



EQUIFACTS

Nutritional Needs of Horses

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Horses, as well as other animals, should be fed according to their nutritional needs. Horses' nutritional requirements are based on stage of production and activity. The categories that determine nutrient requirements are maintenance, gestation, lactation, growth and work. The horse is then fed to meet those nutrient needs. Maintenance requirements are those requirements needed for a horse to simply maintain its present body status, neither gaining nor losing weight. Pregnant mares during late gestation require additional nutrients above maintenance to sustain body weight and provide for the growing fetus.

Nutritional requirements dramatically increase during lactation. This is the stage of production when a mare nurses a foal. Nutrients are needed to maximize milk production and insure adequate foal growth, as well as maintain adequate condition for the mare. Young horses will have specific nutritional requirements during the weaning, yearling, long yearling and 2-year-old growth phases. Nutrient needs will also change based on the length and difficulty of exercise or training programs. Work nutritional requirements are categorized as light (Western and English pleasure), moderate (ranch work, roping, jumping) and intense (polo, race training).

Many times a horse will have nutrient needs for more than one stage of production or activity. Therefore additional nutrients above maintenance, gestation or growth must be provided in the diet. For example, a 2-year-old horse on a moderate work program would have to meet maintenance, growth and work nutritional requirements. Also, a mare in late gestation that is still being used to work cattle would also have to meet nutritional requirements for maintenance, gestation and work.

Nutrient requirements are based on the total of all functions performed.

Nutrients

The basic nutrients needed by any horse, regardless of the stage of production or level of activity, are energy, protein, minerals and vitamins. These nutrients, in combination with water, provide for the nutritional well being of the horse. A balanced diet is one in which all nutrients are supplied in adequate amounts. However, it is just as important for all nutrients to be supplied in correct amounts relative to each other. A horse ration — the total amount of feed a horse eats in a day — is balanced to meet energy and protein needs of the horse. Minerals and vitamins are then added to complement and balance the ration.

Energy is required for virtually all body processes and functions. Energy is required for things such as metabolic action in the tissue, heart beat, muscle tone, and protein and fat synthesis. It is also necessary for reproduction, growth and work. Horses are non-ruminant herbivores that utilize dietary carbohydrates as the primary energy source. Nonstructural carbohydrates (grains) are absorbed primarily in the small intestine, while forages are subjected to fermentation and absorbed in the large intestine.

Proteins are complex organic compounds made up primarily of amino acids. Amino acids are the building blocks of protein and are major components of enzymes and many hormones. They are the structural units which are present in characteristic proportions for each specific protein.

Protein quality is the relationship between the amino acid concentrations of the diet and the amino acid needs of the animal. For example, soybean meal is a high-quality protein source

because it supplies a well-balanced amino acid profile that is especially high in lysine. Lysine is the single most limiting amino acid in the diet of young growing horses. Cereal grains (corn, oats, barley) are poor sources of lysine and should be mixed with a good quality protein source such as soybean meal, linseed meal or dried skim milk.

Proteins are essential as components of the active protoplasm of each living cell. Approximately 22 percent of the fat-free composition of a mature, live horse is protein. Protein includes primary constituents of bones, ligaments, hair, hoofs, skin and soft tissues including organs and muscles.

Minerals and vitamins are, for the most part, dietary essentials and are required in various amounts depending on type and quality of diet, age and activity of the horse. Minerals are needed primarily in the formation of structural components such as bones. Vitamins are required in minute amounts to maintain adequate growth and production by horses. The absence of a single mineral or vitamin can limit productivity in the horse.

All nutrient requirements for horses are based on documented research presented in the *Nutrient Requirements of Horses*¹ and are the values used in this fact sheet. The research is based on the average horse within a certain weight range. For discussion purposes, values in this fact sheet will be based on an 1100-pound, mature-weight horse. This is typical of the mature weights of most "light or pleasure" breeds of horses. Horses that weigh less than 1100 pounds would require less nutrients; conversely, heavier horses would have elevated nutrient needs.

Energy

Energy requirements for horses are expressed in megacalories of digestible energy (DE_{Mcal}) per day. Megacalorie is a quantitative term used to indicate energy concentration of feeds. One megacalorie is equivalent to 1000 kilocalories. Hays range in energy from .7 to .9 DE_{Mcal} per pound with grain containing 1.2 to 1.6 DE_{Mcal} per pound. Energy concentration, or the amount of energy in a diet, will be altered to meet specific production demands. For example, a lactating mare or hard working horse would have a much higher energy need than a mature horse at maintenance. In this situation the grain portion of the diet would probably be increased with a corresponding increase in energy concentration of the diet. A typical grass hay and oat diet would contain about 1 DE_{Mcal} per pound of feed.

Feed is the fuel that allows horses to meet body demands such as growth, milk production

and work. The energy a horse receives will be utilized or stored as body fat or condition. An observant horse owner can visually evaluate the energy state of a horse by the amount of fat throughout the body. Energy levels can be altered according to body condition. A mature horse that is thin can be fed more total pounds of feed, while a fat horse may need feed intake decreased. Specific energy requirements for some classes of horses are shown in Figure 1.

