Zydus AH

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Dear Doctor,

Dairy Cow is truly a genius for its capacity to digest feedstuffs that are poorly digested or indigestible by monogastric animals and convert them into milk, one of nature's most wholesome foods. Micro-organisms living in the rumen allow ruminants like the dairy cow to digest the fibrous components of feed. Therefore, the approach to feeding cows is also to 'look after these microbes which look after the cow'.

A basic understanding of ruminant digestive tract and digestion is essential for good management, sound nutrition and making intelligent feeding decisions. The physiology of digestion of ruminants is unique among domestic animals where in bacterial enzymes play an integral role in absorption, assimilation and metabolism. The rumen microbial population has the first opportunity to digest any feed consumed by the ruminant. Anything that affects the rumen ecosystem will ultimately affect how and which nutrients are available to the animal for productive purposes.

In this issue we discuss the important facets of ruminant digestion and its management in dairy cows.

Happy reading!

Wish you and your family a Happy Deepawali!

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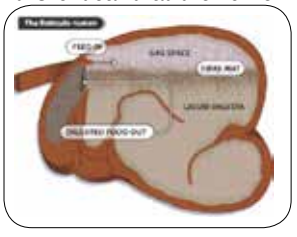
Managment of Digestive Disorders in Ruminants

Introduction

Ruminant species can be considered as super-animals because of their unique ability to digest certain foodstuffs, especially roughages, efficiently that would otherwise get wasted if consumed by monogastric animals. Central in this process is the rumen and the resident microbial population. Rumen ecology plays vital role in the digestion, absorption and assimilation of ingesta in ruminants. Actual digestion of feed is aided by the microbial population in the rumen. Cellulose and related compounds found in hays and roughages consumed by ruminants is dependent upon enzymes elaborated by micro- organisms living within the digestive tract.

When the rumen becomes dysfunctional, feed digestion is impaired and cows become susceptible to a range of metabolic diseases. In order for cows to achieve their genetic potential for milk production and remain healthy, it is critical that the rumen environment be kept in a "healthy" state.



Essentially rumen is a fermentation chamber in which the resident microbial population helps to digest the diet. The partially fermented food and the micro-organisms then pass out of the rumen, into the small intestine. Digestion of food in the rumen occurs by a combination of microbial fermentation and physical breakdown during regurgitation of the food. Microbial attack is carried out by a mixed population of bacteria, ciliate protozoa and a small number of anaerobic fungi. The products of microbial fermentation, mainly volatile fatty acids and microbial protein, are available for absorption by the host cow.

Volatile fatty acids can supply up to 80% of the animal's energy requirement, while microbial protein leaving the rumen can account for between 50 and 90% of the protein entering the small intestine.

Ruminal Indigestion

Rumen microbial population is very important for dairy cows. It provides 50% to 80% of daily protein requirement and up to 80% of its energy requirements. The remainder of the nutrients comes from recommended daily nutrients fed. That's why animal health nutritionists today say, "feed the rumen first". In other words, this concept means to increase count of ruminal microflora through nutrients & to get more nutrients from ration.

However, at the slightest alteration in rumen environment, microbial population is compromised leading to indigestion or dysfunction.

Common causes of ruminal indigestion

Almost any dietary factor that can alter the ruminal environment can cause simple indigestion. The disease is common in hand fed cattle because of variability in the quality & quantity of their feed. The factor may be listed as below:

- Dairy cattle may suddenly eat excessive quantities of highly palatable feeds such as corn or grass silage
- During drought, cattle and sheep may be forced to eat large quantities of poor-quality straw, bedding, or grain
- Sudden change of feed using spoiled or frozen feeds, introducing urea to a ration, turning cattle onto a lush cereal grain pasture
- Introducing feedlot cattle to a high-level grain ration
- Ingestion of placenta by post-parturient cow
- Decrease in ruminal pH due to rapid fermentation of ingested carbohydrates or an increase in ruminal pH due to forestomach hypomotility and putrefaction of ingested feed.
- Accumulation of excessive quantities of relatively indigestible feed that may physically impair rumen function.

These factors lead to decreased dry matter intake which further lead to decrease in milk yield and performance.

In any kind of ruminal indigestion the basic changes in the rumen are-

- Decrease in microbial population in the rumen
- Low ruminal motility
- Decrease in enzymatic digestion
- Changes in rumen pH

Changes in rumen bacteria

Initially, the metabolic disorder increases the growth rate of all bacteria in the rumen, resulting in an increase in total volatile fatty acid production and a decrease in ruminal pH. It is likely that the provision of increased substrates for microbial production, e.g. ammonia and peptides, will favour bacterial growth rather than production of VFA. When large amounts of starch are added to the diet, the growth of Streptococcus bovis is no longer restricted by a lack of this energy source and this population grows faster than other species of rumen bacteria. S. bovis produces lactic acid, an acid 10 times stronger than acetic, propionic or butyric acid, the accumulation of which eventually exceeds the buffering capacity of rumen fluid. Glucose produced from the breakdown

of starch and other carbohydrates are converted to fructose 1,6-diphosphate. Scientists found that fructose 1,6-diphosphate had a positive feedback on the conversion of pyruvate to lactate by activating lactate dehydrogenase. Fructose 1,6-diphosphate is also converted to triose phosphate in increasing concentrations. Triose phosphate acts to inhibit pyruvate formate lyase. The net effect of these changes is a switch from predominantly acetate and formate production to lactate production

Changes to rumen motility

The increase in VFA concentrations may also initially decrease reticulo-ruminal motility by acting on receptors in the rumen wall. Researchers found that the decrease in ruminal motility was independent of a decrease in rumen or systemic pH, and occurred when venous blood concentrations were normal. A decrease in motility results in a decrease in rumination and less production of saliva. Saliva contains high concentrations of bicarbonate ions and is an important buffering mechanism for the rumen. Saliva is produced through stimulation of the rumen and mastication.

