Nutrients and Common Feed Sources for Horses

Feeding the horse is not difficult, but to do it properly, it takes knowledge and consistent attention. Nutritionists and owners must constantly evaluate their feeding program to ensure that their horses are receiving proper nutrition.

Nutrients

A nutrient is defined as any feed constituent that is necessary to support life. The following is a list of functions that nutrients perform in the horse's body:

- source of energy
- component of body structure
- involved in or enhance chemical reactions in the body
- transport substances
- regulate body temperature
- affect feed palatability/consumption.

There are six general classes of nutrients needed in the horse's diet:

- water
- carbohydrates
- fats
- protein
- minerals
- vitamins.

Feedstuffs consumed by the horse contain most of these nutrients in varying amounts. For the horse to utilize these nutrients, the ingested feed must be broken down by digestion and absorbed from the digestive tract.

Water

Horses need a constant supply of good quality, palatable water. The only exception would be immediately after exercise. Especially after intense work, a horse's water consumption should be limited to prevent over-drinking, which can cause digestive upset and other metabolic problems.

The amount of water a horse should consume is determined by the amount lost in the feces, urine, and sweat, and is dependent on a number of factors: environmental temperature and humidity, feed quality, type and amount of feed, physical activity level, and health. As a general rule, horses need 1 to 2 quarts (2 to 4 liters per kilogram) of water per pound of dry matter consumed. This amount will change with

increasing activity level and temperature. A mature horse at maintenance (not being worked, not pregnant, and/or not lactating) under normal environmental conditions will consume approximately 1 gallon (3.78 liters) of water per 100 pounds (45 kg) body weight per day. Therefore, an 1,100-pound (500 kg) Thoroughbred at maintenance would drink about 11 gallons (42 liters) of water per day. If that same Thoroughbred were training intensely for a Three-Day Event, this amount could increase 300 percent, up to 33 gallons (125 liters) of water per day! Mares in lactation will increase their water consumption about 50 to 80 percent for milk production.

In all horses, but most importantly in the performance horse, the amount of water required per day is dependent on the amount lost through sweat during exercise. Sweating is an important function in maintaining the core temperature of the horse. Horses can lose up to 3 gallons (12 liters) of sweat per hour. Therefore, that same Thoroughbred competing in the Three-Day Event would require more water after completing the cross-country course than it would after the dressage test because it worked harder for a longer period of time, causing it to sweat more. Temperature and humidity will also affect water loss from the horse. Horses generally drink more and eat less when the temperature is high. In an environment with high relative humidity (over 80 percent), sweating does not efficiently cool the horse, so it is at a risk for overheating.

Carbohydrates

Carbohydrates provide the majority of a horse's energy. Non-structural carbohydrates, such as starch and glucose from grains and gums and pectins from fiber, are readily utilized as energy sources for the horse. The enzyme amylase breaks down non-structural carbohydrates into glucose and simple sugars, which are absorbed in the small intestine.

Structural carbohydrates, such as cellulose and hemicellulose in plants, can only be broken down by bacterial enzymes in the cecum and colon. The microorganisms convert these carbohydrates to volatile fatty acids (acetate, propionate, butyrate), which can provide 30 to 70 percent of the horse’s energy requirement.

Fats

Fats are a concentrated source of energy (2.25 times that of carbohydrates) and are readily utilized by the horse. They can be provided as either animal fat (tallow) or more commonly as vegetable fat, such as corn oil. All fats exist in the form of triglycerides, which are broken down to three fatty acids and one glycerol molecule by digestive enzymes before being absorbed by the small intestine.

Fats are necessary in the equine diet to absorb fat-soluble vitamins and provide linoleic acid, the essential fatty acid. In addition, the use of fats in the horse’s diet improves hair coat, is an effective way to increase the energy density of the diet without increasing the amount of feed, and has been shown to have an effect on reproduction.

Proteins


Alfalfa and Orchard Grass Mixed Pasture

Proteins are made up of linked amino acids. They serve as structural components for muscle and ligaments in the body and are a source of energy. There are 22 amino acids that are needed by the horse, but not all of them have to be provided in the feed (table below). The non-essential amino acids are produced in the body tissues and therefore not needed in the diet. However, the essential amino acids must be provided in the diet or synthesized by the microorganisms in the intestine. A protein is quantified by the nitrogen content of the feed and is classified as high quality if it contains a high amount of essential amino acids. The amount of protein required in the horse's diet depends on the digestibility of the diet and the individual horse's protein needs. In growing horses, the only essential amino acid that may be limited in normal diets is lysine. It must be provided as 5 to 6 percent of the total protein in the diet.