Maintenance — An 1100-pound horse requires about 16.4 DEMcal each day to maintain body weight. Since a typical ration of grass hay and oats contains about 1 DEMcal per pound, it would take about 16.4 pounds of this feed per day simply to maintain the horse's present body weight and meet the energy requirement. The requirement would also be met with approximately 20 pounds of grass hay.

Gestation — mares in the ninth, 10th and 11th months of gestation have an additional requirement above maintenance because of fetal growth. Mares in the ninth month of pregnancy require 18.2 DEMcal per day or 2 DEMcal per day above maintenance. The energy requirement increases to 18.5 and 19.7 DEMcal per day for the mare in the 10th and 11th months of gestation, respectively (Figure 2). The energy content of feed could be raised from 0.9 to 1.0 DEMcal to meet the additional energy requirement. This generally is done by increasing the grain portion of the ration.

Lactation — After foaling, the energy requirements for the mare dramatically increase (Figure 2). The energy requirement will increase about 70 percent over maintenance for the mare in early lactation. It takes 28.3 DEMcal per day to meet an 1100-pound mare's energy requirements during the first three months of lactation. This represents a 26-pound daily ration, which could be met with a 50 percent grain mixture (corn, oats, barley) and 50 percent forage. This ration would contain about 1.1 DEMcal per pound.

After the foal has reached 3 months of age, milk production in the mare decreases, thus requiring less energy. The energy requirement for the mare from 3 months of lactation to weaning is 24.3 DE_{Mcal} per day. It would take about 23 pounds of total feed per day to adequately meet the energy requirement, provided the diet contained 35 percent mixed grain and 65 percent forage.

Growth — All horse owners are keenly concerned about the optimum growth and development of young horses. For foals to grow at an adequate rate, they must receive an additional source of nutrients to supplement milk from the mare. This additional source is usually provided as creep feed. The energy requirement of a nursing foal is about 14 DEMcal per day, of which only

¹National Research Council, *Nutrient Requirements of Horses*, 5th revised edition (Washington, D.C.: National Academy Press, 1989)

about half is proved by mare's milk, leaving 7 DEMcal per day to be supplied by creep feed.

As horses grow older, gain per day decreases. However, there is a need for increased amounts of feed because the horse has more total body weight. Horses should reach their mature height and weight at 2 ½ to 3 years of age, although many horse owners grow horses at much faster rates. Today's horse owners should be growing foals at an optimum and not a maximum rate. Young, growing horses that are grown extremely fast have a tendency to "break down" due to the increased muscle mass on an immature skeletal structure. The energy requirement for the yearling and 2-year-old horse is approximately 19 DE_{Mcal} per day.

Work — More research is becoming available to quantify the energy requirement for the working horse. One can calculate that an 1100-pound horse, working at a moderate one to two hours per day, needs about 25 DEMcal a day, which is about 9 DEMcal above maintenance. While it takes about 16.4 pounds of feed to maintain a horse at maintenance, it takes about 22-23 pounds of feed (50 percent mixed grain, 50 percent hay) to maintain horses worked at a moderate levels. Intensively-worked horses (polo, race) will require 26-28 pounds of feed to meet the daily energy requirements of 33 DEMcal. The intensively-worked horse would consume more grain than hay (65 to 35 percent) to meet the high energy requirements.

As the amount of work varies, the feeding program will have to be adjusted accordingly. The best way to measure the adequacy of the energy supply in mature working horses is to monitor body weight and condition. As the level of work increases, energy concentration of the ration and/or amount of feed should also increase.

Protein

Protein requirements are expressed in terms of percent crude protein in the diet. Actually, horses do not require a certain percent of protein. Rather, they require a certain amount —grams or pounds — and the requirement can be met by feeding a given amount of feed that contains a known quantity of crude protein. Protein is the most expensive ingredient in a horse ration. The amount of protein required in the diet is a function of the needs of the animal, the quality of protein available and the digestibility of that protein. Mature horses at maintenance are less sensitive to protein quality and quantity than growing horses. The protein requirements of an 1100-pound mature horse are given in Figure 3. The protein values in Figures 3 and 4, as well as the text, are presented on a "90 percent dry matter basis." Most feeds contain about 10 percent moisture on an "as fed basis."

Maintenance. An 1100-pound horse requires a minimum of 7.2 percent crude protein ration or about 1.4 pounds of protein per day. These values are indicative of a mature horse at maintenance that is idle, doing no work and not in production. The protein requirement for this class of horse can be met easily on good quality pasture alone, provided an adequate amount of forage is available.

Gestation — Protein requirements of an 1100-pound brood mare are presented in Figure 4. Note that the protein requirement of a pregnant brood mare is equal to that for maintenance until the ninth month of gestation. Subsequently, there are additional increases during the 10th and 11th months of pregnancy. Feeding pregnant mares is an area in which many horse owners can improve their feeding program (Figure 4).

An 1100-pound mare in late gestation (eleventh month) requires a 9.5 percent crude protein ration. This would be a 32 percent increase in the protein requirement above maintenance for the mare during her last month of pregnancy. This means that a higher quality ration would have to be fed to meet protein needs compared to that fed the mare in early pregnancy.

It is essential to feed pregnant mares a high quality ration to achieve proper fetal development. As indicated, a pregnant mare requires more protein than an open mare; but, more significantly, the protein should be high quality to meet nutrient demands of fetal growth and development.

