Ruminants vs. Pseudo-ruminants vs. Equines
The Small Intestine

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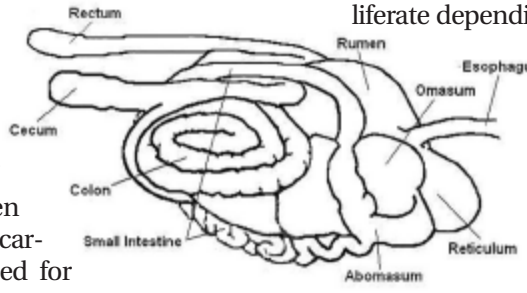
In the last installment, the rumen and its various compartments were discussed. Before the next segment of the gastrointestinal tract (GIT) is examined, it is necessary to understand what is contained in the digesta exiting the rumen complex.

The major products of ruminal microbial activity and the location of their digestion and absorption are: 1) Volatile fatty acids, or VFA - absorbed by the lining of the GIT; and 2) Microbial protein - digested and absorbed in the small intestine. Generally speaking, dietary components that are readily digestible (starch and protein) are degraded first. Very little, if any, of these feed components escape the rumen complex.

The role of the small intestine is basically the same in all mammals — enzymes secreted by the pancreas break down semi-digested feed exiting the stomach. The resulting nutrients are then transported across the intestinal lining, usually involving a sophisticated mechanism and the expenditure of energy. These nutrients are then absorbed into the bloodstream and carried to the liver, where they are used for maintenance or growth.



Bovine Gastrointestinal Tract

The type of feed component an enzyme digests is indicated by its name, followed by the letters "-ase". Some common digestive enzymes and their substrates are: amylases (starch), lipases (fats), and proteases (proteins). The amount of each enzyme secreted depends on the native diet for that species.

Although the arrangement of the small intestine's multiple loops seems haphazard, there is actually method to the madness. Rhythmic contractions of the intestinal walls move digesta through torturous hairpin curves at a comparatively fast pace (usually less than 30 minutes from beginning to end). This rapid and chaotic transit forces semi-digested feed to collide with enzymes, and the products of that collision then collide with the intestinal lining. The result is efficient enzymatic digestion and absorption.

Because so little starch escapes the rumen complex, cattle and camelids normally secrete less amalase than equines and other nonruminants. Protein nutrition is also more complicated. Most dietary protein is fermented in the rumen unless pre-treated with a microbially-indigestible material such as fat. The resulting amino acids are then incorporated into microbial cells. Those microorganisms are then carried into the small intestine, where they are digested by mammalian enzymes.

Animals at different stages of growth require different amounts of protein. The quantity of microbial protein entering the ruminant small intestine can be influenced by manipulating the quality and quantity of the diet. In general, more digestible substrates such as grain and high quality roughage increase microbial proliferation and therefore, the amount of microbial protein exiting the rumen.

Microorganisms that normally inhabit the rumen generate large quantities of water-soluble or B-vitamins. These exit the rumen to be absorbed and used by the host. Because fat-soluble vitamins (A, D, E, and K) are not products of microbial fermentation, they need to be supplied by the diet.

Different species of rumen microorganisms die off or proliferate depending on the diet fed. Any change in diet requires an adjustment in rumen populations. It takes ten to fourteen days for such a shift to be fully implemented. To safely accommodate ruminal reorganization, diet changes must be made gradually.

In general, feeding the ruminant and pseudo-ruminant involves feeding the microorganisms of the rumen. They, in turn, feed the animal. This is why the health and well-being of the rumen and its residents must always be a priority when caring for these species. Anything that impinges on their activity, including stress and antibiotics, will directly impact the host.

Microorganisms also play a critical role in equine nutrition, but in a different location. Although a large quantity of microbial protein is generated in the equine large intestine, which will be discussed in the next installment, most of it is unavailable to the host. The primary site for protein absorption is still the small intestine, but this protein is derived from the diet.

About the author:

Lark Burnham received a B.S. in Animal Science (1979), from Kansas State University and a M.S. in non-ruminant nutrition (1995) from Kansas State Universtity, Manhattan, and a Ph.D. Doctorate in ruminant nutrition (2004) from Texas Tech University, Lubbock. Her special interests are comparative nutrition, the role of the micro flora in all mammals, fiber digestion, and probiotics. Lark currently works for Natur's Way. Inc., Horton, KS, which produces MSE probiotics.