Minerals

Minerals are involved in many physiological functions in the horse. They function in the development and maintenance of structural components (muscle, bone, ligament), play roles as enzymatic cofactors in many biochemical pathways, and are integrally involved in energy transfer. Minerals also function in conjunction with vitamins and in concert with hormones and amino acids. Horses are able to obtain a large portion of their mineral requirements from the feed, but the concentration and availability varies with soil mineral concentration, plant species, and stage of maturity. There are seven macrominerals required in the diet: calcium, phosphorous, sodium, potassium, chloride, magnesium, and sulfur. These are expressed as a percent of the total diet. The horse's requirements for the eight microminerals are expressed as parts per million and are cobalt, copper, fluorine, iodine, iron, manganese, selenium, and zinc.

Minerals	
Macrominerals	**Microminerals**
calcium (Ca)	cobalt (Co)
phosphorous (P)	copper (Cu)
sodium (Na)	fluorine (F)
potassium (K)	iodine (I)
chloride (Cl)	iron (Fe)
magnesium (Mg)	manganese (Mn)
sulfur (S)	selenium (Se)
	zinc (Zn)

Vitamins

Vitamins play a role in regulating many physiological functions in the horse. There are two types of vitamins: fat-soluble and water-soluble (table below).
Fat-soluble vitamins need absorbable fat in the diet to be absorbed in the small intestine. These vitiamins, sometimes refered to as lipid-soluble, are A, D, E, and K. The horse synthesizes two of these lipid-soluble vitamins. Vitamin D synthesis in the horse is activated by sunlight. The microbes in the cecum and large intestine are capable of producing vitamin K. Vitamin A is provided in sufficient quantities by green forages and

can be stored in the liver.
Vitamin E is present in sufficient quantities in most good quality diets, especialy those that include grains.
The water-soluble vitamins are capable of being produced by the horse and are conserved by efficient recycling mechanisms. Therefore, they are not required in large quantities in the diet. Vitamin C and all the B-complex vitamins (thiamin, niacin, riboflavin, biotin, etc.) are all water-soluble vitamins.

Vitamins	
Fat-Soluble Vitamins	Water-Soluble Vitamins
Vitamin A/Carotenes	Vitamin C
Vitamin D	B Vitamins: thiamin, niacin, riboflavin
Vitamin E	Panthothenic acid, B6, B12, Biotin
Vitamin K	Folacin, ascorbic acid, choline

Fiber

Horses evolved as natural grazers and, therefore, have to consume fibrous feeds. Fibrous feeds are a very important part of the horse's diet. They provide nutrients for both the horse and microbes in the hindgut as well as stimulate muscle tone and activity of the gastrointestinal tract.
There are many different fiber types that can be utilized in the equine diet, but not all of them are as efficient to use. Fiber quality varies widely across fiber types and is due to plant species, soil fertility, and stage of maturity at the time of harvest. Common fiber sources are pasture and hay.

Pasture

The most common type of fiber fed to horses is pasture. There are two types of pasture: legumes and grasses. The legume pastures include alfalfa and clovers (red and white) and are usually mixed with grasses. Grasses are subdivided by their growing characteristics into cool-season and warm-season grasses.
Cool-season grasses grow best in temperatures of 60° - 80° F (15.5°-26.6° C) and include Kentucky bluegrass, orchardgrass, timothy, brome, and tall fescue. Warm-season grasses grow best in temperatures greater than 70° F (21° C) and include bermudagrass, bluestems, and bahiagrass. Although spring pasture growth provides horses with an abundance of nutrients, nutrient content decreases as the grasses mature. The table shows an example with Bluegrass. A similar decline in quality occurs with all types of forages as they mature.

Nutrient content at different stages of maturity Bluegrass pasture		
Maturity level	**% Crude fiber**	**% Crude protein**
immature	25.1	17.3
early boot	27.8	14.8
midhead	29.3	12
full head (flower)	32.3	8.9

Hay

Hay is the most popular and one of the least expensive forms of fiber. Hay may be processed as round bales, square bales, cubes, or pellets. There are three major types of hays: legumes, grasses, and cereal. The major legume hay fed to horses in the United States is alfalfa. It can be mixed with grass to form an alfalfa-grass combination. Alfalfa, if processed correctly, has the highest nutritional value when compared to other hays. The second major type of hay is grass hay. Grass hays include timothy, orchardgrass, bluegrass, brome, and bermudagrass. The third major type of hay is cereal hay. Cereal hay is hay made from grain crops that have not been harvested for grain, such as oat hay. The leaves of all hays contain two-thirds of the total energy and the majority of the total protein in the plant. Therefore, leaf loss decreases the nutritional value and quality of the hay.

