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Common Diseases and Health Problems in Sheep and Goats

Lynn Pezzanite, Animal Sciences Student, Purdue University
Dr. Michael Neary, Extension Small Ruminant Specialist, Purdue University
Terry Hutchens, Extension Goat Specialist, Univ. of Kentucky
Dr. Patty Scharko, Extension Veterinarian, University of Kentucky

A sound management program to keep animals healthy is basic to production of both sheep and goats. Producers must observe animals closely to keep individual animals and the whole herd or flock healthy and productive. If the heath status of a herd is compromised, that operation will not be as efficient as possible.

There are some human health risks when dealing with diseased animals. While most diseases affecting sheep and goats do not pose any human health risks, some are zoonotic and it is important to protect not only caretakers, but anyone else that may come in contact with diseased animals.

Sheep and goats share many health problems. While there are some important differences between the species, this publication gives a broad overview of diseases and health problems. For further information on specific diseases, references and sources of additional information are available at the end of this document.

Evaluating Animal Health Status

To recognize clinical signs of diseases common to sheep and goats, it is important to be familiar with what is normal. Producers should assess the herd or flock's general health on a regular basis, including vital signs, body condition, and coat.

A normal temperature range for sheep and goats is between 101.5°F and 103.5°F. The respiration rate for sheep and goats is about 12 to 15 breaths per minute (depending on environmental temperature), and heart rate should be between 70 and 80 beats per minute.

Animals should exhibit a healthy hair coat or fleece, while maintaining a body condition score appropriate to their production stage. Both coat and body condition score are good indications of nutritional adequacy and overall health. Signs of an unhealthy animal include isolation from the rest of the herd/flock, abnormal eating habits, depression, scouring or diarrhea, abnormal vocalization, teeth grinding, or any other abnormal behavior.

Prevention of Disease

Biosecurity begins with the goal of preventing the spread of infectious agents from infected to susceptible animals. A biosecurity plan must take into account all modes of transmission, including direct animal contact within a herd, contact with wild animals or other domesticated species, airborne transmission, contaminated feed or water, and visitors or vehicles that come onto the farm.

The most basic method of disease control in individual herds/flocks is to avoid introduction of disease agents. If possible and practical, producers should keep a closed herd/flock. Most diseases of a contagious nature are introduced into operations when new animals are added. Disease agents can be introduced when breeding animals are added to an operation; when animals co-mingle at a fair, show or sale; or when animals contact wildlife. If a closed herd/flock is not feasible, then use an animal quarantine program. A useful isolation program consists of a facility that prevents co-mingling of animals for at least 30 days, including separate water supplies.

Restricting traffic in and out of a facility can reduce the potential introduction of pathogenic agents. Producers should minimize the number of people and vehicles that enter premises or require a sanitation and disinfectant plan to prevent spread of disease agents.

Other important management tasks that can prevent or help minimize disease issues are sanitation of facilities (especially shared livestock trailers), good ventilation or air turnover, proper stocking or animal density rates, and a good nutrition program.

Utilizing a Veterinarian

Many sheep and goat producers complain that they cannot find a veterinarian who is knowledgeable or interested in sheep and goats. Some veterinarians are very interested in small ruminants and act as important resources for producers. Producers share some of the blame for not attracting knowledgeable animal health professionals to practices that include sheep and goats. Too often, producers only utilize a veterinarian when they have an emergency. Often, these emergency situations do not turn out as successfully as the veterinarian or the producer would like.

However, producers can adopt strategies to attract a veterinarian to service their animal-health needs. First they should cultivate a relationship with the veterinarian as a trained professional to help in whole-herd health maintenance and not just as a source of free information or emergency service. Proactive management tasks such as breeding soundness exams on rams or bucks, tailoring a vaccination program to the producer's farm, purchasing supplies and vaccines from the vet, and using their services for other animals such as household pets are just a few examples. Additionally, producers can work together to obtain services from a veterinarian. Producers who coordinate with other sheep and goat producers in a geographic region are more likely to attract the attention of a veterinarian who is interested in sheep and goats.

Advice and treatment from a veterinarian is almost an absolute in preventing and controlling health problems in a herd/flock. Veterinarians can recommend vaccination programs; help with parasite control programs; assist with reproductive management; deal with emergency situations; prescribe drugs that may be useful, but are not approved for sheep or goats; do necropsies on dead animals; and perform a host of other important management tasks.

Vaccination Programs

Vaccinating the herd/flock can provide some insurance against specific common diseases. However, each vaccination program must be tailored to an individual operation. It is also important that producers understand what they are vaccinating for and why it is important. This is another instance where a veterinarian's assistance can be critical.

Just because there is a vaccine available for a specific disease does not mean producers should use it. There should be economic or other justification to vaccinate for specific diseases. Producers should work through the risk factors and other control programs with a veterinarian and decide whether or not it makes sense to vaccinate.

The clostridial vaccines are the only ones that can be recommended on a blanket basis for almost all sheep and goats. All other vaccination programs need to be developed specific to a herd/flock.

