

Animal Sciences

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Footrot in Sheep and Goats

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Footrot is a costly disease in the sheep and goat industry. Countless producers lose time and money each year in an attempt to control it in their flock or herd. If footrot becomes a problem, it takes much effort and labor to control symptoms and eliminate it. However, footrot is a preventable disease with attentive management.

Causes of Footrot

Footrot is caused by the coexistence of two gram-negative, anaerobic bacteria, *Fusobacterium necrophorum* and *Dichelobacter nodosus* (also referred to as *Bacteroides nodosus*). Several different strains of *D. nodosus* affect both sheep and goats, and can also be carried by cattle, deer, and horses. In general, sheep are affected more severely than goats.

The bacteria *Fusobacterium necrophorum* causes a common disease known as foot scald.

F. necrophorum is a natural inhabitant of the large intestine of small ruminants and is found normally in the soil and manure of pastures or feedlots. Infection is exacerbated by cold, wet conditions where mud and manure have been allowed to accumulate. The mud and manure causes interdigital irritation, and *F. necrophorum* readily infects the soft, irritated area. Alone this bacterium is not capable of causing footrot. *Dichelobacter nodosus*, the second bacteria, is only capable of living in the soil for 10 to 14 days, yet can survive in the hoof for extended time periods given the right anaerobic environment.

These bacteria require irritation of the interdigital area, possibly due to moisture or trauma, in order to gain entry for infection. Hard frozen ground such as that in dry lots can cause irritation to the soft tissue, and create ideal conditions for footrot when the ground

warms to mud. Footrot is most prevalent and highly contagious in wet, moist areas. When pastures have been consistently wet with no dry spells there is a higher incidence of outbreaks. The ideal soil reservoir is high in moisture at temperatures between 50°F to 70°F.

Symptoms

Foot scald and footrot result in lameness, reduced weight gain, decreased milk and wool production, and decreased reproductive capabilities as severely infected animals are reluctant to move in order to feed. Affected animals often carry the affected leg or lie down for extended periods, rubbing off the wool/hair on their flanks, brisket, and knees. These conditions result in production losses, treatment and prevention costs, premature culling, and reduced sale value of infected animals. Other diseases that are sometimes confused with footrot are foot abscesses, laminitis (founder), corns, foreign bodies or traumatic injuries.



An example of a hoof with scald. Notice in this recently trimmed hoof that the scald is confined to the interdigital space, and has not underrun the hoof tissue.

There can be a wide range of severity in foot rot infections, depending on the specific strain or strains of *D. nodosus* present. Sheep or goats can have up to 8 strains of *D. nodosus* at one time. Strains of *D. nodosus* exhibit their level of virility based upon the amount of protease enzymes they release, which determines their ability to digest the connective tissue between the horn and flesh of the hoof.

Footrot can be extremely painful, and affects sheep and goats of all ages. **Benign footrot**, or foot scald, is characterized by reddened, inflamed tissue between the toes (interdigital space). It does not include under-running of the hoof horn. Scald can occur on any farm, especially during the wet season and in locations where sheep and goats commonly congregate such as hay and mineral feeding sites, and watering areas. Foot scald will often resolve quickly with treatment or improving environmental conditions. The economic impact to the producer caused by benign footrot is much less than virulent footrot; however, it is often a precursor to virulent footrot.

Virulent footrot is a much larger problem as the bacteria will enter the hoof and digest the hard, horny tissue of the sole that protects the fleshy tissue of the hoof. In more advanced cases, the hoof horn becomes under-run and can actually separate from the hoof wall.



An example of a fairly severe case of footrot. Notice the decayed tissue at the heel and separation of the hoof wall.

In the more virulent strains of footrot, the hard horn of the foot will begin to separate from the underlying tissue about 10 to 14 days post-infection, producing a foul and very distinct smell. By 28 days, the horn may become completely detached or attached only at the coronet. Chronic virulent footrot appears black and tarry, and flystrike is likely to occur.

