

Basic Horse Nutrition

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Knowledge of horse nutrition has grown by leaps and bounds during the last 15 years. Research has become more precise and critically evaluated. But more important, this research has given horse owners greater understanding of nutrition. They are more aware of the basic nutrients required by all classes of horses, than in past years.

Anatomy of the Digestive System

When you feed horses, you need to have good understanding of their digestive system, including its physical limitations, and important areas of digestion and absorption. Figure 1 shows the important parts of the horse's gastrointestinal tract.

Most digestion and absorption take place forward of the cecum and are similar to other simple-stomach animals like pigs. Digestion begins when the horse eats and its mouth releases enzymes. Then, as food enters the stomach and small intestines, the major digestive enzymes are released and digestion occurs. Major absorption occurs in the small intestines, with less nutrient absorption in the cecum and colon.

Of course, the horse's hindgut is also functionally important, since microbial digestion takes place in it. A functional cecum is beneficial because it produces significant amounts of the B Vitamin complex and volatile fatty acids to help meet vitamin and energy requirements.

Also note the size of the horse's stomach. Because it is small compared to the horse's size, many classes of horses are not able to consume enough forage to meet their nutrient requirements. Therefore, you need to provide concentrates and increase feeding frequency to support proper growth, development and performance.

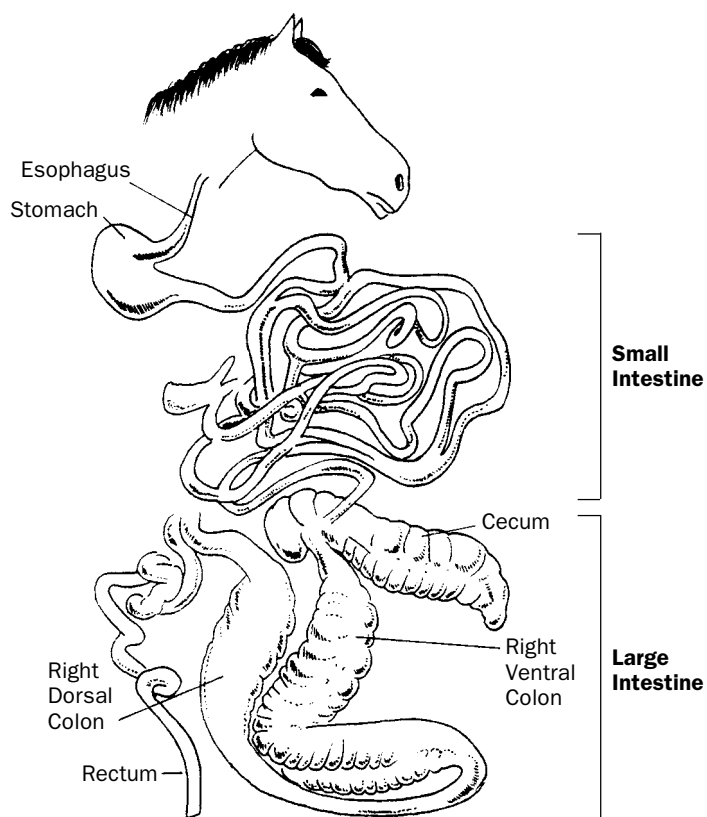
All classes of horses (young, growing horses; horses at work; mature, idle horses; pregnant mares and lactating mares) must get enough essential nutrients: water, energy, protein, minerals and vitamins.

Basic Nutrients

Water

All horses require a good, clean source of fresh water daily for normal physiological function. Clean the water buckets and tanks frequently, removing algae and other foreign material. Water deprivation is more common in winter than summer because of freezing temperatures. Make every effort to ensure that water sources do not freeze, because with most species of animals water deprivation causes death quicker than starvation. Therefore, it is extremely important that a clean fresh source of water be supplied to horses at all times.

Figure 1. Digestive system of a horse. (Adapted from: "Feeding and Care of the Horse". Lon Lewis, Lea & Febiger, 1982.)