Lactation — Feeding a lactating mare properly is challenging and requires a large amount of high quality feedstuffs to promote maximum milk production and insure adequate foal growth. The milk production phase is divided into two segments. The first phase is from foaling until the foal is 3 months old. The second phase would be from 3 months after foaling to weaning. The mare has much higher protein requirements for the first three months after foaling as compared to the later stages of lactation (Figure 4). Peak milk production for the mare will occur at approximately 45 days after foaling. Although the requirements decrease in late lactation, additional protein above previous gestation and maintenance levels is needed.

An 1100-pound lactating mare requires at least a 12 percent crude protein ration from foaling to 3 months of lactation. The milking mare needs about three pounds of protein, so it is necessary to feed approximately 26 pounds of high quality feedstuffs every day to meet those needs (Figure 4). For example, a lactating mare must be fed approximately 13 pounds of hay or good pasture to meet the protein requirement. This also is assuming the mare is fed half her daily ration in hay and the remainder as a concentrate grain mixture.

These early lactation values decrease to about 10 percent crude protein as lactation progresses and total amount of feed can also be decreased.

Growth — It is important to provide adequate quality and quantity of protein in the ration to promote adequate growth rates of young horses. Protein requirements for growth vary according to the age or development of young horses. To ensure proper growth, it is necessary to provide a 16 percent crude protein ration to early-weaned or creep-fed foals.

Weanlings and yearlings require a 13 and 11 percent crude protein diet, respectively. Furthermore, the crude protein level is decreased to about 10 percent as horses reach 2 years of age. It is critical that high quality protein sources be used in the complete ration. This means using feedstuffs that supply an adequate and well balanced amino acid content.

Work — Actually, the protein requirement on a percentage basis increases only slightly as work increases. Although there is some nitrogen loss due to sweating, the protein requirement is quantitatively met due to the increased amount of feed that is fed to the working horse. Remember, a horse requires a certain amount of nutrients, and sometimes the percentage values may not adequately reflect total intake.

Minerals

Minerals are needed in the body for the formation of structural components, enzymatic cofactors and energy transfer. In addition, some minerals play an important role in the synthesis of vitamins, amino acids and hormones. The horse is able to get most of the necessary minerals from pasture, hay and grain. Mineral availability and content from these plant sources are variable, depending on things such as maturity at harvesting, season of the year, plant variety and conditions at harvesting. Therefore, continual evaluation of horse rations is important to provide adequate mineral nutrition for horses.

Although there are seven macrominerals (calcium, phosphorus, potassium, sodium chloride, magnesium, sulfur) required in various amounts for horses, calcium, phosphorus, sodium and chloride are of primary concern. Calcium and phosphorus can be supplied in the diet in the form of dicalcium phosphate, ground limestone and defluorinated phosphate. Sodium and chloride are provided by the addition of common salt to horse diets.

Calcium and Phosphorus. Calcium and phosphorus are essential to sound bone growth and development and make up about 35 percent and 17 percent of the skeleton, respectively. These minerals are essential and must be supplied in the

daily ration (Figure 5). Calcium and phosphorus values shown in Figure 5 and listed in the test are presented on a “90 percent dry matter basis.” Most feeds contain about 10 percent moisture on an “as fed basis.”

A mature horse at maintenance requires .21 percent and .15 percent of the diet for calcium and phosphorus, respectively. As would be expected, foals and young growing horses require much more calcium and phosphorus than mature horses. Calcium needs range from .62 percent of the diet for 4-month-old foals to .28 percent for 2-year-old horses. Any increase in calcium requirements associated with exercise (work) appears to be readily met as dry matter consumption increases to meet energy requirements.

Phosphorus requirements for the 4-month-old foal are .34 percent and .15 percent of the diet for 2-year-old horses. Pregnant mares (last 90 days) require about .40 percent calcium and .30 percent phosphorus in the diet. Lactating mares from foaling to three months require .47 and .30 percent calcium and phosphorus in the diet, respectively. The need decreases to .33 percent calcium and .20 percent phosphorus in the diet after three months of lactation. The hard-working horse requires .31 percent calcium and .23 percent phosphorus in the diet. This represents a 48 percent increase in calcium and a 53 percent increase in phosphorus over the maintenance horse.

The calcium-phosphorus ratio is important, as all diets should contain more calcium than phosphorus. Diets that contain less calcium than phosphorus (less than a 1:1 ratio) can adversely affect calcium absorption. Most of the calcium and phosphorus requirements yield ratios of about 1.2 to 1 to 1.4 to 1 (calcium to phosphorus).

Sodium and Chloride. Sodium is a major extracellular cation and when free in solution has a positive electrical charge. Chloride, which normally accompanies sodium, is a major anion that has a negative charge when free in solution. These charged molecules are involved in acid-base balance and electrolyte regulation of body fluids. Both sodium and chloride requirements can be met with the addition of common salt to diets. Salt is often added at the rate of .5 to 1.0 percent of the diet or fed free choice as plain, iodized or trace mineralized salt.

