Acidosis

Acidosis reduces dry matter intake, fiber fermentation, milkfat production, and milk production. Sub-clinical rumen acidosis is evidenced by manure inconsistency, variable intakes, lack of cud-chewing, and general cow depression. Excessive acid production, lack of effective fiber, inadequate buffer addition, and heat stress are all associated with rumen acidosis. High-producing cows often experience a few hours of high rumen acidity during the day. If this situation is corrected, milk production can be increased. Systemic or metabolic acidosis occurs when the cow’s blood becomes acidic. It can cause laminitis.

Sub-clinical Rumen Acidosis (also called sub-acute rumen acidosis or SARA) occurs when the pH of the cow’s rumen drops below 5.8. When the rumen microbes ferment feed, they produce acids. If this acid builds up in the rumen, rumen pH drops. The rumen bacteria do not grow well when the rumen is acidic. At low rumen pH, the concentration of hydrogen ions outside the rumen microbe increases and hydrogen ions leak into the microbe. In order to maintain near neutral pH within its body, the microbe must expend additional energy to get rid of the hydrogen ions. This process results in less energy available for the rumen microbe to use to grow. Those microbes that ferment fiber are especially affected. The cow’s dry matter intake declines, fiber digestibility is reduced, rumen microbial protein production is limited, milkfat (%) declines, and milk production suffers. As number of hours of rumen acidity increase and the pH drops even lower, laminitis may occur, especially if cows are standing on concrete for too many hours.

All too often farmers and nutritionists assume that there is no acidosis problem unless intakes severely decline, milkfat (%) declines, and laminitis is apparent. This is not the case. High-producing cows often experience a few hours of high rumen acidity during the day. If this situation is corrected, milk production can be increased.

The signs of sub-clinical rumen acidosis are:

- Daily roller-coaster intake and milk production.
- Inconsistent manure (some stiff, some loose, some pasty with bubbles).
- Lack of cud-chewing.
- General cow depression.

CAUSES OF RUMEN ACIDOSIS

1. Too Much Acid Production

The rumen microbes ferment starches and sugars to form the volatile fatty acid (VFA) called propionate. Excessive accumulation of propionate and other VFA’s reduces rumen pH. Accumulation of VFA also encourages the growth of lactic acid producing microbes. Lactic acid is
a stronger acid that further reduces rumen pH, eventually producing metabolic acidosis and laminitis. Because of acid concerns, it is generally recommended that ration non-fiber carbohydrate levels not exceed 40% of the total ration dry matter. Unfortunately, this recommendation doesn’t consider how fast the NFC is fermented in the rumen. At the same level of NFC, one ration containing a large amount of sugars and fast fermenting starches such as barley, high-moisture corn, or bakery product may result in acidosis, whereas a ration containing cornmeal (a more slowly available starch source) may not. If the principle starch source is cornmeal, a good rule of thumb is to have no more than 20-30% of the NFC composed of rapidly available carbohydrates such as, sugars, bakery product, and flour. If barley, high moisture corn, or steam-flaked corn is used, try to limit them so that they provide no more than 60% of the NFC in the ration. Generally, if one is forced to feed only rapidly digestible starches, it is recommended that maximum ration NFC be no higher than 36%. Alternatively, one can use more soluble fiber that creates less of a pH drop, to make up a larger portion of the NFC in these situations. Rations containing more effective fiber will tolerate more NFC and more rapidly fermentable NFC. Finally, provide adequate SIP and DIP to ferment in conjunction with NFC in the ration. This increases microbial protein production and reduces the fermentation of energy to acids.

Feeding management will, in part, determine how much total NFC and how much rapidly fermentable NFC is tolerable. If a total mixed ration (TMR) is fed rather than feeding components of the ration individually, higher levels of both NFC and rapidly fermentable NFC will be O.K. Without a TMR, grain should be fed as many times per day as possible (at least 3-4 times/day). Avoid slug-feeding grain (no more than 10 pounds (4.5 kg) fed at one time). If the ration is consistent from day to day, meaning that the same person feeds the cows, forage dry matter and quality are consistent, and feed bunks are never empty, more NFC and more rapidly fermentable NFC in the ration can be tolerated. It’s the accumulation of acid in the rumen that is the problem. The volatile fatty acids are absorbed from the rumen via the rumen papillae. The rumen papillae are reduced in size and absorptive capacity during the dry period, a time when there is less acid production in the rumen because there is little or no grain in the diet. Avoid sudden increases in NFC. Slowly increasing dietary NFC will help to grow the rumen papillae at a rate more similar to the rate of increasing acid production. Use a pre-fresh diet in which 7-8 pounds (3-4 kg) of grain is fed during the last three weeks before calving. Also, gradually increase grain after calving (1 pound (0.5 kg)/day). These practices also help to gradually shift the microbial population to more propionate producers.

2. Too Little Effective Fiber

Fiber counteracts the acid produced from the digestion of NFC by its own intrinsic buffering capacity as well as by stimulating saliva production to buffer the rumen. Cows will only regurgitate and chew long, “effective” fiber. This chewing action produces saliva. It has been estimated that cows make over 6.6 pounds (3 kg) of sodium bicarbonate in saliva each day. Long fiber also stimulates the movement of rumen contents to increase the absorption of acid out of the rumen. Furthermore, the fiber mat provides a haven for the fiber microbes to reside in and
reproduce. The fiber microbes reproduce at a slower rate than other microbial types and would be washed out of the rumen to a greater extent if the rumen mat did not exist.

