Sub-Acute Ruminal Acidosis: Development and Prevention

Sub-acute ruminal acidosis (SARA), also known as chronic or sub-clinical acidosis, is causing production losses in most dairy herds. Reports suggest high prevalence of SARA in high yielding dairy herds as they are fed with higher grain, lower fiber diets that maximize energy intake during early lactation. The consequence of feeding excessive amounts of rapidly fermentable carbohydrates with inadequate fiber to ruminants is subacute ruminal acidosis, which is characterized by periods of low ruminal pH which is rarely diagnosed. Dairy herds experiencing SARA will have a decreased efficiency of milk production and poor health.

Development of SARA:
Ruminal pH fluctuates considerably during a 24–hr period and is determined by the dynamic balance between the intake of fermentable carbohydrates, buffering capacity of the rumen, and rate of acid absorption from the rumen. In general, subacute ruminal acidosis is caused by ingestion of diets high in rapidly fermentable carbohydrates and low fiber. Subacute ruminal acidosis is most commonly defined as repeatedly occurring prolonged periods of depression of the ruminal pH to values between 5.6 and 5.2. The low ruminal pH is caused by excessive accumulation of volatile fatty acids (VFAs) without persistent lactic acid accumulation and is restored to normal by physiological response of the body.

The ability of the rumen to rapidly absorb VFAs largely determines stability of ruminal pH. Ruminal VFAs are absorbed passively across the rumen wall. This passive absorption is enhanced by rumen papillae which provide massive surface area for absorption. Ruminal papillae increase in length when cattle are fed higher-grain diets; this presumably increases ruminal surface area and absorptive capacity, which protects the animal from acid accumulation in the rumen.
Dairy cows are at high risk during transition period and in peak lactation, when high levels of easily fermentable carbohydrates are fed to avoid negative energy balance as during these periods ruminal mucosa needs time to adapt to high grain diet.

Marked depression of dry matter intake happens when ruminal pH falls below 5.5. This depression is supposed to be mediated by pH and osmolality receptors in the rumen. Inflammation of the ruminal epithelium (rumenitis) could cause pain and also contribute to further depression of feed intake during SARA.

Absorption of VFA inherently increases as ruminal pH drops. These acids are absorbed only in the protonated state. Because they have a pKa of 4.8, the proportion of these acids that is protonated increases dramatically as ruminal pH decreases below 5.5.

Ruminal carbohydrate fermentation shifts to lactate production at lower ruminal pH mostly due to Streptococcus bovis proliferating and shifting to lactate instead of VFA production. Ruminal lactate production is undesirable, because lactate has a much lower pKa than VFAs (3.9 vs. 4.8). For example, lactate is 5.2 times less protonated than VFAs at pH 5. As a result, lactate stays in the rumen longer and contributes to further drop in ruminal pH.

Additional adaptive responses are invoked if lactate production begins. Lactate-utilizing bacteria, such as Megasphaera elsdenii and Selenomonas ruminantium, begin to proliferate. These beneficial bacteria convert lactate to other VFAs, which are then easily protonated and absorbed. However, the turnover time of lactate utilizers is much slower than that of lactate synthesizers. Thus, this mechanism may not be invoked quickly enough to fully stabilize ruminal pH. Periods of very high ruminal pH, as during feed deprivation, may inhibit populations of lactate utilizing bacteria.

Low ruminal pH during SARA also reduces the number of bacteria in the rumen, although the metabolic activity of the bacteria that remain is very high. Protozoal populations are particularly limited at lower ruminal pH, the absence of ciliated protozoa in ruminal fluid is often observed during bouts of SARA. When fewer species of bacteria and protozoa are present, the ruminal microflora is less stable and less able to maintain normal ruminal pH during periods of sudden dietary change. Thus, periods of subacute ruminal acidosis leave animals more susceptible to future episodes of ruminal acidosis.

Subacute ruminal acidosis has traditionally been associated with claw horn lesions, assumed to be caused by subacute laminitis which causes production losses. Prolonged conditions of acidosis may lead to some irreversible health conditions forcing culling of such animals.

Prevention:

Ruminant diets should be formulated to provide adequate buffering. This can be accomplished by addition of dietary buffers with scientifically proven formulation.
There are commercially available alkalizers which maintain ruminal pH within normal range for longer period which in turn will prevent damage of ruminal papillae and will also provide time for adaptation to dietary changes at different phases.

Avilact is a rumen alkalizer from Avitech which is formulated in a way that when added in prescribed rate in feed, it maintains rumen pH within normal range for a considerable period of time and it also removes endotoxins produced which are prime reason for development of laminitis.

Other preventative measures:
• Avoid over-mixing or over-processing of the TMR that reduces particle size
• Minimize separation of feed ingredients during TMR mixing and delivery
• Ensure adequate length of forages and silage during cutting

SARA is causing huge economic losses to dairy farmers subtly in India. A preventive approach can save losses in terms of production and health of dairy animals.

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