Management of Subacute Rumen Acidosis – Feeding Principles, Herd Level Monitoring

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The four “rights” for all dairy herd nutritional programs are to provide the right feed, in the right amounts, at the right time, to the right cows. The right feeds imply that there is a proper balance of forages and concentrates with appropriate particle size to maintain rumen function. The right amounts involve balancing rations so that the chemical analyses are in line with designed parameters. The right time means that cows and heifers are given an opportunity to adapt and adjust to the changes in the ration formulations. The right cows mean that rations are balanced for dry cows, both far off and close-up as well as fresh cows, peak milk cows and those in late lactation. The intent here is to control body condition losses in early lactation and provide adequate nutrition to regain the lost body stores without creating obese cows. Adhering to these principles will lessen the impact of subacute rumen acidosis (SARA) on dairy herd performance. This paper will explore feeding principles for dairy cattle that will help minimize the danger of SARA and define several herd monitors to prevent SARA from stealing profits from dairy operations.

Feeding Principles

Inherent in the feeding practices on modern dairy operations with high producing cows is the real risk of developing SARA. We need to provide enough dietary energy in early lactation to prevent rapid body fat mobilization (potentially leading to ketosis and hepatic lipidosis) while maintaining adequate fiber to stimulate efficient rumination (preventing SARA). For the most part, SARA is a herd-wide condition and needs to be managed as if all cattle in a herd or within a group are susceptible. The origins of SARA in dairy cattle can be classified into three main causes: excessive intake of rapidly fermentable carbohydrates, inadequate buffering of the rumen, and insufficient time to adapt the rumen to a more highly fermentable ration.
Excessive Intake of Rapidly Fermentable Carbohydrates

Causes for acute acidosis such as grain overload in feedlot steers or founder in horses are similar to the origins of SARA in dairy cattle. Reasons for the excess consumption can be varied and in some cases lead to acute rumen acidosis in individual cows. Problems in ration formulation and feed mixing and delivery can lead to excessive intakes of more soluble carbohydrates.

Ration Formulation and Chemical Composition

Most nutritionists will balance rations so that the diets are “safe” according to National Research Council guidelines. Safe diets consider the chemical composition of the carbohydrates (ADF, NDF, effective NDF, NSC, etc.) included in the ration. The main assumption with these carefully balanced rations is that the chemical composition of the feeds included in the diets is accurate. Forages vary greatly over time within storage structures. Library values for some commodities are not always the same as feeds stored on the farm. If SARA is suspected, all feeds should be analyzed for carbohydrate fractions and ration balancing should be adjusted. Types of soluble carbohydrate feeds need to be considered. Some grains are more rapidly fermented than others (wheat>barley>corn>oats) and differing methods of storing grains can have an effect as well. Dry matter of wet forages, particularly corn silage, should be evaluated often so that adjustments in feeding rate can be made to prevent imbalanced diets. Selecting corn silage varieties with higher digestible NDF can be beneficial. Erring on the side of overfeeding fiber and underfeeding starches has less long-term downside risk than accidentally overfeeding rapidly fermentable carbohydrates and inducing SARA.

Ration Formulation and Physical Form

Forage and grain particle size (physical form) can have just as big of impact on the induction of SARA as the chemical composition of the feeds. Inadequate long fiber will reduce ruminations and lead to SARA. Corn silage is the basis for most dairy rations in the US Midwest. New kernel processing allows for longer theoretical length of chop while macerating the corn plant particles for better digestion. Haylages need to be chopped fine enough to allow adequate packing in the storage structure, yet long enough to contribute to the fiber mat in the rumen. Many rations include some long hay to give the diet the “scratch factor” that maintains a healthy rumen environment. Long hay in many TMR mixers can be problematic. Most equipment is good at mixing or grinding, but usually not both. Pre-grinding hay or baling with a hay processor allows the feeders to combine particles of similar size and minimize excessive processing with the mixer wagon. Grains that are finely ground, steam-flaked, or high moisture will ferment more rapidly in the rumen than unprocessed or dry grains. Some finely ground grain is important, but must be included in small amounts.
Feed Mixing and Delivery

Dairy cattle should have free choice access to feed so that there is approximately 5-7% daily feed refusal. This is especially important for cows and first calf heifers in the transition period. Dry matter intake is changing rapidly in these phases of the lactation cycle. Cows are able to self-regulate their rumen pH very effectively if they have continuous and predictable access to the same TMR at the same time, every day. However, cattle without feed for a significant amount of time will tend to gorge as soon as feed is offered. This can lead to the cyclic on and off feed condition and induce SARA. Even if the ration is balanced for chemical fiber composition, particle length is adequate, and grain processing is optimal, feeding cows ad lib for some feed refusal is critical to preventing SARA.

