Immune Support for Respiratory Disease Prevention

Managing a dairy herd for maximum immune system function consists of two related elements, colostrum feeding and vaccination. The goal of both these management practices is to boost the immune system’s ability to fight disease. The immune system is able to recognize and destroy pathogens through the activity of proteins, called antibodies. Antibodies attach to invading pathogens and alert white blood cells to engulf and digest the invaders. Acquired immunity occurs when the immune system uses the “memory” of a past infection to generate antibodies precisely shaped to bind pathogens and initiate a strong and rapid immune response.

I. Immune Support with Colostrum

When an animal, such as a calf, is born it has little or no acquired immunity. Feeding colostrum from a vaccinated dam is the best way to protect a calf from infection, because the dam’s acquired immunity is transferred to the calf in colostral antibodies. High levels of maternal antibodies in a calf’s blood stream protect the calf against disease, including bovine respiratory disease complex (BRDC), and may increase the protective properties of colostrum for calf health. It is critical that calves receive enough colostral antibodies, specifically immunoglobin G (IgG), to protect them from pathogens.

When calves are first born antibodies from colostrum are easily absorbed into the blood stream from the gut, but within hours the efficiency of antibody transfer decreases. To ensure adequate IgG absorption, it is important to feed colostrum within the first few hours of life. Four to six quarts of good quality colostrum, with high IgG content, should be feed within the first 12 hours of life. Calves receive the most benefit when they are fed at least 100g of IgG during their first feeding. Two quarts of good quality colostrum (greater than 50g IgG/L) fulfills this requirement for the first feeding. However, colostrum varies widely in IgG content. Producers that do not measure colostrum quality are suggested to feed 90 lb calves at birth four quarts of colostrum by esophageal feeder or three quarts by nipple, followed 8-12 hours later by two and three quarts respectively.

Bacterial contamination is another element of colostrum quality. Although colostrum is vital to calf health, colostrum can transmit bacterial and viral pathogens. It is important that colostrum be collected from healthy mastitis-free dams. Colostrum should also be handled and stored properly to prevent bacterial overgrowth. Bacterial contamination of colostrum inhibits absorption of antibodies into the blood stream and reduces the immune protection provided by colostrum. Proper sanitation of teat, milking equipment, and feed equipment is essential to prevent contamination, but since colostrum is not sterile colostrum must be used quickly. Bacterial growth in colostrum is rapid. Colostrum that will not be fed immediately should be refrigerated or frozen. Colostrum can be refrigerated (33-35°F) for up to seven days and frozen (4°F) for up to a year. When thawing frozen colostrum do not allow it to sit at room temperature, instead rapidly thaw frozen colostrum in 140°F water to prevent bacterial growth. Be careful to avoid overheating the colostrum, because temperatures higher than 140°F will damage antibodies.
Pasteurization is a potential way to decrease bacterial contamination in colostrum, but pasteurization is not a commonly recommended practice for several reasons. Antibodies are heat sensitive and improper pasteurization temperatures reduce the immune protection provided by colostrum. Additionally, pasteurization can thicken colostrum, making feeding more difficult. However, batch pasteurizers set to lower temperatures (140°F) and longer pasteurization times (60min) have been used successfully to pasteurize colostrum without thickening and loss of antibody function\textsuperscript{14,15}. A recent study found that batch heat treatment of colostrum at 140°F for 60 minutes can be successfully conducted on commercial dairy farms by farm staff to decrease colostrum microbial counts while maintaining colostral IgG concentrations\textsuperscript{16}.

Commercial colostrum supplements are an alternative if high quality colostrum is not available. A recent review of colostrum supplements concludes that colostrum supplements can be an effective way to boost immune function in calves\textsuperscript{17}. However, high quality true colostrum remains the preferred initial nutrition for newborn calves.

II. Immune Support through Vaccination

Vaccines induce acquired immunity by tricking the immune system into generating antibodies against real pathogens. Vaccines contain elements recognized by antibodies that are identical to the pathogen, but do not cause disease. When a vaccinated animal encounters the actual pathogen, the acquired immune response system rapidly acts to prevent infection.

