HEREFORD
Canadian Hereford Association

Profitable Feeding

Fact Sheet 4

UNDERSTANDING RUMEN MICROBES FOR PROFITABLE FEEDING MANAGEMENT

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Feed conversion and rate of gain in cattle and sheep are strongly affected by microorganisms in the rumen. Experiments at the Lethbridge Research Centre over the past 20 years have helped us understand the way that rumen microbes process feed. These findings can help maximize performance and digestive problems.

Microbial Digestion

Before microbes begin the process of digestion, they must first attach themselves to feed particles. They do this by secreting a sticky, mucous-like envelope, which serves as a bridge for the microbial attachment and reduces the chances of their being washed off the feed.

Once attached, microbial cells multiply to form colonies, and begin to release digestive enzymes that break down the feed. The attachment envelope improves the efficiency of digestion since the enzymes produced by the microbes are trapped in close proximity to the feeds they digest. In addition, the envelope reduces the escape of intermediate products of digestion. Other types of microbes, attracted by and able to use the products of the initial digestive steps, also become enmeshed in the mucous envelope. In this way, remarkably efficient multi-species digestive "teams" develop. Eventually, the area is colonized by a diverse mixture of microbial types, each digesting specific parts of the feed particle or particular by-products of digestion.

Regular contractions of the rumen mix the contents and propel colonized feed particles both up the esophagus for rechewing (cud chewing) and down the digestive tract for further processing. Microbes dislodged from their attachment sites by these flows are then free to attach and establish colonies on fresh feed entering the system. Others flow from the rumen with the feed digesta, and are processed by the ruminant animal in the "true" stomach (abomasum) and intestine and serve as an important source of protein to the animal.

Grain Processing

The method and degree to which grain is processed affects the rate of microbial attachment, colonization, and digestion that goes on. Physical attachment of specific gut micoorganisms to feed particles is the essential initial step in the digestive process. However, most plants (e.g., cereal grains, forage leaves) possess protective outer layers which are extremely resistant to microbial colonization. Chewing damage to these outer layers during eating and during rumination (cud-chewing) provides the microorganisms access to the digestible internal components of the plants. Other feed processing techniques, such as rolling rain, are sometimes necessary to permit full release of nutrients from feedstuffs before the feed material passes from the digestive tract. For example, depending on the amount fed and the rate of consumption (which affects the amount of chewing during eating), we have found that five to 15 percent of whole barley kernels may escape chewing damage entirely. Consequently, digestion of the starch and protein within is severely inhibited, and the virtually intact kernels are recoverable from the manure.

Coarse-rolled barley, where the hull is cracked without shattering the kernel, is digested slowly because of the time required for microbes to access internal nutrients. Cracks in the hull provide access points for "inside-out" digestion of the kernel. Finely rolled or hammered grain offers a very large surface area for microbial attachment; breakdown of starch is extremely rapid. Therefore, over-processing of grain should be avoided.

Acidosis and Bloat

One important objective of feedlot bunk management is to minimize fluctuations in feed intake. Feed conversion has been shown to be most efficient when feed consumption occurs at regular, frequent intervals. In some situations, such as when feed intake is too rapid, the efficiency of the microbial digestion "teams" is too high for the good of the ruminant animal. Digestion proceeds too rapidly and upsets the stability of the microbial populations in the rumen. Here is what often happens:

- An external factor, such as a rise in temperature, decreases cattle appetites and feed consumption declines temporarily.
- As the weather moderates, the cattle return aggressively to the bunk and over-consume
- Excess grain intake results in rapid gas and acid production. The fermentation products accumulate in the rumen. The acids overpower the buffering capacity of the animal's saliva

and a sharp drop in rumen pH results

- Low rumen pH reduces the activity of many beneficial microbes (e.g., the fiber digesters), and favors the growth of bacterial that produce lactic acid - a stronger acid- which depresses pH even further (acidosis)

- Cattle go off feed. As the grain in the rumen is depleted, acid production decreases the rumen pH rebounds into normal range.

- Appetite returns and cattle return to the bunks. Unless rations are adjusted, the cycle is repeated

In some cases, mild acidosis leads to bloat. Rapidly growing bacterial, including the lactic acid producers, can produce copious amounts of mucous, which traps fermentation gases, producing a froth of small, stable bubbles. Belching is ineffective in expelling the trapped gases. And because the gases cannot escape, the rumen expands.

Ionophores reduce the incidence of bloat by inhibiting the growth of bacteria typically responsible for excess mucous production. Ionophores also improve feed conversion efficiency because they selectively inhibit some bacteria, including the methane producers, which are less efficient than most at feed conversion.

As well as increasing our knowledge of feed digestion, our research is developing the technologies required by Canadian cattle producers to stay competitive in the world marketplace.