Calf Notes.com

Calf Note 170 – Subacute rumen acidosis in calves

Introduction

Important to the health and growth of calves is proper development of the rumen in preparation for weaning. Rumen development is driven by fermentation of carbohydrates by rumen bacteria (for more information, see Calf Notes #05, #19 And #20). Production of volatile fatty acids (especially butyrate and propionate) from this fermentation cause a cascade of developmental activities, including growth of the rumen papillae, increased absorption of acids from the rumen, changes in bacterial flora, and peripheral alterations so the calf can utilize different energy substrates.

In our quest to drive rumen development, we focus on providing readily fermentable carbohydrates such as starch and sugar. These carbohydrates are rapidly fermented in the rumen and tend to provide the greatest amount of propionate and butyrate. However, in our quest to develop the rumen, we may be inducing subacute rumen acidosis, or SARA, in these calves. This Calf Note provides some evidence that SARA exists in calves. Future Calf Notes will explore whether this is a problem and implications to the animal.

Defining SARA

Initially, let's define SARA and why this is important, at least in lactating dairy cows. What is SARA? Most researchers define the occurrence of SARA when rumen pH remains below a critical level (usually 5.6 or 5.8) for extended periods. Some good background on SARA in cows is here:

http://www.omafra.gov.on.ca/english/livestock/dairy/facts/03-031.htm

http://www.extension.org/pages/26022/new-developments-in-understanding-ruminal-acidosis-in-dairy-cows

Some more technical reports are here:

http://www.vetmed.wisc.edu/dms/fapm/fapmtools/2nutr/sarafacters.pdf

http://www.merckvetmanual.com/mvm/index.jsp?cfile=htm/bc/21704.htm

Let's use the criteria of rumen pH below 5.8 as our criteria for SARA. In this case, does SARA occur in calves around weaning time? Most research data would suggest that SARA is not only frequent in many calves, it may be the norm. Let's look at some research.

The research

Research evaluating rumen development using ruminally cannulated calves consistently reported the pH of calves was below 5.8, often approaching 5.0.

While at the University of Tennessee, my research group monitored the rumen pH of calves from 1 to 12 weeks of age. Calves were fed a "conventional" diet of milk replacer and calf starter pellet. The starter pellet contained 20% ground corn, 7.5% soybean meal, 20% soybean hulls, 25% wheat midds,7.5% cottonseed hulls, 5.8% cottonseed meal, 5% alfalfa meal, 3% molasses, and the remaining was vitamins and minerals. The starter contained 20% CP (DM basis) and 36% NDF. Starters such as this one would ferment more slowly that one based primarily on corn, soybean meal, oats and/or barley, as the NDF content of the starter used was relatively high (36%). Calves were fed without (Control; CON) or with added Bovatec (BOV).

Changes in rumen pH are in Figure 1. Samples were taken from calves once weekly at 2 hr post-feeding. Calves were offered starter for ad libitum consumption and were weaned at 8 weeks of age from milk replacer. As can be seen in Figure 1, there was a consistent decline in rumen pH, from a high of 6.4 at 1 week of age to a low of 5.0 to 5.1 at 12 weeks of age. By 2 weeks of age, rumen pH at 2 hr post-feeding indicated that calves had SARA.

