



Karen Hansen • Associate Professor • Department of Animal Science

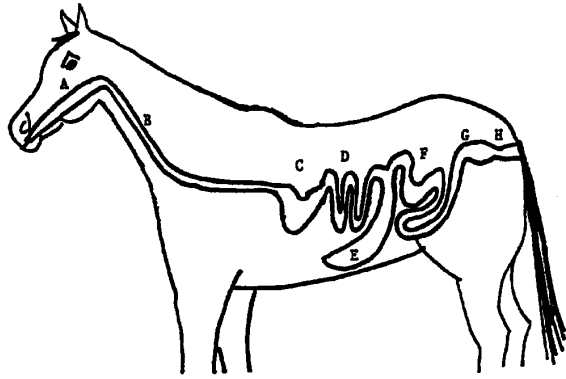
Horse nutrition is of interest to many horse owners. There are many feedstuffs and supplements available for horses. However, feeding recommendations may be confusing without a basic understanding of a horse's digestive system, nutrient requirements, and feed-management concepts. Horses are distinctively different from other species of animals in their digestive tract capacity, tract arrangement, and feeding behavior. An understanding of these differences may help reduce the chance of digestive disorders such as colic or founder caused by poor feeding management. Horses developed as animals that eat small meals frequently, and it is helpful to keep this in mind.

Anatomy and Physiology of the Digestive Tract

A horse is classified digestively as a non-ruminant herbivore. This means it is a plant-eating animal possessing a simple stomach. The digestive tract of a horse can be divided into the foregut and the hindgut. The foregut consists of the mouth, esophagus, stomach, and small intestine (representing about 38.5 percent of the total tract volume of ingesta-

containing parts). The hindgut consists of the cecum, large colon, small colon, and rectum (representing about 61.5 percent of the total tract volume of ingesta-containing parts). The arrangement of the digestive tract and the relative capacities of the major parts are shown in Figure 1.

The teeth of a horse are important for tearing and the initial processing or chewing of feedstuffs. A horse secretes a large amount of saliva, which aids in the transportation of food through the tract and buffers the food in the stomach. The esophagus connects the mouth to the stomach and has strong muscles in the lower end that effectively prevent horses from vomiting or expelling gas. The stomach is small in size relative to the size of a horse and can be overloaded by large amounts of feed (such as grain) at one feeding. The stomach continues the breakdown of feedstuffs and delivers food to the small intestine. The small intestine is approximately 70 feet in length in horses and is the major site for digestion and the absorption of many nutrients. Dietary protein, soluble carbohydrates (such as those found in grain sources), and fats are acted upon in



	Capacity	% of system
A - Mouth	—	—
B - Esophagus	—	—
C - Stomach	4.5 gallons	8.5%
D - Small Intestine	16 gallons	30%
E - Cecum	8.5 gallons	16%
F - Large Colon	20.5 gallons	38%
G - Small Colon	4 gallons	7.5%
H - Rectum	—	—

Figure 1. Parts and relative capacities (of the ingesta containing parts) of the horse's digestive tract.

the small intestine by digestive enzymes. Several vitamins and minerals are also absorbed in the small intestine. The rate of passage of feedstuffs in the foregut is relatively rapid, with much of the contents passing through in 90 minutes after a meal.

Dietary nutrients not absorbed in the small intestine are passed on to the hindgut. The hindgut consists of the cecum, large colon, and small colon and represents the majority of the capacity of a horse's digestive tract. Each segment of the hindgut is host to a large population of bacteria and protozoa that are similar to the population contained in a cow's rumen. The microbial population can break down feedstuffs such as structural carbohydrates that cannot be digested in the small intestine (i.e. cellulose) and provide end products (such as volatile fatty acids, ammonia, and vitamins) that can be utilized by a horse. This relationship is beneficial to horses, and it allows for the utilization of a high percentage of

forage in the diet. Microbes in the hindgut can also process soluble carbohydrates and proteins which normally pass through the foregut undigested in small quantities. Some dietary minerals and the majority of B vitamins are digested and absorbed in the hindgut. Also, the hindgut is the major site of water reabsorption from the digestive tract. The rate of passage in the hindgut is much slower than in the foregut, and some feedstuffs may remain in the hindgut as long as 48 to 72 hours after eating.

In summary, a horse is very different from other animals in the arrangement and function of the digestive tract. This dictates specific feeding management for horses. For example, a cow can utilize a higher percentage of low-quality forage (higher in structural carbohydrates) in the diet than a horse due to the presence and location of a cow's rumen. Because horses are less efficient in digesting low-quality forages, they obtain more benefit by being fed higher quality (lower in structural carbohydrates) forages. Horse cannot relieve excess gas or foodstuff in the digestive tract by belching or vomiting and have a small stomach relative to their body size. Because of this aspect of a horse's digestive tract, managers must closely monitor the amount of forage (especially grain) given at each feeding to reduce the chance of gas buildup in the tract or overwhelming the capacity of the stomach.

