

The Basics of Equine Nutrition

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Digestive System Limitations

Horses are *non-ruminant herbivores* (hind-gut fermentors). Their small *stomach* only has a capacity 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.

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 and is 10 feet long and holds only 5 gallons of material.

Nutrients

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

Water is the MOST IMPORTANT nutrient; horses can't live long without it! Always make sure there is an

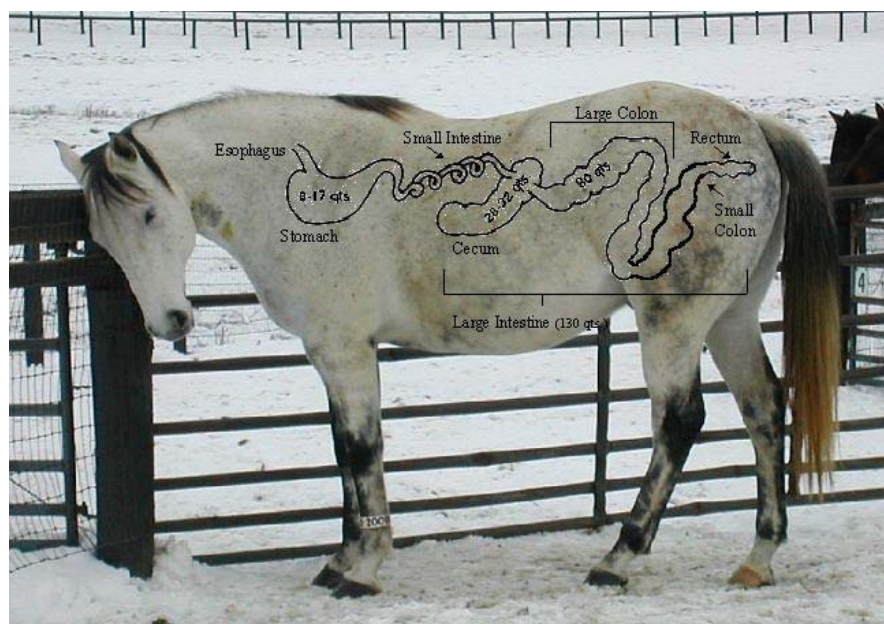


Photo & Diagram: C. Williams

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 is severe. 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 consume physical 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 too much 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, a reduction in growth, weight loss, milk production, and performance. Excess protein can result in increased water intake and urination, and increased sweat losses during exercise leading 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, however vitamin D is obtained from sunlight, so only horses that are stalled for 24 hours a day would 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 also produced by the gut microbes and 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 only needed in very small amounts. They are required for maintenance of body structure, fluid balance in cells (electrolytes), nerve conduction, and muscle contraction. Only small amounts of the macrominerals 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 increases the horses need for sodium, chloride and potassium, which is the

reason for supplementing with electrolytes if a horse is sweating 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 varies 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, such as clover and alfalfa, 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 dried forage, harvested, dried, and baled before feeding to horses. The 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 is usually a good indicator of the amount of nutrients in the hay. Moldy or dusty hay should not be fed to horses. For more information see Table 1.

Concentrates

Grains

Oats are the most popular grain for horses. Oats have a lower energy value and higher fiber content than most other grains. It is 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 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 feed—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 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 nutritious and palatable feed for horses.

Wheat is generally only consumed by humans 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.

Table 1. Evaluating Hay Quality

<i>Characteristics of Good-Quality Hay</i>	<i>Characteristics of Poor-Quality Hay</i>
Low moisture content (12 to 18%).	Damp. Too high 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. Grass hays before seed heads mature and alfalfa cut early in bloom.	Cut late in maturity. Mature seed heads with grass hay or alfalfa cut late in bloom.
Free from weeds, poisonous plants, trash, or foreign objects.	High weed content, poisonous plants, or animal carcasses in bales hay.

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 are a byproduct of the brewing industry (the mash removed from the malt when making beer). It is nutritious and palatable with about 25% crude protein and 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 ¼ 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 and is also 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

1. Forage is the base (always try to feed the most forage possible then add concentrate).
2. Feed at a rate of 1.5 to 2% of the horses body weight (1000 lb. horse = 20 lbs.).
3. Feed by weight not volume!

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

4. 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.
5. Most horses just maintaining body weight need only good forage, water, and a mineral block.
6. Store feed properly: free of mold, rodents, or contamination.
7. Keep Ca:P ratios over 1 part Ca to 1 part P.
8. Feed on a set schedule (horses are creatures of habit and are easily upset by changes in routine).
9. Change feeds gradually (horses stomachs cannot cope with drastic change—could cause colic).
10. When work/exercise decreases—decrease grain.
11. Be aware of the pecking order in your horse's pen—(are they getting their feed?).
12. Examine teeth at least once a year to make sure they are able to chew feed.

References and Supplemental Reading Material

- Lewis, L.D. 1995. *Feeding and Care of the Horse* (2nd edition). Williams & Wilkins, Philadelphia, PA.
- National Research Council. 1989. *Nutrient Requirements of Horses*. National Academy Press, Washington, DC.
- Ralston S.L. 1993. *Analysis of Feeds and Forages of Horses*. Rutgers Cooperative Extension. FS714.

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