Sheep and goats should be vaccinated for *Clostridium perfringens* Types C and D and tetanus (CD&T) at appropriate times. Combination vaccines (7- and 8-way) are also available against other clostridial diseases, such as blackleg and malignant edema. These vaccines are inexpensive, and when used properly, are very effective in preventing losses.

Clostridial diseases are endemic to all sheep and goat operations. They are caused by specific bacteria that commonly live in the gut and manure of sheep and goats and, under specific conditions, can affect both sheep and goats. More information on these diseases will be discussed in the next section.

When handling vaccinations, it is important to follow label directions, as vaccines must be stored, handled, and administered properly. Only healthy livestock should be vaccinated.

Clostridial Diseases

Enterotoxemia Type C, or bloody scours, can occur in two distinct forms. The first form, known as struck, is seen in adults that do not normally exhibit clinical signs. Ulcerations of the small intestine are noted upon necropsy. The second form, known as enterotoxic hemorrhagic enteritis, occurs in lambs or kids within the first few days of life. It causes an infection of the small intestine, resulting in bloody diarrhea or sometimes death without clinical signs. Enterotoxemia is often related to indigestion. It is predisposed by an overabundance of milk, possibly due to the loss of a twin. The risk of enterotoxemia can be reduced with

adequate hygiene at parturition, such as eliminating dung or dirt tags in the wool and cleaning udders.

Enterotoxemia Type D, also known as pulpy kidney or overeating disease, is seen more frequently in sheep than goats. It can occur in lambs less than two weeks old, those weaned in feedlots, those on high carbohydrate diets, or sometimes in animals on lush green pasture. It normally affects the largest, fastest-growing lambs or kids. A sudden change in feed causes this organism, which is already present in the gut, to reproduce quickly, resulting in a toxic reaction. In some cases, animals exhibit uncoordinated movements and convulsions before death.

Tetanus, or lockjaw, is caused by *Clostridium tetani*, when the bacteria gains entry to the body through a contaminated break in the skin. Most cases of tetanus in sheep are secondary to tail docking and castration, especially when rubber bands are used in the process. Animals with tetanus become rigid, exhibit muscle spasms, and eventually die. Treatment is usually unsuccessful, but the disease can be prevented with vaccination and good hygiene. Tetanus can be transmitted to humans, so care should be taken when handling an outbreak.

It is important to vaccinate, especially with CD&T, at appropriate times to utilize the vaccine to the herd's best advantage. If ewes and does have not been vaccinated with CD&T before, or if more than a year has passed since their last vaccination, they should be vaccinated twice with CD&T, with the last vaccination occurring 20 days before parturition. They would then only need one annual booster in subsequent years about 30 days before lambing/kidding. The vaccination 30 days before parturition will confer passive immunity to the offspring via the colostrum. These maternal antibodies will protect the offspring for five to eight weeks. Lambs and kids should then be vaccinated at six to eight weeks, and given a booster shot two to four weeks later.

Soremouth

Soremouth, also known as contagious ecthyma, is a viral skin disease. The condition is caused by a Pox virus that requires a break in the skin to enter the body. Clinical signs of a soremouth infection include scabs or blisters on the lips, nose, udder and teats, or sometimes at the junction of the hoof and skin of the lower leg.

Soremouth results in loss of condition, depressed growth rates, increased susceptibility to other diseases, and death by starvation, since affected animals are less willing to eat while the infection persists. The most serious problem with sore mouth, however, is in susceptible lactating females that have never been infected or vaccinated, as they can get the lesions on the teats. This makes it painful for them to allow their offspring to nurse, which can lead to premature weaning and even mastitis. There is a commercial vaccine available. Normally, the infection will resolve itself in one to four weeks, with immunity lasting for several years.

Soremouth is transmitted by direct contact with affected animals or contact with equipment, fences, feed, and bedding that have been exposed to the virus. The condition will resolve on its own, but can be treated topically with iodine/glycerin solution. It is important to not use a brush or other utensil to rub or abrade the area of a sore mouth lesion as it will spread it further on the face or other tissue. Often, the best way to deal with sore mouth lesions is to leave them alone and let them clear up over time. If flies or other insects are a concern, treat the affected area with an insecticide.

These sheep have soremouth.

It is important for handlers to wear gloves when dealing with soremouth, as the virus is contagious to humans. When humans contract sore mouth, it is termed orf. It can cause painful and contagious lesions on the skin, very often on the hands or fingers. Care should be taken when handling animals with soremouth, handling animals that have been recently vaccinated, and handling the vaccine.

The vaccine is a live virus that, when applied, actually causes the disease locally. The live vaccine for soremouth will cause soremouth lesions at a specific location on the body chosen by the handler. A hairless area of the animal, such as the inside of the ear, under the tail, or inside of the thigh, is scratched, and the vaccine is applied to this area. Because the vaccine is a live virus, it is important to only vaccinate for the virus if it is already present in the herd, as it will introduce the virus if it is not already there. Producers that have closed herds/flocks and don't have sore mouth probably have no need to vaccinate for sore mouth. Once soremouth is introduced to an operation, either from vaccination or other means, it usually returns yearly to susceptible animals.

