KNOW YOUR GOAT DISEASES!

Bacterial Disease

ABSCESSES

Distribution
Abscesses occur to a greater or lesser extent on every small-stock farm in South Africa and elsewhere. The main form of the disease, caused by bacteria, is called caseous lymphadenitis, cheesy gland disease or Preisz-Nocard disease. It is a progressive condition which can become more serious with time.

Cause
Abscesses develop following an injury which has been infected by one of two bacteria, Corynebacterium pseudotuberculosis, previously known as C. Ovis, which occurs almost exclusively in sheep and goats; and Arcanobacterium pyogenes, previously called Corynebacterium pyogenes, which normally causes abscesses in cattle but is found in sheep and goats as well.

Spread
Corynebacterium and arcanobacterium organisms are commonly found in dust, in dung, on the ground and in kraals and shearing sheds. Most commonly, infection results from faulty management practices and shearing, such as:

- Dirty shears.
- Dirty, dusty shearing pens.
- Infected shearers’ clothing.
- Dipping sheep before shearing wounds have healed.
- Infected dip tank.
- Wounds caused by tail docking or castration.
- Infection resulting from certain tick bites and grass seed awns which penetrate the skin.
- Injuries caused by thorns on thorn trees, which can be an important source of infection in goats.
- A dipping stick used during dipping, can damage the skin of the sheep and allow infection to penetrate.
- An abscess lanced or nicked during shearing, which can infect the floor and surroundings.
- The umbilical cords of newborn lambs, which can become infected.
- Recently, it has been shown that infection can result when pus is coughed up from burst lung abscesses. If inhaled by other sheep/goats, this can spread infection.

Symptoms
Abscesses caused by the two bacteria cannot easily be distinguished from one another, but they cause different disease conditions and it is important to determine which one is causing problems in the flock. *C. pseudotuberculosis* occurs almost exclusively in sheep and goats and causes lymph node abscesses. The glands most affected are those in front of the shoulder, in the head and neck, the flank, the hindleg, below the ear or between the lungs. Abscesses can also be found in the liver, lungs, spleen and spinal cord. *Arcanobacterium pyogenes* usually causes internal abscesses in sheep. It is a very common cause of abscesses. It does not usually affect the lymph nodes, but causes superficial abscesses just under the skin.

In sheep and goats, the abscess destroys the structure of the lymph gland. The enlarged gland can easily be seen from the outside, or felt once it has formed a pus-filled abscess. The abscess usually expands until, finally, it bursts through the skin. It can contaminate the entire farm. The pus of corynbacterium is grey-green in colour and is thick, soft and sticky. Old abscesses have the consistency of dense, cheesy matter and some have concentric circles that look like a slice-opened onion. Animals that have abscesses in their lungs or liver may gradually become emaciated and often die from the condition called “hartslagsiekte” or pluck disease.
Infected umbilical cords can allow the bacterium access to the bloodstream, and if they do, the lamb usually dies soon afterwards. Multiple liver abscesses can cause jaundice. The joints of the lamb can also become infected, causing lameness which can worsen steadily until the animal can no longer use the infected leg. The problem can also affect the spinal cord, and often follows tail docking which becomes infected, resulting in the animal's developing “sitsiekte”: an abscess forms in the spinal cord which results in paralysis of the hindquarters. Abscesses sometimes form in the brain after tick bites or grass seed injuries in the upper jaw or head have become infected. Corynebacterium abscesses can also form in the testes, usually following a prior *Brucella ovis* infection of the *epididymis*, as well as in the kidneys.

**Treatment**

The thick, fibrous layer that forms around the abscesses is the body’s natural reaction to isolate the infection, and is the reason a single dose of antibiotic treatment will not cure the condition – the antibiotic cannot penetrate the outer covering of the abscess. The only way to treat abscesses is to lance, clean and disinfect them. They should not be allowed to fester and burst, because they can contaminate the surroundings. The abscess should be monitored carefully and when it is about to burst, it should be lanced properly, drained and cleaned. An abscess is “ripe” when it forms a point on the skin and a soft spot develops where the hair or wool has fallen out. Deeper abscesses may be treated by prolonged high doses of an effective antibiotic. A cross-shaped incision should be made into the soft spot, using a sharp knife, preferably a scalpel. The two lines of the incision, at right angles to one another, should be as long as possible, resulting in four loose flaps of skin which will stop the abscess closing up again. It is usually necessary to use your finger to remove the pus. Wear rubber gloves, wrap cotton wool soaked in surgical spirits around a finger and remove all the pus. Be careful to gather up all the pus and cotton wool and to burn or bury it. Clean the wound with a strong disinfectant; surgical spirits, for example. The treatment of valuable animals should be discussed with a veterinarian.

**Prevention**

**Vaccination**

Before vaccinating, it must be established whether it is *Corynebacterium pseudotuberculosis* or *Arcanobacterium pyogenes* that is causing the disease. A veterinary laboratory can identify the bacterium involved. A severely affected animal can be taken to the laboratory, where the abscess matter is cultured, and the bacterium isolated. Several vaccines are used against *corynebacterium* but they do not offer total protection. Consequently, vaccines should be seen as just one measure against the bacterium and farmers should continue to apply strict hygiene measures during shearing and similar procedures. Some vaccines are one component of multivalent vaccines. Sheep and goats should be inoculated against *Corynebacterium pseudotuberculosis*, in accordance with the manufacturer’s specifications. The initial vaccination for *Arcanobacterium pyogenes* should be given to sheep 3 times, 10 days apart, and thereafter every 6 months. The dose for sheep and goats is 5ml and for lambs under 2 months old it is 2ml. Vaccination is valuable in preventing the disease and reducing the level of infection on the farm. The vaccine is more effective in controlling the disease if severely infected sheep are culled, as they are a source of infection.

