Goat Vaccination

► The goal of vaccination is to stimulate an immune response that provides some level of protection from disease. Unfortunately, most vaccines do not achieve complete protection from infection and subsequent disease. Vaccines are expected to reduce the severity of disease in infected animals or limit the frequency of disease in the herd.

Many factors, including nutrition, stresses, and the general health of animals, can influence the effectiveness of vaccination. Vaccines should be administered according to label directions and only to systemically healthy animals. Consult your veterinarian for guidance when designing and implementing a herd vaccination program. Vaccines should not be expected to eliminate all disease problems and should be considered only as a tool to be used with other management strategies to mitigate the occurrence and impacts of infectious diseases.

Types of Vaccines

Killed Vaccines

Killed vaccines and toxoids consist of killed microorganisms, components of pathogens, or by-products of microorganisms in combination with adjuvants, such as aluminum hydroxide or oil, in order to produce a sufficient immune response. The major advantages of killed vaccines are safety and stability of the product. Disadvantages include the need for multiple doses (booster vaccination) to produce a protective immune response.

Subunit vaccines are a type of killed vaccine that contains only part of the virus or bacteria. These vaccines isolate the most important part of the microorganism needed to produce a proper immune response while eliminating other components of the microorganism.

Autogenous bacterial vaccines (autogenous bacterins) are produced from bacteria isolated from samples collected from diseased animals. The bacteria are cultured, killed, and mixed with adjuvant. These vaccines frequently contain high levels of endotoxin and other by-products found in the culture and should be used with caution. Advantages include the production of custom-made, herd-specific vaccines for which a commercially made vaccine might not be available.

Figure 1. Most vaccines are administered subcutaneously (SQ, under the skin), which can be performed in a triangle of skin in front of the shoulder or in the axillary (under the arm) region. Intramuscular injections should be given only in the neck muscles, using the same injection site.

Modified Live Vaccines

Modified live vaccines (MLV) contain a small quantity of virus or bacteria that has been altered so that it no longer is capable of causing clinical disease. It is still capable of causing infection in the animal, which is necessary to produce an immune response, but warrants cautious use in some animals. For example, a MLV should not be administered to a pregnant doe that was never vaccinated prior to pregnancy. The immunity produced by MLV typically is longer in duration and more robust than the immunity produced by killed vaccines. Careful handling, mixing, and storage of MLV is critical. Exposure to high temperatures, sunlight, freezing, soaps, or delayed administration from the time of mixing can result in damage to the vaccine. MLV products, once rehydrated with diluent, should be used within an hour of mixing.

Vaccination Guidelines

Examples of important small ruminant diseases for which vaccines are available:

- Clostridial enterotoxemia and tetanus
- Caseous lymphadenitis (CL)
- Foot rot
- Pneumonia (pasteurellosis)
- Infectious causes of abortion

Clostridial Diseases–Enterotoxemia and Tetanus

The vaccine commonly known as CD&T is a vaccination against *Clostridium perfringens* type C + D (enterotoxemia) and *Clostridium tetani* (tetanus). Goats are extremely susceptible to enterotoxemia and it is generally held that vaccination against clostridial disease is an absolute requirement and should be considered a core vaccine in all goats. Prevention of disease must include control of potential risk factors (for example, banding castration methods, abrupt changes in diet) and immunization against clostridial toxins. Vaccination must aim to protect adult animals as well as confer protection to kids through transfer of passive immunity (antibodies) in colostrum. Several commercial CD&T vaccines are available as well as other clostridial vaccines that protect against additional clostridial species. Consult your veterinarian to determine if other clostridial diseases are common in your area and herd to determine if protection beyond *Clostridium perfringens* C + D and tetanus is needed. The 7- or 8-way cattle blackleg vaccines are not recommended for use in goats as tetanus is not typically included in these vaccines.

