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Basics of Feeding Horses: What to Feed and Why

This NebGuide discusses the horse's digestive system and appropriate feeding procedures.

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Because of the horse's eating habits and digestive system, feeding practices common to other species of livestock often result in severe digestive dysfunction or even death for the horse. In fact, several anatomical peculiarities of the horse's digestive tract predispose horses to digestive disorders such as colic and laminitis even under the best management. Under poor feeding management, the onset of these disorders is almost assured. The objective of feeding management is to provide a ration with balanced nutrition that both maximizes nutrient utilization while minimizing the occurrence of digestive disorders.

Digestive Tract of the Horse

The horse's digestive tract (*Figure 1*) can be divided into two divisions: foregut and hindgut. The foregut of the horse is made up of the mouth, esophagus, stomach and small intestine. It functions similar to a pig's digestive tract in that it is made of a simple, one compartment stomach followed by the small intestine. The hindgut of the horse is comprised of the cecum, large colon, small colon and rectum. The cecum functions much like a cow's rumen in that the relatively large, fermentation vat houses digestion-aiding microbes. The microbes in the cecum break down nutrient sources which would otherwise be unavailable to the horse. Each part of the digestive tract has peculiarities relating to feeding management.

Mouth -- The mouth is responsible for the initial breakdown of feedstuffs. Mastication (chewing) reduces the size of large-particle feeds and breaks up the less-digestible, outer coverings of grains and forages. Mastication also stimulates salivary glands into releasing saliva, which assists in lubrication of food for swallowing.

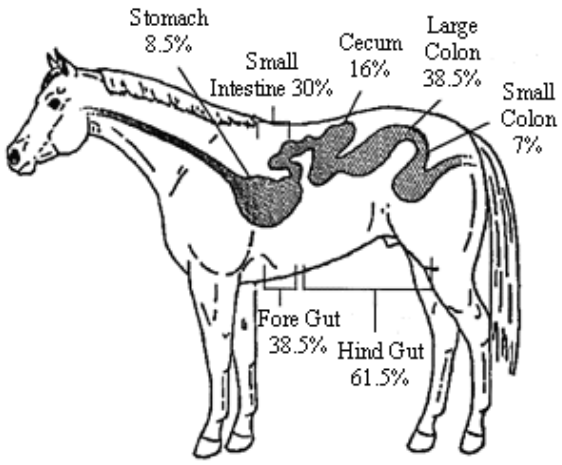

Figure 1. Digestive system of the horse.

Because proper dental conformation is necessary for mastication, qualified individuals should routinely inspect a horse's teeth. As horses age, dental conformation deteriorates. Consequently, older horses require more frequent inspection and treatment of teeth. Signs of poor dental conformation include excessive loss of feed while eating, positioning the jaw or head sideways while chewing, passing large amounts of whole grain in the feces and evidence of general loss of

condition and thriftiness.

Esophagus -- The esophagus is a tube-like structure between the mouth and stomach which allows for the transport of food between the two. The musculature diameter and tone of a horse's esophagus make it difficult for the horse to expel gas through eructation or vomiting. These features predispose horses to gastric (stomach) rupture, gastric distention and colic.

Stomach -- Compared to most livestock, horses have small stomachs, about 10 percent of the volume of the total digestive tract. The small size makes the rate of flow of ingesta (feed material in the digestive tract) through the stomach relatively fast. Because gastric emptying is dependent upon volume, large meals can be expected to pass more quickly than feed eaten continuously in small amounts. Studies have shown the majority of ingesta passes to the small intestine within 12 hours following a meal. When the stomach remains empty, the excess gas produced can cause rupture of the stomach, leading to death. The optimal method to feed horses is to allow for continuous consumption.

Small Intestine -- The small intestine is the main site of both digestion and nutrient absorption. As with the stomach, the level of feed intake influences flow rate of ingesta through the small intestine. Large amounts fed per meal increases rate of flow to the large intestine. Physical form of the feed also influences flow rate; completely pelleted rations pass more quickly than textured grains combined with hay. Liquids pass to the cecum as quickly as a few hours after ingestion.

Within 2-4 hours, any feed not digested and absorbed in the small intestine is passed on to the cecum and colon. Relatively low volume, combined with the rapid rate of passage through the upper gut (stomach and small intestine), makes it easy to overwhelm the digestive capacity of the stomach and small intestine. Because the horse's digestive system is designed so grain carbohydrates and proteins are digested in the upper gut, it is important to feed relatively small amounts, two to four times each day, for safer, more efficient digestion. Avoid feeding more than eight pounds of concentrate (grain) in one feeding. If more is needed, divide it into two to three feedings.