**Management practices**

- Lambs should be docked and ear-tagged in a clean, uncontaminated area of the kraal, where adult sheep are not treated. Disinfect all wounds with tincture of iodine (an alcohol solution of iodine.)
- Instruments such as knives used to mark and castrate lambs should first be properly disinfected or boiled.
- Animals should be dipped regularly to control ticks.
- Control of the disease is best achieved by removing the causes. Implement good hygiene, good veld management to reduce the number of thorns and “steekgras” or *Aristida* grasses, and cull severely infected animals.
“LAMSIEKTE”/BOTULISM

Occurrence
Botulism occurs throughout South Africa and in other countries, and a wide variety of animals are affected. All sheep and goats are susceptible, and can be affected at any age. Animals that have increased nutritional requirements, such as pregnant ewes or weaned lambs, are more inclined to eat carrion or other infected material and develop the disease.

Causes
Botulism is caused by the bacterium Clostridium botulinum, which is found in soil. The bacterium forms spores which are extremely resistant to unfavorable weather conditions. The spores are ingested by the animals as they graze and have no effect on healthy animals, but should the animal die, the carcass becomes favorable material for the spores to develop. The bacteria produce a powerful toxin in the dead organic material and botulism results when animals eat material containing the toxin, or drink water contaminated by infected material. Sheep and goats become infected by the toxin when they eat old carcasses (usually the bones) or drink water contaminated by decomposing infected carcasses.

Bone-chewing behaviour usually happens in late summer or early autumn, when pastures are dry and not very nutritious. The disease occurs commonly where no supplements are provided on dry grazing. Deaths due to botulism caused by a carcass in the drinking water can occur at any time of the year, however.

Feed containing broiler chicken litter or baled hay contaminating by dead animals, e.g. rats, can also cause botulism.

Symptoms
The rate at which symptoms of the disease develop depends on the quantity of toxin ingested and can vary from 12 hours to 2 to 3 days. The first symptom is lagging behind the flock - the animal does not keep up with the grazing flock. The animal stands with its head hanging down and turned to one side. If the head is shaken up and down quickly, the jaws clatter. The tail, or root of the tail, often wiggles from side to side. As the disease progresses, the gait stiffens and the animal walks clumsily; it then usually falls down. The lips are moist and saliva drips out of the mouth. In some cases, especially in goats, the tongue becomes paralyzed and protrudes beyond the lips. A paralyzed tongue is characteristic of botulism in cattle, but is not always present in sheep and goats. Body paralysis starts in the hindlegs; the animal can still stand if supported, but collapses without support. Breathing becomes irregular and laboured as muscles become paralyzed. The symptoms may last for quite a few days, until the animal dies of suffocation.

Post-mortem signs
Very few signs are found on post-mortem examination. In rare cases bleeding can be seen around the heart, or the small intestine is pale red. If the animal was poisoned by eating carrion, small pieces of bone could be present in the rumen.

Diagnosis
A diagnosis is made based on the symptoms. The wiggling movements of the root of the tail are characteristic of botulism in sheep. The other symptoms look very much like those of nenta poisoning (“krimpsiekte”), caused by certain plants that have been grazed.

Treatment
Onderstepoort has developed an anti-serum for treating ruminants that have botulism. Treatment is often successful in the early stages of the disease, if the animal has not ingested too much contaminated material or water. The anti-serum should be stored at between 4 and 8 °C and is administered intravenously. Consult a veterinarian for further information.

Prevention
Animals that have not been vaccinated should be given their first dose at weaning, with another dose about 6 weeks later. Vaccination should then be repeated annually. Vaccination is especially important for stud animals and animals that are fed chicken litter. Prevent depraved appetite (bone-chewing) in sheep on dry pastures by providing
adequate supplements. Check all water sources and hay as regularly as possible to avoid contamination by dead carcasses.

**PASTEURELLOSIS**

Pasteurellosis is a fatal disease usually associated with upper respiratory tract infections and pneumonia. Pasteurella bacteria are carried by healthy animals and only cause disease when the animals are subjected to stress. It is a sporadic, but common, disease in sheep and goats.

**Causes**

The condition is caused by *Pasteurella haemolytica* and *P. multocida*, commonly found in the respiratory system of many animals, especially in the nose, pharynx, bronchi and lungs. The disease occurs when the animals’ condition deteriorates or they are subjected to stress, and the bacteria multiply rapidly. The following factors play a contributory role:

- The concentration of animals and their adaptation to the conditions leads to pasteurellosis being the single largest killer of stock in feedlots.
- Dramatic changes in climatic conditions – for example, drought, sudden changes in temperature (as when it snows), windy weather and heavy rain or extreme cold – particularly soon after shearing, precipitate the disease.
- Exhaustion after being driven over a long distance or transported to feedlots in poorly ventilated trucks predispose animals to pasteurellosis.
- The disease can also follow “jaagsiekte” or lungworm infestation.
- The lungs can be damaged if sheep choke when dosed, and this can lead to pneumonia caused by pasteurella organisms.
- Sometimes Chlamydia organisms, or mycoplasms, precipitate pasteurellosis or aggravate the condition of it already exists.
- The para-influenza 3 virus can also lead to pasteurellosis.

**Symptoms**

The pasteurella organism causes mastitis in ewes and occasionally affects the liver of sheep and goats, causing jaundice. In rare cases the *P. haemolytica* organism can cause arthritis and encephalitis. The most important, and most common, condition caused by pasteurella is pneumonia. (The disease has also been called “bloutong” – pied lung – because of this). Young lambs and kids are most at risk and die rapidly, having shown few signs of the illness beforehand. Sudden deaths occur in the flock and farmers can suffer enormous losses without any symptoms being evident. The following symptoms can be observed in animals suffering from pasteurellosis:

- Depression and listlessness – animals fall behind when the flock is moved.
- They have a raised temperature and do not eat properly.
- Breathing complications – rapid, laboured breathing is evident and the animals gasp for air and cough. They may have a mucous discharge from the nose.
- Some animals develop acute pasteurellosis and die without displaying any symptoms.

