'N Mark II Blowfly Dressing	•			14 days
Diflubenzuron	Duodip		•		Nil
	Fleececare		•		Nil
	Magnum IGR Pour-On			•	42 days
	Strike		•		Nil

Lice

Products registered for the treatment of lice on sheep and/or goats are listed in Tables 28, 29 and 30. Only products that can be applied as a pour-on, spray-on or jetting fluid are listed. Although plunge and shower dipping are 'tried and true' methods of eradicating lice on-farm, they are too labour intensive to be the treatment method of choice for live export sheep or goats.

Lice resistance to synthetic pyrethroid (SP) pesticides is widespread. Off-shears treatment with an SP pour-on is not recommended because a sharp decline in the lice population cannot be guaranteed. For this reason, off-shears SP pour-on treatments are not included in the tables.

Pour-ons A pour-on preparation is the easiest way to treat for lice. For sheep treated at or soon after shearing, products containing diflubenzuron or triflumuron are the treatments of choice. These chemicals do not give an immediate lice kill, rather they act by inhibiting lice reproduction and the maturation of immature lice, so the population of lice declines over a period of weeks after treatment.

Unfortunately none of the pour-on preparations is registered for the treatment of goats.

Table 28. Sheep and goat lice treatments – 'short wool' pour-on preparations

Chemical class	Trade name	Sheep	Goats	Withholding period (meat)
Diflubenzuron	Magnum IGR Pour-On	•		0 – 42 days
Triflumuron	Clipguard	•		14 days
	Epic Pour-On Lousicide for Sheep	•		14 days
	Virbac IGR Pour-On	•		14 days
	Zapp Pour-On Lousicide for Sheep	•		14 days

Table 29. Sheep and goat lice treatments – 'long wool' pour-on preparations

Chemical class	Trade name	Sheep	Goats	Withholding period (meat)
Synthetic pyrethroid	Clout-S	•		3 days
	Vanquish Long Wool	•		Nil

Jetting fluids and sprays The products that contain diflubenzuron, a macrocyclic lactone or spinosad are safe to use and when applied as directed reliably reduce the population of lice to a very low level. However, they are typically 5-10 times more expensive than organophosphate jetting fluids.

The organophosphate products provide good lice control, but are an occupational health and safety concern. Human poisoning can occur with skin absorption or inhalation of OP chemicals. It is important to avoid skin contact, especially when handling the chemical concentrate.

Table 30. Sheep and goat lice treatments – jetting solutions and sprays

Chemical class	Trade name	Sheep	Goats	Withholding period (meat)
Diflubenzuron	Duodip	•		Nil
	Fleececare	•		Nil
	Strike	•		Nil
Macrocyclic lactone	Jetamec	•		7 days
	Paramax Multi-purpose Concentrate for Sheep	•		7 days
Spinosad	Extinosad	•		Nil
Organophosphate	Diazinon	•	•	14 days
	Di-Jet	•	•	14 days
	Ectomort Plus Lanolin Sheep Dip	•		14 days
	Eureka Gold OP Spray-On	•		21 days
	Jetdip	•		14 days
	Nucidol 200 EC		•	14 days

The drugs registered for treating sheep and/or goats for fluke can be classified into four groups, based on their active ingredient:

- triclabendazole;
- closantel;
- oxyclozanide and nitroxynil; and
- albendazole.

Triclabendazole If elimination of fluke is the only consideration, triclabendazole is the drug of choice. This is because it kills both mature and immature fluke. The other drugs available are much less effective against early, immature fluke.

Triclabendazole is only available as an oral drench, and by itself is only effective against fluke. However, when given in combination with a 'mectin' drench, there is a broad spectrum of activity against gastrointestinal worms and fluke. In some areas fluke have developed resistance to triclabendazole, rendering it less effective. However, resistance is not widespread.

Closantel Closantel is effective against mature fluke in the bile duct, with a modest kill of immature fluke. It is also effective against the barber's pole worm (*Haemonchus*), but not against other species of gastrointestinal worms. Closantel is only available as an oral drench. Unfortunately, resistance to closantel is quite widespread.

Oxyclozanide and nitroxynil These older chemicals are moderately effective against mature liver fluke and a narrow spectrum of gastrointestinal parasites. They offer no obvious advantages over products containing triclabendazole or closantel and are unlikely to ever be the treatment of choice for export sheep.