Component-fed herds often introduce grain feeding in early lactation based on level of milk production. This can be disastrous if total dry matter intake has not caught up with the level of soluble carbohydrate being fed. This sets the stage for SARA, since cows cannot eat enough forage to compensate for the extra grain consumed. Grain feeding should be increase gradually until six to eight weeks post partum. Protein feeding can be increased more rapidly (by three weeks after calving) because protein mixes tend to be not as rapidly fermentable in the rumen.

Some cows are experts at sorting the “candy” from the “veggies.” Given the opportunity, cows will sift the finer grain particles out of the diet and self-induce SARA. Rations with excess long forage particles and excess fine particles can increase the risk for SARA. Sorting occurs soon after feed delivery, causing the cows to consume a diet that is low in physically effective fiber. The remaining feed that will be eaten later is excessively high in physically fiber and low in energy. Dominant cows are particularly more susceptible to SARA if sorting is allowed by the ration characteristics. Unfortunately, non-dominant cows get lower energy feeds and may suffer lower milk production and earlier culling. Feed ingredients of more similar particle size, adding water to dry TMR rations and maximizing bunk space are all good methods of preventing sorting.

Inadequate Rumen Buffering

The digestive tract of dairy cattle is highly developed to buffer the volatile fatty acids (VFA) produced by rumen fermentation of carbohydrates. While this capacity to buffer the rumen is relatively small, it can account for the margin of error between healthy cows and cows with SARA. Rations designed to promote rumination (cud chewing) will most likely be the safest. Natural buffers secreted in saliva can moderate some errors in ration delivery. The addition of rumen and intestinal buffers within the mineral component of a diet is now considered essential. In order to achieve high milk production, grain-feeding levels will be high, necessitating the addition of buffers to the diet.
Insufficient Rumen Adaptation Highly Fermentable Diets

Rumen adaptation to ration changes is most critical during the transition period. This is an important time for cows entering a subsequent lactation as well as for heifers entering their first lactation. Both the rumen microbial population and the absorptive capacity of the rumen papillae need sufficient time to adapt to a new ration. Typical far off dry cow diets are low in protein and energy making them less costly to feed. To accomplish this, the rations are typically high in roughage and low in starch. This type of feeding practice limits any increases in body condition score while altering the rumen microbial population and reducing the length of the rumen papillae. Once a cow or heifer calves, the rumen microbes need to adjust to the changing substrates presented to them for microbial fermentation. We attempt to moderate these changes by feeding a different close up ration higher in soluble carbohydrate than the far off dry cow ration, but lower than the impending lactating diet. This close up diet may be fed 14-21 day prior to expected calving dates in order to start the adaptation of rumen microbes to increasing starch levels. As VFA production shifts to more propionate levels, rumen papillae begin to elongate increasing surface area for removal of the additional VFA produced.

Since the accumulation of lactate within the rumen environment is probably the most important factor leading to the clinical signs of SARA, efforts have been made to reduce the production or enhance the removal of lactate in high producing cows. The importance of maintaining a stable rumen environment between lactate production and lactate utilization cannot be underestimated. Supplementation with specific yeast strains may enhance lactate utilization. Direct-fed microbials might be able to precondition the rumen microbes to handle excess lactate. Now that monensin is approved for use in lactating dairy cows in the US, there are several uses for this feed additive. Monensin can reduce rumen lactate production by inhibiting of lactate-producing bacteria and competitively enhancing lactate utilizers. Additionally, feeding monensin to dry cows has been shown to reduce ketosis post calving by improving dry matter intake and rumen fermentation through the transition period.

Herd Level Monitoring

In order to minimize the impact of SARA on dairy operations, efforts to monitor for signs of inefficient rumen fermentation are imperative. Evaluating the feeding program has already been addressed. Both ration formulation and feed mixing and delivery techniques need constant monitoring. Even if excellent standard operating procedures are in place, procedural drift is inherent in human processes and must be scrutinized. Monitoring forage, grain and TMR particle size as well as evaluation of milk production and components, cow observations and if needed diagnostic tests such as rumenocentesis can be performed.
Forage and TMR Particle Size
Using the Penn State Forage Particle Separator attempt to maintain the following physical characteristics of forages entering the ration and TMR delivered.