Internal and External Parasites

For more in-depth information on parasites, refer to Purdue and Kentucky Extension Publication AS-573-W on *Managing Internal Parasitism in Sheep and Goats*.

Parasites pose a significant threat to the health of small ruminants. Parasites can damage the gastrointestinal tract, and result in reduced reproductive performance, reduced growth rates; less productive animals in terms of meat, fiber and milk; and even death.

General clinical signs that an animal is suffering from a parasitic infestation include diarrhea, weight loss or reduced weight gain, unthriftiness, loss of appetite, and reduced reproductive performance. Factors that may affect an individual's susceptibility to parasitism include natural genetic resistance, age, and reproductive stage.

Goats are generally more susceptible to internal parasites than sheep. The groups most susceptible to parasitism are young animals, lactating ewes and does, and those in late gestation or around the time of parturition. The animals least susceptible to parasites are mature, dry ewes.

Internal Parasites. Several types of internal parasites affect sheep and goats, and all sheep and goats have a low level of parasite activity. However, excessively high parasite levels are often detrimental to the health of the animal. The most common internal parasite is the roundworm that lives in the abomasum and small intestine of sheep and goats. There are several types of roundworms that infect sheep and goats, including *Telodorsagia* (*Ostertagia) circumcincta, Haemonchus contortus,* and *Trichostrongylus colubriformis.*

The most dangerous parasite affecting sheep and goats is the gastrointestinal roundworm *Haemonchus contortus*, also known as the barber pole worm. This voracious bloodsucking parasite has a tremendous capacity to reproduce through egg-laying. Clinical signs include anemia (pale mucous membranes), edema, protein loss, and death. Animals suffering from *Haemonchus contortus* become weak and lethargic, often straggling at the back of the herd when driven a distance. Edema, or the accumulation of fluid under the skin, is usually seen as a swelling of the lower jaw, a condition known as bottle jaw.

Tapeworms can cause weight loss, unthriftiness, and gastrointestinal upset. A tapeworm infection can be diagnosed by yellowish-white segments in the feces. Lambs and kids become resistant to tapeworms quickly, so infections are most common in animals younger than four or five months of age. The biggest problem with tapeworms is that producers can actually see the segments in fecal matter and can become overly concerned. Infections by other internal parasites are more serious than a mild tape worm infection.

Coccidia are protozoan parasites that damage the lining of the small intestine. Since the small intestine is an important site of nutrient absorption, coccidia can cause weight loss, stunted growth, and diarrhea containing blood and mucous. Other clinical signs include dehydration, fever, anemia, and breaking of wool or hair. Fly strike and secondary infections can also result from coccidiosis. Coccidia are usually found in animals in confinement or intensive grazing systems, as a result of poor sanitation, overcrowding, and stress. Animals between one and six months of age in feedlots or intensive grazing systems are at highest risk for coccidiosis. Outbreaks of coccidiosis can be controlled by implementing good sanitation techniques, providing clean water, rotating pastures, and avoiding overstocked pens. Outbreaks of coccidiosis can be treated with sulfa drugs. Coccidiostats can be administered to inhibit coccidial reproduction.

Anthelmintics are drugs that either kill egg-laying adults or kill larvae before they grow into adults and become capable of laying eggs. An anthelmintic is normally administered as an oral drench, a thick liquid suspension deposited at the back of the animal's tongue. There are challenges associated with using anthelmintics, since few are approved by the FDA for use in small ruminants (although many are safe), and resistance to the drugs can develop due to overuse and improper dosing. Fecal Egg Count (FEC) Tests can be done to determine when it is necessary to deworm, and to help determine the level of pasture contamination.

A system known as FAMACHA has been developed to identify those animals affected by *Haemonchus* that require anthelmintic. In this method, producers observe the color of the conjunctiva of the lower eyelid to determine the level of anemia that an animal is experiencing. The goal of FAMACHA is to delay resistance by only selectively treating animals in a herd that are showing signs of a parasitic infection. Sheep and goat producers should be trained in the use of the FAMACHA system as it can reduce the need for anthelmintic use and delay anthelmintic resistance.

External parasites may damage the fleece and reduce pelt value. Parasites common to sheep or goats include lice, keds, and mites. External parasites are especially common in the winter when sheep or goats are in closer confinement. Pour-on treatments are a common form of management for many external parasites, and are more effective on shorn sheep or short-haired goats.

This picture shows a goat with bottle jaw, a symptom of parasitic infection. *Photo courtesy of Dr. Ray Kaplan, DVM, University of Georgia*

The many species of lice that parasitize sheep and goats are generally divided into chewing lice and sucking lice. Chewing lice feed from dead skin cells, while sucking lice feed by sucking blood. Lice can be detected by the presence of their eggs, called nits, which are not susceptible to insecticides. Sheep or goats exhibiting wool or hair loss should be checked for nits. Chewing lice are eradicated with pour-on topical insecticides, while sucking lice can be treated with specific anthelmintics that control them.