Albendazole The worm drenches that contain albendazole typically have a secondary claim to 'aid the control of liver fluke'. Few fluke are killed by albendazole. However, there is a reduction in the number of viable fluke eggs passed by fluke infected animals. To achieve this effect a higher dose must be used than is recommended for worm control. Albendazole is vastly inferior to all other registered fluke treatments, and it is difficult to imagine a situation where it would be the treatment of choice. For this reason, products containing albendazole are not listed in Table 31.

Table 31. Fluke treatments for sheep and goats

Flukicide	Trade name	Sheep	Goats	Withholding period (meat)
Triclabendazole	Fasicare 120	•		28 days
	Fasinex 100	•	•	21 days
	Flukare C	•		21 days
	Flukare S	•	•	21 days
	Flukazole S	•		21 days
	Tremacide 50 Flukicide for Sheep, Cattle and Goats	•	•	21 days
	Tremacide 120 Flukicide for Cattle and Sheep	•		21 days
Triclabendazole plus 'mectin' drench	Fasimec Sheep	•		28 days
	Flukamec	•		21 days
	Flukamec Plus Selenium	•		21 days
	Paramax-F	•		21 days
Closantel	Closal	•		28 days
	Closantel	•		28 days
	Closicare	•		28 days
	Closicare with Selenium	•		28 days
	Closicomb	•		28 days
	Razar Plus	•		28 days
	Rotafluke	•		28 days
	Seponver Se	•		28 days
	Sustain	•		28 days
	Sustain + Se	•		28 days
Oxyclozanide	Nilzan LV	•		14 days
Nitroxynil	Trodax	•		28 days

Pinkeye is an infectious disease that occurs commonly in live export sheep and goats, both in Australia prior to departure and at sea. Initially there is conjunctivitis and production of clear, watery tears. The cornea then develops a blue haze, which becomes more opaque and turns white over 3-4 days. Shallow ulcers develop on the cornea, and in a small proportion of cases there is perforation through into the eyeball. Sight is lost whilst the eye is opaque.

Most cases of pinkeye recover, without treatment, in about three weeks. However, if infection spreads deep into the eye, recovery can take months.

The best response to treatment occurs with an eye ointment, such as *Orbenin Eye Ointment* or *Opticlox Eye Ointment*. Instil one quarter of a 5g syringe into the lower conjunctival sac, then repeat the treatment 48 hours later. This is the treatment of choice if there are only a few animals affected, such as a small breeding consignment. However, with commercial slaughter shipments, it is not practical to catch large numbers of sheep for individual treatment, and attempting to do so can be quite stressful on the pen as a whole.

Aerosol can sprays and powders are of limited value as the antibiotic soon washes out of the eye and powders are themselves irritant. Repeat treatment, three times daily, is needed to maintain an effective concentration of antibiotic in the eye. This is not practical with large shipments.

At sea, oxytetracycline antibiotic dissolved in water or glycerine and sprayed into the eye with a garden spray and wand has been used with apparently good effect. This is a crude method of treatment, as the dose of antibiotic delivered and persistence in the eye are uncertain. However, treatment can be done with minimal disturbance to the other animals in the pen.

Vaccine effectiveness can be greatly reduced by improper storage and handling. This is especially so for vaccines which contain a live modified agent. It is critically important that vaccines are stored and handled according to the manufacturer's recommendations. Keeping the vaccine within the correct temperature range is particularly important.

When taken out in the field, vaccines should be kept in an esky with frozen cooler blocks. During meal breaks, smoko, and at any other time when the vaccine is not actually being used, such as during a change of mobs, the vaccine and vaccine applicator should go back in the esky – where it is cool and out of direct sunlight.

Anthrax There is currently only one anthrax vaccine for livestock available in Australia. It is produced by the Colorado Serum Company in the USA and distributed in Australia by Fort Dodge. The vaccine is subject to a special permit from APVMA.

A condition of the APVMA permit is that the vaccine may only be used by persons authorised by the State Chief Veterinary Officer. Another requirement is that the vaccine may only be used as directed by the State Chief Veterinary Officer. In practice, what this means is that specific approval must be obtained from the State Chief Veterinary Officer before an export consignment is vaccinated against anthrax.

The vaccine is a live non-encapsulated spore vaccine that must be stored at 2-7°C (refrigerated). It should be given by subcutaneous injection high on the neck. The vaccine is quite irritant, producing a local reaction at the injection site in a significant proportion of animals.

The immune response to anthrax vaccination includes development of a mild fever and transient loss of appetite. The meat withholding period after anthrax vaccination is 42 days.