**Post-mortem signs**

- When the skull is sawn open along its length, the nasal cartilage will be conspicuously dark red or purple.
- In acute cases, obvious red patches occur in the lungs and there is a solid red-colored mass in the lower parts of the front lobes. The lungs often adhere to the ribcage. In chronic cases the lungs are grayish in colour leading to confusion with “jaagsiekte”.
- Bleeding in and around the heart.
- The liver and kidneys are enlarged and appear redder than usual.

**Diagnosis**

Pasteurella organisms occur naturally in the upper respiratory tract of animals. Evaluation of the diseased lung of a dead animal by a veterinarian is necessary to establish whether the animal died of pasteurellosis, and at least a third of the lung would have to be affected before a diagnosis of pasteurellosis can be made.
Histopathology would reveal fibrinous purulent pneumonia with soft, fibrous threads binding the lung to the ribs. Examination should only be conducted on formalin-fixed specimens.

Treatment

_Pasteurella haemolytica_ vaccines manufactured by Onderstepoort include the following types:

- _Pasteurella haemolytica_, types 1, 2 and 6
- _Pasteurella multocida_, types A and D

Fifteen strains of _P. haemolytica_ have been identified in South Africa and 4 of _P. multocida_. for this reason, even though a farmer vaccinates his flock every 6 months with Onderstepoort pasteurella vaccines, he can nevertheless still have pasteurellosis deaths. These deaths could be caused by a strain not covered by the vaccine. If it is established that the deaths are caused by strain or type 8, or example, Onderstepoort can prepare a specific vaccine for that particular outbreak or farm.

On farms where pasteurellosis is a problem, all sheep should be vaccinated every 6 months. Lambs can be vaccinated after the age of 2 weeks, with 2 inoculations 4 weeks apart. A booster should be given just before weaning. Older lambs can be vaccinated at 6 months, and again 4 weeks later. Sometimes the vaccines cause a shock reaction, so it would be wise to vaccinate a few animals and then wait for 2 days. If nothing untoward happens to the vaccinated sheep, the rest of the flock can be inoculated. The dosage for a lamb 2 months or younger is 2 ml and for an older animal, 5 ml. The vaccine should be stored at temperatures between 4 and 20 °C. Commercial vaccines are also available and can be combined with other vaccines. They comprise a selection of common _P. haemolytica_ strains and are very effective.

_Note:_ Pasteurella pneumonia is usually precipitated by feeding or management problems. Farmers should not rely on the vaccine alone to control the disease, but should try to rectify the underlying problems.

_Fibrin attaching to pleura of eight-week-old lamb with pasteurellosis. Photo: Donal Toolan._

_The lung is from a sheep in the early stages of infection with Pasteurella multocida._

**Black Quarter (BQ)**

Black quarter is an infectious bacterial disease caused by Clostridium chauvoei, a Gram-positive bacterium and is characterized by inflammation with gaseous oedema of skeletal muscle and severe toxemia. The acute nature of the disease makes successful treatment difficult, but there is an effective vaccine available to provide animals with protective immunity.

**What causes Black Quarter in bovines?**

BQ is most commonly caused by Clostridium chauvoei. These are Gram-positive, rod-shaped; anaerobic that can produce environmentally-persistent spores in unfavorable conditions. These spores can remain in the soil for years in an inactive state, and return to their infectious form when consumed by grazing livestock and infect the large muscles of the animal where the bacteria grow and produce large amount of gas. Contaminated pasture is a
predominant source of these organisms, which are also found naturally in the intestines of animals. Disease can occur over many years in areas where there is soil or manure contamination with the bacteria, and it is extremely difficult to remove the spores from the environment.

Where the disease is found?
It is seen in livestock all over the world, usually affecting cattle, sheep and goats. It has been seen occasionally in farmed bison and deer.

What symptoms or signs can be seen in affected animals?
Initially animal may develop fever, and the affected limb is hot to touch. The limb swells significantly, and the animal develops lameness on the affected leg. Crepitating, or the sensation of air under the skin, can be noticed as the area seems to crackle under pressure. Once clinical signs develop, the animal may only live a short while, sometimes as little as 12 hours. Occasionally, cattle will succumb to the disease without showing any symptoms at all, and only a post-mortem reveals the cause.

How the disease is diagnosed in animals?
The diagnosis is by physical examination and confirmation of gram positive rods in the slide made out of serous fluid from the site. During post-mortem examination, a diagnosis is usually made very quickly, as the affected muscle is generally mottled with black patches. These patches represent dead tissue, killed by the toxins that the bacteria release when they infect a live tissue. If viewed under a microscope, small rod-like bacteria can be visualized to confirm the diagnosis.

Any treatment is available?
Treatment is generally unsatisfactory due to the rapid progression of the disease; however penicillin is the drug of choice for treatment. Treatment is only effective in the early stages and as a control measure.

How to prevent the disease? Does vaccine available?
Prophylactic vaccination with a combined vaccine containing formaldehyde inactivated cultures of Pasturella multocida and Clostridium chauvoei adsorbed on aluminum hydroxide gel will give good immunity against BQ along with Haemorrhagic Septicaemia.

What is the vaccination schedule?
Primary vaccination: six months of age or above, followed by booster dose after one month.
Revaccination: Annually

FOOT ABSCESSES
Foot abscesses are often confused with foot rot.

Distribution
Foot abscesses are found throughout South Africa but are more common in areas of thorny bushveld or where ticks are a serious problem. Under spray irrigation conditions or in high rainfall areas, where hooves are continuously wet, the skin of the hoof softens, which leads to a high incidence of foot abscesses.