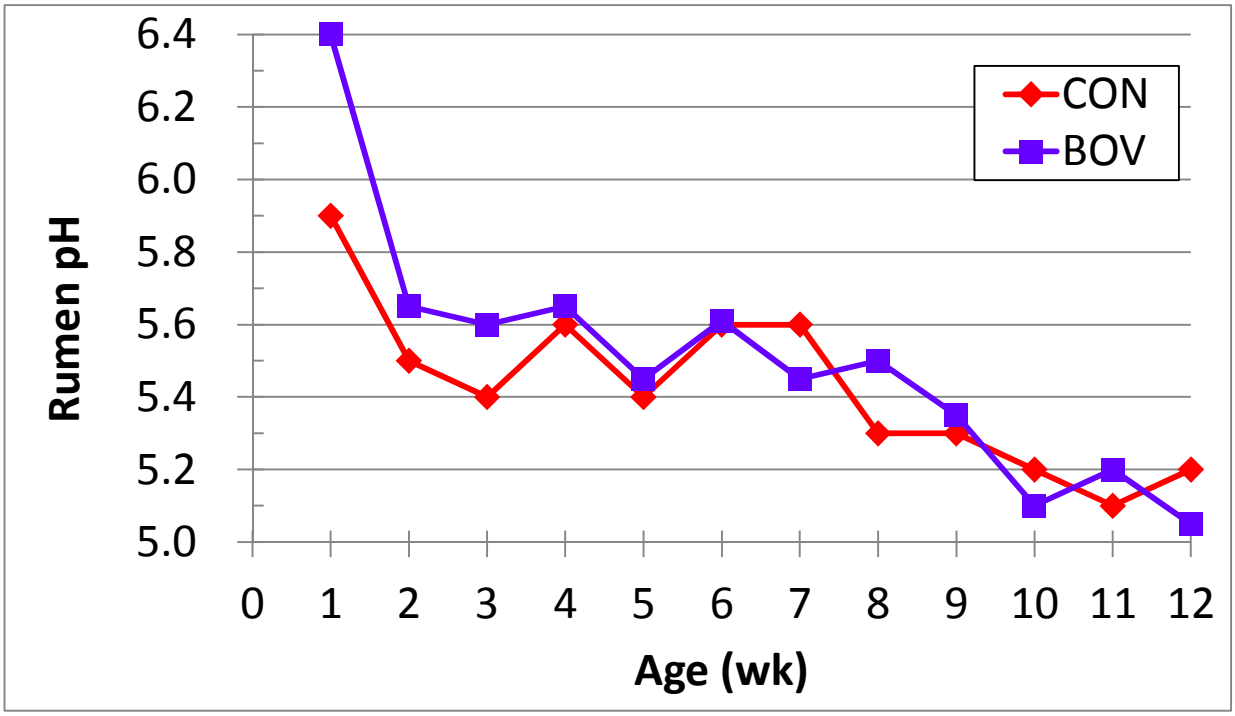

Figure 1. Change in rumen pH (taken 2 hr after a.m. feeding) with advancing age in Holstein calves. From Quigley et al., 1992a.

The previous study had the limitation of only monitoring calves at one time point for each week. To indicate SARA, calves should have rumen pH < 5.8 for extended periods. It was not possible tell for sure if calves had extended periods of low pH. Thus, a second study was organized.

In this second study, ruminally cannulated calves were fed similar diets without or with added grass hay (available for ad libitum consumption). No Bovatec was offered in this study. Calves were limit fed during the week of sampling so that they ate meals in the first 2 hours after feed was offered (at 8:00 a.m.).

