

The Ins and Outs of Digestion

A basic understanding of digestion can help you plan an appropriate diet for your horse.

by Lori K. Warren, Ph.D.

As a horse owner, you likely make a conscientious effort to select quality feeds for your horse to eat. You are also probably well acquainted with the by-products of digestion each time you clean your horse's stall. But how often do you think about what takes place in your horse's body in between?

Selecting the Best

Digestion begins with the prehension (grasping) of food by the lips, tongue and teeth. Horses have very mobile lips that help them select desirable feeds and avoid those that are undesirable. Many of us have witnessed this lip dexterity-ever wonder how some horses skillfully sort out powdered medications you have tried to hide in their sweet feed, or what about the soggy pellets left behind in the feed tub that were deemed unworthy?

Chew Your Food!

The next step is chewing, which is an extremely important part of the digestive process. Chewing helps to break down large food particles into smaller ones so that digestive enzymes and microbes have a greater surface area to extract the nutrients. Horses with poor dentition (a common ailment of older horses) or horses that "bolt" their feed and fail to chew properly are at greater risk for choke and impaction colic. Feed that is inadequately chewed is also harder to digest, so weight loss may become an issue because the horse gets less out of the feed than horses that chew thoroughly.

Horses spend more time chewing forages (hays or pasture grasses) than grains or pelleted feeds. The average horse will spend about 18 minutes eating one pound of long-stem hay, whereas it will take him less than 5 minutes to eat a pound of oats. Therefore, whenever grains are added to the diet, the horse spends less time eating. An unfortunate side effect of reducing the horse's "chew time" is boredom and behavioral vices, such as wood or tail chewing.

The nature of the feed also affects saliva production. Twice as much saliva is produced when horses eat forage compared to grains and other concentrates. Saliva moistens the feed, making it easier to swallow, and it's also rich in bicarbonate, which helps buffer the acid produced in the

stomach.
Acid Attack

After being chewed and swallowed, the ingested feed passes into the stomach. The horse's stomach is relatively small for its large body size, approximately the size of a small watermelon. A horse's stomach functions similar to a human's stomach, producing acid and the enzyme pepsin, which initiates the breakdown of proteins in the feed.

In humans, dogs and pigs, acid is only secreted by the stomach in response to a meal, but in the horse acid is produced continuously. Horses evolved as grazing animals, often foraging for 16 or more hours per day. Therefore, a steady production of acid was necessary to process small meals consumed at frequent intervals. However, with today's practice of feeding a distinct breakfast and supper, many horses spend a significant amount of time between meals without anything in their stomachs to absorb the acid. Furthermore, when the horse isn't chewing, there is no saliva produced to help buffer the constant flow of acid. Adding insult to injury, the top one-third of the horse's stomach is made up of tissue similar to that found in the esophagus and can easily be destroyed by the potent stomach acids (basically the acid digests the stomach lining). Consequently, limiting intake to one or two meals per day allows acid to build up in the stomach between meals and increases the risk of gastric ulcers.

The Horse's Digestive Tract

The Horses Digestive Tract Extraction

Extraction and absorption of nutrients begins in earnest once the ingested feed reaches the small intestine. Although feed spends a very short amount of time traversing this 70-foot long tube (1-3 hours), the small intestine is the primary site for the digestion and absorption of sugar, starch, protein, and fat. Vitamins A, D, E and K, as well as calcium and some phosphorus, are also absorbed from the small intestine.

The horse's small intestine is very good at breaking down and absorbing simple sugars, such as those found in molasses or very leafy pasture grasses. However, the horse is not as efficient at digesting starch, which is a major component of cereal grains (oats have ~50 percent and corn ~70 percent starch). Rolling, flaking and other forms of grain processing help to increase the amount of starch digested in the small intestine. Nonetheless, with large grain meals, there is a risk that undigested starch

will reach the large intestine (more on this later). As a result, a meal of grain should typically not exceed 0.5 percent of the horse's body weight (about 6 pounds for a 1200-lb horse).

In comparison to starch, the horse's small intestine is very good at breaking down proteins into their constituent amino acids. Similarly, even though the horse lacks a gall bladder, he is quite capable of digesting fats. Forages and cereal grains are naturally low in fat (~3 percent), but studies have shown that horses can effectively digest 10 percent fat in the total diet. If you choose to use fat to provide additional calories, make sure to increase the amount gradually over two or three weeks to allow the digestive system to adjust.

Forage The Fermentation Vat

Once digesta leaves the small intestine it flows into the large intestine (or hindgut). The first segment of the large intestine is the cecum, which is equivalent to the human appendix. However, in the horse, the cecum is very well-developed, with a capacity of about 12 gallons. In fact, the cecum, combined with the large and small colon, make up over 65 percent of the total capacity of the equine digestive tract.

The hindgut houses billions of bacteria, protozoa and fungi, which assist the horse in the digestion of fiber found in hay or pasture. No animal possesses the enzymes needed to digest these fibrous feeds; therefore, herbivores like the horse rely on these microbes to process the fiber into something useful they can absorb.

Microbes break down cellulose and hemicellulose, both of which are forms of fiber, into volatile fatty acids. These volatile fatty acids serve as an important source of energy for the horse. In addition, the microbes in the hindgut produce vitamin K and the B vitamin complex. As a result, a healthy horse consuming a high-quality, high-forage diet will generally not require these vitamins in their diet.

Lignin, another form of fiber, cannot be processed by either the horse or the microbes living in the hindgut, and will be passed in the manure. The amount of lignin, as well as other types of fiber, greatly influence the nutritional value of the forage consumed by the horse. For example, overly mature grass hay will be relatively high in lignin, which depresses the overall digestibility of the fiber. In contrast, young leafy grass, beet pulp and soy hulls contain lower amounts of lignin and higher amounts of hemicellulose and soluble fibers, making them highly digestible.

Another important function of the large intestine is the absorption of water. The horse's digestive tract secretes a large volume of water (~35 gallons)

to aide in the digestion process. This fluid is reabsorbed as digesta passes through the hindgut, allowing the formation of semi-solid fecal balls in the rectum.

Proper function of the horse's large intestine is highly dependent upon the health of the microbial population. These microbes do their job best when the horse is in its natural environment grazing pasture or when the horse is fed an all-forage diet. Heavy grain feeding can upset this delicate balance. When the capacity for starch digestion in the small intestine is overwhelmed, undigested starch from grain enters the large intestine. Starch is rapidly fermented in the hindgut, producing lactic acid and decreasing the pH. As the hindgut becomes more acidic, some of the microbes die off and produce harmful toxins that may lead to diarrhea, colic, and/or laminitis.

What the Digestive Tract Tells Us About Feeding

The horse's digestive system functions best when it is fed a predominantly forage diet on an almost continual basis. Problems are more likely to arise when a horse is fed a high-grain, low-forage diet, particularly when given in one or two large meals per day. If your horse needs more calories than can be supplied by an all-forage diet, try to reduce the amount of starch by using grain mixes that include highly digestible sources of fiber (e.g., beet pulp, soy hulls) and by adding fat to the diet. If possible, spread the daily grain allotment over three or more meals. Finally, allow your horse to nibble on hay or pasture as much as possible throughout the day.