Keds pierce the skin and suck blood, and are usually found on the neck, shoulders, and flanks. Ked bites are very irritating to sheep, causing them to scratch, rub, and bite themselves, which damages the wool. Keds also cause wool discoloration, which further reduces the value of the fleece. Ked bites affect the hide quality as well. Shearing sheep will remove most adult keds and larvae, and is especially important before lambing. Further treatment with pour-on insecticides after shearing or injection of Ivermectin are both effective methods to wipe out a ked infestation.

Unlike lice and keds, mites burrow beneath the skin instead of living on the surface. This irritates the skin, causing the sheep and goats to itch, which results in wool or hair loss and lesions or scabs. Mange can be diagnosed by doing a skin scraping. Administering injectable Ivermectin or topical insecticides can help affected animals.

Respiratory Problems

Respiratory infections, or pneumonia, are a common and serious disease in sheep and goats. A number of different types of pneumonia complexes affect sheep and goats. Many times, a combination of viral and bacterial agents infect the lungs as a result of stress such as weaning, transport, change of weather, poor air quality (high ammonia in confinement or dusty conditions in corrals), or a combination of factors.

Clinical signs of pneumonia include fever with a temperature over 104°F, along with a moist, painful cough and dyspnea (difficulty breathing). Anorexia and depression may also be observed in an animal suffering from pneumonia. Treatment of pneumonia upon diagnosis involves administration of antibiotics. Because there are different types of pneumonia, it is important to work with a veterinarian to identify the type of pneumonia present and determine the most effective treatment.

To reduce the incidence of pneumonia, it is important to implement optimal sanitation and air quality practices in herd housing. Making sure buildings have adequate ventilation and reducing dust are very important. Any environmental condition that irritates the lungs gives infectious agents a chance to affect the animal. Minimize transportation stress, and quarantine new animals before introducing them to the rest of the herd to prevent the spread of outside pathogens. Provide good nutrition and water, and supplement with trace minerals to enhance immune function as necessary. For more in-depth information on footrot, refer to Purdue and Kentucky Extension publication AS-596-W, *Footrot in Sheep and Goats*.

Foot Scald / Footrot

Footrot is a bacterial infection prevalent in warm, moist areas. Footrot is caused mainly by the synergistic action of the bacteria *Fusobacterium necrophorum* and *Dichelobacter nodosus.* The *D. nodosus* bacteria can cause various degrees of involvement of the sole. Footrot can have a range of clinical signs, depending on the specific strain(s) of *D. nodosus* present.

Foot scald infects only the area between the toes and often clears up quickly with treatment or with improving environmental conditions. Virulent footrot is much more of a problem, as the bacteria enter the hoof and digest the hard, horny tissue of the sole that protects the fleshy tissue of the hoof. Virulent footrot in sheep and goats causes much economic loss and increased management effort. Once it infects a herd/flock, it is difficult to eradicate.

This picture is of a goat with foot scald. *Photo Courtesy of UK and KSU Goat Producers Newsletter, December 2008.*

Clinical signs of foot scald include redness and inflammation between the toes and a bad odor. In advanced cases, the hoof horn becomes under run and actually can separate from the hoof wall. Foot scald and footrot can cause lameness, reduced weight gain as animals are less willing to move to feed, and decreased reproductive capabilities. These conditions result in production losses, treatment and prevention costs, premature culling, and reduced sale value of infected animals.

Both sheep and goats are susceptible to footrot. Moreover, some of the different strains of *D. nodosus* affect both animal species. In general, goats are usually less severely affected by footrot than are sheep.

Footrot commonly appears on a farm when an infected sheep or goat is brought into the herd. The *D. nodosus* bacteria can not live in the environment for more than about 14 days, so almost always, the source of the bacteria in an unaffected herd/flock is a carrier animal. Footrot occurs more commonly when feet are not trimmed frequently enough and in crowded housing situations. Some individuals are genetically more susceptible than others, and 5 to 10 percent of infected sheep become chronic carriers of footrot. These animals should be culled to prevent them from re-infecting the rest of the herd.

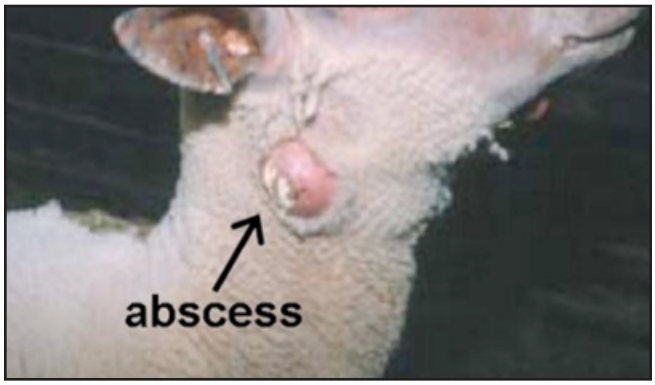
While not as likely as with carrier animals, footrot can also be spread on boots, tires, feeders, or handler's hands, so care must be taken if footrot is present in the herd. Producers should not purchase animals with footrot or from infected flocks, and should not use areas or vehicles that infected sheep have inhabited. Quarantine any new additions to the herd for 30 days, and trim feet before introducing them to the other animals.