Although precise recommendations for sodium cannot be made, the requirement is estimated at 12.5 (7.5 - 15.0) grams per day for maintenance, 21 to 36 grams per day for light work and 16 and 18 grams per day for late gestation and lactation, respectively. Chloride requirements are adequate when sodium requirements are met with sodium chloride. Since natural feedstuffs for horses are often lower than 0.1 percent sodium, it is important

to incorporate salt into the diet or provide free-choice salt.

Potassium, Sulfur, Magnesium. The potassium requirements are estimated at 19 grams per day for maintenance and 27.5, 35 and 45 grams per day for light, medium and heavy work. Mares in late gestation would require approximately 20 grams of potassium per day, while 28 grams per day would be required for lactation. Potassium requirements for growth were estimated to be (grams per day) 9 grams for months three to six, 12 for months seven to 12 and 15 for months 13 to 24. Forages contain significant amount of potassium; therefore, the requirement for the horse is easily met because of the large intake of forage in the ration.

Sulfur requirements for the horse have not been established; however, it appears that horses consuming high quality protein in the diet are able to meet their sulfur requirements. This is a result of sulfur-containing amino acids that make up a portion of the protein molecule.

The daily magnesium requirement for the mature horse at maintenance is estimated at between 7.5 and 12.0 grams per day. An important note: pastures that are conducive to magnesium deficiency, tetany and death in ruminants do not have the same effect on horses. However, tetany in transported horses has been attributed to hypomagnesemia.

Trace Minerals. There are eight microminerals (cobalt, copper, fluorine, iodine, iron, manganese, selenium, zinc) that play an important role in horse nutrition. Several of these minerals have not been adequately studied to determine the actual requirement. However, their significance should not be understated.

Most of the trace minerals are generally available in feedstuffs commonly fed to horses. Specifically, selenium is a major concern in mineral nutrition. Horses deficient in selenium may develop muscle degeneration, while those consuming an excess may become blind and paralyzed. Crops and forages produced in areas of the Pacific Northwest and the Northeastern United States are deficient in selenium. However, in the Great Plains and Rocky Mountain states, selenium toxicity can exist. Selenium levels are variable in Tennessee and most horse diets include additional selenium.

Based on this information, it is important to know where various feedstuffs are produced. Typically, all major feed processors closely monitor selenium content of feeds so as to safely sell quality products to horse owners. The selenium requirements for all classes of horses are 0.045 milligrams per pound of diet.

Vitamins

Vitamin requirements are affected by age of the horse, stage of production, intensity of exercise, and health and integrity of the digestive tract. The need for vitamin addition to the diet depends primarily on the type and quality of feedstuffs, extent of synthesis and absorption of vitamins in the digestive tract. Horses grazing high-quality pastures are likely to need little or no vitamin supplementation because forages are a rich source of vitamins.

There are two classifications of vitamins: fat-soluble and water-soluble. Fat-soluble vitamins include vitamin A and carotenes, vitamin D, vitamin E, and vitamin K. Water-soluble vitamins are thiamin, riboflavin, niacin, vitamin B₆, biotin, folacin, vitamin B₁₂, ascorbic acid and choline.

Fat-soluble Vitamins. The fat-soluble vitamins are soluble in lipids or lipid solvents and may be stored by the body in fat cells and liver. Therefore, the horse can maintain a reserve supply of fat-soluble vitamins.

Vitamins A and E are dietary essentials and must be present in the diet. Vitamin D does not have to be present in the diet if the horse is exposed to sunlight (ultraviolet light). Anaerobic bacteria in the intestinal tract can synthesize vitamin K to meet nutritional requirements. Quantitative requirements are usually expressed in International Units (IU) for vitamins A, D, E and milligrams for vitamin K. Fat-soluble vitamins requirements are shown in Table 1.

Water-soluble Vitamins. The B-complex vitamins and vitamin C are not stored in the body and therefore must be synthesized by the digestive tract of the horse or provided in the diet. It is relatively easy to meet all water-soluble vitamin requirements because of two primary reasons. First, all B-complex vitamins, with the exception of vitamin B₁₂, are supplied in adequate amounts in good quality forage. Secondly, abundant synthesis of vitamin B₁₂ and other B vitamins by the intestinal microflora provide ample water-soluble vitamins to horses. Therefore, if horses are healthy and eating good quality diets, few problems exist with water-soluble vitamins.

Research with water-soluble vitamin nutrition is very limited and actual requirements have been established for only thiamin and riboflavin. To date, research efforts have tended to investigate areas of more significant concern. Obviously, these water-soluble vitamins play important roles in metabolism; but due to synthesis in the digestive tract, few problems have existed.

Summary

Equine nutrition is a comparatively new science. Researchers know that horses can and

should be fed to meet their nutrient needs. In the past, many horses were fed based on tradition which included folklore and trade secrets. Today, the entire concept of horse nutrition and feeding is much more advanced and in line with scientific feeding principles involved in other species of domestic livestock.

For illustrative purposes, an 1100-pound horse was used as the model in this fact sheet. It must be emphasized that horses with different weights will have different nutritional needs. Figures 6, 7 and 8 indicate changes in energy, protein, and calcium and phosphorus requirements, respectively, for horses of various mature weights.

The economic impact of horses in certain areas has warranted an increase in scientific research. Horses are a valuable commodity and horse owners are searching for better and more economical means of feeding horses without reducing performance. Feeding horses to meet nutrient needs will help achieve that goal.