Cecum and Colon -- Ingesta not digested or absorbed in the small intestine is present in the cecum and colon. Together, the cecum and colon make up about 50 percent of the volume of the digestive tract. The cecum and colon house the bacterial, protozoal and fungal populations which function in microbial digestion of fibrous feeds, such as hay or pasture. If large amounts of these concentrates reach the cecum, they will rapidly ferment and may produce excessive gas or lactic acid, causing colic or laminitis. Normal gut sounds of the cecum can be heard by pressing one's ear against the horse's right flank.

Passage of ingesta through the large and small colon is relatively slow. Rates of flow through the colon may take up to several days following eating. Because the diameter of different segments of the large colon varies and the arrangement includes several flexures where the colon turns back onto itself, horses are predisposed to digestive upsets when nutrient flow is abnormal. Because the horse's gastrointestinal tract is designed to digest primarily forage, fewer problems will occur when the diet is predominantly hay and pasture.

Digestive System Dysfunction

The digestive system of the horse is susceptible to twisting, impaction and other types of colic. A natural response of a horse with a digestive disorder is to roll, which, in extreme situations, can cause a section of the intestine to become twisted. Impaction can occur when a section of the intestine is damaged by parasites or toxins. Colic results from the formation of gaseous products resulting from microbial digestion. If large amounts of starch (like that found in grains) are available to microbes in the hindgut, large amounts of gaseous compounds are produced. Because these gaseous compounds cannot be absorbed or released as quickly as they are produced, gaseous swelling of the hindgut occurs. This swelling can, and often does, cause the horse to develop colic. Major causes of laminitis (founder) are also related to byproducts of microbial digestion.

Nutrient Requirements

When fed properly, a horse's body is supplied with the energy, proteins, vitamins and minerals it needs and uses as it works. Daily requirements are needed just to maintain the body; larger amounts are needed for work, growth or lactation. The harder the body must work and the more nutrients it uses means more nutrients must be supplied in the feed. The recommended daily nutrient requirements for an 1,100 pound (mature weight) horse are given in *Table I*. The absolute nutrient requirements of horses of different sizes and under similar production states can be expressed as percentages of their daily ration. Recommended nutrient concentrations for typical rations are listed in *Table II*. Ration nutrient concentration's are higher for growing horses than mature horses due to the combination of increased need and daily intake limitations.

Table I. Daily nutrient requirements of horses[1].

	Body weight (lb)	*Daily gain (lb)*	*Dig. energy (lb)*	*Crude protein (lb)*	*Calcium (g)*	*Phosphorus (g)*	*Vitamin A (1,000 IU)*
Maintenance	1,000	--	16	1.4	20	14	15
Pregnant mare							
9 months	--	--	18	1.8	35	26	30
10 months	--	--	19	1.8	35	27	30
11 months	--	--	20	1.9	37	28	30
Lactating mares							
First 3 months	1,100	--	28	3.1	56	36	30
3 months to weaning	1,100	--	24	2.3	36	22	30
Working, mature							
Light work	1,100	--	21	1.8	25	18	22
Moderate work	1,100	--	25	2.2	30	21	22
Intense work	1,100	--	33	2.9	40	29	22
Weanling, 4 months	385	1.9	14	1.6	34	19	8
Weanling, 6 months							
Moderate growth	475	1.4	15	1.7	29	16	10
Rapid growth	475	1.9	17	1.9	36	20	10
Yearling, 12 months							
Moderate growth	715	1.1	19	1.9	29	16	15
Rapid growth	715	1.4	21	2.1	34	19	15
Yearling, 18 months							
Not in training	800	0.8	20	2.0	27	15	18
In training	800	0.8	27	2.6	36	20	18
Two year old							
Not in training	990	0.4	19	1.8	24	13	20

In training	990	0.4	26	2.5	34	19	20

[1]Adapted from NRC, 1989 for 1,100 pound horse.

Table II. Recommended nutrient concentrations in rations for horses (90% dry matter basis)[1].