Most veterinarians recommend vaccination to protect cattle against viruses and occasionally the bacteria involved in BRD. Commercially available vaccines have been demonstrated to stimulate disease-fighting immune responses, leading to the expectation that appropriately administered vaccines limit the incidence and severity of BRD. However, because BRD is a difficult disease to study, in part due to the involvement of numerous pathogens and environmental stressors, vaccination to reduce the incidence of BRDC is not well-supported by scientific research\textsuperscript{18,19}. Since vaccination has not proven to be entirely preventative against BRD, vaccination should be considered one element in a total management strategy to reduce BRD. Selection of vaccine type and timing of administration are important to the success of a vaccination protocol. There is no single recommended vaccination protocol for dairy herds. Vaccination protocols should be made with the advice of your veterinarian, who will consider the needs of your herd and regional disease pressures in determining which vaccines to administer and the timing.

Vaccines can be purchased from your veterinarian or over the counter. When over the counter vaccines are used it is very important to trust that the vaccine has been handled and stored correctly. Some vaccines need to be refrigerated, and if they have been allowed to warm they lose their effectiveness. Always read and understand the enclosed information which provides information on dosage, mode of administration, storage, and safety.

There are nasal and parenteral (injection) vaccines for BRD pathogens. Young calves may not produce specific antibodies after parenteral vaccination in the presence of maternal antibodies (passive immunity from colostrum)\textsuperscript{19}. Maternal antibodies from colostrum may interfere with vaccines and inhibit the calf's immune response\textsuperscript{20} (Figure 1). To overcome this problem, research has recently focused on the use of intranasal vaccination to target the mucosal immune system. Nasal vaccines may be more suitable for young calves that have received passive immunity through colostrum.
Although intranasal vaccination has proven effective in some studies, they do not always prevent clinical disease\textsuperscript{21-23}. Follow all label directions, as some vaccinations must be repeated, while others are single injections. It is particularly important to remember to give booster vaccinations to calves, given their immature immune system and the possibly suppressive effects of maternal antibodies.

\textbf{Figure 1.} Development of the immune response in the calf: from conception to puberty\textsuperscript{24}.

Most vaccines are one of two varieties: killed or modified-live. Vaccines that contain killed viruses are often in liquid form. Vaccines that contain modified-live viruses often come in a powder that is reconstituted before use. Once reconstituted, modified-live vaccines must be protected from sunlight and extreme temperatures and used within a few hours. Modified-live vaccines usually stimulate a broader immune response than killed vaccines. However, because modified-live vaccines actually cause a mild infection, they can cause abortion in pregnant animals. For this reason modified-live vaccines are not normally recommended for use in pregnant animals. Some modified-live vaccines can be used in pregnant animals if certain conditions are met; if so, these conditions will be indicated on the label included with the vaccine. Because of the risks of using modified-live vaccines in pregnant animals, use these vaccines in pregnant animals only if your veterinarian agrees they are appropriate for your herd.

\textbf{Further reading and internet resources:}

- Health and Immune Function of Dairy Calves. \url{http://www.wcds.ca/proc/2012/Manuscripts/Leslie.pdf}
- Calf notes by Dr. Jim Quigley: English \url{http://www.calfnotes.com}
  Spanish/Español \url{http://www.calfnotes.com/CNnotasterneros.htm}
- Calf facts by Dr. Sam Leadley: English and Spanish/Español \url{http://atticacows.com}
- University of Wisconsin Dairy Calf Clinical Information and Forms including respiratory scoring chart \url{http://www.vetmed.wisc.edu/dms/fapm/fapmtools/calves.htm}
- Dairy Heifer Health, Disease Control, and Vaccinations \url{http://pubs.ext.vt.edu/404/404-284/404-284.htm}
1. Fulton, R.W. et al. Maternally derived humoral immunity to bovine viral diarrhea virus (BVDV) 1a, BVDV1b, BVDV2, bovine herpesvirus-1, parainfluenza-3 virus bovine respiratory syncytial virus, Mannheimia haemolytica and Pasteurella multocida in beef calves, antibody decline by half-life studies and effect on response to vaccination. Vaccine 22, 644-650 (2004).

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