Energy

Energy is what horses use to do work. Their energy requirements are influenced by age and by the work's degree and duration. Young, growing horses, horses at high work intensities and lactating mares have the greatest requirement for energy. ATP is the basic unit of energy substance utilized at the cellular level. Energy is provided by the breakdown of starch and other soluble carbohydrates and from volatile fatty acids arising in the cecum as a result of microbial digestion of fibrous dietary components.

Cereal grains like corn, oats, barley, wheat, wheat by-products, etc. are the primary energy sources found in concentrate mixes. In most cases the greater the energy requirement, the greater the energy density (units of energy [kcal]/lb of feed) of the concentrate. For example, the horse in hard race training needs a more concentrated, energy-dense feed than the pregnant mare.

Mature, idle horses and mares in the first 2 trimesters of pregnancy require less energy and therefore can meet their energy requirement on good quality hay or pasture alone. In young, rapidly growing horses, horses at work and lactating mares the hay fed should be supplemented with concentrated energy sources to meet their energy requirements.

Protein

Horses use protein to synthesize various body tissues, such as muscle. Proteins are composed of amino acids and will vary in amino acid composition. Currently, the exact amino acid requirements of horses are not known. But feeding an adequate source of protein should ensure that horses get the composition of amino acids they need.

Protein requirements vary for different classes of horses. Young, growing horses have a higher requirement for protein because they are growing body tissues like muscle and bone.

Mature horses have a much lower requirement for protein than do young horses since mature horses need protein for maintenance of body tissue rather than growing new tissue. Note that horses with increased exercise do not need more protein than do horses not in training. They lose a small amount of nitrogen in the sweat, but the additional grain fed to meet the performance horse's energy needs will more than adequately provide for the increased nitrogen requirement without increasing the percent protein in the diet. When protein is fed beyond what the horse requires, the body uses it as an energy source and excretes the unused nitrogen in the urine. Although doing so does not harm the horse, protein is a very expensive energy source.

Both the forage and concentrate portions of the horse's diet supply protein. The quality of hay or forage fed will greatly influence how much protein is required in the concentrate. A good quality legume hay will contain from 14-18% crude protein and a high quality grass hay will contain 7.0-12% crude protein. Cereal grains will also supply protein in the diet. But depending on the class of horses being fed, the forage component of the diet may not be able to meet their protein requirement. Cereal grains will range

in protein content from 8.0-12.0%. To meet the protein requirement of the young, growing horses you will need to use a protein supplement.

Soybean meal is the most common protein supplement used in horse rations. Other protein supplement sources are available such as linseed meal, cottonseed meal, dried skim milk or commercially prepared protein supplements which may contain a combination of the above ingredients.

Minerals

Minerals are needed by the horse's body for various purposes, ranging from serving as components of the horse's skeletal system to maintaining nerve conductivity, muscle contraction and electrolyte balance.

Calcium and **phosphorus** comprise about 70% of the mineral content of the horse's body. Therefore these minerals need to be supplied to the horse in the greatest amount and are of most concern in formulating horse rations. Horses are more likely to suffer from a lack of calcium and phosphorus than from lack of any other mineral. Proper levels and ratios (calcium:phosphorus) of these 2 minerals are very important to normal development of bone, because if inadequate levels or improper ratios are supplied structural deformities may result. Ideally calcium and phosphorus should be fed at a 1.2-1.6: 1 ratio. However, ratios as high as 6:1 have been fed to mature horses and ratios of 3:1 have been fed to growing horses with no detrimental effects. Never feed an inverted calcium:phosphorus ratio because it may harm the horse.

Always provide **salt** to the horse free-choice. Salt is most commonly given by providing a trace mineralized salt block free choice. In addition to the block, include a trace mineralized premix in the ration at 1/2% of the concentrate mix. Salt is composed of sodium and chloride which are important in maintaining electrolyte and acid base balance. Over consumption of salt is usually not a problem if free choice, non-saline water is available. The practice of providing trace mineral salt will not only meet the horse's sodium and chloride requirements but will also meet its needs for other trace minerals.

Copper and **zinc** have been implicated in metabolic bone disease. Although their exact role is not clearly understood, it is recommended to include copper in the concentrate at 30-50 ppm and zinc at 80-120 ppm.