To prevent footrot, it is absolutely imperative to avoid the introduction of the disease to a footrot-free herd/flock. Other management tasks that help maintain good foot health include regular hoof trimming and sound nutrition. Foot soaking baths using zinc sulfate can be constructed to treat footrot in conjunction with systemic treatment. Vaccines are effective 60 to 80 percent of the time, and can be used with other management practices to reduce the prevalence of footrot. A combined treatment plan of foot trimming, foot baths, vaccination, and antibiotic treatment (for the most severe cases), can be effective in controlling the physical clinical signs of footrot. To eliminate footrot from the herd takes a dedicated and labor-intensive plan of action that includes treating animals, separating infected from non-infected animals, and culling of animals that can not be cured.

Caseous Lymphadenitis

Caseous lymphadenitis (CL) is a condition that affects the lymphatic system, resulting in abscesses in the lymph nodes and internal organs. When it affects the internal organs, CL becomes a chronic wasting disease, with economic losses due to reduced hide value and carcass trimming. CL can also result in decreased weight gain, wool growth, milk production, and reproductive capabilities. Affected animals are often culled early and may die.

Caseous lymphadenitis is caused by the bacteria *Corynebacterium pseudotuberculosis*. An abscess can develop either at the location where the bacteria enters the body or at a lymph node nearby. From there, the infection can spread through the blood or lymphatic system, causing abscesses to form in other lymph nodes or internal organs throughout the body. The organs most commonly affected are lung, liver, kidneys, and their associated lymph nodes. Abscesses, though not painful, grow slowly over time, and may rupture if close to the skin. The disease is spread by direct contact with an infected animal or through contaminated equipment or a contaminated environment.



This sheep has caseous lymphadenitis. *Photo Courtesy of Dr. Justin Luther, Ph.D., and Dr. Charlie Stoltenow, DVM, North Dakota State University*

While infected animals may show no clinical signs, CL can cause anemia, anorexia, weight loss, and fever. Caseous lymphadenitis is a significant human health risk as well, since it has zoonotic potential. The disease can be contracted by humans through consumption of raw milk from infected sheep and goats, or if humans come in contact with infected carcasses and the bacteria enters a break in the skin. The spread of CL to humans can be prevented by reduced contact with contaminated objects, and through the pasteurization of milk before consumption.

A vaccine for this disease is available in two forms. The first is a toxoid for the bacteria causing CL alone, and the second can be combined with the CD-T vaccine. The vaccine works best in animals that do not already show signs of CL infection. Do not vaccinate for CL in the last trimester of pregnancy to avoid vaccine-induced abortions. The vaccination does not treat for existing infections; animals must be vaccinated prior to exposure for the vaccine to be effective. The use of this vaccine is controversial, and producers should seek the advice of a veterinarian before making it a part of their herd management program. It does not provide complete protection, so cases will still occur on a farm infected with CL, but the incidence will decrease.

Listeriosis

Listeriosis is a bacterial infection caused by the bacteria *Listeria monocytogenes*. Natural reservoirs for the bacteria are the soil and the GI tracts of mammals. Sheep and goats usually ingest *L. monocytogenes* by grazing pastures contaminated by feces containing the bacteria. The bacteria can also gain entry to tissue via wound or inhalation.

Listeriosis is also a concern when animals are consuming ensiled forages such as haylage or corn silage. Try to not feed the moldy portion of silage to animals and limit soil contamination when putting up silage, as listeriosis is most prevalent in the soil and in molded areas of silage.

Listeriosis can result in abortion, septicemia, or meningoencephalitis. Clinical signs of listeriosis include anorexia, depression, disorientation, facial paralysis, excessive salivation, and in severe cases, affected animals may fall on their sides and exhibit involuntary running movements. Abortions due to *L. monocytogenes* usually occur during the third trimester of gestation, and may occur at a rate of up to 20 percent in affected sheep flocks. Encephalitis and abortion do not usually occur simultaneously in a flock.

L. monocytogenes affects sheep and goats of all ages and both sexes. Onset is fast, and death may occur 24 to 48 hours after onset of clinical signs. Diagnosis of listeriosis is confirmed by isolation and identification of *L. monocytogenes*, usually from the cerebrospinal fluid. Bacteria have also been isolated from nasal discharge, urine, feces, and milk of affected animals.

Listeriosis should be treated aggressively with high doses of penicillin or tetracycline, along with supportive therapy, including fluids and electrolytes. As *L. monocytogenes* can be transmitted to humans who handled aborted lambs or kids, or during necropsy of septicemic animals, precautions should be taken. While cases of human listeriosis are rare, mortality rates can be as high as 50 percent, and there is the risk of abortion for pregnant women who contract the bacteria.

Abortive Diseases

Abortion refers to a female losing her offspring during pregnancy or giving birth to weak or deformed babies. Abortions can be due to infectious or non-infectious agents. Non-infectious abortions can be caused by trauma such as fighting or rough handling, but are much less common. The main infectious agents that cause abortion in sheep and goats are Vibriosis (*Campylobacter)*, *Chlamydia* (also known in sheep as Enzootic Abortion of Ewes or EAE), Toxoplasmosis, and Leptospirosis to a lesser extent. In addition, Border disease virus, Cache Valley virus, *Listeria*, and *Salmonella* have been known to cause abortion in sheep and goats in specific regions of the United States.