<table>
<thead>
<tr>
<th>Percent in each box</th>
<th>Haylage</th>
<th>Corn Silage processed</th>
<th>Corn Silage unprocessed</th>
<th>TMR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top</td>
<td>&gt;20</td>
<td>5-15</td>
<td>5</td>
<td>10-15</td>
</tr>
<tr>
<td>Second</td>
<td>&gt;40</td>
<td>&gt;50</td>
<td>&gt;45</td>
<td>&gt;40</td>
</tr>
<tr>
<td>Middle</td>
<td>&lt;20</td>
<td>&lt;30</td>
<td>&lt;40</td>
<td>&lt;30</td>
</tr>
<tr>
<td>Bottom</td>
<td>&lt;5</td>
<td>&lt;5</td>
<td>&lt;10</td>
<td>&lt;20</td>
</tr>
</tbody>
</table>

If cottonseed is fed, the percent of the TMR in the top box can drop to 5-7%.

Corn Grain Particle Size
Using 4 sieves and a pan, ground corn can be evaluated for fineness of particle size. Finer grind provides additional surface area for rumen microbes to attach to. Too coarse of a grind will allow much grain to pass in the manure.

<table>
<thead>
<tr>
<th>Sieve No.</th>
<th>Micron Size*</th>
<th>Characteristic</th>
<th>HM Corn Percent &gt;30%</th>
<th>Dry Corn Percent &lt;20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>#4</td>
<td>&gt;4500</td>
<td>Whole &amp; coarse</td>
<td>75</td>
<td>0</td>
</tr>
<tr>
<td>#8</td>
<td>&gt;2200</td>
<td>Cracked</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td>#16</td>
<td>&gt;1100</td>
<td>Ground</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>#30</td>
<td>&gt;600</td>
<td>Pig Feed</td>
<td>0</td>
<td>50</td>
</tr>
<tr>
<td>Bottom Pan</td>
<td>&lt;550</td>
<td>Powder</td>
<td>0</td>
<td>20</td>
</tr>
</tbody>
</table>

* Particles of this size or greater will remain on top of the screen.

Cow Observations
- Manure scoring
  1. Thin, fluid consistency; arcs when passed
  2. Loose, splatters on impact with ground
  3. Stacks up, dimples in center, sticks to boot (recommended)
  4. Stacks up higher, drier manure
  5. Hard firm manure, balls up much like horse manure
- Lameness scoring
  1. Stands and walks with straight back
  2. Stands with straight back, walks with slight arch to back
  3. Stands and walks with arch to back
  4. Stands favoring one or more limbs, stands and walks arched
  5. Three-leg lame, will not bear weight on one or more limbs
- Cud Chewing
  o Healthy cows ruminate around 10 hours/day
  o Desire 40% of cows not eating at the feed bunk or drinking water
Milk Production Records Analysis

Milk fat test can be influenced by the VFA production during rumen fermentation. Increased levels of propionate and lactate from fermentation of excess quantities of rapidly fermentable carbohydrates in the diet can lead to milk fat depression. Evaluation of milk fat test for groups of cows within a herd can help determine if SARA is affecting the suspect cows. SARA can still occur even if milk fat test depression is not evident in the records. The steps to appropriately evaluate these conditions include:

1. Divide by parity and breed if Jerseys and Holsteins are milked together.
   a. Parity
      i. First lactation cows
      ii. Second lactation cows
      iii. Third and greater lactation cows
2. Determine the average fat test for each group of animals above for the first test date, second test date and third test day after calving.
   a. The first three test dates are most important when considering the long-term impact of SARA on cows.
3. Compare the proportion of individuals within each respective group that are one full percentage point below the group average
   a. There should be no more than 10% of the animals within each group that fall one full percentage point below the group average for each of the first three test dates.
   b. No more than 10% of the whole herd (all lactations combined) that are more than one full percentage point below the herd average for each of the first three test dates.
   c. If the group average is below 3.5% for Holsteins, there may be a herd-wide problem with rumen acidosis.
4. Look for protein:fat inversions within each group over the first three tests.
   a. Protein:fat inversion is defined as fat test being 0.2 percentage points or more below the corresponding protein test.
   b. Less than 5% of the animals should be inverted within each group or within the whole herd at each of the first three test dates.
5. Conversely, determine the proportion of Holstein cows that exceed 5% fat test in early lactation. This could be an indicator of excessive body fat mobilization, subclinical ketosis and hepatic lipidosis.