Research suggests that the duration of protective immunity is much shorter in goats when compared to sheep and cattle using similar clostridial vaccines. Goats may need to be vaccinated at intervals of 3 to 4 months to maintain adequate protection against enterotoxemia using currently available clostridial vaccines. At a minimum, goats should be vaccinated annually and ideally semiannually (every 6 months) following an appropriate primary vaccination schedule, especially if disease pressure or risk is considered to be high. Initial vaccination must be followed by a booster 3 to 4 weeks later. Kids should be vaccinated initially at 6 or 8 weeks of age, with vaccination occurring before weaning. Booster vaccines should be administered to kids 3 to 6 weeks later, depending on product recommendations. Some experts recommend 3 doses administered 4 weeks apart as the primary series of vaccines in young kids. If a kid is born to an unvaccinated dam and, therefore, did not receive colostral antibodies against clostridial species, vaccination of the kid should take place within the first 2 weeks of life. Protection against tetanus is imperative, especially in herds where banding castration of young kids is practiced. Does should be vaccinated against clostridial diseases approximately 30 days prior to kidding to ensure that adequate antibodies are produced and concentrated in colostrum, which provides protection in the kids. Replacement doelings and other purchases should receive a minimum of 2 doses prior to kidding. Do not forget to vaccinate bucks and other replacements, especially those with unknown vaccination status.

Caseous Lymphadenitis

Caseous lymphadenitis, also known simply as CL, is caused by the bacterium *Corynebacterium pseudotuberculosis*, which results in the abscessation of lymph nodes. Goats typically have involvement of peripheral lymph nodes around the face (submandibular, parotid), but the disease can also affect internal lymph nodes, such as those associated with the lungs. This pathogen is zoonotic (can infect humans). When handling diseased goats, always wear protective clothing and gloves.

Vaccination against CL should be carried out under the guidance of a veterinarian, as there are several approaches to dealing with CL at the herd level. This is especially important in herds in which goats will be checked via serology (blood antibody titer) tests, as vaccination will interfere with interpretation of titer results. Vaccination does not prevent infection by the bacteria, but serves to lessen the severity of disease

and reduce the incidence of abscess formation. Vaccine types available for CL include bacterins, toxoid, combination products (bacterin + toxoid), and autogenous. A commercial vaccine labeled for use in sheep is available in the United States and has been used successfully in goats. However, it should be noted that another vaccine that contains Clostridium CD&T plus CL antigens produces a strong adverse reaction and is not recommended by the Federal Drug Administration for use in goats.

Foot Rot

The colloquial term *foot rot*, especially when applied to small ruminants, can be misleading as foot rot is not a simple one-bug, one-disease condition. Rather, several forms of foot rot lesions can occur in small ruminants, and it is important that the correct disease process be diagnosed before pursuing vaccination against infectious foot rot.

Benign foot rot (also known as foot scald) is due to *Fusobacterium necrophorum* infection, whereas contagious virulent foot rot is due to bacterial infection by *Dichelobacter nodosus*. The former (*F. necrophorum*) is more akin to the foot rot found in cattle, whereas the latter (*D. nodosus*) is found most often in sheep and is highly contagious and can spread through flocks and herds causing lameness in multiple feet, in multiple animals.

Commercial vaccines exist for both conditions. Vaccination against *F. necrophorum* is labeled for cattle use only; efficacy in goats has not been demonstrated and is considered extra-label use of the vaccine. Vaccines against contagious (virulent) foot rot due to *D. nodosus* are labeled for use in sheep, but are not currently commercially available in the United States. The vaccine has proven effective as a tool to minimize the incidence and spread of the disease in flocks with foot rot. However, it is not labeled for use in goats, and a clear diagnosis of foot rot due to this pathogen should be established by a veterinarian before implementing vaccination, as it is only one tool of many required to eradicate the disease from a flock or herd. Contact your veterinarian for more information about benign versus contagious foot rot in small ruminants.

