

Fiber – Friend or Filler?

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Roughages are one of the most important components of the equine diet. The average horse can eat 25 Lb of hay or graze up to 100 Lb of grass in a day! Roughage sources can supply most of the energy and nutrients needed for a horse to survive. Additionally, fiber from roughage is key to maintaining gut health and motility. Even horses with high nutrient demands (for example growing horses, lactating broodmares, or horses in heavy to intense work), roughage sources should still make up the majority of the horse's diet.

The Foundation of the Equine Diet

There are a variety of roughage sources in the equine diet. Forages, such as grasses and legumes, are the primary roughages fed to horses. In well-managed pastures, horses have access to fresh forages. Alternatively, the forage may be preserved as hay or haylage. Hay can be further processed into chopped hay, hay cubes, or hay pellets. These processing methods make forage easier to feed in some areas or to horses with special dietary concerns (for instance, an older horse with limited chewing ability).

The most common species of grasses and legumes differs by location in the United States. The most common pasture grasses in Florida include bahiagrass, bermudagrass, and ryegrass. Bahiagrass and bermudagrass are warm-season grasses because they grow best in warm, tropical climates. Annual ryegrass, a cool-season grass, is typically seeded into pastures to provide pasture grass over winter months. Orchardgrass and timothy are common cool-season grass hays shipped to the southeast from northern or western regions on the country. Alfalfa and perennial peanut are common legume hays fed to horses in the southeast, but some clover species are found in pastures. Often, cool-season grasses and alfalfa are grown and harvested in mixtures, and then sold as grass/alfalfa mix hay.

Although forages may be the most common roughage source, other alternative roughages are popular in equine diets. Beet pulp and soybean hulls are left over products from agricultural processing of sugar beets and soybeans, respectively. The fiber concentrations of beet pulp and soybean hulls are relatively high, indicating these alternative roughages can substitute for some of the forage in a horse's diet. Both can be fed alone, but they are often mixed into commercial concentrate products to increase the amount of fiber in the diet.

Nutrition Facts

Roughages contain many nutrients that the horse utilizes for daily function. The concentrations of nutrients such as carbohydrates, protein, vitamins, and minerals will vary greatly depending on the roughage source. Roughages are high in structural carbohydrates, often referred to as fiber. The most prevalent types of fiber in roughages are cellulose, hemicellulose, lignin, and pectin. These fibers are part of the plant cell wall, acting as glue and scaffolding. In general, roughages have low concentrations of nonstructural carbohydrates such as starch and sugar.

Within forages, generally legumes have a greater nutritive value than grasses (Table 1). Legumes typically have higher concentrations of digestible energy, protein, and some minerals and lower fiber concentrations compared to grasses. Protein concentrations of grasses, particularly warm-season grasses, are largely controlled by pasture or hay management. Well-managed grass fields with proper fertilizer applications have greater protein concentrations than fields without fertilizer applications. Fresh forage typically has higher concentrations of vitamins than preserved forages. Other roughages such as beet pulp and soybean hulls have similar feeding value to legume hays.

Table 1. Range of nutrients in roughages commonly fed to horses.

Nutrient ^a	Cool-Season Grass	Legume	Warm-Season Grass	Beet Pulp	Soybean Hulls
Digestible Energy, Mcal/Lb	0.81 – 1.01	1.06 – 1.32	0.87 – 1.02	1.11 – 1.29	0.75 – 1.11
Crude Protein, %	7.0 – 14.7	18.6 – 23.9	8.2 – 17.3	7.6 – 11.0	7.9 – 18.9
ADF, %	34.1 – 43.7	26.8 – 34.6	31.6 – 39.3	22.4 – 29.9	38.6 – 52.2
NDF, %	55.6 – 69.6	33.7 – 44.1	61.9 – 71.3	36.1 – 46.4	55.0 – 72.1
Sugars, %	4.6 – 9.7	5.5 – 8.6	4.1 – 8.5	4.0 – 13.5	1.2 – 6.1
Starch, %	0.4 – 9.7	0.7 – 2.6	1.5 – 7.7	0.0 – 2.4	0.0 – 3.2
Calcium, %	0.27 – 0.72	1.22 ^b – 4.0	0.39 – 0.60	0.62 – 1.39	0.34 – 0.91
Phosphorus, %	0.15 – 0.33	0.24 – 0.32	0.15 – 0.26	0.04 – 0.13	0.01 – 0.33

^aValues from the Dairy One Forage Library accumulated crop years 2001-2016

^bValue from National Research Council. Nutrient Requirements of Horses 2007

Fiber Type

Unlike commercial grain mixes, most roughage sources don't come with a feed tag. The best way to analyze the nutritive value of roughage is to send a sample to a laboratory for nutrient analysis. A good analysis starts with collecting a representative sample. The National Forage Testing Association provides guidelines related to best practices when sampling forages (www.foragetesting.org). A typical lab analysis will include crude protein, digestible energy, and some mineral concentrations. There are several measurements of fiber that may be included in a nutrient analysis.

