

The Basics of Equine Nutrition

Carey A. Williams, Ph.D., Extension Specialist in Equine Management
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Digestive System Limitations

Horses are *non-ruminant herbivores* (hind-gut fermentors). Their small *stomach* only has a capacity of 2 to 4 gallons for an average-sized 1000 lb. horse. This limits the amount of feed a horse can take in at one time. Equids have evolved as grazers that spend about 16 hours a day grazing pasture grasses. The stomach serves to secrete hydrochloric acid (HCl) and pepsin to begin the breakdown of food that enters the stomach. Horses are unable to regurgitate food, so if they overeat or eat something poisonous vomiting is not an option.

Horses are also unique in that they do not have a *gall bladder*. This makes high fat diets hard to digest and utilize. Horses can digest up to 20 % fat in their diet, but it takes a span of 3 to 4 weeks for them to adjust. Normal horse rations contain only 3 to 4 % fat.

The horse's *small intestine* is 50 to 70 feet long and holds 10 to 23 gallons. Most of the nutrients (protein, some carbohydrates and fat) are digested in the small intestine. Most of the vitamins and minerals are also absorbed here.

Most liquids are passed to the *cecum*, which is 3 to 4 feet long and holds 7 to 8 gallons. Detoxification of toxic substances occurs in the cecum. It also contains bacteria and protozoa that pass the small intestine to digest fiber and any soluble carbohydrates.

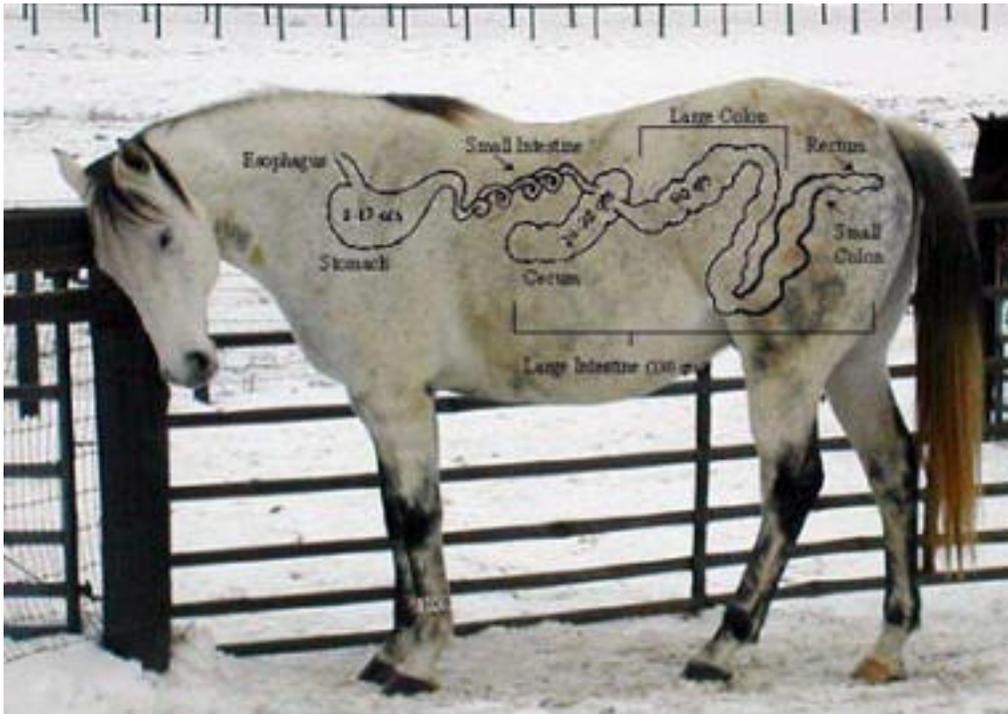


Photo & Diagram: C. Williams

The large colon, small colon, and rectum make up the large intestine. The large colon is 10 to 12 feet long, and holds 14 to 16 gallons. It consists of four parts: right ventral colon, sternal flexure to left ventral colon, pelvic flexure to left dorsal colon, and diaphragmatic flexure to the right dorsal colon. The sternal and diaphragmatic flexures are a common place for impaction. The small colon leads to the rectum. It is 10 feet long and holds only 5 gallons of material.

Nutrients

Horses require six main classes of nutrients to survive; they include *water, fats, carbohydrates, protein, vitamins, and minerals*.

Water is the MOST IMPORTANT nutrient; horses can't live long without it! Always make sure there is an adequate, clean supply of water. Horses generally drink about 2 quarts of water for every pound of hay they consume. In high temperature, hard work, or for the lactating mare the water requirement may be 3 to 4 times the normal consumption.

