

Feeding horses has been often described as a combination of both art and science. Part of the science is providing feed in a manner that not only meets the horse's nutritional needs but also maintains a healthy digestive tract. How can you feed to keep your horse healthy?

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The horse evolved as a grazing animal. As a grazer, the horse under normal conditions would eat small amounts of feed on a frequent basis. To effectively utilize a varied diet, the horse has a complex digestive system. A portion of the system uses enzymatic digestion to break down feedstuffs to absorbable components while another portion of the system uses fermentation to break down feedstuffs. Because of this system, the horse can make use of a wide variety of feed to meet its nutrient requirements but is also susceptible to problems related to the gastrointestinal tract. An overview of the digestive system will explain why feed management is so important to maintaining a healthy horse.

### The System

The processing of feed starts in the mouth. As the horse ingests feed, chewing breaks it down into smaller particles. These small particles are more available to digestive enzymes and fermentation. The more the horse chews, the better disruption of the feed and the smaller the particle size. In addition to reducing the particle size of the feed, chewing and the presence of feed in the mouth stimulates saliva production. Mixing saliva with the feed moistens it and facilitates movement of the feed through the digestive tract. While saliva does not contribute much in relation to enzymes, it is rich in bicarbonate that helps to buffer stomach contents. Again, more chewing, as with a high forage diet, there is more saliva more bicarbonate and more buffering; all good things for a healthy digestive tract.

Food leaves the oral cavity and moves down the esophagus. The 48-60 inch muscular tube moves food by muscular contraction to the stomach. This is a one directional system, designed to move food only one way.

The stomach of the horse makes up a small portion of the total digestive system. It is estimated to comprise 8-10% of the total capacity. The stomach has two main segments; one with squamous epithelium and the second which is more glandular in nature. The glandular region secretes digestive juices and stomach acids on a fairly continuous basis. This continuous secretion is related to the more continuous feeding nature of the horse. The environment in the glandular region is very acidic and starts the process of protein digestion breaking down larger dietary proteins to small ones with the aid of the enzyme pepsin. The bicarbonate in the horse's saliva can aid in buffering this stomach acid and help reduce the incidence of ulcers.

Food remains in the stomach for a relatively short period of time before entering the small intestine. This portion of the tract is 60-70 feet long in a typical light horse and is the site of enzymatic digestion. Digestive enzymes are secreted into the first segment of the small intestine the duodenum from the pancreas. In addition to enzymes, the pancreas also adds bicarbonate to reduce the acidity of the contents and allow for optimal enzyme function. Also in this segment of the small intestine, bile is secreted from the liver. The horse has no gall bladder but bile is secreted in a continuous manner to aide in the digestive process. The enzymatic process breaks down the soluble carbohydrates (sugars and starches) to simple sugars, which are absorbed in the jejunum and cum ileum. Proteins digested by enzymes are absorbed in this portion of the tract as amino acids. Other nutrients such as fats, minerals and vitamins are also absorbed in the small intestine. The fibrous portion of the feeds are not digested in the small intestine because the horse does not have enzymes capable of breaking down the structural carbohydrates that make up the fiber. Feed travels quickly through the small intestine. Any of the hydrolysable nutrients not digested and absorbed here will be digested in the hindgut.

As the digesta leaves the small intestine, it enters the cecum, which is the first part of the hindgut. In the hindgut, digestion is facilitated by fermentation due to the large population of microbes found here. These microbes have the ability to digest fiber converting it to volatile fatty acids, which help to meet the horse's energy requirements. The cecum starts the process and is a four-foot long blind sac found on the right side of the horse. Digesta enters from the ileum and then exits to the large colon. Structures are such that digest moves in one direct with no movement from the cecum back to the small intestine.

When the digesta moves from the cecum to the large colon, the process of fermentation continues. In addition to breaking down the fiber fraction of the digesta, which is done by the microbes, other feed components such as the soluble carbohydrates (starch) that escaped digestion in the small intestine will also be fermented by the microbial population. Excessive amounts of starch can lead to a significant change in the microbial population, which can alter the digestive process. This change, which can occur with a rapid change in feed, alters the environment in the hindgut leading to digestive disturbances such as colic and laminitis.

As digesta moves slowly through the hindgut, water and other nutrients are absorbed. Once the digesta reaches the small colon, water content is reduced further and the typical fecal balls are formed in the rectum. The trip through the system allows feeds to be digested via an enzymatic process, followed by fermentation resulting in the horse making good use of feeds offered. Being aware of what takes place in the various segments of the tract should help horse owners feed appropriately. The following are some feed management ideas based on what occurs to the feeds as they move through the digestive tract.