Selenium is also a trace mineral required by the horse. Most naturally occurring feedstuff will have enough selenium to meet the horse's needs. (Selenium is extremely toxic when fed in quantities above recommended levels.) However, Kentucky is a selenium marginal state and as such most commercial feeds will contain selenium at .1 ppm. Therefore, do not top-dress it as a mineral supplement.

Vitamins

Vitamins A, D and E are the most common vitamins added to horse diets. Although B complex vitamins may not be commonly supplemented, including them in performance horse diets may be necessary. It is a common practice to fortify diets with a vitamin premix like the one shown in Table 1.

Vitamin A is the vitamin most likely to be marginal in most horse diets. The natural source of Vitamin A is beta-carotene which occurs in green forages and properly cured hays. As long as the hay source has a green color and is leafy, then it will probably be more than adequate to meet the horse's Vitamin A requirement. Vitamin A functions in the maintenance of epithelial integrity, normal bone metabolism and is very important for night vision. Therefore, a deficiency in Vitamin A may result in night blindness, upper respiratory infection, brittle bones and possibly many other deficiencies. One reason to supplement Vitamin A is that horses are not very efficient in converting beta-carotene to active Vitamin A.

Table 1. *Vitamin Premix for Horses*

Vitamin	Per lb Premix	Amt per lb feed when premix added at:	
		2 lb/Ton	1 lb/Ton
Vitamin A	1,000,000 I.U.	1000 I.U.	500 I.U.
Vitamin D	100,000 I.U.	100 I.U.	50 I.U.
Vitamin E	5,000 I.U.	5 I.U.	2.5 I.U.
Thiamine	1.2 g	1.2 mg	0.6 mg
Riboflavin	800 mg	0.8 mg	0.4 mg
Pantothenic Acid	800 mg	0.8 mg	0.4 mg
Vitamin B12	5 mg	5.0 mcg	2.5 mcg

Vitamin D is very important in the normal absorption and utilization of calcium and phosphorus. It also functions in the absorption of several minerals for bone deposition. Vitamin D is converted from precursors through a series of reactions in the skin stimulated by sunlight. Rickets in young horses and osteomalacia in older horses are the two most common symptoms of Vitamin D deficiency. Giving large doses of Vitamin D should be avoided as toxicity may occur resulting in calcification of soft tissue. Natural sources of Vitamin D occur in sun-cured hay and cod liver oil.

Vitamin E is found in ample quantities in most natural feedstuffs to meet the horse's requirement. Roughages, cereal grains and especially cereal germ oils are high in Vitamin E, particularly wheat germ oil. Vitamin E has been implicated in many physiological functions in the horse body. It maintains membrane stability and red blood cell integrity. Selenium and Vitamin E interactions may play a role in treating and preventing "tying up," and possibly in assuring normal reproduction.

It is believed that the microflora in the cecum will synthesize adequate amounts of **B vitamins** for absorption to meet the horse's requirement. Many of the B vitamins function as coenzymes in energy pathways and it is questionable whether adequate amounts of B vitamins are synthesized by the horse to meet the needs of young, rapidly growing horses and horses at high work levels.

Remember that horses need long stem roughage in their diet for normal digestive function. Horses fed hay or those on pasture are more able to maintain gastro-intestinal tract normalcy, experience less colic and are less prone to developing annoying stable vices when compared to horses not receiving a long stem roughage source.

Feed horses a hay that is bright colored, leafy, harvested in an early stage of maturity and free from mold or foreign matter. Common hays fed include alfalfa, timothy, clover, orchardgrass, brome-grass, prairie hay and bermuda. You can also combine these hays for feed. When timothy and alfalfa are used together, alfalfa will usually be fed as a nutrient source and timothy as the roughage source.

Use pastures to their utmost in a feeding program. Many classes of horses can meet their nutrient requirements on pasture alone, if the pasture is managed and stocked properly. Mature, idle horses, barren mares and mares in the first 2 trimesters of gestation on well managed pasture should require little or no supplementation.

Remember that horses are individuals and should be managed as such. By knowing the nutrients they need and their function, you will find the art of feeding horses much easier and simpler.

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