Diarrhea in Calves:
How Does it Happen and What Can be Done to Prevent It?

Take Home Messages

- Diarrhea occurs commonly in dairy calves and can have both short-term and long-term consequences that affect their health and welfare.
- When diarrhea develops, it is not simply due to exposure to pathogens, but also the result of changes that occur in the gut microbiota.
- Prevention of diarrhea requires a focus on setting the calf up for success by ensuring excellent colostrum management and a high plane of milk nutrition is fed.
- Other considerations include feeding transition milk or probiotics/prebiotics to improve gut development.
- Environmental cleanliness is also a key consideration, so ensuring that steps are taken to minimize pathogen exposure will prevent future cases of diarrhea.

Introduction

Diarrhea occurs commonly in dairy calves, with studies showing that in Canada between 23% to 28% of calves are treated at least once for diarrhea in the preweaning period (Windeyer et al., 2014; Lardé et al., 2020). There are also several consequences to calves developing diarrhea, such as a reduced growth rate (up to 15 kg reduction over preweaning period [Renaud et al., 2021]), reduced reproductive performance (increased number of breedings to become pregnant as a heifer [Abuelo et al., 2021]), and reduced first lactation milk production (325 to 344 kg loss in milk [Abuelo et al., 2021; Svensson and Hultgren, 2008]). In addition, when calves have diarrhea, there is always a risk for mortality due to acidemia, bacteremia, arrhythmia, and hypovolemia, which can lead to death (Naylor, 2009).

Due to the challenges that result as a consequence of diarrhea, an emphasis needs to be placed on prevention; however, it is critical to first highlight how diarrhea develops to best develop a preventative plan.

How Does Diarrhea Develop?

There are several changes that happen in early life that can lead to an increased likelihood of diarrhea. To really understand this, several studies have collected fecal samples from healthy and diarrheic calves to evaluate the dynamic processes that are occurring that increase susceptibility to disease.

Exposure to Pathogens

Calves are commonly exposed to a variety of diarrhea-causing pathogens. Specifically, calves are often exposed to coronavirus, rotavirus, and *Cryptosporidium parvum*. Other pathogens also include *Salmonella* and *E. coli,* among others. What is interesting to note, is that despite having the presence of pathogens in their feces, especially coronavirus, rotavirus, and *Cryptosporidium parvum*, calves can also be healthy. For example, a study conducted at a calf raiser in Ontario found that despite 94%, 86%, and 57% of calves testing positive for bovine rotavirus A, coronavirus, and *Cryptosporidium parvum* over 3 sampling time points in early life, only slightly higher levels of diarrhea were seen in infected calves (Renaud et al., 2021). This doesn't mean that efforts shouldn't be made to reduce exposure of calves to pathogens, but it does clearly suggest that there is more to the story than just pathogen exposure.

Microbiome

Research has demonstrated that gut microbiota (the range of microorganisms found in the gut) plays a critical role in influencing the risk of developing diarrhea. Specifically, studies have found that in diarrheic calves there is delayed stability and diversity of gut bacteria (Ma et al., 2020). Higher stability is particularly important, as it makes the gut more resilient to external influences. The presence of specific bacteria also influences the development of diarrhea; bacteria such as *Trueperella* and *Escherichia/Shigella* are associated with the development of diarrhea (Ma et al., 2020), whereas a higher level of butyrate-producing bacteria are associated with a healthy non-diarrheic calf. Therefore, strategies should be put in place to ensure that young calves develop a diverse and stable gut microbiota that has a component of butyrate-producing bacteria to protect against disease.

Preventing Diarrhea: Setting the Calf Up for Success

How calves are managed in early life plays a critical role in influencing their risk of developing diarrhea. To best influence the gut microbiome to best protect the calf, it is important to consider (Malmuthuge et al., 2015a):

1. **Colostrum Feeding.** Colostrum really is the start of most conversations about calves, and that is definitely the case with diarrhea as well. Specifically, calves that have failed transfer of passive immunity (<10 g/L of serum IgG) are 1.51 times more likely to develop diarrhea (Radoisson et al., 2016). Although most of the focus is on ensuring enough IgG is transferred, it is much more than that. There are many bioactive components, such as oligosaccharides, that can inhibit pathogen adherence to the intestinal wall and colostrum feeding will aid in establishing a healthy microbiota (Malmuthuge et al., 2015b). Hence, a focus on getting 3-4 L of high-quality (>50 g/L) clean (< 100,000 cells/ ml of total bacterial count) colostrum quickly (<4 hours after birth) into the calf following birth is essential (Godden et al., 2019).

The impact of colostrum doesn't end just at the first feeding after birth. There is a growing body of evidence to suggest that feeding transition milk or low levels of colostrum replacer for several days to 2 weeks following calving can improve gut health (Carter et al., 2021). Specifically, prolonged supplementation of transition milk or colostrum leads to improved gut development (Pyo et al., 2020), health (reduction in diarrhea, respiratory disease, and antimicrobial use [Chamorro et al., 2017; Conneely et al., 2014]), and higher levels of growth (Berge et al., 2009; Kargar et al., 2020).

2. **Plane of Nutrition**. There has been a substantial amount of research demonstrating that calves should be fed a high plane of milk nutrition. When looking specifically at diarrhea, feeding 8 L or more of milk per day leads to improved immune function, lower treatment for disease, and when calves get diarrhea, improved recovery from a diarrhea bout (Ballou, 2012; Ollivett et al., 2012). There are also other benefits of a high plane of nutrition, such as higher levels of growth and better feed efficiency, which in heifers, contributes to higher first lactation milk production.

3. **Microbial-Based Probiotics and Prebiotics.** There is a growing body of evidence that certain probiotics and prebiotics can aid in preventing diarrhea, especially in circumstances where there is a high disease burden or challenge (Cangiano et al., 2020). Specifically, yeast species, especially *Saccharomyces cerevisiae boulardii*, and lactic acid bacteria, such as *Lactobacillus* spp., *Bifidobacterium* spp., *Enterococcus* spp., have been shown to reduce the level of diarrhea and improve growth through reinforcement of positive bacteria, preventing pathogen adherence to the intestine, and improving immunity at the level of the gut.

4. **Other Considerations: Environmental Cleanliness.** Minimizing exposure to pathogens is imperative to reducing the occurrence of diarrhea. Minimizing risk starts at birth, by ensuring the calving area is clean and has minimal fecal contamination as dams can serve as a reservoir for pathogens (McGuirk, 2008). From there, cleaning calf housing is of the utmost importance, especially when dealing with *Cryptosporidium parvum*. Making sure a proper cleaning protocol is in place, not just for the calf housing but also for feeding equipment, will reduce the quantity of pathogens present. Other calf housing considerations include having a clean and dry environment where bedding is added frequently (Medrano-Galarza et al., 2018). Finally, farm staff and visitors can also be a source of disease transmission; ensuring that those that come into contact with calves clean clothing, hands, and boots frequently can aid in reducing the cyclicity of pathogens on farm. Lastly, working from the youngest to the oldest calves and treating sick calves last will also prevent pathogens from spreading to more susceptible populations.

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