Care should be taken when handling aborted fetuses or placentas, as all the pathogens that cause abortion in sheep and goats can be transmitted to humans.

Campylobacter infections result in late pregnancy abortions or stillbirths. They are seen much more commonly as a cause of abortion in ewes than in does. If the abortions are due to an infection by *Campylobacter* bacteria, infected animals are often responsive to either tetracycline or sulfa drugs to prevent further abortions. A vaccine is available to prevent Campylobacter infections.

Chlamydia infections cause abortions during the last 2 to 3 weeks of gestation, resulting in stillbirths and weak offspring. Ewes and does infected by this bacterium rarely abort more than once, but can continue to shed the bacteria from their reproductive tract, infecting other herd members. It is likely the infectious agent is *Chlamydia* bacteria if the abortions occur in ewe lambs or young ewes. Abortions due to *Chlamydia* bacteria can be stemmed by treating ewes with tetracycline given in the feed or by injections. There is also a vaccine for *Chlamydia*.

If ewes or does contract ***toxoplasmosis*** early in gestation, they usually reabsorb the fetus. When infected later in gestation, abortions are common. Toxoplasma abortions are unique in that Toxoplasma is a protozoan parasite, not a bacterim, so the manner in which ewes are infected is different. Toxoplasma is a parasite of cats and rodents, who shed the agent into the environment (hay or feed) through their feces, where it can be ingested by sheep or goats. The only treatment for toxoplasmosis is prevention. It is important for producers to cover stored feed and discourage stray cats from hanging around barns that house gestating ewes or does. Feeding a coccidiostat, such as Monensin or Decoquinate, mixed into feed can also be effective in preventing abortion due to toxoplasmosis. Not all coccidiostats are FDA-approved for sheep and goats, so a veterinarian should be consulted if this method is considered, as several can be effective.

Leptospirosis, caused by the bacteria *Leptospira interrogans*, can cause abortion in goats, though sheep are less susceptible. It is generally transmitted when animals come into contact with standing water, such as a lake or pond, with the bacteria. Clinical signs of infection may also include anemia and icterus. Icterus, also known as jaundice, is a condition where the skin and white of the eyes appear yellow due to an accumulation of bilirubin in the blood caused by the breakdown of red blood cells. It can be a symptom of anemia or liver disease. A diagnosis of Leptospirosis can be made conclusively by testing the dam's urine, the aborted fetus, or the placenta.

Q fever is a bacterial infection that can cause abortion, especially in goats, but also in sheep. It is caused by the bacteria *Coxiella burnetii*, which are shed in milk, urine, feces, placental tissue and amniotic fluid, as well as spread through the air. Pasteurization is effective in killing the bacteria in milk. Clinical signs in ruminants include anorexia, abortion, and lesions. The disease is usually diagnosed by bacteria from an infected placenta, which will be covered with a gray-brown secretion. Outbreaks can be managed by administration of oral tetracycline, separating pregnant animals inside from the rest of the herd, and burning or burying reproductive waste. The disease can be spread to humans, especially farmers, veterinarians, and researchers who assist in the birthing process, who often exhibit flu-like clinical signs.

Even if a specific infectious agent is suspected as the cause of abortion in a herd or flock, it is still necessary to submit an aborted fetus and placenta to a diagnostic lab for confirmation. It is important to include the part of the placenta where lesions are present as this is critical to identification. Producers can work with veterinarians when packaging and shipping the fetus and placenta. To prevent the spread of infectious agents while waiting for results from the diagnostic lab, aborting ewes or does must be isolated from the rest of the herd, and aborted fetuses or placentas should be removed from the pen.

Specific management practices can help to reduce the incidence of infectious abortions in the herd or flock. Any new additions to the flock or herd should be quarantined or, if they are pregnant ewes or does, penned separately until they give birth. *Campylobacter* and *Chlamydia* bacteria are often spread to a non-infected herd or flock when a purchased animal is introduced from another farm. Feeding high doses of tetracycline prior to lambing or kidding has been effective in reducing *Chlamydia* and *Campylobacter* abortions. Ewes or does should not be fed on the ground, as *Campylobacter* and *Chlamydia* are transmitted by ingestion of materials in contact with infected feces or fetal and placental fluids. Vaccination for *Campylobacter* and *Chlamydia* is important for flock or herd health as well. There is, however, no vaccine for toxoplasmosis available in the United States.

Polioencephalomacia

Polioencephalomacia is a condition found usually in feedlot lambs between 5 and 8 months of age, but can affect sheep of all breeds, sex, and ages. Losses are most often sustained in animals on a high plane of nutrition.

There are two levels of this disease, subacute and acute. In the subacute form, animals show signs of incoordination, weakness, tremors, blindness, and depression. In the acute form, lambs are found dead or comatose, experiencing involuntary muscle contractions or seizures. Body temperature is not affected. At necropsy, lesions in the central nervous system and necrosis of the cerebral cortex of the brain are found.