Clostridial diseases Vaccination against black disease, blackleg, enterotoxaemia, malignant oedema and/or tetanus (the 'clostridial diseases') is a common requirement in export protocols for breeding animals.

The vaccines listed in Table 32 are all killed vaccines that must be stored at 2-8°C (refrigerated). Two doses of vaccine, at least four weeks apart, are needed to develop strong immunity. The first vaccination primes the animal's immune system, with antibody production stimulated in earnest by the second dose.

There are almost no adverse side effects and little if any difference in efficacy between the vaccines available for each disease.

Many of the clostridial vaccines contain extra components – a selenium or vitamin B₁₂ supplement, a vaccine against cheesy gland or a 'mectin' drench. The selenium, vitamin B₁₂ and cheesy gland components are rarely of importance to the live export trade, but the 'mectin' drench may be of benefit. Otherwise, choice of product is based largely on availability and cost.

Table 32. Clostridial vaccines for sheep and goats

	Trade name	Sheep	Goats	Withholding period (meat)
Black disease Blackleg Enterotoxaemia Malignant oedema Tetanus	Glanvac 6	•		Nil
	Glanvac 6 B12	•		Nil
	Glanvac 6S	•		Nil
	Glanvac 6S B12	•		Nil
	Guardian 6-in-1	•		Nil
	Guardian 6-in-1 plus Selenium	•		Nil
	Tasvax 5-in-1	•	•	Nil
	Tasvax 5-in-1 Plus Selenium	•		Nil
	Ultravac 5 in 1 Vaccine	•		Nil
	Websters 5 in 1 vaccine for Cattle and Sheep	•		Nil
	Websters 5 in 1 Vaccine with Selenium for Lambs	•		Nil
	Websters 5 in 1 Vaccine with Vitamin B ₁₂ for Cattle & Sheep	•		Nil
	Websters 6 in 1 Vaccine (Inc. Cheesy Gland) for Sheep	•		Nil
	Websters 6 in 1 Vaccine (Inc. Cheesy Gland) for Sheep	•		Nil
	Websters 6 in 1 Vaccine with Selenium (Inc. Cheesy Gland) for Lambs	•		Nil
	Websters Low Volume 5 in 1 Vaccine for Cattle and Sheep	•		Nil
	Websters Low Volume 6 in 1 Vaccine (Inc. Cheesy Gland) for Sheep	•		Nil
	Black disease Blackleg Enterotoxaemia Malignant oedema Tetanus plus 'mectin' drench	Cyductin Eweguard 6 in 1 Vaccine and Wormer for Sheep	•	
Cyductin Weanerguard 6 in 1 Vaccine and Wormer for Lambs		•		28 days

Table 32. Clostridial vaccines for sheep and goats cont....

	Trade name	Sheep	Goats	Withholding period (meat)
Enterotoxaemia Tetanus	Glanvac 3	•		Nil
	Glanvac 3 B12	•		Nil
	Glanvac 3S	•		Nil
	Glanvac 3S B12	•		Nil
	Guardian 3-in-1 Plus Selenium	•		Nil
	Websters Low Volume 3 in 1 Vaccine with Selenium (inc. Cheesy Gland) for Lambs	•		Nil

Footrot There are two footrot vaccines registered for use in Australia. Both are killed, multiserotype vaccines emulsified in oil. They must be given by subcutaneous injection, high on the neck. The vaccines are quite irritant, producing a local reaction at the injection site in a significant proportion of animals. Severe reactions can be expected if the vaccine is inadvertently injected into muscle.

Prior approval from the State Chief Veterinary Officer is required for use of the footrot vaccine in WA.

Table 33. Footrot vaccines for sheep and goats

Trade name	Sheep	Goats	Withholding period (meat)
Footvax	•		Nil
Vaxall Footrot Vaccine for Sheep	•		Nil

Scabby mouth There is only one vaccine currently available in Australia – *Scabigard*. It is a live virus vaccine that is scratched onto the skin using a purpose designed *Scabigard* applicator. For sheep, the recommended scratch site is the bare skin on the brisket inside the foreleg. Goats are best scratched on the bare skin beneath the tail.

When the vaccine ‘takes’, a line of small scabs develops along the vaccine scratch line 4-5 days after vaccination. Protective immunity develops about two weeks after vaccination.

Care must be taken when handling *Scabigard* vaccine; it is a concentrated source of live scabby mouth virus which can produce a nasty scab if scratched onto human skin.