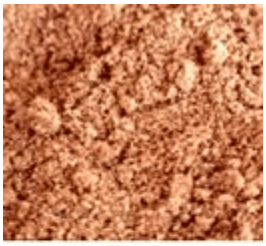
Ensiled hay, commonly known as haylage or silage, is another source of fiber that can be fed to horses. Haylage is not a popular feed for a couple of reasons. First, there is an increased risk of the horse consuming spoiled haylage that contains botulism, a mold that grows in hot, moist conditions. Second, haylage is not readily available in heavily horse-populated areas.

Nutrient content of common hays

Hay Type	DE (Mcal/kg)	% Crude Protein	% Calcium	% Phosphorous
alfalfa, midbloom	2.07	17	1.24	0.22
burmudagrass	1.96	10.9	0.3	0.19
orchardgrass, early bloom	1.94	11.4	0.24	0.3
timothy, midbloom	1.77	8.6	0.43	0.2
oat hay	1.75	8.6	0.29	0.23

Values adapted from *Nutrient Requirements for Horses*, 1989

By-Products

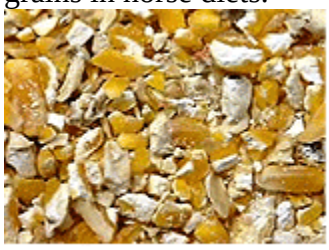

Bran


Sugar Beet Pulp

The by-products of grain production can be used in horse diets. By-products are made up of the fibrous stems or hulls of a plant. Bran, straw, soybean hulls, almond hulls, and sunflower hulls are all examples of by-product feeds. Some by-products provide little nutritional value to the horse but can be used as a source of fiber, or "bulk," in the diet. Sugar beet pulp is a popular by-product feed used in horse diets because it provides fiber similar to the fiber in hay and has digestible energy content similar to oats.

Concentrates

Certain classes of horses, such as growing or working horses, require more energy or protein than can be provided by hay or pasture alone. Therefore, it is necessary to provide horses with concentrates. Grains are the harvested seed portions of cereal crops that serve as a high nutrient store. Cereal grains can be fed to horses as the whole grain or processed by cracking, rolling, crimping, steam flaking, or extruding. Grains are very palatable, dense, and usually low in fiber if processed correctly. Concentrates should be fed to horses as a supplement to the forage portion of their diet and should not be greater than 50 to 60 percent of the total diet. The pictures shown here are examples of commonly used cereal grains in horse diets.


Cracked Corn


Crimped Oats


Steam Flaked Barley

Energy Feeds

Energy Feeds


Cracked Corn


Crimped Oats


Steam Flaked Barley


Molasses on Sweet Feed


Oats

Feedstuffs that contain less than 20 percent crude protein are considered to be energy feeds. These include oats, corn, barley, wheat, sorghum, and rye. Certain by-product feeds can be used for energy as well, such as wheat bran, wheat middlings, soybean hulls, and sugar beet pulp. Fats/oils (animal or vegetable) and molasses are also used to increase the palatability and energy density of the diet without increasing the amount of feed.

Protein Supplements


Soybean Meal

Feedstuffs that contain more than 20 percent crude protein are considered to be protein supplements. The most common plant protein supplements are soybean meal, canola meal, cottonseed meal, and linseed meal. The animal protein supplements that may also be used in horse feeds include casein and dried skim milk. Both are good sources of the limiting amino acid lysine and, therefore, are good for growing horses.

Vitamin and Mineral Supplements

Mineral supplements are usually required in the horse's diet. Macrominerals are added to a horse's diet to balance the ration to meet mineral requirements. Athletic horses lose a lot of sodium chloride in sweat and may need to be provided a salt block. Many horse rations are deficient in either calcium or phosphorous and in some cases both. Ground limestone is a good source of calcium when additional calcium is required in the diet. A good source of phosphorous can be provided by using either monosodium or disodium phosphate. Dicalcium phosphate is the most common supplement used to provide both calcium and phosphorous. Trace mineral blocks are the most common way to meet trace mineral requirements.

Although there are plenty of vitamin supplements available on the market today, vitamin supplementation is not necessary unless a low-quality forage is being fed or the horse is in strenuous exercise.

Complete Feed

Complete feeds are another way to feed the horse. They contain all the concentrates (both energy and protein feeds), vitamins, and minerals that a certain class of horse will need. The advantage to feeding this kind of feed is that the owner doesn't have to measure out each ingredient at every feeding, which can be time consuming for a large horse farm.