Polioencephalomacia is thought to be caused by thiamine deficiency as a result of diets or water containing toxic levels of sulfur. A thiamine-like substance is produced in the rumen during digestion of high-sulfur diets. This thiamine-like substance competes for thiamine receptors in the rumen and binds some of the receptors in the place of thiamine. As a result, less thiamine is absorbed by the body, even though thiamine production in the rumen is sufficient. This decreased thiamine absorption results in neuronal degeneration and death of brain cells. Traditional diets do not contain high levels of sulfur.

Polio seems to be endemic to certain farms, probably due to types of feedstuffs or water available. Some water wells contain high levels of sulfur in the water, and some feedstuffs are known to contain high levels of sulfur. Fish products and by-products from corn distillation for ethanol (distillers' grains) have high levels of sulfur. If polio is a problem on specific farms or if feed ingredients with high sulfur content are fed, then thiamine should be routinely added to grain mixes fed to sheep and goats.

A diagnosis of polioencephalomacia can be made when clinical signs such as blindness are observed in animals with normal temperatures, or lesions are found during necropsy. To treat the condition, thiamine hydrochloride can be administered twice daily for several days. Affected animals should be isolated to provide easy access to feed and water. Intravenous (IV) fluids, electrolytes, and nutrients can be given using a stomach tube if necessary. Complete recovery depends on the extent of damage done to the brain.

Mastitis

Mastitis refers to an inflammation of the mammary glands due to a bacterial infection. Udder damage, often caused by mastitis, is one of the leading causes of culling in sheep and goat operations. The risk of developing mastitis increases with poor sanitary conditions, systemic infection, or trauma inflicted by offspring. Mastitis can occur as an acute or chronic condition, and may be localized to a single gland or both.

Mastitis can be diagnosed through physical examination of the udder of the animal or by looking at a sample of milk from an affected gland on a strip cup against a black background. Acutely mastitic mammary glands are warm, swollen, and painful, and may produce milk that is abnormal in consistency or color. If mastitis becomes septic, meaning that bacteria have entered the bloodstream, the condition may be accompanied by signs of fever, anorexia, depression, and lethargy. In chronic mastitis, the main symptom observed is offspring that are failing to thrive, as affected dams are reluctant to let them nurse.

Mastitis can be treated with both intramammary and systemic antibiotics treatment. If mastitis is a chronic problem in an operation, then the causative agent should be cultured, and antibiotic choice based upon those results. It is helpful to work with a veterinarian to develop a mastitis control strategy, as individual cases, even if treated properly, result in udder damage.

White Muscle Disease

White muscle disease is a degenerative muscle disease found in sheep and goats. It is caused by a deficiency of selenium and/or vitamin E. Selenium deficiency is associated with areas where the soil is deficient in selenium, while a vitamin E deficiency reflects poor forage quality. White muscle disease is most often seen in newborns and fast-growing animals.

White muscle disease may affect skeletal muscles, heart muscle, or both. When the skeletal muscles are affected, the animal will arch its back with a hunched appearance, and have a stiff gait. When the heart muscle becomes affected, the animal may present with difficulty breathing; fever; and frothy, blood-stained nasal discharge.

Other clinical signs associated with selenium and vitamin E deficiency that may be seen along with white muscle disease include reproductive losses such as lower conception rates, fetal re-absorption, dystocia, retained placenta, reduced milk production, reduced semen quality, and reduced immune response.

White muscle disease can be treated with an injection of both vitamin E and selenium since the condition may be caused by a deficiency in one or both. Affected animals will usually respond to a single treatment within 24 hours, and a second dose of vitamin E (though not selenium) may be given if individuals are unresponsive. Treatment should not exceed two doses on a short-term basis.

Selenium and vitamin E deficiencies occur when animals are fed feedstuffs low in one or both compounds. Indiana and Kentucky, and most surrounding states, are known to have selenium-deficient soils. The disease can be prevented through feed and mineral supplementation. Injections of selenium and vitamin E can also be given, but a producer should get advice on the use of these injections from a veterinarian.

Pregnancy Toxemia

Pregnancy toxemia (ketosis) affects ewes or does during late gestation. It occurs more commonly in sheep than goats. It occurs most commonly in either fat or thin animals that carry two or more feti. The condition develops when the ewe or doe cannot ingest enough nutrients to meet both the glucose requirements of the growing fetus and her own body metabolism. During early gestation, the dam's increased appetite is enough to encourage her to compensate for the increased nutrient needs. By late gestation however, the growing feti are taking up more space in the dam's abdomen, and she is often physically incapable of eating enough to meet her needs unless more nutrient-dense feeds are provided.

If adequate energy is not available to the gestating ewe or doe, she can metabolize body fat to meet her own nutrient requirements. When fatty acids are metabolized at high rates, ketone bodies are produced, which can be dangerous in high levels. The condition where excess ketones are present in the bloodstream, known as ketosis, results in depression and anorexia until the ewe or doe becomes too weak to stand.