Causes
The organisms that cause foot abscesses penetrate the skin of the hooves through small wounds and injuries. Ticks commonly cause these injuries, and those with long mouth parts are particularly dangerous, especially *Thipicephalus glabroscutatetem* and *R Simus*. Other tick species, such as the bont tick (*Amblyommn hebraeum*) and the bont-legged tick (*Hyalomma*) can also cause injuries.

Some parts of South Africa have dense stands of thorn trees or thorny shrubs and goats browsing these plants stand against them and injure their hooves on the thorns.

Although sharp stones, wood splinters and wire can also cause injury to hooves, this is unusual. The organisms entering through these wounds tend to form abscesses which then affect the foot joints of the sheep. Lengthy periods of wet weather soften the skin to the point where it is weakened enough to allow organisms to penetrate,
even when there are no obvious injuries. A specific form of abscess, called “toe abscess”, results when the hoof separates from the sole.

**Symptoms**
The first sign of foot abscess infection in sheep and goats is lameness, but lameness is not always caused by foot abscesses or foot rot. The infection usually affects only 1 foot, but in bad cases, 2, 3 or even all 4 can be affected. In the early stages of the disease, the feet show no outward signs of infection. Check for ticks in the split in the hoof or injuries to the skin which might allow the organisms access to the body. If the foot is hot to the touch or the animal shows pain when the hoof is pressed, the farmer should suspect foot abscesses. As the disease progresses, the foot swells just above the hoof, and becomes hot and very painful. A soft area develops in the skin just above the hoof and, in time, bursts. Sticky yellow pus drains out. Sometimes the abscess opens under the hooves, which is why there is confusion with foot rot. In serious cases, the bone and joint of the foot can be seen clearly or felt through the opening in the skin. In some long-standing cases, the hoof becomes enlarged and deformed, especially if ligaments have been destroyed. Foot abscesses cause animals to lose condition because the pain makes it difficult for them to graze and move around. In advanced cases, they will not eat at all and can die from emaciation and blood poisoning.

**Post-mortem signs**
If the foot of the dead animal is cut open, the abscess will be clearly visible. It often forms in the last joint, which will be full of pus. The horny layer of the hoof is seldom affected.

**Treatment**
There is no quick way to treat the animal – it takes 2 to 3 months of rest and nursing to restore the use of the foot, with or without treatment. This is important for valuable animals. Treatment is difficult even for those animals that appear to be less severely affected; the reason is that it is usually very difficult to lance and drain abscesses, and antibiotics to not easily penetrate the thick fibrous wall of the abscess. They should, however, be lanced and drained as much as possible, and rinsed every day with a liquid antibiotic. Giving large doses of antibiotic, e.g. tetracycline, every day for 3 weeks or longer can sometimes cure an animal. For the best results in an intensive treatment programme, a veterinary laboratory should identify the organism and recommend the best antibiotic to use. The veterinarian will also suggest an effective treatment programme.

**Prevention**
The first move is to establish what is causing the foot abscesses and then to ut effective preventative measures into practice. If ticks are the major cause of infection, strict tick infestation control mechanisms should be instituted before the anticipated outbreak. Remember that it takes a few weeks for a tick infestation to lead to foot abscesses. In most cases, a 10 cm deep foot dip, filled with a registered tick dip, should be sufficient. The frequency of treatments depends on the remedy’s residual action, the severity of the tick infestation, and the rainfall pattern. It may be necessary to bodydip animals to reduce the level of tick infestation on the farm. Farmers sometimes use spot treatments, but some of these are not intended for small stock and it can be risky to use them. Very little can be done to prevent foot abscesses caused by thorns or prolonged wet weather. Formalin foot bath could be used to toughen the skin and hoof, so that organisms cannot enter the foot. Regular vaccination with *Arcanobacterium pyogenes* or *Corynebacterium pseudotuberculosis* vaccines may also reduce the incidence.

**FOOT ROT**
The names of foot diseases in sheep and goats often cause confusion. Any lameness or foot infection tends to be called foot rot, regardless of its cause. There are a number of diseases, however, which could be responsible for lameness or infection.
Distribution
Foot rot occurs in sheep and goat flocks in many countries. It was introduced into South Africa, and has established itself in KwaZulu Natal and in the Eastern and Western Cape. No measures are in place to stop its spread into other provinces, or areas where conditions are favorable.

Incidence
Some breeds of sheep are more susceptible to foot rot than others. Merinos and related breeds are susceptible, while certain meat breeds, such as the Romney, are resistant to the infection. No breed is totally immune, however. In any one breed there will be some animals that are more resistant than others. What is important is that this resistance is an inheritable trait – it is associated with the structure of the hoof and the width between the claws of the hoof, the so-called interdigital space, as the animal walks.

Cause
Contagious ovine foot rot is caused by a bacterium, *Dichelobacter modosus*, which lives only in the hooves of infected sheep. Other organisms also play a role in the infection, helping in the penetration of the foot-rot bacteria. *D. Nodusus* develops in oxygen-free conditions during wet, buddy periods, and lives on the hoof material and skin, which it digests. The bacterium can survive for a long time in the hoof and not be apparent until conditions change. The disease is also associated with the presence of certain worms that penetrate the skin, especially the white bankrupt worm (Strongyloides papillosus). Another possible cause of initial injuries is sharp kikuyu grass, that breaks the skin in the interdigital space.

Spread
Carrier animals that appear to have recovered from an infection can continue to harbour the organism in their hoof material for up to 3 years. Also, the bacteria can remain viable in mud in contaminated camps for up to 2 weeks. The carrier animal becomes a constant source of infection in grass and muddy conditions. Prolonged wet conditions, lasting weeks or months, activate the organism and, once activated, the outbreak spreads quickly. Regular irrigation can also create ideal conditions for an outbreak. In some overseas countries, warm weather is a predisposing factor, but it is doubtful whether the temperature in South Africa plays a role in an outbreak.