Specific Concerns

The care of teeth is important in horses. The normal chewing of food may cause the development of sharp edges or "points" on the inside lower and outside upper molars. Tooth alignment and appearance is shown in Figure 2. If a horse's teeth are not checked and floated (filing off sharp edges) when needed, a horse will not chew properly. Poorly chewed feedstuffs can lead to digestive disorders such as colic. Also, neglect of sharp teeth points may cause a horse to reduce its feed intake and lose condition due to painful chewing.

In addition in improper tooth care, several aspects of the digestive tract make horses susceptible to

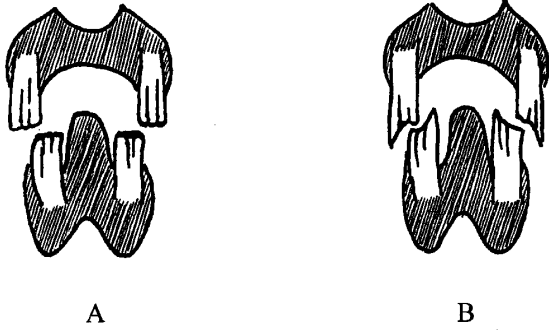


Figure 2. Cross-section of molar teeth of the horse showing (A) proper tooth alignment and (B) molar teeth with sharp hooks on inside lower and outside upper teeth (showing neglect).

digestive disorders such as colic (abdominal pain) or laminitis (founder). Parasite infestation and migration can cause damage to the intestine or blood supply in a horse which may cause colic. Horses should be de-wormed on a regular basis to reduce parasite damage. The large colon of a horse has areas of large diameter followed by areas of much smaller diameter which may be susceptible places for the impaction of inadequately digested feedstuffs. Impaction and subsequent colic can be caused by feeding large quantities of low-quality forage or by insufficient water intake. Water restriction will also negatively affect digestion and reduce feed intake.

An overload of soluble carbohydrates (such as in an overabundance of grain or lush, young forage) will pass through the foregut rapidly and can be dumped into the hindgut undigested. This drastic change in feedstuff can cause gaseous buildup in the digestive tract due to enhanced bacterial fermentation. The horse cannot adequately expel the gas; therefore, colic may occur. In addition, nutritional laminitis (founder) can be caused by a carbohydrate overload due to the absorption of toxic levels of by-products of bacterial fermentation in the hindgut. A horse's ration should be adjusted gradually, and all feeds should be stored in an area that is secured and inaccessible to horses to prevent colic or laminitis.

Feeding Management Guidelines

Water

Horses should have access to clean, palatable water at all times. The only exception to this involves hot horses, which should be allowed limited access to water (a few sips at a time) until after they have cooled off to prevent colic. Horses will normally consume 5 to 12 gallons of water daily and should be monitored for adequate water consumption.

Water intake will rise with an increased ambient temperature, workload, and lactation. It is especially important in the winter that horses be encouraged to consume water by breaking ice or using a water tank heater. Water is vital to horses in many aspects of their bodily functions, especially in the digestion of foodstuffs.

Forage

It is important to feed high-quality forages to horses. All horses should have access to some long-stemmed forage daily. Horses utilizing high-quality pasture will normally consume adequate forage; however, horses not on pastures need to be fed long-stemmed hay at a level of at least 1 percent of their body weight per day. Long-stemmed, high-quality forage provides essential nutrients and promotes the normal intestinal function and rate of passage of foodstuffs. Forage also provides fuel for normal bacterial function in the hindgut. Feeding long-stemmed forage reduces the incidence of behavioral abnormalities such as wood chewing and mane/tail chewing. Hay may be fed in a variety of ways but usually should not be fed loose on the ground because hay will be wasted. This type of feeding will also increase the chance of horses picking up additional parasites, sand, and other foreign material. High-quality hay should be selected on the basis of leafiness, bright green color, high leaf/stem ratio, small stem size, and fresh smell. The following principles should be kept in mind when utilizing grazed and harvested forages:

- a. *Alfalfa* – Alfalfa hay can be very high in energy and protein. Although alfalfa is a very desirable forage source for many classes of horses, it should be fed with care because overfeeding can cause digestive disorders. Alfalfa hay may contain blister beetles, which are highly toxic to horses. This problem is more common in hay grown in the Midwest but may occur anywhere. It is prudent to make sure a hay supplier checks fields and provides adequate pest control when needed along with continually monitoring hay for any indication of beetles.
- b. *Tall Fescue* – Some tall fescue may contain an endophyte fungus that is dangerous when consumed by pregnant broodmares. The fungus causes a lack of milk in mares and may cause a thickened placenta, thus increasing the birth loss of foals. If endophyte-infected tall fescue grazing cannot be avoided, mares should be removed from tall fescue pastures at least 90 days before foaling for the best results.
- c. *Sorghum/Sudan* or *Hybrids* – Grazing sorghum/sudan pastures may cause prussic acid poisoning in horses. It is best to use alternative forage sources.

Feed High-Quality Feedstuffs

Grains and hays that are fed to horses should be stored in a cool, dry place off the ground and away from horse access. Hay that is damaged, discolored, dusty, or looks or smells moldy *should not* be fed to horses. Moldy feedstuffs can cause colic, and they can also cause or aggravate respiratory problems in horses.

Feed by Weight

Always feed horses by the *weight* of the feedstuff and not by *volume*. This will aid in determining how much of a feedstuff to supply to meet a horse's nutrient requirement. Feeding by *weight* will reduce the chances of overfeeding, which can lead to serious digestive disorders. Feeds vary tremendously in weight per unit volume and the energy supplied in that volume. For example, a 3-pound coffee can of oats weighs about 4 pounds and supplies about 5

megacalories of energy. In contrast, a 3-pound coffee can of corn weighs about 6 pounds and supplies about 9 megacalories of energy. A volume substitution could double or halve the amount of energy supplied in this volume, which could have serious digestive side-effects. This principle is also important when substituting pelleted feeds because pelleting increases the weight per unit volume.

Processing and Feeding Grains

Grains with a hard seed coat such as barley, wheat, and sorghum (milo) should be processed for maximum utilization by horses. These grains should be rolled, flaked, or otherwise roughly processed. The digestive benefits of normal processing methods for oats and corn are small and usually do not offset the increased cost of processing for horses with good teeth. Managers should avoid feeding finely processed grains to horses because horses tend to refuse these feeds, and they may aggravate respiratory problems.

Grain should be fed wisely because not all horses need grain in their diets. An overload of soluble carbohydrates, which are high in grains, can cause colic and/or laminitis in horses.

Change Rations Slowly

Avoid abrupt ration changes. Change rations if needed over at least four to seven days depending upon how drastic the change is. Change rations by a small amount at each feeding. This will reduce the chance of digestive disturbance by allowing the digestive tract and the microbial population therein time to adjust to the new food supply.

Feed Supplements and Commercial Rations Wisely

The nutrient content of a horse's current ration should be taken into consideration before supplementation. Horses consuming high-quality forages and grains usually do not need additional supplementation except for salt. If supplements are fed, they should be fed according to label recommendations. Increasing the amount of supplement over recommended levels can cause a nutrient imbalance or toxicity.

Refrain from “cutting” commercially balanced rations with additional feedstuffs (such as single grains). Commercial rations are balanced, especially for calcium and phosphorus, and cutting may result in a nutrient imbalance.

Mineral Feeding

Salt (sodium chloride) should be added to horse grain mixes at a level of .5 to 1.0 percent salt to meet sodium and chloride requirements. Horses on pasture as the sole source of feed should have free access to trace-mineralized salt to supply salt (90 percent sodium chloride) and very small amounts of trace minerals (iodine, manganese, zinc, copper, cobalt, and iron). Trace-mineralized salt blocks *do not* contain calcium and phosphorus, so they must be supplemented in addition to trace mineralized salt. All rations should contain *no less* than a 1:1 ratio of calcium to phosphorus. A higher level of phosphorus in the diet than calcium can induce a calcium deficiency and should be avoided.

Loose minerals without other feedstuffs (such as grain, salt, or molasses) are not very palatable, and horses do not have the ability to consume minerals to meet their requirements if offered as a free choice. For optimum consumption, mineral supplements should be added to the grain portion of a ration.

Regular Feeding

Feed horses on a regular basis at equal intervals. Horses should be fed at the same time each day to reduce stress that could cause digestive disorders. If feeding two times a day, feedings should be spread out in 12-hour intervals to allow for the regular rate of passage through the tract. Total daily feed should be split into two feedings if the grain portion of a horse’s diet exceeds .5 percent of its body weight (about 5.5 pounds for a 1,100-pound horse). This will also help reduce the chance of overwhelming the digestive tract and causing digestive disorders.

Feed Individually and Properly

Feed horses as individuals to the level of work performed for maximum efficiency. Reduce the grain portion of hard-working horses on days of rest.

This will lower the incidence of azoturia (Monday morning sickness or tying up) and similar muscular disorders. When managing horses in groups, arrange them by class and feed accordingly to avoid overfeeding some and underfeeding others. For example, mature idle geldings may be grouped with idle mares in early gestation because their nutrient requirements are similar.