Producers can take steps to prevent pregnancy toxemia by properly managing the weight of ewes or does throughout the year, and especially prior to breeding and during gestation. Ewes and does should be body-condition scored at breeding, as overweight and excessively thin ewes or does are at a higher risk for ketosis. They can also be ultrasounded during pregnancy to determine fetal number, and animals gestating multiples can be fed and managed differently than those with singles. If possible, ewes or does should then be divided into two pens and managed differently during gestation to minimize their risk of toxemia. While it is acceptable for overweight ewes or does to lose weight during the first two trimesters, they should be gaining weight by the third trimester.

Feeding grains with increased energy density during the third trimester, or about six weeks prior to lambing or kidding, will help to prevent pregnancy toxemia. Providing higher quality hay is also a good idea for gestating ewes or does. Shearing ewes also makes it easier to monitor body condition and causes increased feed intake.

Lactic Acidosis

Ruminal lactic acidosis, often referred to as grain overload, develops as a result of animals consuming large quantities of carbohydrates. Excessive consumption of carbohydrates, specifically grain, results in a lowered rumen pH. The lowering of ruminal pH, or making the stomach more acidic, occurs because the microbial population of the rumen is not able to metabolize high levels of lactic acid produced during starch breakdown. In general, sheep or goats with the condition demonstrate symptoms of discomfort, anorexia, teeth grinding, muscle twitching, ruminal stasis, and diarrhea that may be off in color with a watery consistency.

The type and intensity of clinical signs depends on acid quantities, which in turn depend on the amount of starch consumed and the ability of microorganisms to metabolize the acids. In sub-acute acidosis, animals may simply decrease intake of high grain or starch diets, while in severe acute cases of grain overload, animals can become extremely sick and the mortality rate is high.

To avoid inducing lactic acidosis in sheep and goats, high grain diets should be introduced slowly over a period of 10 to 14 days to allow rumen microbial adjustment to the diet. Dietary buffers, such as limestone or calcium carbonate, can also be fed to neutralize acid present in the rumen and keep appetite and feed intake high. Do not store grain in areas where sheep or goats can access it easily. Carbohydrate engorgement, resulting in lactic acidosis, can be potentially fatal and result in large economic losses for the producer.

Copper Toxicity

Sheep are especially sensitive to copper poisoning, which may occur in either an acute or chronic form. Acute poisoning can result from accidentally providing excess amounts of copper in mineral mixes or incorrectly balanced grain rations. Low levels of molybdenum or sulfate in the diet can also affect copper metabolism and often predisposes sheep to chronic copper poisoning. Chronic copper poisoning is brought about when sheep ingest too much copper over an extended period of time.

Sheep are especially sensitive to copper in their diet, because they do not excrete copper from the body as efficiently as other species. Ingested copper is bound very tightly in the liver. When the liver becomes saturated, large amounts of copper are released into the bloodstream, resulting in destruction of red blood cells and further tissue damage. Often, sheep do not even exhibit noticeable clinical signs before death.

Preventative management strategies are the best way to minimize the risk of copper toxicity in sheep. This includes providing only feed that is formulated for sheep—with the appropriate levels of copper. Be wary of beef and dairy products as they may contain high levels of copper. Feeds and forages can be tested for levels of copper, molybdenum, and sulfur. Molybdenum can be supplemented at a rate of 3 ppm if levels are low.

Treatment of sheep with copper toxicity should be done by a veterinarian. It usually involves drenching or feeding ammonium molybdate, sodium sulfate, and penicillamine over several weeks. Recovery is variable, so prevention is the best way to reduce the incidence of copper toxicity.

Nutrition and General Management

Nutrition is vital for raising healthy livestock and for proper reproductive management. Flushing, or feeding females so that they gain weight prior to breeding, will help them to conceive. Forages should be used as much as possible when feeding sheep and goats, but producers may need to supplement with protein or energy, depending on nutritional demands. Important times to supplement are during late gestation, during lactation, during growth of replacement breeding stock, and prior to breeding.

Minerals and salt should also be provided year-round in a block, mixed in feed, or loose. Minerals used should be designed and formulated for the species of animal being fed. Goats should be fed minerals formulated for goats, and sheep should be fed minerals formulated for sheep. Remember to pay particular attention to copper content of feeds and minerals used for sheep as they are very susceptible to copper toxicity. Proper mineral nutrition can enhance the immune system of animals. Well-fed livestock are more resistant to diseases and parasites, so balanced rations appropriate for production stage should be fed in order to maintain body condition and control losses due to parasitism and infectious diseases. Any changes in feeding should be made gradually.

Summary

Check List for Maintaining Health of Sheep and Goats

1) Implement a vaccination program, primarily for clostridial diseases and tetanus.
2) Have an effective parasite control program; consider implementing FAMACHA.
3) Quarantine new additions to the herd for at least 30 days. Require visitors to cover feet so they do not track infectious agents between farms.
4) Provide adequate nutrition for optimal reproductive capability and to reduce susceptibility to disease and parasitism.
5) Maintain clean, well-ventilated housing without drafts.
6) Keep a closed herd/flock to avoid many health problems.
7) Establish a working relationship with a veterinarian to prevent and treat health problems.

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