Signs that your horse may be water deficient include decreased feed intake and physical activity, and signs of dehydration like dry mucous membranes in the mouth, dry feces, and decreased capillary refill time. Possible causes of water deficiencies include no water source, low water palatability, or accessibility (frozen or receiving or contaminated), or illness.

Energy isn't one of the six nutrients because the horse cannot physically consume energy, however, it is a requirement for sustaining life. The most dense source of energy is fat (almost three times more than carbohydrates or proteins); however, carbohydrates in the forms of fermentable fiber or starch are the most common source. Horses exercising, growing, pregnant in late gestation or early lactation need increased energy in their diet.

Signs of energy deficiency include weight loss, decreased physical activity, milk production, and growth rate. However, feeding a diet too high in energy can cause obesity increasing the risk of colic, laminitis, and contribute to increased sweat loss and exercise intolerance.

Fat can be added to a feed to increase the energy density of the diet. Fat has 9 Mcal/kg of energy, which is three-times that of any grain or carbohydrate source. Fat is normally found at 2 to 6% in most premixed feeds; however, some higher fat feeds will contain 10 to 12% fat. See *Fat Supplements* section for more.

Carbohydrates are the main energy source used in most feeds. The main building block of carbohydrates is glucose. Soluble carbohydrates such as starches and sugars are readily broken down to glucose in the small intestine and absorbed. Insoluble carbohydrates such as fiber (cellulose) bypass enzymatic digestion and must be fermented by microbes in the large intestine to release their energy sources, the volatile fatty acids. Soluble carbohydrates are found in nearly every feed source; corn has the highest amount, then barley and oats. Forages normally have only 6 to 8% starch but under certain conditions can have up to 30%. Sudden ingestion of large amounts of starch or high sugar feeds can cause colic or laminitis.

Protein is used in muscle development during growth or exercise. The main building blocks of protein are amino acids. Soybean meal and alfalfa are good sources of protein that can be easily added to the diet. Second and third cutting alfalfa can be 25 to 30% protein and can greatly impact the total dietary protein. Most adult horses only require 8 to 10% protein in the ration; however, higher protein is important for lactating mares and young growing foals.

Signs of protein deficiency include a rough or coarse hair coat, weight loss, and reduced growth, milk production, and performance. Excess protein can result in increased water intake and urination, and increased sweat losses during exercise, which in turn lead to dehydration and electrolyte imbalances.

Vitamins are fat-soluble (vitamin A, D, E, and K), or water-soluble (vitamin C, and B-complex). Horses at maintenance usually have more than adequate amounts of vitamins in their diet if they are receiving fresh green forage and/or premixed rations. Some cases where a horse would need a vitamin supplement include when feeding a high-grain diet, or low-quality hay, if a horse is under stress (traveling, showing, racing, etc.), prolonged strenuous activity, or not

eating well (sick, after surgery, etc.).

Most of the vitamins are found in green, leafy forages. Vitamin D is obtained from sunlight, so only horses that are stalled for 24 hours a day need a supplement with vitamin D. Vitamin E is found in fresh green forages, however, the amount decreases with plant maturity and is destroyed during long term storage. Horses that are under heavy exercise or under increased levels of stress also may benefit from vitamin E supplementation. Vitamin K and B-complex are produced by the gut microbes. Vitamin C is found in fresh vegetables and fruits, and produced naturally by the liver. None of these are usually required in a horse's diet. Severely stressed horses, however, may benefit from B-complex and vitamin C supplements during the period of stress.

Minerals are required for maintenance of body structure, fluid balance in cells (electrolytes), nerve conduction, and muscle contraction. Only small amounts of the macro-minerals such as calcium, phosphorus, sodium, potassium, chloride, magnesium, and sulfur are needed daily.

Calcium and phosphorus are needed in a specific ratio ideally 2:1, but never less than 1:1. Alfalfa alone can exceed a Ca:P ratio of 6:1. Sweating depletes sodium, potassium, and chloride from the horse's system, therefore, supplementation with electrolytes may be helpful for horses that sweat a lot. Normally, if adult horses are consuming fresh green pasture and/or a premixed ration, they will receive proper amounts of minerals in their diet, with the exception of sodium chloride (salt), which should always be available. Young horses may need added calcium, phosphorus, copper, and zinc during the first year or two of life.

Forages

Forages are classified as legumes or grasses. The nutrients in the forage vary greatly with maturity of the grasses, fertilization, management, and environmental conditions. In order to determine the nutrient content in forage it is best to take samples and get them analyzed by a forage testing lab (contact your local County Extension Office for testing information or see the fact sheet, FS714, *Analysis of Feeds and Forages for Horses*).