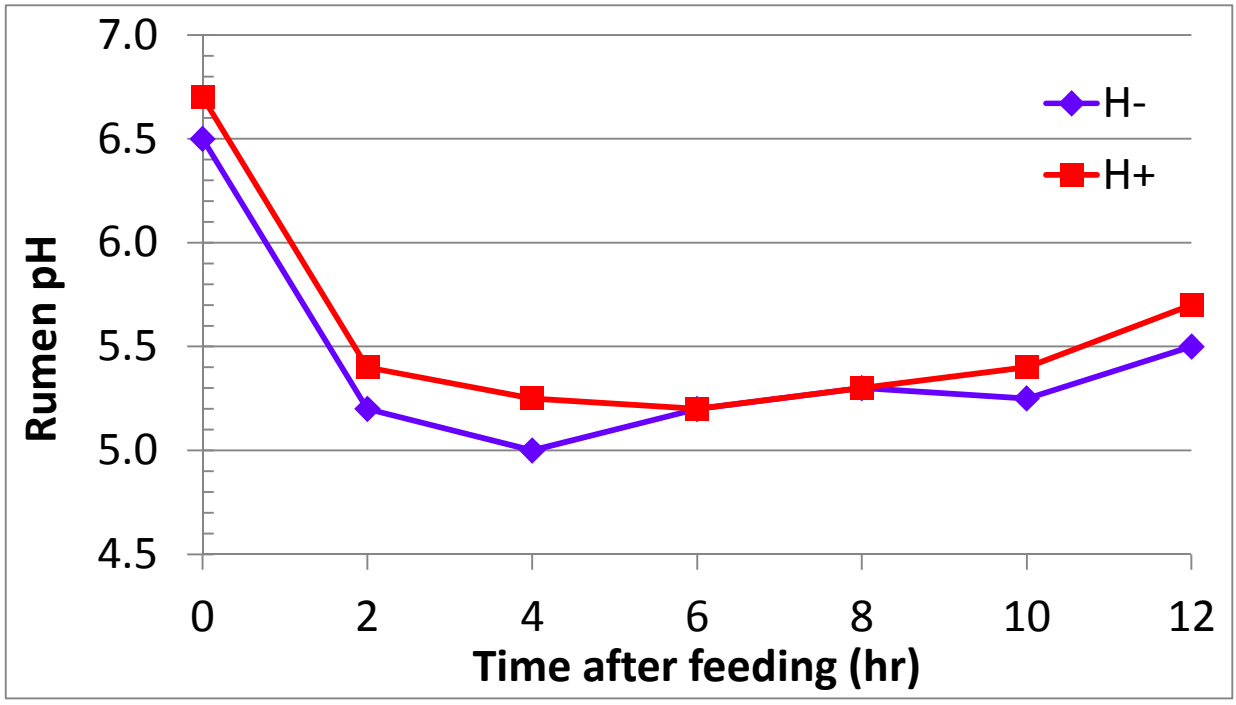

Figure 2. Change in rumen pH after feeding in Holstein calves. From Quigley et al., 1992b.

As can be seen in Figure 2, rumen pH decreased rapidly with feeding to levels typical of SARA. These low rumen pH's persisted for at least 10 hours, clearly indicative of SARA.

Other researchers have also documented that rumen pH is often well below 6.0 in young calves, particularly in finely ground diets (Beharka et al., 1998; Greenwood et al., 1997). Some possible reasons for this might include:

1. Rapid fermentation of carbohydrate by rumen bacteria. Further, formulation of diets to include rapidly fermentable sources of starch and sugar may exacerbate this effect;

2. Limited VFA absorption, especially in the first few weeks of life;

3. Once pH falls below 6.0, protozoa die off (once they are established in calves), which results in less sequestration of starch granules and increased rate of fermentation;

4. Young calves often have limited saliva production, and saliva doesn't contain as much bicarbonate as older calves;

5. Lack of effective fiber resulting in development of keratinization of the rumen may slow absorption of VFA, thereby increasing rumen acids and reducing pH;

6. Lack of rumen mat and regurgitation limits additional saliva production.

The bottom line of these studies is that calves often (usually?) have SARA. Observing calf fecal consistency on many dairies and calf ranches suggests that SARA is real and common (see Figure 3 for an example of feces suggestive of SARA).

The next Calf Note will explore the implications of SARA to digestion and energy availability for the calf. We'll also look at the potential implications of SARA on calf health, particularly immediately post-weaning.

Figure 3. Feces from a weaned calf that suggests SARA. Photo courtesy of M. Thompson, Cargill.

References

Beharka, A. A., T. G. Nagaraja, J. L. Morrill, G. A. Kennedy, and R. D. Klemm. 1998. Effects of form of the diet on anatomical, microbial, and fermentative development of the rumen of neonatal calves. J. Dairy Sci. 81:1946–1955.

Greenwood, R. H., J. L. Morrill, E. C. Titgemeyer, and G. A. Kennedy. 1997. A new method of measuring diet abrasion and its effect on the development of the forestomach. J. Dairy Sci. 80:2534–2541.

Quigley, J. D., , S. I. Boehms, T. M. Steen, and R. N. Heitmann. 1992a. Effect of lasalocid on selected ruminal and blood metabolites in young calves. J. Dairy Sci. 75:2235-2241.

Quigley, J. D., T. M. Steen, and S. I. Boehms. 1992b. Postprandial changes of selected blood and ruminal metabolites in ruminating calves fed diets with or without hay. J. Dairy Sci.75:228-235.

Written by Dr. Jim Quigley (06 October 2012)

Calf Notes.com (http://www.calfnotes.com)