Other vaccines The vaccines listed in Table 34 are rarely used to treat export livestock, but are included here for the sake of completeness. Veterinary advice should be obtained if use of these vaccines is being considered.

Table 34. Other vaccines for sheep and goats

	Trade name	Sheep	Goats	Withholding period (meat)
Botulism	CSL Botulinum Vaccine	•		nil
	Websters Low Volume Bivalent Botulinum Vaccine for Sheep and Cattle	•		nil
Erysipelothrix	Eryvac	•		nil
Johne's disease	Gudair	•	•	nil

Appendix A: Acronyms and abbreviations

AI	Artificial insemination
APVMA	Australian Pesticides and Veterinary Medicines Authority
BVD	Bovine viral diarrhoea, bovine pestivirus
CVO	Chief Veterinary Officer
HGP	Hormonal growth promotant
IBR	Infectious Bovine Rhinotracheitis
IGR	Insect growth regulator
IM	Intramuscular
IV	Intravenous
NSAID	Non-steroidal anti-inflammatory drug
OP	Organophosphate
S4	Schedule 4 drug
SC	Subcutaneous
SP	Synthetic pyrethroid

Appendix B: Drug Schedules

Drugs and poisons are classified into Schedules, which determine the legal requirements for possession, storage, handling and use. Most of the drugs used to treat export livestock are classified in Schedules 4 and 6.

<p>Schedule 1. This Schedule is intentionally blank.</p>
<p>Schedule 2. Pharmacy Medicine – Substances the safe use of which may require advice from a pharmacist and which should be available from a pharmacy or, where a pharmacy service is not available, from a licensed person.</p>
<p>Schedule 3. Pharmacist Only Medicine – Substances the safe use of which requires professional advice, but which should be available to the public from a pharmacist without a prescription.</p>
<p>Schedule 4. Prescription Only Medicine or Prescription Animal Remedy – Substances, the use or supply of which should be by or on the order of persons permitted by State or Territory legislation to prescribe and should be available from a pharmacist on prescription.</p>
<p>Schedule 5. Caution – Substances with a low potential for causing harm, the extent of which can be reduced through the use of distinctive packaging with strong warnings and safety directions on the label.</p>
<p>Schedule 6. Poison – Substances with a moderate potential for causing harm, the extent of which can be reduced through the use of appropriate packaging with simple warnings and safety directions on the label.</p>
<p>Schedule 7. Dangerous Poison – Substances with a high potential for causing harm at low exposure and which require special precautions during manufacture, handling or use. These poisons should be available only to specialised or authorized users who have the skills necessary to handle them safely. Special regulations restricting their availability, possession, storage or use may apply.</p>
<p>Schedule 8. Controlled Drug – Substances which should be available for use but require restriction on manufacture, supply, distribution, possession and use to reduce abuse, misuse and physical or psychological dependence.</p>
<p>Schedule 9. Prohibited Substance – Substances which may be abused or misused, the manufacture, possession, sale or use of which should be prohibited by law except when required for medical or scientific research, or for analytical, teaching or training purposes with approval of Commonwealth and/or State or Territory health authorities.</p>

Appendix C: Injection techniques

Unless specified otherwise by the product manufacturer, subcutaneous and intramuscular injections should be given into the neck – a part of the carcass of lower value and an area with a lower risk of causing nerve or other structural damage.

To minimise local tissue scarring and the risk of infection at the injection site, with multiple dose syringes, only use sharp needles and replace the needle as soon as it becomes burred. With treatments given by single dose syringe, use a new, sterile needle for each injection.

Subcutaneous injection For subcutaneous injections with a multiple dose syringe, the needle should be no more than 15mm long. A 14G or 16G x 12mm (½ inch) needle is recommended for cattle and a 16G x 12mm needle is recommended for sheep and goats. Longer needles are OK when used with a single use syringe, if the skin is pinched and the needle slid under the folded skin. However, with longer needles on a multiple dose syringe, there is a high risk of injecting into the muscle rather than under the skin. Broader gauge needles (lower G number) are generally not recommended as they cause more pain and tissue damage.

If a large volume is to be injected subcutaneously, (eg a 100+ml pouch of calcium / magnesium solution), a broader gauge needle should be used, with the fluid injected into multiple sites and the skin massaged to aid dispersion.

Intramuscular injection An 18G x 38mm (1½ inch) needle is recommended. It should be inserted deep into the muscle, perpendicular to the skin surface. With irritant substances, such as the long-acting oxytetracycline preparations, it is often better to inject into two or more sites – check and follow the product manufacturer's recommendations.