15% of the particles in the diet should exceed 1.5 inches (3.8 cm) in length. Forage NDF should make up more than 21% of the diet if the forage NDF is relatively digestible and there is little inclusion of non-forage fiber sources such as soy hulls or beet pulp. If NDF digestibility is high and fiber length is marginal, higher amounts of forage NDF may be required to avoid acidosis. With poorly digestible forage NDF and the addition of non-forage fiber, 19% Forage NDF in the ration is usually thought to be the minimum. Roughage should be fed prior to grain or in a TMR. This will help to create a rumen mat and will stimulate cud-chewing at a time when acid production is high.

**GENERAL RECOMMENDATIONS FOR PARTICLE SIZE USING THE PENN STATE PARTICLE SIZE SEPARATOR**

<table>
<thead>
<tr>
<th></th>
<th>Coarse, &gt;0.75 inch</th>
<th>Medium</th>
<th>Fine, &lt;0.31 inch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processed Corn Silage</td>
<td>20-25%</td>
<td>30-40%</td>
<td>5-50%</td>
</tr>
<tr>
<td>Unprocessed Corn Silage</td>
<td>10-15%</td>
<td>35-45%</td>
<td>35-45%</td>
</tr>
<tr>
<td>Hay Crop Silage</td>
<td>20-25%</td>
<td>30-40%</td>
<td>35-50%</td>
</tr>
<tr>
<td>TMR</td>
<td>10-15%</td>
<td>30-50%</td>
<td>40-60%</td>
</tr>
</tbody>
</table>

Note: Some researchers suggest that only 6-10% of the TMR needs to remain on the top screen. The exact recommendation depends in part on the make up of the NFC’s in the diet and feeding management. The author has had the most success across diets with the above recommendations.

Evaluate cud-chewing activity of the cows that aren’t eating a few hours after feeding time. Cows need to ruminate about 8 hours per day. They also eat about 5 hours per day. They usually spend 3-4 hours per day being milked. Thus, you should see at least 50-60% of the cows cud-chewing when you observe them.

Even when effective fiber appears to be adequate (15% of the particles greater than 1.5 inches (3.8 cm), many experienced nutritionists still prefer to have 2-3 pounds (1-1.5 kg) of long hay added to a TMR designed for high production, especially for fresh cows. The extra long, dry fiber particles seem to help stimulate cud-chewing more and improve rumen health. Also, the hay helps to provide a consistent source of fiber when fermented fiber sources may not be consistent.

It is interesting to note that acidosis has been seen in cows fed rations containing relatively low amounts of grain (less than 15 pounds (7 kg)). It must be recognized that regardless of the amount of grain and the level of ration NFC, saliva production is still needed to buffer the acids produced. Without adequate effective fiber and saliva production, acidosis will occur.

**3. Too Little Added Buffer**
Generally it is recommended that buffers, such as sodium bicarbonate, be added to rations designed for high production. Their inclusion rate should be at least 1% of the ration dry matter. In situations where cows may be heat stressed or otherwise more challenged with acidosis, it is recommended to add buffer at a rate of 1.5% of the ration dry matter. Always offer high-producing cows buffer and salt free-choice in separate tubs. Cows will consume buffer if they are experiencing acidosis. An increase in free-choice buffer consumption can be a helpful early warning of a problem with acidosis.

4. Heat Stress

Cows that are heat stressed will eat less forage, producing less saliva to buffer the rumen and causing an increase in the NFC concentration of the diet. This results in more acidosis. Use fans and misters. Open up the barn. Make sure the ration has a positive cation balance (see below).

**Systemic or Metabolic Acidosis** occurs when the cow’s blood becomes acidic from too much acid being absorbed from the rumen into the blood. Acidic blood cannot carry as much oxygen. The cow’s feet, being at the farthest points of the cow’s body, receive the least oxygen. The cow’s feet swell. Pressure between the hoof wall and bone inside results in the pain, hemorrhages, and ulcers associated with laminitis. Laminitis is defined as an inflammation of the sensitive tissues (lamellae) which are located in between the outside wall of the hoof and the coffin bone (on the inside).

**Signs of Laminitis:**
- Cows “plod” as they walk or they look like they are “walking on eggs”
- Cows stand with their feet close together or crossed
- Above the coronary band it is pink and puffy
- Hemorrhages appear as pink striations in the hoof
- White line separation and sole ulcers are seen
- Hooves become wide and flat and develop ridges

**Sub-Clinical Metabolic Acidosis** is often experienced by high-producing cows. Their blood can become more acidic than it should be but they still milk reasonably well and they don’t show any signs of laminitis. Just like the rumen microbes, the cells of the cow’s body do not work as well in acid. The activity of enzymes is impacted by blood pH. Regulation of blood pH in animals is just behind the need for oxygen and the need to get rid of carbon dioxide in order of priority. Metabolic acidosis is more apt to occur when a cow is heat stressed because she loses potassium via sweat.

Milk production can be increased by decreasing blood acidity. Increasing the Dietary Cation-Anion Difference (DCAD = (Sodium + Potassium) – (Chloride + Sulfur)), increases the ability of the cow’s blood to buffer acids and raises blood pH. The current recommendations are to increase the DCAD to 35-40 by raising dietary potassium to at least 1.6% (often up to 1.8%), increasing the buffer in the ration to 0.75 pounds/cow/day, and adding 4 oz. of Potassium Carbonate (K-Minus sold by Church & Dwight Co.). When the extra potassium is added, more magnesium must be added to the ration because potassium decreases the cow’s absorption of magnesium. It’s recommended that the Potassium:Magnesium ratio be maintained at 4 to 1.
Research trials have increased milk production by more than 3 lbs (1.4 kg) /cow/day by increasing DCAD.

REFERENCES:


