CHAPTER 5: FEEDING HORSES

Anatomy and physiology of the digestive tract

Understanding the anatomy and function of the horse's gastrointestinal (GI) tract is critical for maintaining its health and preventing conditions such as colic and laminitis.

A horse's GI tract consists of the mouth, esophagus, stomach, small intestine, cecum, large colon, small colon and rectum (see figure 14). The volume and length of each compartment of the GI tract is shown in the table below.

Forty-five to 72 hours is required for food to completely pass through the digestive tract of the horse. The time food spends in various parts of the GI tract is illustrated in table 3.

	Volume (qts)	Length (ft)
Stomach	8-19	-----
Small Intestine	68	70
Cecum	28-36	4
Large Colon	86	10-12
Small Colon	16	10-12
Large Intestine	136	29

Table 2. Horse digestive system.

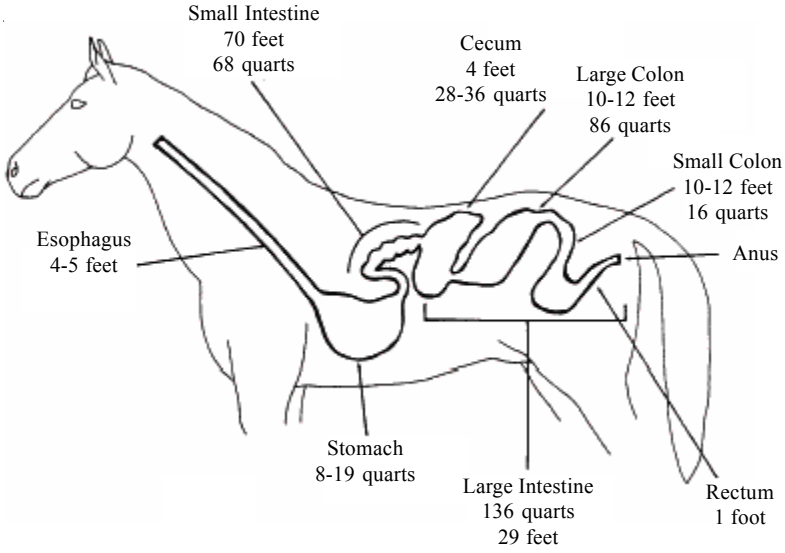

Figure 14. The horse's digestive system.

Each part of the digestive system serves a specific function in the digestion and absorption of nutrients. The mouth has several important functions including prehension (seizing and grabbing) of feed, chewing and swallowing. The lips of the mouth serve as prehension devices aiding in the movement of feed into the mouth and the selection of feeds that are most palatable or tasty. Incisors (front teeth) are used to cut feeds such as forages, whereas the molars (teeth in the rear of the mouth) are used to grind feed, reduce the particle size and aid in the digestive process.

The mechanical grinding of feed by the teeth is known as mastication. Horses chew in a circular motion that results in the eventual formation of sharp points on the molars that can cut the cheeks, a painful situation that may impair mastication. Sharp points on molars are prevented by having the teeth "floated," which involves filing the sharp points down. Your veterinarian can provide this service. Swallowing is another function of the mouth. Ingested feed is ground and incorporated into a bolus (ball), lubricated with saliva and then swallowed into the esophagus.

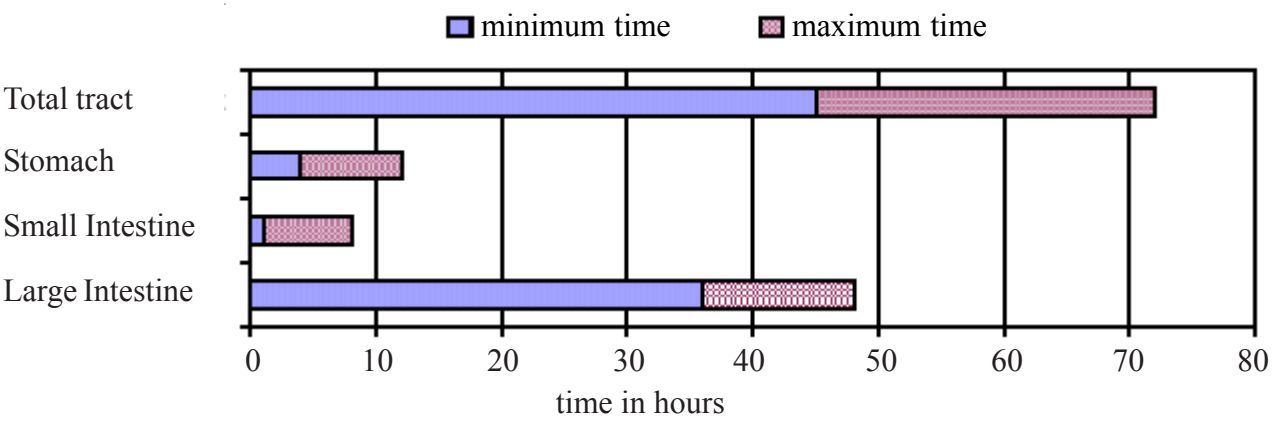

Table 3. Rate of passage of food through various segments and the total equine GI tract.

The esophagus can be thought of as a pipeline from the mouth to the stomach. No digestion occurs in the esophagus. Food in the esophagus can only move in one direction — toward the stomach. If food becomes lodged in the esophagus the horse may choke. Although choking is painful and uncomfortable to the horse, it is not life-threatening like that in humans when the airway is cut off. A choking horse's head often is hung low with saliva and masticated food coming out of the horse's nostrils. A choking horse requires immediate veterinary attention and is usually treated with minimal complications.

The stomach and the small intestine make up the foregut of the horse; the cecum, large colon, small colon and rectum make up the hindgut of the horse. The majority of starch (the principle component of cereal grains metabolized for energy), protein, fat, vitamins and minerals are digested and absorbed in the foregut (primarily in the small intestine) by enzymes and other digestive substances secreted into the small intestine by the pancreas, liver and cells making up the wall of the small intestine. The hindgut contains microbes, which are bacteria and protozoa capable of digesting dietary fiber supplied by roughages in the diet. The horse does not produce enzymes which digest fiber and need microbes to break it down. Microbes enable horses to utilize fiber quite well. Horses require fiber in their diet for the gut to function normally. It is recommended that the diet contain *no less than 1 percent of body weight of roughage such as hay, pasture, etc.* For example, a 1,100 pound horse requires at least 11 pounds of roughage. It also is important not to overfeed grain to horses because this causes digestive upset such as colic. When too much grain is fed, much of it is digested in the small intestine. It spills into the hindgut where microbes digest it rapidly, producing large amounts of gas and acid, both of which can cause discomfort and manifest into colic and, in some cases, laminitis. It is recommended that horses *not be fed more than 1 percent of body weight from a grain source.*

Some other important rules of thumb for maintaining the health of the horse's digestive system are to feed consistently. For example, feed two to three small meals at the same times each day. The horse's gut functions best with small amounts of feed moving through it regularly, keeping it somewhat full. This is best accomplished by trying to maximize the amount of forage being fed

in the diet and minimize the amount of grain *while still meeting the horse's requirements.* This is not to say that grain should not be fed, but only feed the amount necessary to provide what is lacking in the forage. In addition, horses should have constant access to plenty of fresh, clean water for the gut to function normally.

In summary, the horse's GI tract is a delicate system. Feeds should be selected not only for their ability to meet the animal's nutrient requirements, but also for compatibility with the horse's GI tract.

Feeding your horse

When you feed your horse, take into account its age, weight, work and growth to determine its diet. Some horses are easier to feed and require fewer nutrients than others. Other horses are very difficult to feed and require special attention. It is important to know how to feed your horse and to make sure it gets all the nutrients it needs.

Five types of nutrients

A horse requires five types of nutrients. Each nutrient has an important role in the horse's body and is needed to keep the horse healthy. Those nutrients are:

- energy nutrients (such as carbohydrates and fats),
- proteins,
- vitamins,
- minerals and
- water.

None is more important than another with the exception of water and energy nutrients. Energy in feeds is measured in Megacalories (Mcal) of digestible energy (DE).

Water
Water is the greatest single part of nearly all living things. Water performs many tasks in the body. It makes up most of the blood which carries nutrients to cells and takes waste products away. In addition, water is the body's built-in cooling system; it regulates body heat and acts as a lubricant. A horse drinks about 10 to 12 gallons of water daily depending on the work it is doing. In hot weather, a horse may drink up to 15 to 20 gallons of water. In very cold weather, water heaters may be needed to prevent the water from freezing.

Energy nutrients
Energy nutrients are the body's fuel and make up the bulk of the diet. After food is digested, blood carries its energy to the body. Energy nutrients power muscle movement to walk, breathe and blink eyes. (At the same time, this energy maintains body temperature).

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- *Carbohydrates* are the main energy source for all animals. Carbohydrates are complex compounds made up of carbon, hydrogen and oxygen. Cellulose (carbohydrates found in hay and grass) is one of the more complex carbohydrates. Horses can digest cellulose (grass and hay) because they have small microbes in their large intestine (cecum) that can break it down.
- *Fat or oil* is another source of energy. Like carbohydrates, fat is made up of carbon, hydrogen and oxygen and also provide energy for movement and heat. Energy in fat is more concentrated than energy in carbohydrates. Fat has 2.25 times more energy per gram than carbohydrates.

Proteins
Proteins supply material for body tissue. During digestion, proteins break down into amino acids. Amino acids build bodies; they enter the blood stream from the intestine, and blood carries amino acids to all parts of the body. Proteins form body tissue.

Proteins eventually become muscle, internal organs, bone and blood. Skin, hair, hooves and many other parts of a horse also are made of protein. Protein not needed to maintain or build a horse's body is either converted into energy or passed through the digestive system. Total protein in feeds is measured by crude protein (CP).

Vitamins
Vitamins are needed in much smaller amounts than other nutrients, but they are just as vital. Each vitamin has a different job in the body. Some vitamins are in the food a horse eats while others are produced inside the horse. Depending on its diet, a horse may need vitamin supplements. Supplements usually are not necessary if a horse is allowed to graze on grass.

Minerals
Small amounts of minerals usually are needed. Iron, copper, phosphorous, calcium and magnesium are examples of minerals that are important for a horse's body. Without iron, blood cannot carry oxygen to the body's cells. Without calcium and phosphorous, bones and teeth will not form properly. Calcium and phosphorous should be fed in a ratio that ranges from 3:1 (three parts calcium for each part of phosphorous) to 1:1. An imbalance of these minerals can cause developmental bone disease in young, growing horses.

Types of feeds

Your horse can get essential nutrients from many types of feed.

Roughage/Forage
Roughage, found in hay or grass, is the bulk of the horse's food. Grass or alfalfa hay, or a combination of the two, are good sources of roughage. Grass hay is generally higher in fiber and dry matter than alfalfa, but alfalfa may be higher in protein, energy, vitamins and calcium.

- *Hay* comes chopped or cubed, in pellets or, most common, in longstem hay bales. Many horsemen feed straight alfalfa or a combination of grass and alfalfa to their horses. Grasses used as hay include brome, orchard, and timothy or grasses native to many areas of the country.

— Longstem hay is the traditional baled hay. It is cut, cured, and baled or crimped. It can be bundled in 50 to 80 pound square bales or large, round or long square bales that can weigh tons.
— Hay cubes are about an inch wide and one to three inches long.
— Hay pellets are ground hay compressed into 1/8 inch by 1/2 inch pellets.
— Chopped hay, common in the Midwest, is cut three to four inches long. Horses can eat it faster and consume more feed in a shorter period of time. Chopped hay is not usually fed to horses.

Horses need a good quality hay. It should be bright green, leafy and fine textured, with a fresh, pleasant aroma. Musty hay, or other indications of mold or heating, and dust, weeds and other foreign material in hay can be unhealthy for an animal. Color is an indicator of quality and nutrient content; good hay is a bright green.

Most nutrients in hay are in the leaves, and leafy hay is a valuable source of food. Leafiness is influenced by the kind of hay, its maturity when cut, the weather conditions while growing and curing the hay, and curing procedures of the hay.

Dust is objectionable in any feed for horses. It not only reduces the taste of the hay, it also aggravates respiratory problems. Sprinkling or dunking dusty hay in water can reduce dust. Avoid feeding moldy or dusty hay.

In the field, heavy rain on cut drying hay, leaches energy and protein from the hay. Hay baled before it is dry enough will lose nutrients through fermentation, or heating in the bale. This sometimes starts fires through spontaneous combustion in barnyard stacks of stored, baled hay. This type of hay is unacceptable for horses.

- *Good pasture* or grass that an animal can graze can be an economical food for horses, but pasture must be maintained. If animals are allowed to graze on a pasture too long, the grass may be killed. Some of the basic requirements for a good pasture are:
  — a supply of appetizing plants such as grasses or legumes;
  — a paddock or stall to house your horse for part of the day. Only use pastures for daily exercise and grazing;
  — a year-round supply of fresh, clean water;
  — shelter from wind, cold and sun;
  — safe, durable fencing;
  — no poisonous plants (see Table 8: Common Poisonous Plants of New Hampshire);
  — no equipment, holes or other dangerous materials in the pasture; and
  — grain for highly active horses or if the quality of the grass is poor.

  Well-managed pastures reduce feed costs and provide energy, protein, vitamins and minerals to animals. An exercise lot with a few blades of grass is not a pasture; such a lot, or overgrazed pasture, is not a source of nutrients and can be a serious source of internal parasites. When a

grass stand becomes too thin, overgrown, coarse or unappetizing to a horse, it should be clipped or mowed. Lush pasture forages can act as a laxative in early spring and may cause founder. Introduce horses gradually to pastures by slowly increasing their daily grazing time.

Concentrates
Small grains, such as corn, oats and barley, are known as concentrates. Concentrates are lower in fiber and higher in energy than roughages. The grain should be clean, mold- and insect-free, with a bright color. Grain quality is just as important as hay quality. Grains may be cracked, steamed or rolled, but, if ground too finely, may cause respiratory problems or colic.

Oats are the safest and easiest grain to feed with hay because it is high in fiber and low in energy, and higher in protein than corn. Corn has the highest energy content of any grain and can put weight on a horse quickly. It can be fed on the ear, cracked, rolled or shelled. Barley is an intermediate source of energy and protein content. All grains are low in calcium, but high in phosphorus.

Supplements
Protein and vitamin-mineral supplements are added to the diet to increase the diet's concentration. Grains are energy supplements to a high forage diet. Only add supplements to the diet if something is missing.

Some protein supplements are oilseed meals, soybeans, cottonseed, linseed (flaxseed) meal, peanut meal, sunflower seed and rapeseed (canola).

Add vitamin and mineral supplements to the diet only if the horse is deficient.Generally the only minerals of concern in feeding horses are calcium, phosphorus and salt. In some geographical areas, lack of selenium and, in growing horses, copper and zinc, is a concern. Other minerals are likely to be present in adequate amounts in a normal diet.

Commercial grain mixes or complete feeds
Concentrated mixes are cereal grains with supplements added to increase the specific nutrient content of the mix. A complete feed is a grain mix that is high in fiber because it contains a forage or high-fiber byproducts feed such as hulls. Complete feeds are held together, usually by extrusion (puffed up like dog food) or by forming into pellets. If you are feeding a commercial complete feed, you will not need to feed hay (follow the label for feeding recommendations).

There are also feeds for specific classes of horses. Some feeds are specially formulated for young, growing horses (weanlings and yearlings); and for geriatric (aged) horses who are very old and have specific nutritional needs. Some commercial feed companies make premixed, convenient, easy-to-use formulated feeds for horses who are on different hay diets such as grass or alfalfa. You should not need to add any other supplements to the diet. These feeds may be more expensive than developing your own ration, but they are good for the owner who does not want to spend time to research their horse's diet.

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Horse pasture management tips

1. One 1,000-pound horse requires 600 pounds of dry forage each month. Non-irrigated pasture in Colorado produces 500 to 2,500 pounds per acre per year. Horses will trample grass and be selective in grazing, so follow the "take half, leave half" principle. Generally, a minimum of 29 acres of dryland pasture are needed to support one horse for one year.

2. Divide the pasture into two or three equal units and rotate livestock before grass is grazed to minimum height. Under a three-unit system, graze each unit seven to 10 days, then rest for 14 to 20 days, or corral horses and turn them out for a few hours per day to rest grass. (This guideline will vary greatly.)

3. "Take half, leave half" is a good rule to follow to allow roots to store enough food to produce a healthy plant the following season. This is very important in protecting dryland pastures; irrigated pastures can be grazed more intensely.

4. Give your horses extra feed if you do not have enough grass to support them. Livestock pastured on small lots should be confined to pens and allowed to graze and exercise for a limited time. Otherwise, livestock will devour or trample all vegetation in the pasture.

5. Provide adequate water in each grazing pasture. In large pastures, distribute water tanks equal distances apart to encourage more even grazing throughout the pasture.

6. Control weeds that invade your pastures. Spray weeds with an approved herbicide or mow before weeds go to seed. Always read and follow label directions for chemical substances. Don't spray around horses or allow them to graze for several days.

7. Mow uneven growth to prevent spot grazing.

8. When possible, irrigated grass can be fertilized to increase production and the nutrients they contain. Test soil to determine how much nitrogen, phosphorus and potassium the pasture needs. A productive, established pasture requires 150 to 180 pounds of nitrogen per acre per year. Read fertilizer labels for guidelines on grazing after application.

For more information on maintaining a pasture, contact your local Cooperative Extension office.

Nutrient requirements for different horses

The nutrient requirements of a horse vary with its age, weight and the amount of work it performs. Hay is sufficient feed for a mature horse that is ridden very little. With an increase in work, grain should be added to its diet.

Use the chart as a general rule or you can be more exact and balance your horse's ration. Review Horse Ration Analysis worksheet.

When balancing or evaluating a ration, use the National Research Council tables as a guideline to determine available nutrients to meet your horse's requirements (see Table 5).

Table 4. Daily feed required by the average 1,000 pound horse.

1,000-pound horse	Approximate Amounts Hay	Grain
No work	20-25 lbs.	—
Light (1-2 hrs./day) (1-1.5 lbs. grain/hr. of work)	15-20 lbs.	1-3 lbs.
Medium (2-4 hrs./day) (1.5-2 lbs. grain/hr. of work)	15-20 lbs.	3-8 lbs.
Heavy (4 or more hrs/day) (1.5-2.5 lbs. grain/hr. of work)	15-20 lbs.	5-10 lbs.

Only a horse that is worked extremely hard would ever receive half of its ration in grain. A race horse in heavy training is an example of a horse requiring half of its ration in grain.

When you balance a ration take the following steps.

- Determine the age, weight and level of activity or work of the horse.
- Follow the daily nutrient requirements in Table 5 which lists what your horse needs according to its physiological status and level of activity.
- Determine the actual nutrient content of the available feed by sending your feed to a commercial feed-testing laboratory. Contact your Cooperative Extension county educator for the name of the laboratory nearest you. If you cannot have your feed tested, use the average values listed in Table 6: Nutrients in Common Horse Feeds.
- Weigh the amount of each feed you plan to use in the ration. If you use premix feed, use the ingredient analysis listed on the feed tag for the percent of each ingredient.
- Determine the pounds of forage your horse should eat. This usually is calculated as 1 to 2 percent of the horse's body weight.
- Multiply each nutrient in each food source by the pounds of feed fed per day. Add up individual nutrients for each food source. See your project horse's nutrient total. (Example: crude protein.

If your horse eats 8 pounds per day of a 10 percent protein feed, it consumes 0.8 pounds of crude protein per day: 8 lbs. x .10 = 0.8 lbs.).

- Check your totals against the daily nutrient requirements listed in Table 5. If the requirements are greater than the totals in your ration, then the ration is inadequate or not balanced for the horse. If your ration is deficient in a nutrient, you can add a good source of the deficient nutrient with a new ingredient to balance the diet, or increase an ingredient you already have that is a source of the nutrient. Always be careful not to create an excess of other nutrients when increasing feed ingredient levels. Excesses of some nutrients can interact with other nutrients. For example, excess calcium can prevent complete utilization of phosphorus. Check National Research Council tables for calcium to phosphorus ratios; however, a good rule of thumb is a 2.5:1 ratio.

Metabolic disorders, such as laminitis, osteochondrosis and epiphysitis, stem from an imbalance in nutrients. Many disorders can be avoided by giving your horse a balanced ration.

Remember, each horse has to be fed as an individual. Feed an amount that is adequate to maintain a body condition similar to that of an athlete. The National Research Council requirements are suggested values; individual horses may require adjustments to these nutrients. Constantly assess the body condition of your horse. A properly conditioned horse will have enough fat so its ribs don't show, but you should still be able to feel the ribs when you run your fingers over them. See figure 16 for areas emphasized in the Body Condition Score System. Depending on your horse's use, you will want to have its body score between five and six. Some horses require less feed than others.

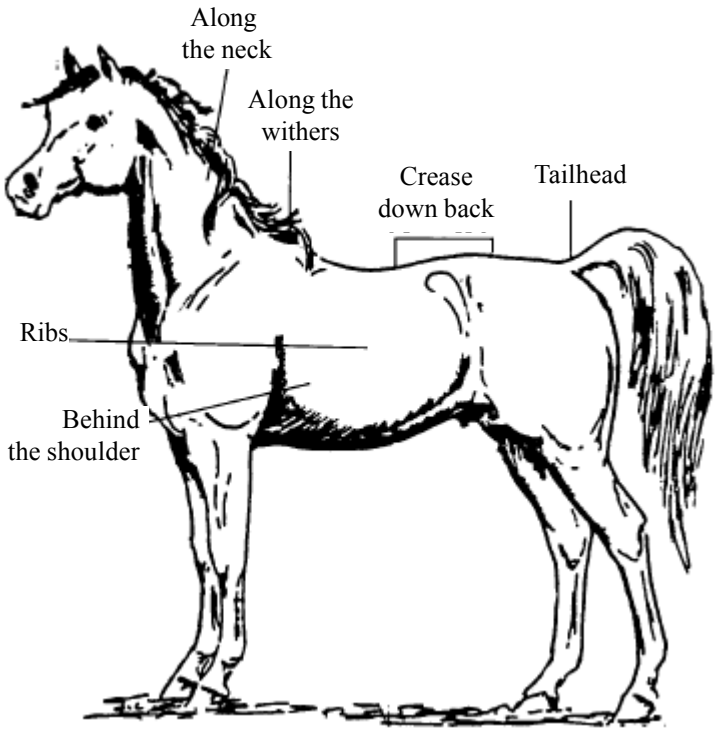

Figure 16. Diagram of areas emphasized in body condition score. Visual appraisal areas used when determining body condition score.

Description of body condition score system

(use figure 16 to determine your horse's body score)

1. Poor
Animal extremely emaciated. Spine, ribs, tailhead, and hooks and pins projecting prominently. Bone structure of withers, shoulders and neck easily noticeable. No fatty tissues can be felt.

2. Very thin
Animal emaciated. Slight fat covering over base of spine projection, transverse processes of lumbar vertebrae feel rounded. Spine, ribs, tailhead, and hooks and pins prominent. Withers, shoulders and neck structure faintly discernible.

3. Thin
Fat built up about halfway on spine projection, cannot be felt. Slight fat cover on ribs. Spine projection and ribs easily discernible. Tailhead prominent, but individual vertebrae cannot be visually identified. Hook bones appear rounded, but easily discernible. Pin bones not distinguishable. Withers, shoulders and neck accentuated.

4. Moderately thin
Negative crease along back. Faint outline of ribs discernible. Tailhead prominence depends on conformation, fat can be felt around it. Hook bones not discernible. Withers, shoulders and neck not obviously thin.

5. Moderate
Back level. Ribs cannot be visually distinguished but easily can be felt. Fat around tailhead beginning to feel spongy. Withers appear rounded over spine projection. Shoulders and neck blend smoothly into body.

6. Moderate to fleshy
May have slight crease down back. Fat over ribs feels spongy. Fat around tailhead feels soft. Fat beginning to be deposited along the sides of the withers, behind the shoulders and along the sides of the neck.

7. Fleshy
May have crease down back. Individual ribs can be felt, but noticeable filling between ribs with fat. Fat around tailhead is soft. Fat deposited along withers behind shoulders and along the neck.

8. Fat
Crease down back. Difficult to feel ribs. Fat around tailhead very soft. Area along withers filled with fat. Area behind shoulder filled in flush. Noticeable thickening of neck. Fat deposited along inner buttocks.

9. Extremely fat.
Obvious crease down back. Patchy fat appearing over ribs. Bulging fat around tailhead, along withers, behind shoulders and along neck. Fat along inner buttocks may rub together. Flank filled in flush.

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Feeding tips

These helpful hints will help you care for your horse nutritionally.

- Provide high quality alfalfa or grass roughage with a complementing grain to balance the horse's diet. Feed by *weight,* not by volume.
- Always maintain at least half of the ration as roughage, such as hay or grass.
- Never feed moldy or dusty hay, grass or grain.
- Never feed lawn grass clippings.
- Have fresh, clean water available at all times-except to a hot horse. A hot horse needs to be given water slowly.
- Keep feed and water containers clean. Check and clean water buckets and tanks regularly.
- Watch your horse while it eats and inspect feed containers daily to detect abnormal eating or drinking behaviors.
- Check horse's teeth annually for sharp points that interfere with chewing. Floating sharp edges of teeth will increase feed efficiency. If a horse dips mouth in water while eating, it may have a sharp tooth. Tilting head to one side while eating grain may indicate a tooth problem.
- Ration changes be should be gradual — over a minimum of five days to prevent digestive disturbances.
- Proper exercise improves appetite, digestion, muscle tone and mental health for horses.
- Because a horse's stomach is very small and cannot hold a large amount of feed at one time, it should be fed at least twice a day on a regular schedule. Some horses benefit from three or more feedings per day, however, don't overfeed your horse; too much feed at one time can cause founder.

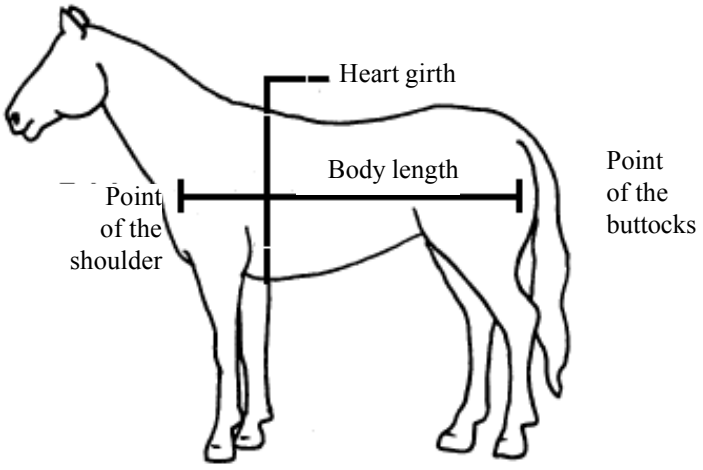

Figure 17. Estimate your horse's body weight. Multiply the girth (in inches) times itself (heart girth^2) times the body length (in inches) and divide by 330.
Example:

Heart Girth = 74.8 inches
Body length = 63 inches

$$\frac{74.8 \times 74.8 \times 63}{330}$$

Equals 1,068 pounds

Table 5. Daily Nutrient Requirement of Horses (1,000 lb. mature weight) According to the National Research Council

Animal	Digestible Energy (DE) (Megacalories 1,000 calories	Crude Protein (CP) (g)	Lysine (g)	Calcium (g)	Phos-phorus (g)	Magne-sium (g)	Potas-sium (g)	Vitamin A (10^3 IU)
Mature horses								
Maintenance	16.4	656	23	20	14	7.5	25.0	15
Working horses								
Light work[a]	20.5	820	29	25	18	9.4	31.2	22
Moderate work[b]	24.6	984	34	30	21	11.3	37.4	22
Intense work[c]	32.8	1,312	46	40	29	15.1	49.9	22
Stallion (breeding season)	20.5	820	29	25	18	9.4	31.2	22
Pregnant mares								
9-months	18.2	801	28	35	26	8.7	29.1	30
10-months	18.5	815	29	35	27	8.9	29.7	30
11-months	19.7	866	30	37	28	9.4	31.5	30
Lactating mares								
Foaling to 3-months	28.3	1,427	50	56	36	10.9	46.0	30
3-months to weaning	24.3	1,048	37	36	22	8.6	33.0	30
Growing horses								
Weanling, 4-months	14.4	720	30	34	19	3.7	11.3	8
Weanling, 6-months								
Moderate growth	15.0	750	32	29	16	4.0	12.7	10
Rapid growth	17.2	860	36	36	20	4.3	13.3	10
Yearling, 12-months								
Moderate growth	18.9	851	36	29	16	5.5	17.8	15
Rapid growth	21.3	956	40	34	19	5.7	18.2	15
Long yearling, 18-months								
Not in training	19.8	893	38	27	15	6.4	21.1	18
In training	26.5	1,195	50	36	20	8.6	28.2	18
Two-year-old, 24-months								
Not in training	18.8	800	32	24	13	7.0	23.1	20
In training	26.3	1,117	45	34	19	9.8	32.2	20

Note: Mares should gain weight during late gestation to compensate for tissue deposition. However, nutrient requirements are based on maintenance body weight.

[a]Examples are horses used in western and English pleasure, bridle path hack, equitation and so forth.

[b]Examples are horses used in ranch work, roping, cutting, barrel racing, jumping and so forth.

[c]Examples are horses in race training, polo and so forth.

Reprinted courtesy of National Research Council's Horse Nutrient Requirements, 1989

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Table 6: Nutrients in Common Horse Feeds

Type	% Dry Matter	% Crude Protein	Digestible Energy (Mcal/lb.)	% Calcium	% Phosphorous
Hay					
Alfalfa					
Early bloom	90.5	18.0	1.02	1.28	0.19
Mid-bloom	91.0	17.0	0.94	1.24	0.22
Mature	90.9	15.5	0.89	1.08	0.22
Dehydrated Meal	90.4	15.6	0.91	1.25	0.23
Native Hay					
(Mountain meadow)	95.1	8.2	0.73	0.58	0.17
Timothy	89.1	9.6	0.83	0.45	0.25
Orchard	89.1	11.4	0.88	0.24	0.30
Oat	90.7	8.6	0.79	0.29	0.23
Smooth Brome	87.6	12.6	0.85	0.29	0.28
Pasture					
Alfalfa					
(late veg)	23.2	5.1	0.31	0.40	0.07
Bluegrass					
(early veg)	30.8	5.4	0.29	0.15	0.14
Crested Wheatgrass					
(early veg)	28.5	6.0	0.33	0.12	0.09
Orchard grass					
(early bloom)	23.5	3.0	0.24	0.06	0.09
Smooth Brome					
(early veg)	26.1	5.6	0.31	0.14	0.12
Concentrates					
Barley	88.6	11.7	1.49	0.05	0.34
Corn	88.0	9.1	1.54	0.05	0.27
Cottonseed meal	100.0	45.4	1.37	0.18	1.22
Oats	89.2	11.8	1.30	0.08	0.34
Molasses	77.9	6.6	1.20	0.12	0.02
Soybean meal					
(solvent extracted)	100.0	54.0	1.70	0.29	0.71
Wheat Bran	89.0	15.4	1.33	0.13	1.13

Table 7: Minerals

	Dry Matter %	Calcium %	Phosphorous %	Sodium
Dicalcium Phosphate (dical)	97	22.00	19.03	0.05
Limestone (calcperfium carbonate)	100	39.39	0.04	0.06
Monocalcium Phosphate	97	16.40	21.60	0.06
Monosodium or Disodium Phosphate (XP-4)	97	—	22.50	16.68

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Horse Ration Analysis Worksheet: Show your project horse's feeding program

(complete this page and the following four pages; then to balance your horse's ration, see Appendix III)

Junior and intermediate members should not attempt to complete this worksheet without adult assistance. Senior members should be able to complete this worksheet on their own. In the boxes below, show your project horse's record of rations. Adjust feed to the usage of the horse and record feed amounts in pounds.

What is the age, weight and physical activity (riding, work or pregnancy) of your project horse.

Age _____	**Weight** _____	**Work** _____	**Body Condition Score** _____
yrs.	**lbs.**	**hours/avg. per day**	**1=poor, 9=extremely fat**

Turn to Table 5, Daily Nutrient Requirement of Horses, and select the description that best fits your horse under the column *Animal.*

Fill in the box below with the numbers to the right of your selection. These are nutrient values your horse needs.

Digestible Energy		**Crude Protein**		**Calcium**		**Phosphorus**	
(DE)	**(Mcal)**	**(CP)**	**(g)**	**Ca**	**(g)**	**P**	**(g)**

If you feed cubes or pellets, weigh three buckets for the *average weight*. List the type of food and results in the box below.

☐ **Pellets** _____

☐ **Cubes** _____

Average weight of full bucket _____ **lbs.**

What type of salt do you offer your horse(s)?

☐ **Blocks** ☐ **Trace minerals** ☐ **Calcium and phosphorus added**

CHAPTER 5: FEEDING HORSES

Show your project horse's roughage feeding program

If you feed longstem hay, weigh three flakes of hay for an *average flake weight.* Do this for each different type of hay you have and every time you buy new hay. List the results in the box below.

Types of hay	**Average flake weight**
_____	_____ **lbs./day**
_____	_____ **lbs./day**

Calculate the dry matter (DM) of the hay you are feeding (see Table 6 for DM percentages). Dry matter is the part of feed that is not water and is used to calculate nutrients in feed. For pasture dry matter percentage, use .40 average.

pounds of forage per day				(forage of dry matter)
lbs.	**X** .90 DM% (avg)	=		**lbs.**

Turn to Table 6, Nutrients in Common Horse Feeds, and find *Hay* under the *Type* column. Use the numbers corresponding to the type of hay you usually feed to complete the boxes below. Use your actual weight, as fed, because dry matter is already calculated. (Remember, .02% = .0002; move the decimal over two places.) If you are feeding more than one hay type, you will need to copy this page and repeat the calculations for each hay source. Then you will need to add the nutrients together to give you the total megacalories or pounds per day.

You feed: (pounds of hay per day)		(Digestible Energy in Mcal per pound)	=	(Digestible Energy in Mcal per day)
lbs.	**X**	**mcal/lbs.**	=	**mcal/lbs.**
(pounds of hay per day)	**X**	(% Crude Protein)	=	Crude Protein in pounds per day
lbs.	**X**	(converted to decimal)	=	**lbs./day**
(pounds of hay per day)	**X**	(% Calcium)	=	Calcium in pounds per day
lbs.	**X**	(converted to decimal)	=	**lbs./day**
(pounds of hay per day)	**X**	(% Phosphorous)	=	Phosphorous in pounds per day
lbs.	**X**	(converted to decimal)	=	**lbs./day**

CHAPTER 5: FEEDING HORSES

If you feed your project horse a commercially-prepared grain mix, concentrate, complete this page.

Weigh three full buckets of your grain mix concentrate and calculate the *average weight* of a full bucket. List the results in the box below.

Grain mix (3-way, etc.)	**Average weight of bucket full**
_____	_____ **lbs./day**

If you feed a grain mix concentrate, fill in the boxes below for the nutrients shown *on the feed bag tag*. (DE, CP, Ca, and P) or see Table 6, Nutrients in Common Horse Feeds.

You feed:

(pounds of mix concentrate per day)		(Digestible Energy in Mcal per pound)	=	(Digestible Energy in Mcal per pound)
lbs.	**X**	**mcal/lbs**	=	**mcal/lbs.**

(pounds of mix concentrate per day)		(% Crude Protein)	=	Crude Protein in pounds per day
lbs.	**X**	(converted to decimal)	=	**lbs./day**

(pounds of mix concentrate per day)		(% Calcium)	=	Calcium in pounds per day
lbs.	**X**	(converted to decimal)	=	**lbs./day**

(pounds of mix concentrate per day)		(% Phosphorous)	=	Phosphorous in pounds per day
lbs.	**X**	(converted to decimal)	=	**lbs./day**

Do you need to feed any supplements? If so, what kind and how much?

Supplement	**Amount**
_____	_____ **oz./day**

Note: The nutrient values given for feed in this manual are approximate. Actual values can be determined by laboratory analysis. A Cooperative Extension 4-H or agricultural educator can assist with an analysis.

CHAPTER 5: FEEDING HORSES

If you feed your project horse a straight grain concentrate, complete this page.

In Table 6: Nutrients in Common Horse Feeds, look under the *Type* column and find *Concentrates.* Find the concentrate or grain type or information on the feed bag that is most like what you usually feed. Use the numbers from the table to fill in the boxes below.

Remember, the percent amounts (example: 20% = .20 or .20% = .002) must be converted to decimal form before you can use them in these calculations.

Grain type (oats, etc.)	**Average weight of bucket full**
_____	**lbs.** _____
	lbs.

You feed:

(pounds of concentrate per day)		(Digestible Energy in Mcal per pound)	=	(Digestible Energy in Mcal per pound)
lbs.	**X**	**mcal/lb.**	=	**mcal/lbs.**

(pounds of concentrate per day)		(% Crude Protein)	=	Crude Protein in pounds per day
lbs.	**X**	(converted to decimal)	=	**lbs./day**

(pounds of concentrate per day)		(% Calcium)	=	Calcium in pounds per day
lbs.	**X**	(converted to decimal)	=	**lbs./day**

(pounds of concentrate per day)		(% Phosphorous)	=	Phosphorous in pounds per day
lbs.	**X**	(converted to decimal)	=	**lbs./day**

Show your project horse's nutrient total

Your totals should match as close as possible to the requirements for your horse in Table 5. Digestible energy should match, but make sure the other nutrients are at least as high as needed.

Your Calcium:Phosphorus ratio should range from 1.5:1 to 3:1 (divide Ca by P; example: 68 grams÷22 grams = 3 oz. or 3:1 ratio)

Hay

Digestible Energy in Mcal per day

mcal/day

Crude Protein in pounds per day

lbs./day

Calcium in pounds per day

lbs./day

Phosphorous in pounds per day

lbs./day

Concentrates

Digestible Energy in Mcal per day

mcal/day

Crude Protein in pounds per day

lbs./day

Calcium in pounds per day

lbs./day

Phosphorous in pounds per day

lbs.day

Totals

Digestible Energy in Mcal per day

mcal/day

Crude Protein in pounds per day

lbs./day

⇩

X 454 to get:

⇩

grams/day

Calcium in pounds per day

lbs./day

grams/day

⇩

X 454 to get:

⇩

Phosphorous in pounds per day

Table 8: Common poisonous plants of New Hampshire that Affect Horses

Plant Name	Part of Plant that is Poisonous	Symptoms
Black Nightshade	Fruit Leaves Vegetation	Loss of appetite, diarrhea, marked thirst, general body weakness, inability to stand, abdominal pain. Advanced Symptoms: unconsciousness. Death may follow in 1, 2 or 3 days.
Bracken Fern	Entire plant (fresh or dried)	General weakness, incoordination, light coloration of mouth lining and eyes, nervousness, anemia. Advanced Symptoms: fever, anemia, bloody nasal or rectal discharges, death.
Buttercup	Fresh leaves, fresh flowers (dried plant material in hay is not poisonous)	Inflammation and blisters where plant juice touched the animal, mouth blisters cause drooling, loss of appetite, stomach irritation, colic, diarrhea, slow pulse. Advanced Symptoms: Convulsions, sinking of eyes in their sockets, blindness, may end in death.
Cherry Black Cherry Choke Cherry Wild Cherry	Leaves Twigs Bark Pit (Stone/Seed)	Anxiety, staggering, falling down, rapid and labored breathing, convulsions, rolling of eyes, tongue hanging out of mouth, loss of sensation, dilated pupils. Advanced Symptoms: quiet, bloats, dies within a few hours of ingestion.
Common Milkweed	Entire plant	Depression, weakness, staggering, seizures, increased temperature, loss of appetite, excitable, rapid weak pulse, difficulty breathing. Advanced Symptoms: dilated pupils, convulsions, coma, death.
Field Horsetail	All parts (green or dried)	Symptoms are slow to develop; appetite remains normal until near the end of illness, weakness, staggering gait, excitability. Advanced Symptoms: constipitated, paralysis, muscles rigid, pulse rate increases and weakens, body extremities become cold before death, animal becomes calm and comatose.
Jimson Weed	All parts (especially seeds and leaves) in hay, seeds in grain	Symptoms vary in time: thirst, impaired vision, fast weak pulse, nausea, loss of muscular coordination, violent aggressive behavior, trembling. Ingestion of small amounts produces symptoms; larger amounts: death.
Lambsquarter	Foliage	Symptoms appear within 1 to 4 hours after consumption, labored breathing, rapid, weak pulse. Advanced Symptoms: muscle tremors, becomes weak, prostrate and dies.
Marsh Marigold	All parts of mature plants. Young plants may be less toxic (dried in hay is reported harmless)	Stomach upset, acute inflammation of the gastrointestinal tract, vomiting, restlessness, colic, depression, nervous excitation, twitching of eyelids, bloody urine, diarrhea. Advanced Symptoms: weak pulse, slow breathing, weakness and death.

Table 8: Common poisonous plants of New Hampshire that Affect Horses (continued)

Plant Name	Part of Plant that is Poisonous	Symptoms
Mountain Laurel	Flowers Twigs Green Plant Parts	Appearance of symptoms averages 6 hours; loss of appetite, repeated swallowing, profuse salivation, watering of mouth, eyes and nose, slow pulse, low blood pressure, incoordination, dullness, depression, vomiting, frequent defecation. Advanced Symptoms: weak, diffulty in breathing, coma, death.
Pigweed	Foliage	Rapid onset of weakness, trembling and incoordination 5 to 10 days after ingestion, body temperature remains normal.
Poison Hemlock	All parts	Symptoms occur within an hour after ingestion; nervousness, trembling, pain, dilated pupils, weakened and slow heartbeat, drowsiness, nausea, vomiting, coldness in extremities or the entire body, labored breathing, bloating, diarrhea (may be bloody). Symptoms usually begin in the hind or lower extremities. Advanced Symptoms: convulsions, perspiration, weakened respiration, weakened pulse, salivation, impaired vision, death may result.
Pokeweed Pokeberry Inkberry	All parts (especially roots)	Symptoms occur 2 or more hours after plants are eaten. Gastrointestinal cramps, retching spasms, vomiting, diarrhea. Advanced Symptoms: convulsions, perspiration, weakened respiration, weakened pulse, salivation, impaired vision. Death may result.
Oaks	Acorns Young shoots (especially eaten in quantity)	Loss of appetite, initial constipation (hard, dark fecal pellets) passing to diarrhea. Advanced Symptoms: death. If animal lives: inflammation of the stomach and the intestines, thirst, excessive urination.
Rhododendron Azaleas	Foliage of some species is toxic. Consider all species potentially poisonous	Loss of appetite, repeated swallowing, profuse salivation, tearing of eyes, nasal discharge, slow pulse, low blood pressure, incoordination, dullness, depression, vomiting. Advanced Symptoms: weak, difficulty in breathing, convulsions, paralysis, coma, death.
Saint Johnswort	All plant parts (is toxic when in hay)	Photosensitivity in the presence of sunlight. Skin develops dermatitis, inflammation of unpigmented portion of the skin. Affected area becomes sore and reddened and may peel. Tongue and mouth may be affected. Wounds heal slowly, animals may produce hairless scars. Advanced Symptoms: death may result from infection and gangrene.
Sudangrass Sudan x Sorghum hybrids	Vegetative portion of the plant during drought conditions or after frost; not the grain	Nitrate poisoning. Symptoms seen within 1 to 4 hours after consumption, labored breathing, rapid, weak pulse. Advanced Symptoms: muscle tremors, general weakening, prostrate, death.
Water Hemlock	All plant parts (green or dried)	Symptoms seen within 1 to 4 hours after consumption. Excessive salivation, muscle tremors, spasmodic convulsions, abdominal pain, increased temperatures, pupils dilated, diarrhea, irregular pulse and heart rate, behavorial abnormalities. Advanced Symptoms: complete paralysis, respiratory failure, death.
Yew Family	Entire plant	Gastric distress, diarrhea, vomiting, tremors, dilated pupils, breathing diffiiculties, weakness, fatigue, collapse. Advanced Symptoms: convulsions, coma, slow heart rate, circulatory failure, death. Death can be so rapid that few symptoms appear.

For more information, or for help in identifying poisonous plants, contact your local Cooperative Extension county office.