Additional information on horse nutrition is available from your county Extension office. Information available would include PB798 **Horses Need High Quality Pastures**, TNH-0003 **Feeds for Horses**, TNH-0001 **The Digestive System of the Horse**, and TNH-0005 **Guidelines for Feeding Horses**.

Table 1

Fat Soluble Vitamin Requirements for Horses¹

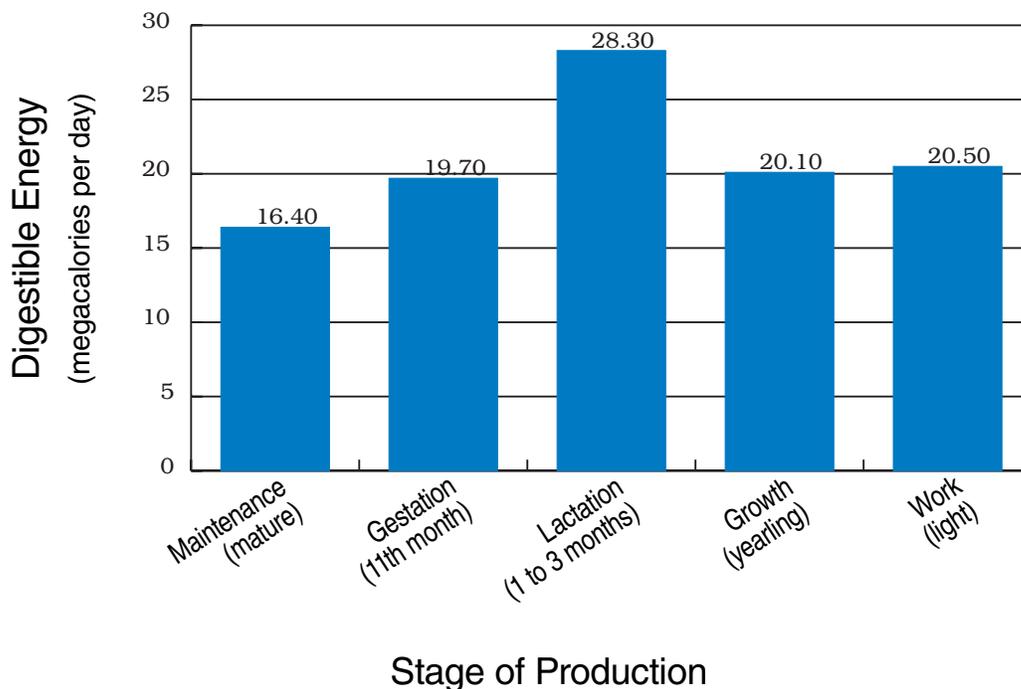
	Maintenance	Pregnant and Lactating Mares	Growing Horses (yearling)	Working Horses
Vitamin A	2,000	3,000	2,000	2,000
Vitamin D	300	600	800	300
Vitamin E	50	80	80	80
Vitamin K ²				

¹ International Units Per Kilogram of Diet

² Requirements have not been determined

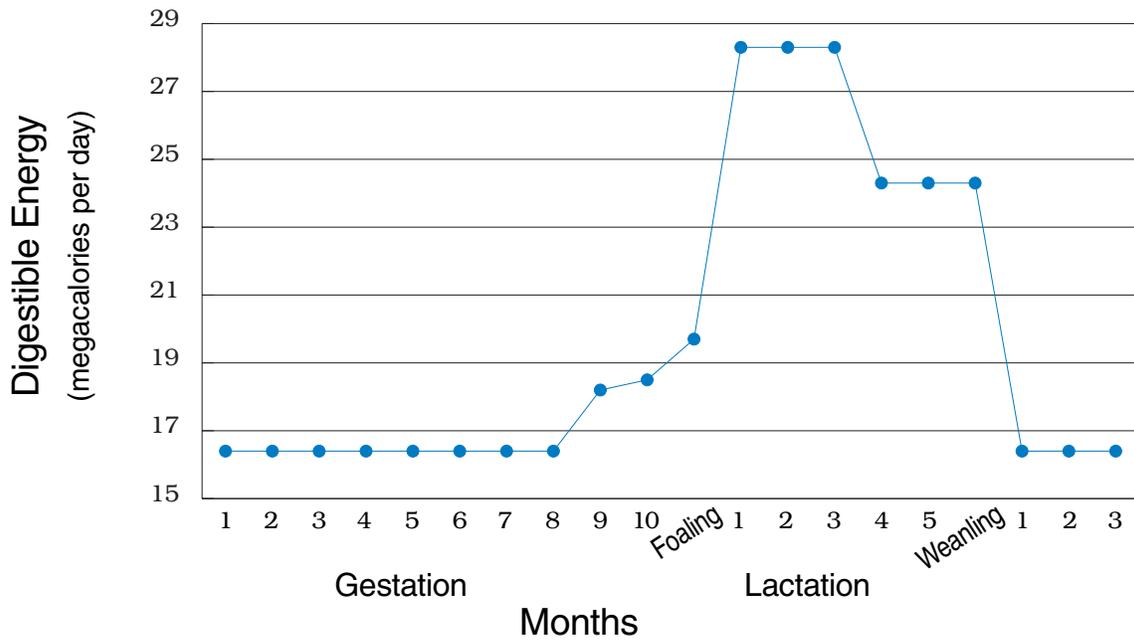
Source: *Nutrient Requirements of Horses*, Fifth Revised Edition, 1989.