	Diet Proportion						
	Digestible energy[2] (Mcal/lb)	*Grain (%)*	*Hay (%)*	*Crude protein (%)*	*Calcium (%)*	*Phosphorus (%)*	*Vitamin A (IU/lb)*
Maintenance	0.8	0	100	7.2	0.21	0.15	750
Pregnant mare							
9 months	0.9	20	80	8.9	0.39	0.29	1510
10 months	0.9	20	80	9.0	0.39	0.30	1490
11 months	1.0	30	70	9.5	0.41	0.31	1490
Lactating mares							
First 3 months	1.1	50	50	12.0	0.47	0.30	1130
3 months to weaning	1.0	35	65	10.0	0.33	0.20	1240
Working, mature							
Light work	1.0	35	65	8.8	0.27	0.19	1100
Moderate work	1.1	50	50	9.4	0.28	0.22	970
Intense work	1.2	65	35	10.3	0.31	0.23	800
Weanling, 4 months	1.25	70	30	13.1	0.62	0.34	650
Weanling, 6 months							
Moderate growth	1.25	70	30	13.0	0.50	0.28	760
Rapid growth	1.25	70	30	13.1	0.55	0.30	670
Yearling, 12 months							
Moderate growth	1.15	60	40	11.3	0.39	0.21	890
Rapid growth	1.15	60	40	11.3	0.40	0.22	790
Yearling, 18 months							
Not in training	1.05	45	55	10.1	0.31	0.17	930
In training	1.10	50	50	10.8	0.32	0.18	740
Two year old							
Not in training	1.00	35	65	9.4	0.28	0.15	1080
In training	1.10	50	50	10.1	0.31	0.17	840

[1]Adapted from NRC, 1989.

[2]Values are specific for feeding a grain mix with 1.5 Mcal/lb and hay with 1 Mcal/lb dry matter.

Energy -- Energy, the fuel for various body processes, must be digestible and provided efficiently in the forms of carbohydrates and fats. Energy is measured as Digestible Energy (DE) which is expressed in calories (or Mega Calories - 1,000 calories) and represents the amount of energy actually available to the horse in a digestible form. Energy intake above the amount needed to fuel the body for maintenance, production and growth will be deposited as fat. Horses in good body condition receiving insufficient daily energy intake will burn that stored energy. Horses in poor body condition receiving insufficient daily energy intake, however, can quickly develop serious health problems which may lead to death.

Protein -- Proteins are essential to all life. Proteins form the greater part of the muscles, internal organs, cartilage, connective tissues, outer tissues (skin, hair, hoofs, etc.) and the nervous system. Proteins are made up of amino acids, including lysine, the most important amino acid for growth in young horses. Diets for growing horses must include lysine levels of .6 - .7 percent of the total diet. Commercial feeds containing urea, a non-protein nitrogen source, should not be fed to horses, as they cannot utilize non-protein nitrogen as effectively as cattle. Excess protein (the amount fed above the requirement) is broken down into energy and a nitrogen by-product called urea, which is excreted in the urine causing increases in both urination and water intake.

Minerals -- Minerals are present in very small amounts and are absolutely necessary for growth and the functions of the skeletal system, blood and the body's soft tissues. Calcium and phosphorus are the two most important minerals for skeletal development and maintenance. The suggested calcium to phosphorus ratio is 1.5 to 2:1. There should never be more phosphorus than calcium in horse rations.

Salt aids the body in fluid and temperature regulation. During hot weather, body temperature is controlled by sweating; therefore salt and other minerals lost through perspiration must be replenished. It is vital for horses to have salt available, either as block, loose or mixed in the feed in the form of trace mineralized or iodized salt. Most grain mixes contain between .5 and 1 percent salt, sufficient amounts for most horses. However, pastured horses or those which do not receive a concentrate mix containing salt must have access to free-choice salt.

Vitamins -- Vitamins are necessary for growth, reproduction, lactation and general health. Most vitamin requirements are supplied by the forages and grains in horse diets, although it is often standard practice to include a vitamin premix in horse diets. A major vitamin of concern in horse rations is vitamin A. While most of the horse's maintenance requirements for vitamin A are met by forage consumption, additional vitamin A many be needed for horses during production and growth. Excessive supplementation of certain vitamins can be harmful. Therefore vitamin premixes should be fed only at recommended levels on the label and horse owners should account for sources added to grain mixes before top dressing with additional supplements.

Nutrient Sources

Horses typically receive nutrients from hay, pasture, grain or a combination of these. Pasture, grain and hay selection is often based on traditional beliefs and local availability.