- Crude fiber (CF): An approximation of fiber concentration based on portion of sample that is resistant to chemical analysis. Reported on feed tags, but other measurements of fiber explain roughage fiber more accurately.
- Neutral detergent fiber (NDF): Representation of cellulose, hemicellulose, and lignin in sample. A good representation of overall fiber concentration in grasses but underrepresents fiber concentration of legumes and other roughage sources.
- Acid detergent fiber (ADF): Represents cellulose and lignin in feed sample. Can be used to estimate hemicellulose concentration of feed by $\text{hemicellulose} = \text{NDF} - \text{ADF}$.
- Lignin: Measurement of indigestible component of feed sample.
- Total dietary fiber (TDF): A measurement from human nutrition that may be most applicable to horses. Includes hemicellulose, cellulose, and lignin along with soluble fibers (pectin, gums, etc.) not included in NDF. Not available at most animal feed testing laboratories.

Turing Filler into Fuel

The equine digestive tract can be broken down into two main sections, the foregut and the hindgut. The foregut is similar to a human digestive tract consisting of the esophagus, stomach, and small intestine, whereas the hindgut differs greatly from the human colon. The equine hindgut includes the cecum,

colon, and rectum. The cecum and the large colon combined are approximately 21 to 24 gallons for the average Lb horse and account for over half of the equine digestive tract. The massive hindgut is responsible for digesting fiber from roughage sources.

Horses don't directly produce the digestive enzymes needed to breakdown dietary fiber; however, over a billion microbial organisms in the hindgut are able to digest fiber. The microbial organisms have a symbiotic relationship with the horse. The hindgut of the horse is a suitable environment for the microbes that provides a steady source of food, mainly ingested forage or other roughage. The microbes use the fiber from roughage to support microbial growth while creating by-products such as heat, gas, volatile fatty acids, and vitamins. This process of fiber digestion is known as microbial fermentation. Volatile fatty acids are absorbed in the hindgut and converted to energy by the horse. The energy from volatile fatty acids provides up to 80% of a horse's daily energy requirement. Additionally, B-vitamins and vitamin K can be absorbed and subsequently used by the horse.

Functional Fiber

Although there is no known fiber requirement for horses, fiber intake and feeding forage to horses is linked to positive health outcomes. Good feeding management and feeding roughage can often prevent digestive disorders such as gastric ulcers and colic. Horses take almost 5 times longer to eat hay than grain, increasing saliva production and time food is in the stomach. Both saliva and feed buffer stomach acid, reducing the risk for gastric ulcer formation. Horses with constant access to pasture and forage are 3 times less likely to have a gastric ulcer than horses with limited access to forage and pasture. Access to roughage helps maintain a healthy microbial community in the equine hindgut, which can reduce the incidence of colic.

Forages and other roughage sources have reduced digestible energy concentrations compared to grain. For overweight horses, reduced calorie intake is vital to achieve a healthy weight. Limiting grain intake and selecting hay with a lower nutritive value (greater fiber concentrations and reduced energy concentrations) reduces calorie intake. A greater quantity of lower nutritive value hay can be fed to overweight horses, preventing digestive disorders while trimming waistlines.

An up and coming use of fiber is the development of prebiotics. Prebiotics are preferentially fermented substrates used by the gut microbial organisms linked to health improvements. Prebiotics are a hot topic in human nutrition and have been gaining popularity in the animal feed industry. Effective prebiotics for humans may differ from good candidate equine prebiotics due to major differences in digestive physiology. Equine researchers are actively exploring the potential of prebiotic fibers to increase horse health and digestive function.

Clearly, fiber is more than filler in equine diets. Fiber from roughage is an important energy source for horses and also helps maintain gut health. Because of the variety of roughage sources available to horse owners, feed selection can be paired with an individual horse's nutrient requirements to maximize the amount of roughage in the diet. Combined with good feeding management, a diet consisting mainly of forage is key to happy, healthy horses.

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