Figure 1. Energy Requirements (1100 Pound Mature Weight)



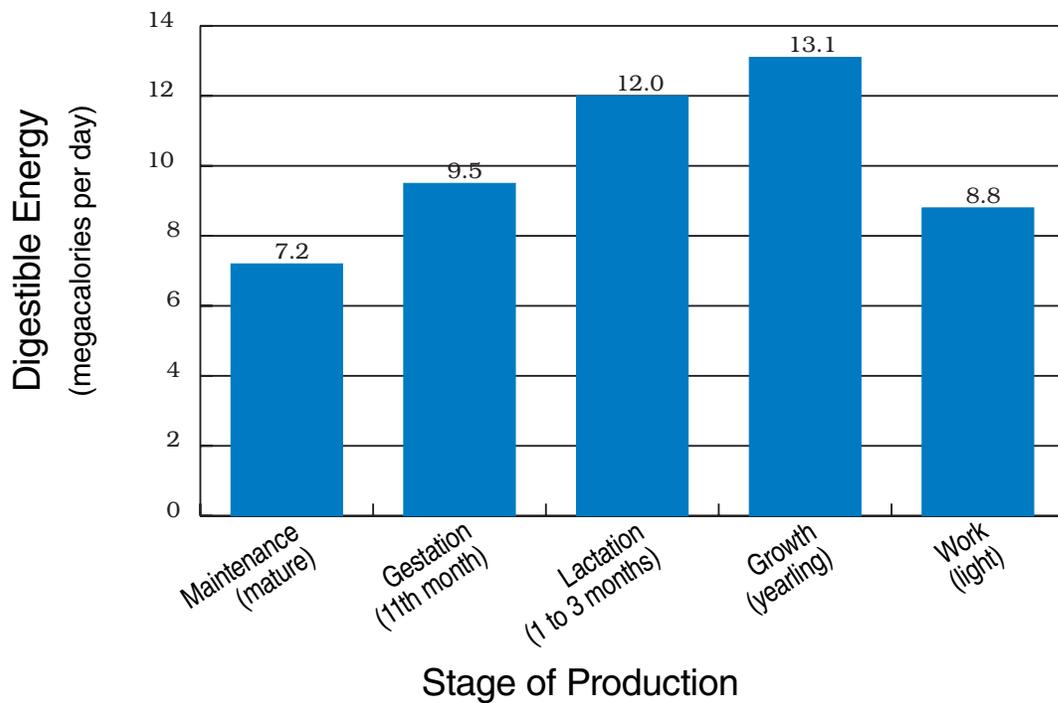
Source: *Nutrient Requirements of Horses*, Fifth Revised Ed., 1989

**Figure 2. Energy Requirements for the Brood Mare
(1100 Pound Mare)**



Source: *Nutrient Requirements of Horses*, Fifth Revised Ed., 1989

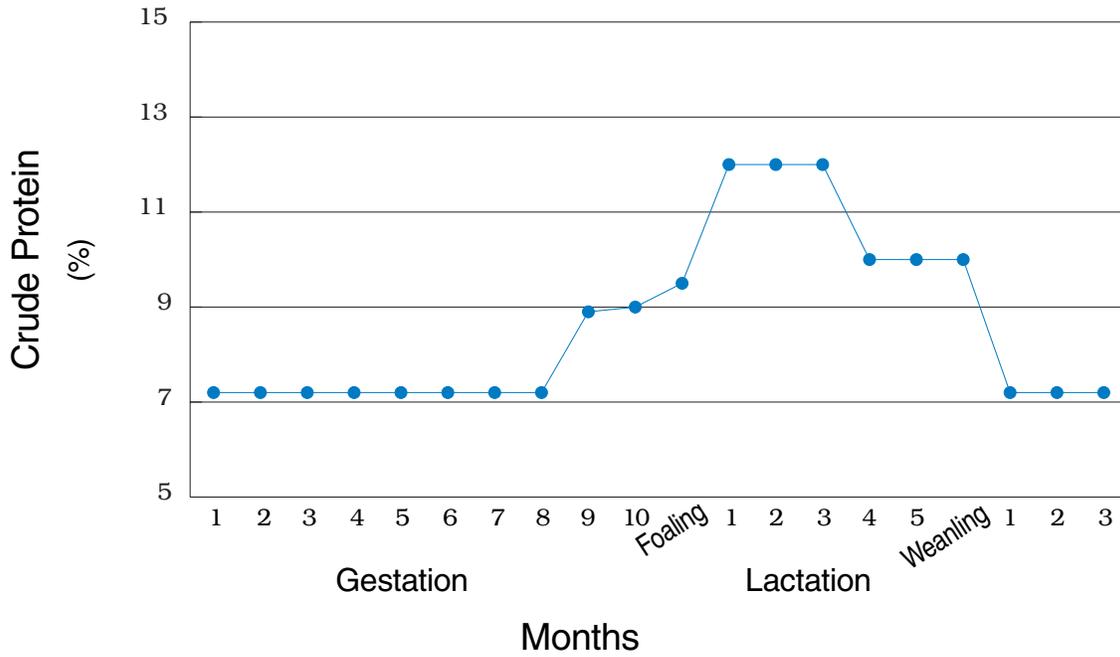
**Figure 3. Protein Requirements
(1100 Pound Mature Weight)**