Susceptibility and Resistance

Environmental conditions, nutrition, and genetics all affect a sheep or goat's susceptibility to footrot. Other factors that can influence susceptibility include foot shape, structure, and age, as younger animals are generally more susceptible. Sheep are usually more severely affected than goats, whereas goats are more commonly affected by foot scald and goats are likely to show different symptoms of footrot when infected with the same strain of bacteria. It is estimated that 5% to 10% of infected sheep become chronic carriers of foot rot. Sheep and goats that have been infected with or exposed to footrot do not develop classic resistance or immunity.



A hoof that is overgrown, full of caked mud and manure, with evidence of necrotic tissue at the heel. Hooves in this condition are more susceptible to footrot infection.

The severity of a footrot infection is scored on a scale of 1 to 5. Benign footrot, or an inflammation between the claws, receives a score of 1 or 2. Under warm, moist conditions this can progress to virulent footrot, with a score of 3, 4, or 5. When there is significant under-running of the hoof, the foot has a score of 3. If there is separation of the soft and hard horn from the underlying tissue across the entire sole, the foot has a score of 4. If this separation extends up the wall, the foot receives a score of 5.

Some individuals are genetically more susceptible than others to footrot. Genetic markers (DNA patterns) for natural resistance to footrot have been identified. Footrot can be controlled naturally by breeding for sheep with this natural resistance. When challenged with footrot causing agents, whether the individual actually develops the condition is related to the presence of a specific group of genes that control immune response. According to *R&D Brief*, a DNA test is available in New Zealand to classify the susceptibility of an individual, without having to actually expose the sheep or goat to footrot. The degree of resistance may vary within and between breeds of sheep and goats.

In a Kentucky study, goats were observed to have highly variable rates of hoof growth in observations made from 142 goats on 4 farms. Goats with rapid foot growth and in an overgrown condition were more susceptible to foot disease than goats with slower growing feet. Goats with an open structured narrow foot, commonly seen in dairy breeds, had less foot disease than the larger, more closed-structure meat-type goats. Goats selected for slower horn growth and open structure may be less susceptible to foot disease.

Producers with genetically resistant herds or flocks still need to implement best management practices such as providing proper nutrition in order to maintain high immune response to minimize the risk of footrot infection. Offering good nutrition also saves time in treating infected animals, and is more profitable for the producer.

Prevention and Eradication

Footrot is most commonly spread by the introduction of an infected animal to a herd or flock. In order to prevent footrot, it is imperative that it not be brought into an uninfected herd or flock. Any new animal additions to the herd or flock should be quarantined for 30 days and have their feet trimmed before comingling with other animals.

While not as likely, footrot can also be spread on boots, vehicle tires, feeders, hoof trimmers, or handlers' hands. Care must be taken by producers if footrot is known to be present in the herd. Extra care should be taken by producers during the wet season in maintaining sanitary conditions to reduce footrot outbreaks. Since bacteria are spread more easily in moist areas contaminated with feces, it is a good management practice to move feed and water troughs and avoid trampled, muddy, or overgrazed pastures.

To eliminate footrot from a herd requires dedication to treatment, separation of infected animals from non-infected, and culling of animals that cannot be cured. An eradication program has the best chance of succeeding if producers consult with a veterinarian early in the process. Maintenance of facilities and fencing is important, in order to be able to handle, inspect, and treat sheep properly. Eradication methods focus on keeping unaffected sheep clean. Be aware that apparently healthy sheep or goats can be carrying the bacteria in a pocket of infection in the foot during dry conditions, and show no clinical signs of infection.

A program to eliminate footrot from a herd or flock involves three steps: 1) prevention, 2) eradication, and 3) surveillance. When footrot is first detected in a herd or flock, producers must manage its spread before further action can be taken. The **prevention phase** involves controlling further spread of footrot by footbathing, trimming feet, use of antibiotics, and vaccination.

Hoof trimming is necessary in order to allow air to reach the hoof, eliminating the bacteria that cause footrot. Under normal circumstances, sheep feet should be trimmed 1 to 2 times per year. Trimming creates a flat sole surface, removing trapped mud and feces and reducing the possibility of foot scald and footrot infection.