Symptoms
In favorable conditions, the disease spreads through the flock very quickly. A large number of animals become lame at almost the same time, either walking with difficulty or on their knees. The pain and lameness can become so severe that they stop eating and lose weight, with a consequent decrease in the wool growth. One or more feet can be infected on each sheep. In the early stages of the infection, the interdigital skin becomes red and moist with a characteristic foul-smelling, yellow-grey, puslike discharge. This allows the bacteria to multiply and causes inflammation, which results in the separation of the soft tissue from the hoof. The sole and external hoof material are damaged. The hoof becomes soft and crumbly and is easily loosened from the soft tissues within it. Infected hooves are hot and painful and soon become obviously deformed. If the horny exterior is cut away, the same smelly pus discharge is exposed. Eventually the inflammation can result in permanent lameness. Contagious ovine foot rot seldom causes death, but severely affected animals should be culled.

Treatment
Contagious ovine foot rot should be treated as follows:

- To limit the spread of the infection to the rest of the flock, isolate infected animals immediately in a dry shed until they have recovered.
- Have the infected animals stand for several minutes in a foot bath containing a 10 percent zinc sulphate solution, until the hooves appear healthy, and dry.
- All infected parts of the hooves should be pared thoroughly. If any infected material is left behind, the infection may recur after the treatment ends.
- Treat the exposed parts of the hoof with suitable antibiotics, antiseptics or hydrogen peroxide.
• Antibiotics such as tetracycline, or those available on prescription from veterinarians, should be administered intramuscularly to promote healing.
• Treated animals should not rejoin uncontaminated flocks during the wet season. If it is at all possible, they should stay separate, even if they appear to be healthy, as they are potential carriers and should not be allowed to spread the infection to healthy flocks.

Prevention
The following guidelines may be followed to reduce the incidence of foot rot:

• Pare hooves vigorously every year, before the beginning of the foot-rot season (November to May in KwaZulu-Natal).
• Stand the animals in a foot bath containing a 5 percent formalin or 10 percent zinc sulphate solution for several minutes, every week. The foot bath should be large enough to accommodate several sheep at the same time, and shallow enough to wet just the hooves. Scraps of wool, wood shavings or hay should be placed in the foot bath to reduce splashing and wastage. The hooves should first be washed with water in a foot bath, or with a hose. After treatment, the sheep should stand on dry concrete to allow the treatment time to act. Dipping should be done in the shade, to reduce evaporation and formalin fumes.
• Muddy areas should be attended to because that is where infection occurs. Cover areas around kraals, gates and watering points with agricultural lime or gravel.
• Keep animals out of contaminated camps for at least 2 weeks so that the organisms have time to die off.
• Zinc sulphate can be added to a lick in areas where its intake in the diet is low. This should be done judiciously and in consultation with an expert, as mineral imbalances could result.
• Separate infected animals and keep them apart from the flock, even after treatment. Badly or repeatedly infected animals should be slaughtered as soon as possible; they are possible carriers of the bacterium and could have an inherited susceptibility to the infection.
• Select animals for purchase very carefully. If carrier animals are brought onto a previously uncontaminated farm, the disease could establish itself there permanently, or even worse – a more severe strain of the disease could be introduced to an area where a mild form existed before.
• Vaccines for the control of foot rot bacterium have been used successfully, but have limitations. They are fairly expensive and have to be injected often. Immunity is short-lived, and does not offer full protection. The oil base of the vaccine can cause reactions and swelling at the site of the injection. The vaccine is, nevertheless, valuable in controlling contagious ovine foot rot and preventing major outbreaks.
• In New Zealand and Australia, virulent foot rot is eradicated on individual farms by examining the hooves of all sheep in the dry season and culling all sheep showing signs of being carriers (they have misshapen hooves). Eradication often needs more than one season, and must be accompanied by a closed flock policy: no sheep are bought from other farms unless they have been certified free of foot rot.
**ORF**

Orf is an infectious viral disease of the skin of sheep and goats. It occurs in all parts of the world where sheep and goats are farmed, and is common throughout South Africa.

**Occurrence**

All sheep and goat breeds are susceptible to the orf virus, which is related to the group of viruses that cause smallpox. Animals of all ages can be affected, but lambs are the most susceptible. Adult sheep and goats usually develop an immunity to the disease because of exposure to it when they were young. **Humans handling** infected animals can also contract the disease, usually on their hands or arms but occasionally also on the face. People should therefore be careful not to become infected when touching animals that have orf, and they should wear gloves when treating or vaccinating infected animals.

There have been report of dogs developing the disease after eating the meat of animals that died from the orf virus, but infection of dogs and people is rare. Orf is not seasonal and can occur throughout the year, but it is associated with the lambing season because of the number of susceptible young lambs.

**Transmission**

The virus can survive in the veld or in kraals from one lambing season to the next. The new lambs become infected from the grazing or from old scabs in kraals – in other words, by contact with the virus. Lambs can also infect each other by direct contact when they are kept in crowded conditions. Large outbreaks, that spread rapidly, occur where there are thorn bushes or Aristida grasses or “steekgras”, because of the wounds inflicted around the mouths of the animals and on their skin. The thorns cause small wounds on the lips and in the mucous membranes of the mouth. The virus enters these small lacerations and causes a red lump which later forms a scab. Insects such as blackflies (river midges) can also cause injuries that allow the virus to enter the body, and accelerate the spread of the outbreak.