Pasteurellosis

Mannheimia hemolytica and *Pasteurella multocida* are pathogens that cause bacterial pneumonia in goats of all ages. *Mannheimia hemolytica* is also a cause of septicemia in young kids and mastitis in does. The role of *Biberstinia trehalosi* in the epidemiology of goat pasteurellosis has yet to be fully determined. The leukotoxin of *M. hemolytica* impairs and destroys macrophages and neutrophils (white blood cells in the lungs), resulting in injury and death of lung tissue. Serotype is important for all of the above bacterial species. With *Mannheimia*, serotype A2 is most commonly isolated from the lungs of diseased sheep and goats. This is in contrast to cattle, in which serotype A1 is more commonly isolated. This is important from a vaccine standpoint, as vaccines developed against *Mannheimia hemolytica* and *Pasteurella multocida* target cattle-specific serotypes, which are not necessarily the serotypes found in diseased small ruminants.

No bacterin has proven completely effective against pasteurellosis in goats. Use of cattle toxoid vaccines developed against the leukotoxin may provide some protection. Use of the cattle vaccine constitutes extra-label use, and a veterinarian must be consulted to prescribe the vaccine before its administration. Generally, vaccination of kids older than 3 months of age is carried out with an initial series of 2 shots administered 2 to 4 weeks apart. If given before 3 months of age, the kids should be revaccinated at 4 to 6 months of age. Autogenous vaccines for pasteurellosis in goats are also available. Consult your veterinarian for diagnosis, sample collection, and production of autogenous vaccines.

Prevention of pasteurellosis by vaccination might be best attained with the use of vaccines that incorporate iron-regulated proteins (IRP); this type of vaccine has been evaluated in small ruminants in other countries. Such vaccines are available in Europe and are used mainly in sheep, with a primary series comprised of 2 injections 4 to 6 weeks apart followed by an annual booster 4 to 6 weeks before lambing. Unfortunately, no

IRP vaccines or inclusion of *Mannheimia* strains specific to small ruminants in commercial vaccines are currently available in the United States.

Infectious Causes of Abortion in Small Ruminants

If abortions or reproductive failure (low pregnancy rates, increased rates of return to estrus, or birth of weak kids) are present on farm, consultation with your veterinarian is imperative in determining if an infectious agent is involved. Strict hygiene should be practiced and protective clothing and gloves should be worn whenever handling does that have aborted, including aborted fetuses and placentas.

There are several infectious causes of abortion in small ruminants, of which several have zoonotic importance (can infect humans and can have serious health consequences, especially in pregnant women). These include *Campylobacter* spp. (Vibriosis), *Leptospira* spp., *Listeria* spp., *Toxoplasma gondii*, *Coxiella burnetti* (Q-fever), and *Chlamydophila abortus* (Enzootic pneumonia). Further description of clinical signs in does and fetal and placental lesions in aborted fetuses due to these various infectious agents can be found elsewhere. There are currently no vaccines against *Listeria* spp., *Toxoplasmosis*, or *Coxiella burnetti* (Q fever) available in the United States.

For vibriosis, a killed combination *Campylobacter fetus-C. jejuni bacterin* is available. Annual vaccination 30 days before the start of the breeding season should be carried out. Vaccination against several serotypes of *Leptospira* can be carried out in does either prebreeding or, if necessary, in the face of an outbreak, along with antibiotic treatment. In areas with a high incidence of leptospirosis, annual immunization is recommended. The unreliable availability of a vaccine against *Chlamydophila abortus*, the causative organism of enzootic abortion, in the United States, makes it difficult to recommend its routine use. The vaccine, however, has proven effective in preventing abortion and significantly reducing the shedding of the organism by infected animals.

Brucella melitensis also causes abortion in goats, but it is sporadic and occurs extremely rarely in the United States. It is the causative agent of Malta fever in humans. Vaccination is not permitted in the United States and affected animals should be eliminated.

Consultation with a veterinarian, examination of affected and unaffected animals, submission of fetal and placental tissues for necropsy examination, and identification of infectious agents in abortion outbreaks is absolutely essential for a proper diagnosis. This should be done before implementing vaccination strategies, as management of such infectious diseases is complex.

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