Changes in rumen pH

A decrease in bicarbonate and increase in lactic acid concentrations in the rumen further decreases ruminal pH. When ruminal pH is maintained above 5.5, equilibrium exists between producers and utilisers of lactic acid, such that lactic acid does not accumulate in the rumen. When pH is less than 5.5, no cellulolytic and relatively few saccharolytic bacteria, including P. ruminicola, a significant producer of VFAs, survive. In contrast, S. bovis multiplies until ruminal pH is less than 5.0, a pH that allows an increase in Lactobacillus growth. Both of these bacterial species produce D and L-lactic acid. D-lactate and L-lactate are absorbed across the rumen wall and depress blood pH resulting metabolic acidosis. The lowered pH creates a ruminal environment hostile to protozoa and fungi and populations of both these fall precipitously. Chemical damage of the surface epithelium of the rumen mucosa occurs and results in the adherence of debris and penetration by particulate matter from the rumen. Bacterial and mycotic organisms begin to invade the rumen wall causing ruminitis. Rumen papillae are damaged and can slough from the rumen wall. Absorption patterns change and endotoxins and histamine are released in the acute stages of the disease process

Line of Treatment

So the approach to rumen indigestion should be directed to overcome the basic dysfunction holistically. The need is to increase microbial count, provides enzymes & amino acids to serve immediate need of digestion and rumen environment restores.

Feeding of important enzymes during ruminal indigestion is very significant as they can take care of decreased enzymatic activity because of changed ruminal environment.

In our country the traditional feeding system for dairy cattle is based on the use of rice straw, natural grasses supplemented with a little concentrates. Therefore, cellulose activity accounts for the majority of fibre digestion in the rumen. This digestion captures most of the energy from fibre when pH is maintained within normal limits. Studies has indicated that yeast culture in diet helps to decrease lactate accumulation in the rumen by stimulating the bacteria that use lactate which helps to maintain rumen pH above 6.0 and increase fibre digestibility.

During ruminal indigestion, amino acids should be fed as animals become deficient in essential amino acids during this period. These amino acids are also required for microbial growth.

In a nutshell, optimizing the rumen microbial population helps to maximize the feed intake, fibre digestion and microbial synthesis of consistently high production levels. It also increases volatile fatty acid production for increased energy availability, decreases the risk of acidosis by reducing accumulation of organic acids and optimizes protein digestion in the rumen.

Prebiotic, Probiotic and Symbiotic

The term prebiotic was introduced by Gibson and Roberfroid. Prebiotic is a dietary supplementation in the form of nondigestible carbohydrate that favors the growth of desirable microflora that helps in digestion.

Probiotics have been defined also as “a live microbial feed supplement which beneficially affects the host animal by improving its intestinal balance”. There is a relatively large volume of literature that supports the use of probiotics to prevent or treat intestinal disorders.

Probiotics are determined as viable microbial feed supplements, which are believed to stimulate growth and the health as well as to modify the ecology of the intestine in a beneficial manner for the host. Probiotics should lead to beneficial effects for the host animal due to an improvement of the intestinal microbial balance or of the properties of the indigenous micro-flora. There are also many mechanisms by probiotics enhance intestinal health, including stimulation of immunity, competition for limited nutrients, inhibition of epithelial and mucosal adherence, inhibition of epithelial invasion and production of antimicrobial substances.

The term symbiotic is used when a product contains both probiotics and prebiotics. This term is specifically used for the composition in which the prebiotic compound favors the probiotic compound. Any preparation of symbiotic nature will solve the problem of ruminal indigestion effectively and will maintain the higher production and performance as a result.

Amino acids in ruminant

It is important to determine just how much potential there is for increasing the yield of microbial protein in the rumen. Opportunities for improving efficiency of protein utilization through manipulation of dietary amino acid supply are not as great with ruminants as with swine and poultry. The fact is that the large amount of microbial protein produced in the rumen, representing 40-70% of protein reaching the intestine, is already well balanced regarding amino acid. Nonetheless, it is well documented that lysine and methionine are usually the most limiting amino acids for milk production, and that under the appropriate dietary situations small improvement can be made in utilization by supplementing rumen protected lysine and or methionine.

Conclusion

Micro-organisms living in the rumen allow ruminants like the dairy cow to digest the fibrous components of feed. The rumen functions in coordination with the reticulum to support contractions of the musculature that create the functions of rumination (cud chewing and rumen contractions) and eructation (gas release). Factors affecting the viability of micro-organisms in the rumen, as well as anywhere along the gastrointestinal tract of the ruminant, impact the host animal.

Indigestion in dairy cattle reduces rumen motility and kills rumen micro-flora. Simple indigestion can be associated with sudden changes in dietary ingredients or with anything that alters the consistency of the feeding program. Almost any dietary factor that can alter the ruminal environment can cause simple indigestion.

Digestive disorders in cattle directly affect the economics of dairy farm due to impact on production. In order for animals to achieve their genetic potential for milk production and remain healthy, it is critical that the rumen environment be kept in a “healthy” state. So the approach to rumen indigestion should be directed to overcome the basic dysfunction holistically. Preparation of symbiotic nature that contains prebiotic & probiotic will solve the problem of ruminal indigestion effectively.

The need is to increase microbial count, provide enzymes and amino acids to animal for better digestion and to restore ruminal environment. This in turn will maintain high production and performance of the dairy animals.

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