Legumes are usually higher in protein, calcium, and energy than grasses. They have more leaves than grasses and require optimal growth conditions (warm weather and good soil) to produce the best nutrients. Some legumes include clover and alfalfa. Some commonly used grasses include orchard grass, timothy, bluegrass, and fescue.

Hay is forage that has been harvested, dried, and baled before feeding to horses. Legume hay can contain 2 to 3 times more protein and calcium than grass hay. However, it is usually more costly. Common grass hays include timothy, brome and orchard grass. They have fine stems, seed heads and longer leaves than legumes. They are most nutritious when cut earlier in their growth stage. Maturity at harvest is key to quality. Second cut grass hays average 16 to 20% protein.

Appearance can be a good indicator of the amount of nutrients in the hay, however, color should not be used as sole indicator. Moldy or dusty hay should not be fed to horses. For more information see Table 1.

Table 1. Evaluating Hay Quality

Characteristics of Good-Quality Hay	Characteristics of Poor-Quality Hay
Low moisture content (12 to 18%).	Damp. Too much moisture causes mold.
Green in color.	Brown, yellow or weathered in color. Gray or black indicates mold.
Sweet smelling, like newly cut grass.	Musty, moldy or fermented odor.
Free of mold and dust.	Dusty and moldy hay is unacceptable.
Cut before maturity.	Cut late in maturity. Mature seed heads with grass hay or alfalfa cut late in bloom.
Grass hays before seed heads mature and alfalfa cut early in bloom.	High weed content, poisonous plants, or animal carcasses in hay bales.
Free from weeds, poisonous plants, trash, or foreign objects.	

Concentrates

Grains

Oats are the most popular grain for horses. Oats have a lower digestible energy value and higher fiber content than most other grains. They are also more palatable and digestible for horses than other grains; however, they can be expensive.

Corn is the second most palatable grain for horses. It provides twice as much digestible energy as an equal volume of oats and is low in fiber. Because it is so energy dense it is easy to over feed corn, causing obesity. Moldy corn should never be fed—it is lethal to horses.

Sorghum (Milo) is a small hard kernel that needs to be processed (steam flaked, crushed, etc.) for efficient digestion and utilization by the horse. It is not palatable when used as a grain on its own, however, it can be used in grain mixes. Like corn, sorghum is high in digestible energy and low in fiber.

Barley also has hard hulls that should be processed to allow easier digestibility. It has moderate fiber and energy content, and can be a nutritious and palatable feed for horses.

Wheat is generally not used as a feedstuff because of its high cost. Its small hard kernels should be processed for horses to digest. Wheat is higher in energy than corn and best used in a grain mix because of its low palatability.

Protein Supplements

Soybean meal is the most common protein supplement, which averages around 44% crude protein. The protein in soybean meal is usually a high-quality protein with the proper ratio of dietary essential amino acids.

Cottonseed meal (48% crude protein) and peanut meal (53% crude protein) are not as common for horses as soybean meal.

Brewer's grains (the mash removed from the malt when making beer) are a byproduct of the brewing industry. It is nutritious and palatable with about 25% crude protein and is also high in fat (13%) and B vitamins.

Fat Supplements

Vegetable oil is the most commonly used fat source in horse feeds. If adding the oil supplement as a top dress to feed start with $\frac{1}{4}$ cup/feeding and increase to no more than 2 cups/day over the course of 2 weeks for the average size horse (1000 lbs.).

Rice bran is a newer fat supplement on the market. It is distributed by some commercial feed dealers. It consists of about 20% crude fat, giving it an energy content of 2.9 Mcal/kg.

Feeding Guidelines

Forage is the base! Always try to feed the most forage possible then add concentrate.

Feed at a rate of 1.5 to 2% of the horse's body weight (1000 lb. horse = 20 lbs.).

Feed by weight not volume!

** A 1 lb. scoop of Oats does not equal 1 lb. of Corn**

Stomachs are small so concentrates, if used, should be fed twice a day if not more with no more than 0.5% body weight per feeding.

To maintain body weight, most horses need only good forage, water, and a mineral block.

Store feed properly: it should be kept free of mold, rodents, or contamination.

Keep Ca:P ratios around 2 parts Ca to 1 part P.

Feed on a set schedule (horses are creatures of habit and are easily upset by changes in routine).

Change feeds gradually (horses' stomachs cannot cope with drastic changes in feed; could cause colic).

When work or exercise decreases, decrease the grain.

Be aware of the pecking order in your horse's pen— are they getting their feed?

Examine teeth at least once a year to make sure they are able to chew feed.

References and Supplemental Reading

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National Research Council. 1989. *Nutrient Requirements of Horses*. National Academy Press, Washington, DC.

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