Protein Requirements for Mature Horses

MISSISSIPPI STATE UNIVERSITY EXTENSION

Protein is a frequently misunderstood nutrient in horses. In humans, protein can be readily used for energy, so many horse owners apply that same principle to their horses. However, horses do not store protein for later use and cannot efficiently use protein as an energy source like they can with fats and carbohydrates. This publication addresses two common questions many horse owners have about protein:

(1) *How much protein does the horse need?*

(2) *How do horses utilize protein?*

The term "crude protein" is frequently used when discussing protein requirements in horses. Crude protein (also known as CP) describes the estimated amount of protein in a certain feedstuff by analyzing the nitrogen (N) content. It is important to note that there are other substances in many feedstuffs that contain N, so this analysis is subject to some error. However, CP is predominantly used because isolating and providing individual amino acids by themselves would be expensive. There is also some danger of having a deficiency in some of the lesser defined essential amino acids if the provided diet contained certain individual amino acids.

Adult (mature) horses at maintenance are defined as 5 to 19 years of age with no additional energy requirements, unlike performance horses in moderate-heavy work or pregnant/lactating mares. All horses have maintenance requirements that are used as a baseline for the requirements of other classes of horses. Adult horses at maintenance require protein only for repair and maintenance of body tissues, so their total protein requirement tends to be fairly low as defined by the 2007 NRC (Table 1). Protein requirements for mature horses can be met using a lower percent CP, that equates to 8 to 10 percent CP in their forage or a combination of forage and concentrate.

Many mature horses can get a majority, if not all, of the protein they need from grass or hay alone. Coastal Bermuda hay, for example, can provide about 10 to 14 percent CP. Mature horses, on average, can consume around 2 to 3 percent of their body weight in forage per day, with 2.5 percent being a common daily intake for an all forage diet. To calculate how much forage to provide a horse, take its body weight (1,100 pounds, for example) and multiply it by 2.5 percent (.025). This calculation would result in 27.5 pounds of forage this horse needs per day. Providing a horse 27.5 pounds of Bermuda grass hay that is 12 percent CP would mean the horse is consuming 3.3 pounds of protein from the hay. Protein must be digested and absorbed before it reaches the cecum (a pouch considered to be the beginning of the large intestine), so you must also take into consideration the pre-cecal digestion rate of the forage. An all-forage diet has around a 46 percent digestibility rate of protein. This means the horse will digest and absorb 1.518 pounds (688.6 grams) of protein, enough to cover the CP requirement of an average horse at maintenance.

Table 1. National Research Council (2007) protein requirements of adult maintenance horses.

Class of horse	Weight (lb)	CP (g)
Adult – no work		
Minimum	1,100	540
Average	1,100	630
Elevated	1,100	720

Owners can confirm that a horse's protein requirements are met by having their pastures and hay analyzed. To get hay or pasture analyzed, multiple samples can be sent to Mississippi State University's Forage and Manure Analysis Lab; http://extension.msstate.edu/publications/publications/forage-and-manure-analysis-laboratories. Analyzing forage can be beneficial because of the variability of forage quality, including factors like the type of hay, hay maturity (when the hay was cut), whether the forage was fertilized or not (and can vary with type of fertilizer used), and season of the year. If the analysis shows that protein levels of the forage are too low, a feedstuff with a higher protein content can be supplemented with the lower quality forage. For example, alfalfa hay can be about 17 to 22 percent CP and could be supplemented with a lower quality grass hay to meet CP requirements until a higher quality grass hay becomes available.

Some horses have higher CP requirements. Exercising horses have a slightly elevated protein requirement (Table 2). However, it is a minimal increase, and the

Table 2. National Research Council (2007) protein requirements of adult working horses.