¹90% Dry Matter Basis

Source: *Nutrient Requirements of Horses*, Fifth Revised Ed., 1989

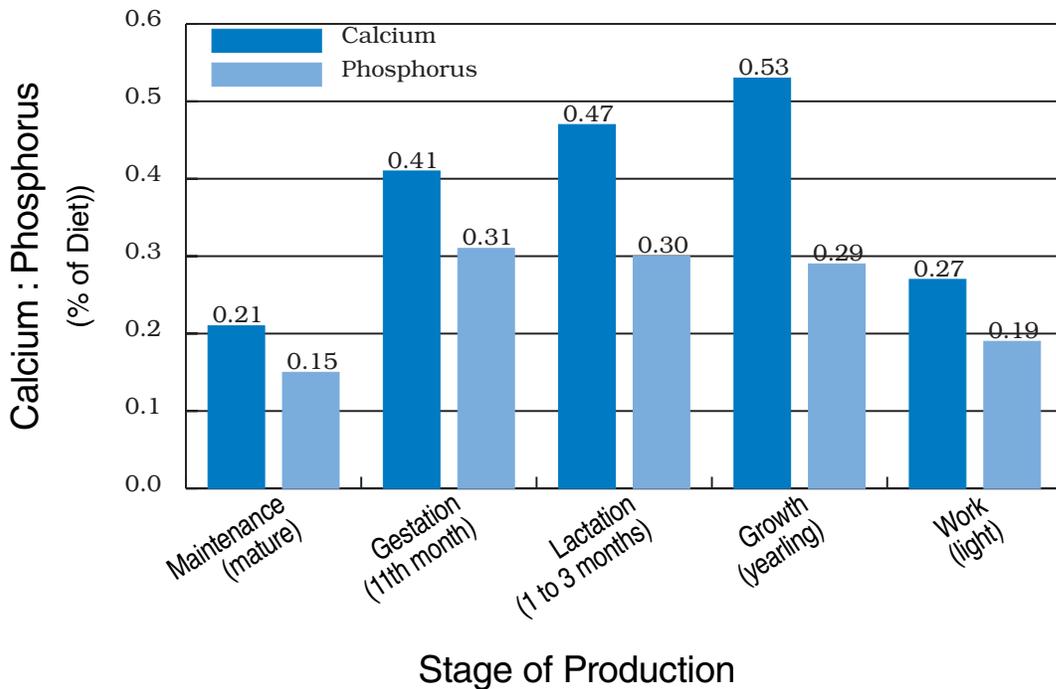
**Figure 4. Protein Requirements for the Broodmare¹
(1100 Pound Mare)**



¹90% Dry Matter Basis

Source: *Nutrient Requirements of Horses*, Fifth Revised Ed., 1989

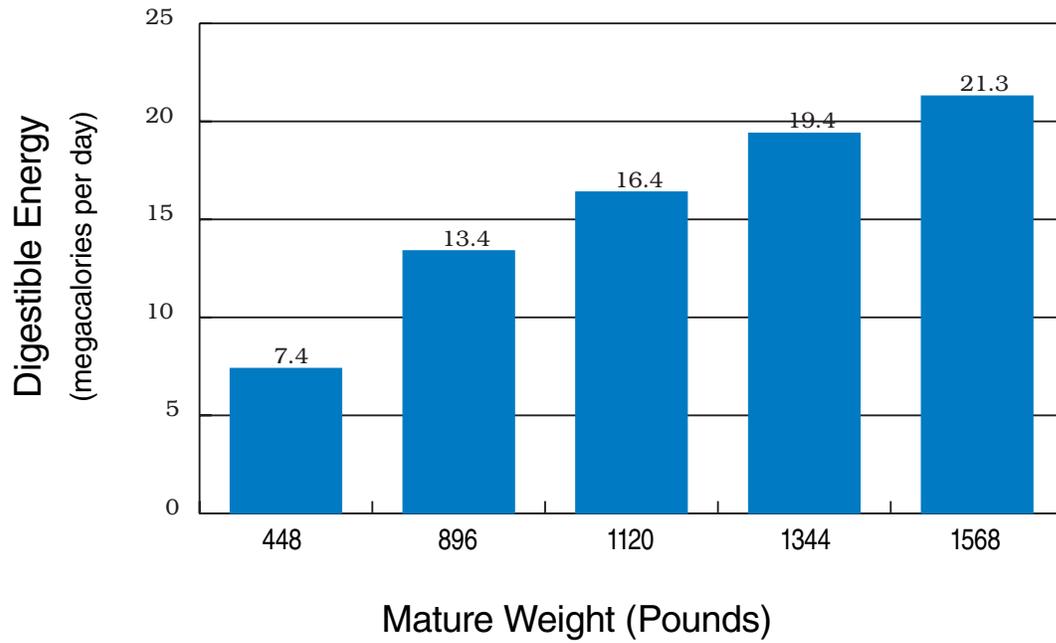
**Figure 5. Calcium and Phosphorus Requirement¹
(1100 Pound Mature Weight)**