Monitor Body Condition Score

Body condition score is a visual assessment of fat stores of an animal using a numerical scale from 1 to 9 (1 = thin; 9 = obese). Scoring horses based on the body condition scoring system will help managers group horses appropriately for feeding. Thinner horses may need more total feed than fatter horses, so horses grouped by body condition score are less likely to be overfed or underfed. The ideal body condition score for most animals is a 5 or moderate body condition. This score is described as “back is flat (no crease or ridge), ribs not visually distinguishable but easily felt, fat around tailhead beginning to feel spongy, withers appear rounded over spinous processes, shoulders and neck blend smoothly into body.” Animals that are below a body condition score of 5 may have a reduced ability to handle breeding, pregnancy, and other stresses. Body condition scores above 5 are not ideal for health or soundness. Figure 3 shows the area emphasized in the horse body condition scoring system. This scoring system is adapted from Henneke et al. (1983).

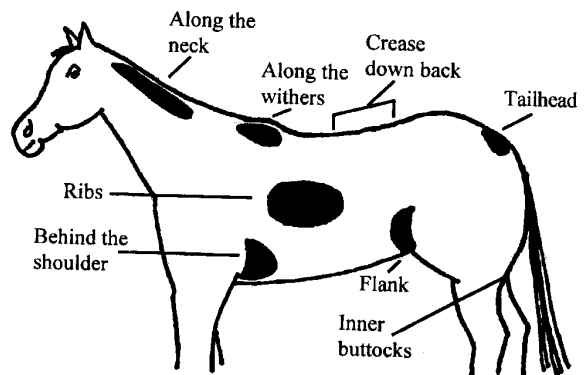


Figure 3. Areas emphasized in the horse body condition scoring system.

Examine Feeders and Surroundings

Take time to examine a horse's surroundings. Feeders, feed refusals, and a horse's feces should be examined on a regular basis. Feeders should be in good repair with no loose parts or sharp edges that could injure a horse. Greater than normal feed refusal or abnormal feces may indicate damaged feed, digestive disorders, or other illnesses.

Pasture and Group Feeding

When feeding in a pasture situation, provide individual feeders spread well apart so all horses will have a chance to eat. It is advisable to provide one more feeder in each pasture than there are horses to encourage even the most timid horse to eat. It is important to spread feeders far apart so one horse cannot guard more than one feeder at a time.

Horses should not be allowed access to free-choice grain. To protect horses that are fed in a pasture or group from digestive disorders, grain mixes should have a crude fiber content of at least 8 percent.

By feeding grain mixes that have at least 8 percent crude fiber, horses that consume slightly more than their allotted portions would be less likely to have digestive disorders from an overload of an extremely rich feedstuff.

Monitor Feeding Behavior

Discourage overaggressive eaters and encourage timid horses to eat. Horses that gulp feed can be discouraged and protected from digestive disorders by spreading the feed out in a shallow feeder and adding several large, smooth stones to the feed box. Encourage timid horses to eat by providing a safe place in which they may consume their ration. A solid wall or stall partition may help them eat without threat.

Feeding Foals

Foals should be allowed access to creep feed (their own balanced pre-weaning ration) if possible. Allowing foals access to creep feed will encourage them to eat feed regularly before weaning. Regular feeding before weaning will make the weaning process less stressful. Rations can be mixed in composition or pelleted and should be watched for sorting by foals. Foals should have daily access to fresh creep feed in addition to high-quality forage.

Creep feeders in stalls should allow access to foals but not mares. Pasture creep feeders should be large enough for the number of foals to be fed. Again, individual feeders should be provided and spread far apart for feeding animals in a group. Feed should be discarded when exposed to wet weather to reduce the chance of foals eating moldy feedstuffs that could cause digestive disorders.

Good nutrition is only one aspect of good management. Horses should have proper health care including annual vaccinations, teeth inspections, and regular deworming (at least three times per year or more if confined). Horses should also be exercised daily for optimum health and performance.

References

Henneke, D. R., G. D. Potter, J. L. Kreider, and B. F. Yeates. 1983. "Relationship Between Condition Score, Physical Measurement, and Body Fat Percentage in Mares." *Equine Veterinary Journal* 15:371.

Issued in furtherance of cooperative extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Glen Whipple, director, Cooperative Extension Service, University of Wyoming, Laramie, Wyoming 82071.

Persons seeking admission, employment, or access to programs of the University of Wyoming shall be considered without regard to race, color, religion, sex, national origin, disability, age, political belief, veteran status, sexual orientation, and marital or familial status. Persons with disabilities who require alternative means for communication or program information (Braille, large print, audiotape, etc.) should contact their local UW CES office. To file a complaint, write to the UW Employment Practices/Affirmative Action Office, University of Wyoming, 1000 E. University Ave., Department 3434, Laramie, WY 82071-3434.