Class of horse	Weight (lb)	CP (g)
Working		
Light exercise[1]	1,100	699
Moderate exercise[2]	1,100	768
Heavy exercise[3]	1,100	862
Very heavy exercise[4]	1,100	1,004

[1]Light exercise: average heart rate (HR) 80 beats per minute (bpm) — 1 to 3 hours per week, 40 percent walk, 50 percent trot, 10 percent canter.
[2]Moderate exercise: average HR 90 bpm — 3 to 5 hours per week, 30 percent walk, 55 percent trot, 10 percent canter, 5 percent skill work (jumping, cutting, etc.).
[3]Heavy exercise: average HR 110 bpm — 4 to 5 hours per week, 20 percent walk, 50 percent trot, 15 percent canter, 15 percent gallop or skill work.
[4]Very heavy exercise: average HR 110–150 — 1 hour per week speed work or 6 to 12 hours per week slow work.

amount depends on their level of work. This increased protein requirement is needed since exercising horses are building and repairing muscle tissue. Exercising horses will have a greater increase in their Digestible Energy (DE) requirement as compared to protein, so, if the nutrient-to-calorie ratio is maintained, CP should increase with the increasing amounts of DE in the diet.

Growing horses have an elevated protein requirement as well (Table 3) but are more sensitive to protein quality than mature horses. This is because they are using protein for growth and need essential amino acids, such as lysine, as building blocks for the formation of new tissues. Growing horses have requirements that cannot be completely met by forage alone, and they should have a concentrate feed added to their diet. These requirements for growing horses might be slightly more elevated with the introduction of exercise (Table 3).

Mares that are in foal or nursing have elevated requirements, as well. Pregnant mares will have increased CP needs starting around 9 months of gestation (third trimester) to compensate for the large spike in fetal development (Table 4). Once mares start lactating, their CP needs will dramatically increase (Table 5), and forage alone will not completely meet increasing nutrient needs, so concentrate will have to be added to the diet to supplement high-quality forage. In early lactation (first 3 months), the mare's needs can be met with a high-quality forage and supplemented with a 14 to 16 percent CP feed. After the third month of lactation, the mare must still be fed high-quality forage, but you can gradually decrease the amount of grain she is receiving because of the decrease in milk production. The decrease in milk production correlates with a decrease in the mare's CP requirements. Overfeeding protein can have negative consequences as discussed later in this publication.

Approach to Feeding

Hay and grain should always be fed by weight and not by volume. This means feedstuffs should be fed by pounds (or kilograms) instead of by number of flakes or scoops. Flakes of grass hay can range from about 2 to 5 pounds, depending on the type of hay, flake density, and flake width. Alfalfa flakes can be variable as well, weighing anywhere from 3 to 8 pounds. The same goes for various commercial feed scoops. The common plastic scoop is 3 quarts, which equals around 2 to 3 pounds of commercial equine grain per scoop (more weight variability with other grains such as corn or oats). Metal scoops can come in many sizes (3, 4, and 6 quarts), and the scoops of grain can weigh in ranges that vary by 3 to 4 pounds, 5 to 6 pounds, and 6 to 7 pounds, respectively. Additionally, the weight of one scoop can vary depending on the type of grain being scooped (large pellets vs. oats). The amount of food a horse is getting can be variable when based on volume and can affect whether the horse's dietary requirements are being met. For example, a horse given two flakes of grass hay could be receiving from 8 to 20 pounds of hay. Additionally, a horse getting one scoop of grain could be getting 2 to 7 pounds of grain, depending on the type of scoop and grain. Feeding horses based on weight instead of volume is very important because a horse's CP requirements must be met. Deficiencies in essential amino acids can cause poor hoof growth, poor hair quality, loss of muscle mass, and reduced milk production in lactating mares (Evans 1977).

Table 3. National Research Council (2007) protein requirements of growing horses.

