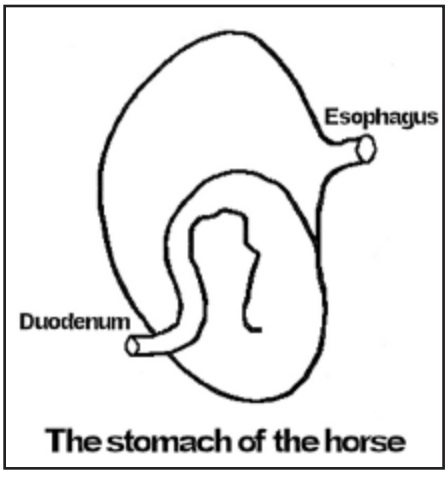
Ruminants vs. Pseudo-ruminants vs. Equines: The Stomach By: Lark Burnham

There are three major goals for the gastrointestinal tract: 1) reduction of feed particle size; 2) absorption of nutrients; and 3) elimination of indigestible material. Although all mammals are designed along the same general digestive plan — stomach, small and large intestines — individual species have evolved variations on this common theme that allow them to better utilize vegetation. This was necessary because vegetation contains varying amounts of material indigestible by mammalian enzymes, generally denoted by the term 'fiber'.

One of the greatest differences between ruminants, pseudo-ruminants, and equines lies in the stomach. Mammals are generally categorized as 'fore' or 'hind' gut fermenters. These terms refer to the location of what is essentially a fermentation vat, either before (foregut) or after (hindgut) the small intestines. We will see that the location of this primary fermentative organ will determine how well microbial protein generated in that organ is utilized.

Although the rumen predominates in foregut fermenters, they actually have the ability to ferment both fore and aft, so to speak. The fermentation capacity of the large intestine of ruminants and pseudo-ruminants is often overlooked because the rumen is so efficient. In these two groups, the large intestine ferments whatever manages to escape the rumen and small intestine, as well as any sloughed tissue from the tract itself.

Another way to categorize these three groups is by stomach complexity. In the past, the term 'monogastric' was used to describe nonruminants such as the horse or pig; this implied that ruminants had more than one stomach. Now the horse and pig are considered to have 'simple' stomachs. This is more accurate; ruminants have only one, 'complex', or multi-compartmentalized, stomach. In addition to rigorous fermentation, ruminants and pseudo-ruminants have evolved specialized rumen compartments for mixing, sorting, and water retrieval.



The stomach of the horse

Fiber digestion in all mammals is accomplished through a symbiotic relationship with micro-organisms. Efficient removal of nutrients contained in vegetation by microorganisms requires 1) access to a steady stream of feed material; 2) removal of fermentation products to prevent build-up; and 3) a relatively quiet and untroubled area to proliferate. These three functions are served by the rumen in bovines and camelids, and by the large intestine in equines

Ruminants and pseudo-ruminants are foregut fermenters with compartmentalized stomachs, while equines are hindgut fermenters with simple stomachs. The discussion of the stomach will begin with the horse, since it is the simplest and does not possess any of the bells and whistles associated with fermentation.

After well-masticated feed leaves the mouth of the horse, it is propelled by waves of muscular contraction down the esophagus and then through the cardiac sphincter, which allows it to pass into the stomach. The stomachs of all nonruminants secrete hydrochloric acid (HCl), this corrosive acid helps break

down and solubolize non-fibrous material such as protein and simple carbohydrates (sugars and starch), which are then absorbed in the small intestine. Fermentation of some sugars does occur in the stomach of nonruminants, but it is predominantly facilitated by the acid-loving Lactobacillus sp. These microorganisms line the walls of the stomach and play a critical role in host-defense. This latter benefit will be discussed in a future article about probiotics.

Particle size reduction is promoted by strong muscular contractions which thoroughly mix the ingested feed with HCl. The pH of the horse stomach is not as low (as acidic), as that of other non-ruminants, nor does the feed spend as much time there. The vast bulk of the basically undigested diet passes out of the stomach through yet another sphincter, into the small intestine for enzymatic digestion (protein and simple carbohydrates). The fibrous material continues on to the large intestine for microbial fermentation.

We will see that many of the functions performed by the compartmentalized rumen are mimicked by the large intestine of equines. A description of the various compartments in both ruminants and pseudo-ruminants will be covered in the next installment.

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 University, 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 mammels, fiber digestion, and probiotics. Lark currently works for Natur's Way. Inc., Horton, KS, which produces MSE probiotics.