Examples of restraint methods to trim hooves.

When trimming the feet of an animal known to have footrot, all necrotic tissue should be removed, which may cause some bleeding. After trimming is a good time to run sheep or goats through a foot bath as well.



A hoof that has been pared fairly severely to remove necrotic and infected tissue.

Footbathing will reduce the risk of infection of footrot on sheep and goats, minimizing the number of individuals that need to be culled. Sheep and goats can be treated every 5 to 7 days by standing them in a 10% zinc sulfate solution for up to 15 minutes to reduce the risk of infection.



There are many types of containers that can be used to soak animals' feet in footbath solutions. This is a salvage container that is effective in containing animals in the solution. Ideally, feet should be allowed to soak for 20 to 30 minutes 3 to 4 times weekly to help to cure footrot.

Copper sulfate is another preparation that may be used for footbaths. While effective, it is more toxic to sheep and goats if ingested. Copper sulfate will stain wool as well. Paring of the feet before bathing may expose the infection and increase penetration of footbath chemicals.

Zinc sulfate and copper sulfate are drying agents that dry the tissue and hoof area, making it less hospitable for bacteria to grow there. Producers can also add a small amount of laundry detergent to the foot bath to improve access to the hoof.

Vaccines against *D. nodosus* are available, although this method of prevention can be expensive. They provide protection against footrot for 4 to 6 months, and some evidence suggests that they also allow infected feet to heal more quickly. Most producers report a 60% to 80% success rate with this vaccine. When using any vaccines, be aware of withdrawal periods prior to slaughter. Vaccinations can be ineffective in some situations, depending on which strains of *D. nodosus* are present on a specific hoof.

Once the initial footrot infection has been controlled, producers can begin the second phase, **eradication**. Upon initial inspection, the herd or flock should be divided into those that are infected and those that are not. If the proportion of infected animals is low, producers can cull all of those animals. When culling is not an option, such as in the case of high-value animals, animals should then be treated. Footbathing and paring of the feet should be continued. Antibiotics can be effective in eradication and are available through a veterinarian.

When *D. nodosus* is no longer present in a herd or flock, producers move on to the **surveillance phase**. It is important to detect any re-infection early, so flocks and herds should be inspected regularly for lameness and other symptoms of footrot. Minimize the risk of re-infection by buying sheep and goats only from reputable breeders with footrot-free flocks. Co-mingling animals at fairs, shows, and sales also puts sheep and goats at risk of picking up footrot.

Conclusion

The objective of treating footrot is to enhance animal well-being by reducing painful symptoms of the disease using the most cost-effective means for the producer. A prevention plan that combines treatments of regular feet trimming, foot baths, vaccination, and antibiotic treatment is effective in controlling the physical symptoms of footrot. To entirely eliminate footrot from the herd requires a dedicated and labor intensive plan of action that often includes treatment, separating infected animals from non-infected, and culling of animals that can not be cured. While footrot is a costly disease to the sheep and goat industry, it is preventable in individual herds by utilizing a strict biosecurity protocol which includes not introducing livestock with the disease.

Key Points for Prevention of Footrot

1. Do not buy sheep or goats with footrot or from a flock where footrot is present. Quarantine all new additions for 30 days before introducing them to the rest of the herd or flock. Observe sheep and goats for any signs of lameness. Isolate and treat diseased animals before co-mingling.
2. Trim and treat all animals by foot bath before releasing them onto the farm.
3. Avoid using facilities and pens where infected sheep have been during the past 14 days.
4. Do not transport sheep or goats in a vehicle that has not been cleaned and disinfected.
5. Routinely trim feet and implement foot baths using zinc sulfate every 5 to 7 days as prevention. In animals known to be infected, foot soaks given 3 to 4 times per week can be used as treatment for footrot as well.
6. Consult with a veterinarian before vaccinating the herd or flock for footrot, or treating with antibiotics.

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