Class of horse	Weight (lb)	CP (g)
Growing		
4 months old	370	669
6 months old	476	676
12 months old	707	846
18 months old	853	799
18 – light exercise[1]	853	853
18 – moderate exercise[2]	853	906
24 months old	946	770
24 – light exercise[1]	946	829
24 – moderate exercise[2]	946	888
24 – heavy exercise[3]	946	969
24 – very heavy exercise[4]	946	1,091

[1]Light exercise: average heart rate (HR) 80 beats per minute (bpm) — 1 to 3 hours per week, 40 percent walk, 50 percent trot, 10 percent canter.
[2]Moderate exercise: average HR 90 bpm — 3 to 5 hours per week, 30 percent walk, 55 percent trot, 10 percent canter, 5 percent skill work (jumping, cutting, etc.).
[3]Heavy exercise: average HR 110 bpm — 4 to 5 hours per week, 20 percent walk, 50 percent trot, 15 percent canter, 15 percent gallop or skill work.
[4]Very heavy exercise: average HR 110–150 — 1 hour per week speed work or 6 to 12 hours per week slow work.

Another concern regarding protein in horse diets is the potential for overfeeding. Excess protein in the diet, especially in mature horses, is a problem stemming from common misunderstanding that protein relates to energy. In reality, proteins are the most difficult energy source for the horse to convert to usable energy. Horses will utilize carbohydrates—both structural and nonstructural—and fats as energy sources first. Horses will start breaking down protein as energy only in times of extreme starvation. The protein that is not utilized immediately by the horse's system is broken down to release nitrogen atoms, which become converted into ammonia. Ammonia is then converted into urea, which is excreted in urine. Before ammonia and urea can be excreted in urine, they must be filtered out of the blood—a process that, over time, can potentially tax the kidneys, especially in aging horses (Harris et al. 2006). You can think of the horse's body as a parking garage and protein as cars. The parking garage will only hold a certain number of cars. The cars that cannot find a parking spot will leave the garage.

Effects of extra protein can include increased water intake, increased urination, and a noticeably strong ammonia smell in horse stalls. Excess ammonia in the urine can potentially lead to respiratory problems in stabled horses. Decreased athletic performance is another possible outcome of a high-protein diet. Some studies have shown evidence that excess protein can interfere with calcium absorption in some species and might be similar in horses. Other studies have shown that excess protein can negatively impact the absorption of both calcium and phosphorus in weanlings. Researchers differ, however, on how much damage a high-protein diet can cause and how long a horse must be fed such a diet before the effects (if any) are noticeable. There is stronger evidence for the detrimental effect of excess protein in growing horses. In one study, weanlings and yearlings were fed a diet 25 percent higher in protein than required. They showed slower rates of growth overall and higher incidences of developmental bone and joint problems (Brigs 1997).

Table 4. National Research Council (2007) protein requirements of pregnant mares.

Class of horse	Weight (lb)	CP (g)
Pregnant mares		
Early (<5 months)	1,100	630
5 months	1,111	685
6 months	1,120	704
7 months	1,135	729
8 months	1,153	759
9 months	1,177	797
10 months	1,208	841
11 months	1,248	893

Table 5. National Research Council (2007) protein requirements of lactating mares.

Class of horse	Weight (lb)	CP (g)
Lactating mares		
1 month	1,100	1,535
2 months	1,100	1,530
3 months	1,100	1,468
4 months	1,100	1,398
5 months	1,100	1,330
6 months	1,100	1,265

High-protein diets can also affect horse owners. Protein is the most expensive additive in a commercial concentrate feed. The more protein being added to the diet, the more the feed cost will rise. The same goes for protein supplements. They are usually more expensive when compared to other additives, like fat. If your horse's requirements are being met, the protein will pass out of the system unutilized, which is not cost-effective for the owner.

Using these main principles in determining the protein needs of individual horses will result in healthier horses and development of a more cost-effective feeding program. Unfortunately, the vast array of needs of different horses (growing vs. lactating vs. maintenance, etc.) make feeding strategies difficult for horse owners. However, implementing feeding strategies with knowledge-based approaches will serve both horse and horse owners more effectively. For more information or to seek help determining the protein needs of your horse, please contact your local Extension agent or equine specialist.

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