¹90% Dry Matter Basis

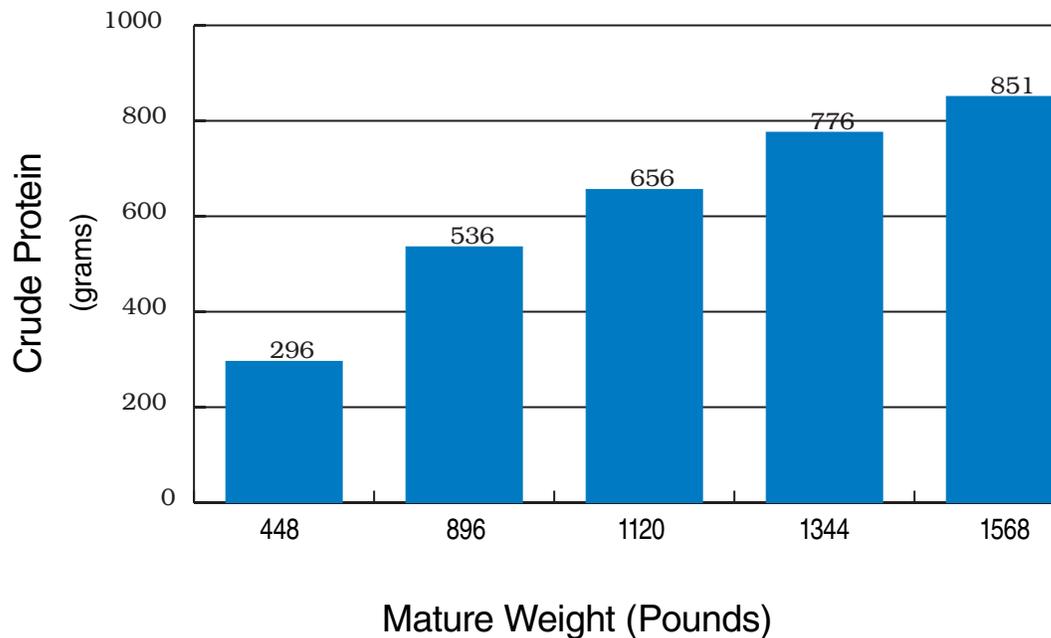
Source: *Nutrient Requirements of Horses*, Fifth Revised Ed., 1989

Figure 6. Maintenance Energy Requirements for Horses with Various Mature Weights



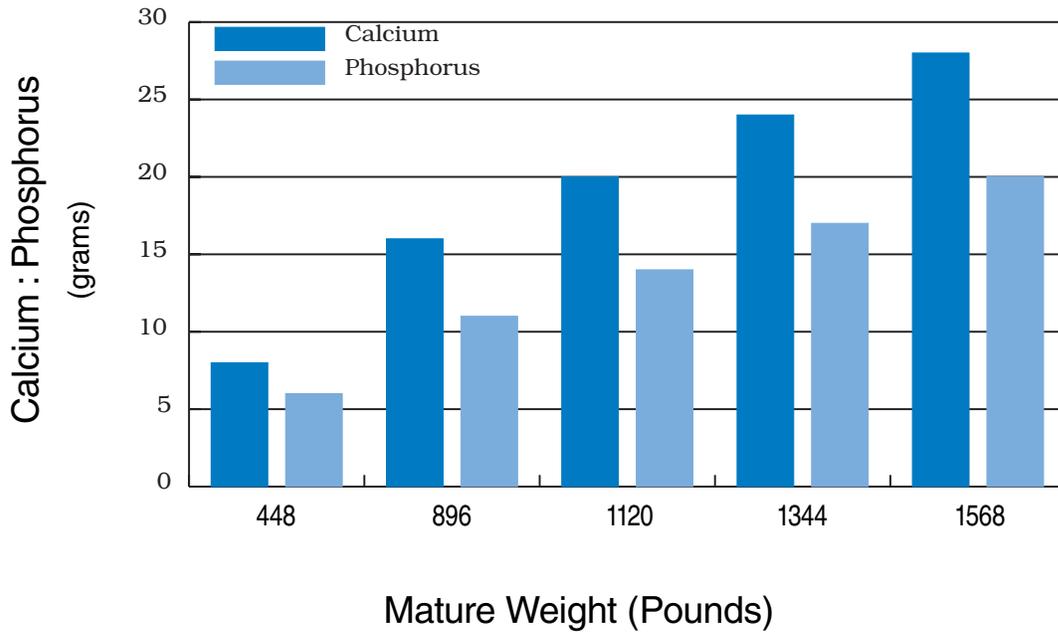
Source: *Nutrient Requirements of Horses*, Fifth Revised Ed., 1989

Figure 7. Maintenance Protein Requirements for Horses with Various Mature Weights



Source: *Nutrient Requirements of Horses*, Fifth Revised Ed., 1989

Figure 8. Maintenance Calcium and Phosphorus Requirements for Horses with Various Mature Weights



Source: *Nutrient Requirements of Horses*, Fifth Revised Ed., 1989

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