**Symptoms**

The lesions occur mainly on the lips of affected animals, and may spread to the gums and palate. The nose and nostrils are often also infected. In some cases, there are wart-like lesions on the eyelids and ears and even between the claws of the hoof and around the crown. Ewes can develop lesions on their teats from their infected lambs. Any injury to the lamb is a potential site of infection by the virus, no matter where it is, and the infected injury will develop a lesion. The initial lesions look like small lumps or pox. These multiply rapidly and form large scabs. If the scabs are removed, the skin underneath is lumpy, wart-like and bleeds easily. Orf is usually not fatal and the scabs fall off after 2 to 3 weeks, without leaving a lesion. But some lesions become so dense that the lambs refuse to eat and lose condition, and ewes that have lesions on their teats refuse to allow the lamb to suckle and can develop mastitis.

Some lambs develop a more serious form of the disease, where the lesions continue to develop inside the mouth and on the tongue, and even in the rumen, abomasum and small intestine. These lesions can have serious consequences:

- Secondary bacterial infections can lead to death caused by pneumonia or liver abscesses.
- Lesions on the mouth and lips can become so painful that the animal cannot eat or drink.
- Lesions on the udder of ewes can lead to mastitis.
- Blow flies sometimes attach the lesions and lay their eggs around the scabs.
- Some lesions become infected with the *Fusobacterium necrophorum* bacteria, which is fatal.
- The lumpy wool bacteria can also infect the lesions, which makes treatment and healing more difficult.

**Treatment**

Affected areas should be treated with an ointment containing an antibiotic or antiseptic to keep the scabs soft. An aerosol spray containing an antibiotic can also be used. If an infected lamb can no longer drink from its mother, it
should be placed in a camp where there is soft green pasture, such as Lucerne or oats. Very young lambs should be fed milk by stomach tube.

**Prevention**

A veterinarian can prepare a vaccine against orf by collecting scabs from several lambs and grinding them up in a 50 percent glycerol-saline solution. The mixture is made up of 1 g of scabs to 1 ml of glycerol-saline. An antibiotic is added to kill any bacteria. A vaccine is also available from Onderstepoort.

The scab vaccine is used like other pox virus vaccines: the skin is scratched off inside the leg of the animal where no hair or wool grows, and the liquid suspension is applied to the scratches. The scratches should be about 2.5 cm long and not be deep enough to bleed. Check the vaccination site a week later to make sure that scabs have developed. The inner leg is used for vaccinating so that the lesion will not bother the lamb. Vaccination will also speed up the healing of the lesions. Vaccination need only be done on farms where the disease is a problem, to prevent lamb losses and mastitis in ewes.

Many palatable, spiny plants, such as *Eberlancia ferox*, are grazed by sheep and goats in the Karoo. The spines cause wounds in the skin around the lips and mouth, and allow the orf virus to enter the body. The plants contribute to the rapid spread of the disease.

**HEARTWATER**

**Distribution**

Heartwater is caused by a rickettsial organism called *Cowdria ruminantium*. The tick that transmits the disease prefers warm, frost-free areas and can be found in the Lowveld, Bushveld, parts of Swaziland and KwaZulu-Natal and the Eastern Cape coastal area as far south as Mossel Bay. It is also found in most parts of sub-Saharan Africa.

Heartwater is an acute disease of sheep and goats, and can be fatal if not treated. It can lead to large-scale losses in susceptible animals.

**Cause**

The disease is caused by the rickettsial organism transmitted by the bont or heartwater tick (*Amblyomma hebraeum*). During long periods of drought, tick numbers are reduced and animals lose their immunity. When weather conditions change again and bont tick numbers increase, stock losses resulting from heartwater become a serious problem. If animals carrying the ticks are moved to previously unaffected areas, the disease causes severe losses in susceptible animals. However, the ticks will not survive in unfavorable conditions for longer than 1 season.

**Transmission**

Animals that have recently recovered from the disease are carriers of the heartwater organism. Several wild antelope species can harbour both the ticks and the rickettsia organisms. It is almost impossible to eradicate Amblyomma ticks, or heartwater.

When the tick nymphs or larvae feed on an infected or carrier animal, they become infected with the organism. In the next development stage, the tick then passes the organism on to a susceptible animal. The organism cannot be transmitted through the eggs of the ticks. If the ticks’ development stages are interrupted by dipping, the disease can be brought under control.

**Symptoms**
The first symptoms are a fever and listlessness. Animals are reluctant to eat and fall behind the flock when it moves on. If animals are not treated at this stage, they develop muscle tremors. The disease affects the brain, causing the animals to display increasing nervousness and to walk in circles, sometimes with a high-stepping gait; they also lean their heads against solid objects. Eventually, the animals lie down, their heads arched backwards and their legs extended stiffly, and make typical paddling movements with their limbs. Animals that have heartwater become very sensitive to light, blink their eyelids rapidly in bright light, and their eyes dart back and froth. Death occurs soon after these signs are seen. Often there is froth at the mouth and nose in the last stages.

**Post-mortem signs**

One sign of heartwater in a carcass is the presence of straw-coloured or bloody fluid in the body cavities, as well as in the heart sac. The internal organs are dark and full of blood. The lungs are heavy and dark purple, and there is white foam in the windpipe. The spleen is noticeably enlarged. There is also usually haemorrhaging in the inner and outer walls of the heart chambers. The intestines may be reddened.

**Diagnosis**

A veterinarian can confirm heartwater by microscopic examination of a properly prepared brain smear.

**Treatment**

There are several tetracycline preparations available for treating heartwater. It is important to treat animals as soon as possible, and with the correct dose, because it becomes increasingly difficult to treat them as the disease progresses. Animals in the advanced stages of heartwater disease seldom respond to treatment. Medicines past their expiry date or stored at the wrong temperature will not be effective. All labels and instructions should be read and followed carefully.