Forage - Pasture/Hay -- All horses need long-stemmed forage to both maintain normal digestive tract function and satisfy their need to chew. A horse which consumes an all-hay diet will eat between 1.5 to 2 percent of their body weight per day (1,000 pound horse = 15 to 20 pounds of hay/day). Mature horses doing minimal work can be maintained on either this type of diet or all pasture. However, horses eating an all-forage diet must have access to trace mineralized salt. The forage portion of a horse's diet can be supplied by pasture, long hay or cubes with at least a three quarter-inch particle size. Pelleted feeds can, however, cause digestive problems when fed alone and a diet consisting solely of pellets results in less time spent eating and can lead to boredom and increased wood or tail chewing.

The most commonly used hays in Nebraska are alfalfa, brome and prairie (*Table III*). In general, forages are lower in digestible energy and higher in fiber than grains. Although crude protein content varies among

forages, large amounts of minerals and vitamins are supplied by them. Due to higher energy requirements, horses at hard work or brood mares with foal cannot eat enough of an all-roughage diet to furnish all the nutritional requirements.

Concentrates - Grains/protein supplements -- *Table IV* lists the nutrient characteristics of several types of feed. Most grain rations consist of oats, corn and soybean meal; however, several other grains can also be used. Oats are the primary grain in most rations because they are lower in energy and higher in fiber than most grains and their bulky nature results in less digestive upset. Corn is high in energy but low in protein quality and quantity. Corn is considered a heavy grain because it is denser and higher in energy per unit weight compared to oats.

Most grains fall into two basic groups: energy feeds and protein sources. Oats, corn, milo, barley and wheat are energy feeds. Protein sources include soybean meal, linseed meal and sometimes, alfalfa pellets. When compared to soybean meal, linseed meal is a lower-quality protein as it is low in lysine. Most grains, however, have adequate protein to meet the needs of mature horses, either idle or working. Grains are also high in energy, so they can meet the energy needs of any class of horse. The primary problem with most grains: low in calcium content and high amounts of phosphorous. Therefore, most grain rations have calcium added to maintain a balanced ration. Because grains vary considerably in density, feed according to weight, not volume. For example, a gallon of corn weighs about seven pounds; a gallon of oats only about four. Always weigh your feeds.

There are many excellent commercial feeds available that are balanced specifically for horses. Some horseowners prefer to mix their own rations, rather than purchasing commercially prepared feeds. *Table IV* provides sample rations for various classes of horses using common Nebraska feedstuffs.

Table III. Nutrient content of selected hay, grains and protein sources[1] (Dry Matter Basis).

	Digestible energy Mcal/lb	*Crude protein (%)*	*Calcium (%)*	*Phosphorus (%)*
Hay				
Alfalfa - mid bloom	1.04	18.7	1.37	0.25
mature	0.99	17.0	1.19	0.27
Clover	1.04	15.0	1.38	0.24
Brome	0.85	12.6	0.25	0.25
Bluestem	0.90	7.4	0.40	0.20
Orchardgrass	0.99	12.8	0.27	0.34
Prairie	0.70	6.4	0.35	0.14
Grain				
Corn	1.7	10.0	0.04	0.53
Oats, heavy	1.5	13.0	0.06	0.33
Sorghum	1.5	12.0	0.03	0.30
Wheat	1.75	13.0	0.05	0.41
Protein sources				
Soybean meal	1.47	49.9	0.40	0.71

[1]Adapted from NRC for horses, 1989.

Table IV. Grain ration options				
Ingredients[1]	*Weanlings and yearlings %*	*Broodmares late gestation %*	*Lactation %*	*Maintenance %*
Oats	58.5	90	72.5	97.5
Corn	25		15.0	
Soybean meal	10	5	7.5	
Molasses	2	2	2-	
Dicalcium phosphate	2		.5	1.0
Limestone	1	1.5	1	
Salt (trace mineral)	1	1	1	1.0
Vitamin premix	.5	.5	.5	.5
	100	100	100	100
Daily Allowances (lb feed/100 lb of horse)				
Grain ration	1.0-1.5	0.5-1.0	1.0-1.5	0.0-0.5
Hay[2]	1.0-1.5	1.25-1.75	1.5-2.0	1.50-2.0

[1]The grain rations could be reformulated using other common grains (barley, sorghum, wheat) and protein sources (canola meal) depending on availability.

[2]The hay used in this table is an average quality legume grass hay. Changes to the grain ration formula may be necessary depending on the type and quality of hay.

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