## Feed Management

### Forage is the Primary Source of Nutrients

Horses were born to eat grass. The small frequent forage meals allow feed to pass continually through the digestive tract. Horses on high forage diets chew more and produce a greater volume of saliva. Because of the buffering capacity of the saliva, this aids in reducing the acidic nature of the horse's stomach contents. Research has noted that horses on high forage diets have a lower incidence of gastric ulcers.

A minimal daily forage intake of 1% body weight is recommended to aid in normal gut function and normal gut health. The forage in the diet is also important to maintain a healthy microbial population in the hindgut of the horse. Changes in this microbial population can result in severe gastric disturbance, which may lead to colic or laminitis.

While 1% is a suggested daily minimum for forage intake, horse owners need to maximize forage intake. For a typical light horse at maintenance consuming an average quality forage, an intake of 1.75 % body weight per day can easily meet the majority of its nutrient needs. Table 1 shows how much hay is needed to meet requirements at maintenance. Notice that when feeding a high nutrient quality alfalfa grass hay the horse owner will feed less feed than when using a grass hay.

The horse's stomach is a very acidic environment. As such, the horse is at risk for the development of ulcers. One might question the wisdom of developing a system that is so acidic but as continuous grazer chewing forage and producing significant quantities of saliva, horses

on high forage diets (pasture) have a reduced incidence of ulcers. Horses on minimal amounts of forage and high concentrate diets who chew less and produce less saliva are at greater risk. Research has shown not only do high forage diets provide some protection; the kind of forage may also help. Horses on alfalfa hay were reported to have a low risk of ulcers. This is due in part to the high buffering capacity of the alfalfa hay. Providing adequate forage in all horse's diets is something all horse owners need to consider.

### Eating Too Fast

Horses that bolt their feed or eat too fast may be prone to choke. In some instances, this is due to the horse not properly chewing the feed offered breaking it down to a reasonable particle size and mixing it with adequate amounts of saliva. The drier feed gets stuck in the esophagus. Horses that have choked once may be at a greater risk to choke in the future due to damage to the esophagus. Feeding small amounts of feed trying to reduce hunger, or placing obstacles in the feed bucket to slow down feed consumption may help. The musculature of the esophagus is designed to move food towards the stomach so getting food stuck can be a serious issue for the horse and the horse owner.

### Does My Horse Need Grain?

In some situations, horses do need a portion of the daily nutrient need supplied by a grain mix. This need can occur when the horse has elevated nutrient requirements such as the extensively worked horse or when the available forage may be limited in nutrient quality or is limited in quantity. Most grain mixes are fed as primary sources of calories. These calories are often based on the starch content of the grain. Starch is broken down by enzymatic digestion in the small intestine and absorbed as glucose. While this is a relatively efficient process in the horse, the system can only handle a certain amount of starch at any one time. (Remember the system is designed to handle small amounts of food frequently). Any excess intakes of starch that bypass the small intestine end up in the hindgut where the microbes will digest them. This influx of starch to non adapted microbes can result in digestive disturbance. What occurs is a change in the microbial population, which can negatively impact the gut environment leading to problems such as laminitis and colic. As a horse owner, how can you reduce the risk of the occurring? By feeding grain meals in controlled amounts to limit the starch intake per meal is an effective feeding practice. How much grain per meal? It is recommended that for a 1000 lb horse, the grain meal should not exceed 5 lbs. (This is 0.5% of body weight, which can be used for horses weighing greater than 1000 lbs.) If the horse requires 10 lbs of grain to meet its nutrient needs, then the horse should be fed twice a day.

Knowing how much you feed by weight, not volume will also help to reduce the risk of excessive grain intakes. Horse owners need to appreciate how much concentrate is in the grain scoop in order to control starch intake.

### Feed Changes

Horses should be given time to adapt to new feed supplies. If the change is from one load of hay to another of similar hay, that change can be done fairly quickly and often times has to be. When adding grain to the diet, a gradual increase of 14-21 days will give the horse time to adapt. Remember, it is the microbial population that is adapting to this new feed supply and changes take time. In addition to adapting to grain in the diet, changes from a hay-based diet to pasture in the spring also require a period of adaptation. Gradual access to pasture over 10-14 days should be considered. The same can be true if you are moving horses later in the grazing seasons to a higher quality pasture. These pasture grasses have a higher level of soluble carbohydrates than hay and can cause a disruption to the microbes in the hindgut.

The horse's digestive system is complex but allows horse owners to use a wide variety of feeds to meet their horse's nutrient needs. Considering where the feed is being digested can help reduce digestive disturbance. While it may seem that the horse is resilient to many changes in their diet, when things go wrong, it can be a disaster.

Consider what your horse needs and how you can effectively provide for those nutrient needs of your horses and reduce the risk of serious digestive problems.