**Prevention**

There are very effective dips available to control ticks, and stock losses can be kept to a minimum. The tick larvae and nymphs are at their most active in autumn, winter and spring, and the adults in summer. In mild coastal areas, all 3 stages of the ticks’ development may be found simultaneously, at any time of the year. In areas where heartwater is a problem, it is advisable to dip every week in summer and every second week in week in winter. The intervals can be longer, depending on the dip used. The tick population on the veld will also be greatly reduced if dipping continues through the winter months. Animals born in heartwater areas are usually immune, because they are exposed to infection in the first 3 weeks of life, during which time they become naturally immunised and do not contract the disease. They should therefore not be dipped before they are a month old. Tick control should be very light, to maintain immunity. Heartwater susceptibility is not only a matter of the age of the animals but also of the breed – angora goats appear to be especially susceptible to the heartwater organism and they do not develop prolonged immunity. There are different strains of heartwater, and some are more virulent than others. Immunity to one strain will, however, also give immunity to the others. Onderstepoort uses the relatively benign Ball 3-strain to prepare vaccines.

**Vaccination**

Vaccinating lambs and kids younger than 3 weeks of age seldom produces serious symptoms. On farms where heartwater immunisation is done routinely, it is preferable to vaccinate all young animals before they are 3 weeks old. These animals should then be watched carefully for a few days to see if they develop clinical heartwater, in which case they must be treated. A veterinarian should be consulted when adult animals are to be vaccinated. The farmer should not vaccinate more animals than he can treat simultaneously, as the temperature of the vaccinated animals must be monitored at least
once, but preferably twice, a day after the 8th day. Farmers should look out for reaction to the heartwater vaccine in their adult sheep and goats 10 – 18 days after vaccination. Immunity will be improved if the animals have a high temperature for at least 12 hours before they are treated. If they are treated too soon, immunity will not be as effective, because the animals need time to develop good immunity. Block treatment about 10 to 12 days after vaccinating can be considered, but many animals will have poor immunity. Long-acting implants can be used instead of the injected tetracycline treatment. Animals born in heartwater areas are generally immune because they are exposed to infection in the first 3 weeks of life, during which time they become naturally immunised and do not contract the disease. They will retain this immunity for life, if its boosted from time to time by re-infection. Animals introduced from heartwater-free areas are very susceptible and may contract severe, acute heartwater. They should be vaccinated at least a month before they are moved into the heartwater area.

**PARASITES**

**Internal parasites**

Internal parasites or “worms” form the most prevalent, and most important, group of diseases in sheep and goats. More money is spent on combating these diseases, and more economic losses are experienced by farmers, than for any other grouping of diseases. It is probable that on many farms, more money is spent on parasite control than on all other diseases together.

**Classification**

Internal parasites, apart from nasal bots which are actually the maggot larvae of a fly, are classified as follows:

**Roundworms:** These worms have long cylindrical bodies, are unsegmented and have simple life cycles, which involve free-living larval stages. Some are blood suckling, such as the wireworm, while others imply damage the intestine.

**Flukes:** These have shorter bodies and more complex life cycles, which involve a secondary host through which they must pass to complete their life cycle. In Sheep and goat flukes, these intermediate hosts are certain freshwater snails.

**Tapeworms:** They are characterised by long, segmented bodies and an indirect life cycle. In some cases the sheep or goat is the final host (i.e. it has the adult tapeworm) but in other cases carnivores such as dogs play this role, while the sheep is the intermediate host (i.e. it has the intermediate bladder or measles stage in its flesh.)

Worms have a number of effects on the host. Outright death or obvious disease is simply the most dramatic sign in a long list of effects:

**Weight loss** and slower weight gains: Profit from slaughter lambs depends largely on satisfactory weight gains. In young, growing weaners that are particularly prone to parasitism, these gains can be cut dramatically. Some trials indicate that with worms such as the brown stomach worm, an index of infection such as the faecal egg count (f.e.c.) shows a reduction in live-weight fain of 30 g for each 100 eggs per gram (e.p.g.) of faeces. Other trials show that even on good feed, parasitism causes weight gains to drop by 25 percent. This illustrates how easy it is to underestimate the effect of parasitism on profits, as many advisors will not advocate treatment at low e.p.g. counts.

**Reduced milk production:** Parasitism affects ewes that are heavily pregnant or lactating much more than otherwise. Estimates of 15 percent lower milk production show that this will impact severely on lamb growth, which has further knock on effects such as later weaning and reduced fertility.

**Lower carcass quality and value:** Not only are weight gains reduced, but parasitism can cause carcass quality to drop, an din extreme cases could lead to the carcass being condemned and being a total loss for the farmer. Lower grading on a number of sheep or goats also cause major financial loss. Individual organs can also be condemned for human consumption at the abattoir, as a result of liver fluke, liver tapeworm or bladderworm cysts.

**Blowfly:** Poor parasite control can lead to diarrhea.
Aggravation of other diseases: Existing diseases can be made worse by worm infections. For example, the effects of selenium deficiency become worse in parasitized lambs. Stock also become more prone to infection by other disease organisms.

Reduced reproduction: The general effects of parasitism have a secondary effect on reproduction. Reduced lambing and weaning percentages are the end result.

Treatment programmes
The aim should be to use the right remedy at the right time, for those animals that need treatment, to achieve optimal, cost-effective control of the worm species that pose a danger on the farm in question. This implies that an expert should draw up a programme for each farm, since conditions vary even between neighbouring farms. However, there are a number of principles common to all situations, that should be used in every programme.

- Consider which parasites do not only occur but constitute a threat on farm or in a region.
- The expected climatic factors influence when, and how severe, the worm problem will be when it occurs.
- Deviations from the expected climatic pattern, which alter treatment programmes.
- The use of strategic treatments, i.e. when drug use is likely to have the best effect on parasites on a farm although usually a relatively fixed time, it has to be adapted to the climatic situation every year.
- The use of tactical dosing when and if circumstances warrant treatment. The decision is made on the pattern of recent rain, humidity, temperature, how long the animals have been in a particular paddock, the stocking density, the class of animals to be treated, and the faecal egg count pattern.
- Use the most appropriate drug for the circumstances. This is not necessarily the cheapest, or the most expensive remedy, or the one that has the broadest spectrum.
- The number of treatments should be the minimum needed to achieve affective control.
- Use of prolonged activity drugs or formulations should be restricted to situations where they are really necessary; in effect, only in ewes or does around lambing or kidding time, and immature animals after weaning, when they are most at risk and do not develop good immunity.
- Although it was a standard recommendation for nearly a century, the practice of treating the entire flock and then moving them immediately to a rested, clean pasture is dangerous and can lead to resistant worms becoming dominant. If the entire flock must be treated, then leave the flock in the infected camp for a few weeks to allow them to pick up larvae that have not survived a treatment. These unselected worms will remain dominant and prevent resistant worms from gaining the upper hand.
- However, the old assumption of always treating the entire flock should be dropped. Although some circumstances demand this, as other times it would be better to treat only those animals unable to cope with worms. One practical way of identifying sheep unable to cope with wireworm is to inspect the eye mucous membranes of the entire flock at regular intervals during summer, increasing in frequency to every second week, or even weekly, towards the end of summer. The sheep quickly become accustomed to this and 500 sheep can be done in an hour. Only those that are clearly anaemic (pale mucous membranes) are treated. The system has been widely tested and accepted by farmers in the summer rainfall regions. It has some limitations, however, the most important being that it only works for wireworm, and must be part of an overall worm-control programme. Other worm species are much more difficult to monitor in living animals, and some researchers are testing systems in which a significant proportion of the flock is intentionally left untreated at each dosing.
**Prevention**

Controlling worms entails a combination of treatment measures given above and what follows. They cannot be viewed separately. Only an integrated programme will be successful, long term, in preventing worms from causing financial losses. If we continue to rely too heavily on drugs, the problem of drug resistance, already severe on many farms, will become a major obstacle to profitable sheep/goat farming.

- **Spelling (resting) of pastures.** Wherever possible, goats should not return to graze a pasture within 3 months of the last grazing. This is not always feasible, so the second-best scenario is to return adults (other than heavily pregnant or nursing ewes) to the pasture as they are more resistant to infection.
- **The best way of utilizing pastures from a worm control point of view is to alternate goats with other species, such as cattle or horses.** They are not really susceptible to most goat parasites and when they graze, they remove the source of infection – a “vacuum cleaner” effect.
- **Natural grazing systems (veld management) that require long periods of rest (over 6 months) are also beneficial for parasite control, as few parasites survive on the pasture for such a period.**
- **Fence off danger areas, if this is feasible.** Flukes must have snails, that need permanent water (marshes) to survive, and fencing off these areas makes it possible to limit exposure, and treat only those animals exposed.
- **Leaking water troughs or pipes, especially those in holding pens, are particularly dangerous as they encourage the growth of grass, which becomes very heavily contaminated with worm larvae because of the high concentrations of stock in the pen.**
- **Do not graze susceptible stock (especially weaners) with older, immune animals.** The immune animals may still be producing large numbers of eggs, which can later cause disease in the weaners.
- **Use the faecal egg count to monitor the worm situation on a regular (monthly) basis during the worm season.**
- **Use drug treatment carefully and only when needed.** This will reduce the selection pressure on worms to develop drug resistance, and prolong the useful life of remedies.
- **Breed for resistance.** It has been shown conclusively that some sheep produce far fewer eggs in their dung. More important, this trait is partly genetic and therefore selection is possible. For practical and economic factors, selection is only possible in rams. Make sure that the rams used have also been selected for resistance, on the basis of low f.e.c. This has been extensively tested and also implemented as part of practical breeding in both Australia and New Zealand, and should be used elsewhere.
- **Select for resilience.** Animals able to withstand the effects of parasites should be preferred to those needing several treatments. At present, this is only feasible for resistance to wireworm, using the FAMACHA system of treating according to anaemia. Animals treated are marked with plastic cable ties around a leg each time, and those with multiple ties at the end of the season are clearly the ones to be culled.

**CORRECT VACCINATION TECHNIQUE**

To minimize carcass damage and to prevent further infection after vaccination, it is important to give careful attention to vaccination technique and hygiene. To avoid carcass damage it is important to:

- **Sterilise all needles and metal vaccinator guns by boiling in water for at least 10 minutes before use.** If using a plastic vaccinator gun immerse in 500 ml of water plus 20 ml of household bleach (4% w/v available chlorine) for 1 hour. Flush with cool boiled water before use. Avoid the use of strong disinfectants.
- **Needles should be sharp and clean, replace frequently (every 20-30 animals)**
- **Short needles work best.** For sheep/goats the recommended maximum size needle is 15 mm x 18 gauge.
- **Avoid injection of animals during wet weather or under dusty conditions.**
- **Inject animals only under the skin and not into the muscle.** This is best achieved by raising a fold of skin and injecting the dose under the raised skin.
- **Inject animals high up on the neck, behind the ear.**
Storage of Vaccines
It is recommended to store all of the Coopers vaccines in a refrigerator between 2°C and 8°C. Vaccines should be protected from light and used before the expiry date marked on the label. The use of an insulated container is recommended during the day to protect the vaccine. If vaccine is to be hung beside the race, ensure it is on the shady side. Once opened, it is recommended that the vaccine be used up within 24 hours and any remaining vaccine after this time should be discarded.

Resealing Instructions
A partially used pack can be kept for use the next day if the following steps are taken:
1. Unscrew the delivery tube from the vaccine pack.
2. Empty the delivery tube and vaccinator by depressing the plunger several times.
3. Disinfect the stopper.
4. Store the vaccine in the refrigerator.