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Feeding the Arena Performance Horse

Contents

On the Cover

Many of today's performance horses, such as this arena trail and pleasure horse, have a light workload. They are usually fairly easy to feed and manage. Other horses might be classified as having a moderate or intense workload, depending on what they do and how they are worked.

Feeding the Arena Performance Horse

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Today's horse owners are often bombarded with information about so-called "magic" products or practices to improve their horses' performance. Such reports have prompted many horse owners and trainers to try "hearsay" techniques to improve their horses' performance. Unfortunately, many of those recommendations are not based on research, and most have never been proven to improve athletic performance. Some are even harmful or fatal to horses.

To ensure that a horse performs at top levels and that nothing is done inadvertently to harm the horse or impair its performance, it is best to rely on sound research to identify only the nutritional and management practices that have been proven to be effective.

Texas is home to more than 1 million horses, and almost 75 percent are horses that are used for riding activities. About half of the horses in the state fit into the pleasure/recreational riding or showing/competition categories[5]. With so much interest in performance horses, more research attention has been directed toward equine athletes.

In recent years, scientists have studied the effects of various nutritional factors on performance horses and have developed research-based feeding and management practices[15] that can improve the athletic performance, delay fatigue and reduce injuries in performance horses. Studies have shown that horses perform best if they are properly conditioned and are fed a balanced diet containing the fuel and nutrients they need.

If a horse has the available energy and the nutrients it needs to use that energy, there is good evidence that it will voluntarily run faster, jump higher, stop harder, move more consistently around the arena and otherwise perform at a higher level than horses that have insufficient fuel and other nutrients to perform these tasks.

Recent studies indicate that the fuel supply in the muscles of horses can be altered and performance can be improved by specific ration formulations and the application of appropriate feeding management and training regimens. Research has pinpointed more exact mineral requirements of horses, especially young performance horses that are still growing[12, 14, 22].

Significant progress has been made in research-based feed formulation for horses. This more finely tuned supply of nutrients, when combined with specific feeding management practices, can improve performance of horses.

Energy for various workloads

The primary nutrient of concern in performance horses is energy (usually measured in calories). Horses must have enough energy to achieve and maintain their ideal body condition as well as to perform their work.

To estimate the energy needs of a horse, one must take into consideration the amount of work required, the kind of work done (aerobic vs. anaerobic) and the horse's stage of development.

Workload: Just as in humans, the energy needs of horses differ according to the level of work they must perform:

- Workloads usually required of hunter under saddle, western pleasure and equitation horses can be characterized as "light" work. These horses usually receive daily riding that is not very exhaustive and seldom go into an anaerobic state (which occurs when the heart rate rises well above 150 beats a minute). They usually require about 25 percent more energy than do nonworking horses.

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Many performance horses exceed the "light workload" classification and require energy to support a "moderate workload."

Nutrition influences a horse's body condition, bone strength and available nutrients to perform at various workloads.

- Workloads required of timed-event horses, hunters, jumpers and many cattle-working events can be characterized as "moderate" work. These horses may require 50 percent more energy than idle horses.
- Workloads required of cutting horses, some cow horses and reiners, and polo ponies are considered "heavy" work. These horses often require twice as much energy as nonworking horses.

For estimates of the energy needs of horses for various levels of work and for different stages of development, see Table 1. Notice also the importance of other nutrients, some of which are also listed in Table 1.

Anaerobic vs. aerobic work: In deciding what to feed, horse owners need to know how much their horses depend on their aerobic and anaerobic systems of energy metabolism.

Long-distance endurance horses perform much of their work aerobically and can use the more slowly released energy from **fat and fiber** in their diets. These horses can use the energy from fat and fiber when the work load is low enough to allow sufficient oxygen to reach the muscle for energy production. However, they must have adequate car-

Table 1. Approximate daily nutrient requirements of performance horses (1,100 pound mature weight)[a]

Class	Digestible Energy (Mcals)	Crude Protein (pounds)	Calcium (grams)	Phosphorus (grams)	Vitamin A (IU's)	Vitamin E (IU's)	Thiamin (mg)	Salt (grams)
Mature horses[a]								
Light work	20.5	1.8	25	18	22,000	675	100	90
Moderate work	24.6	2.2	30	21	22,000	800	150	100
Intense work	32.8	2.9	40	29	22,000	1,100	200	140
Two-year olds[b] (in training)	26.3	2.5	50	27	20,000	800	150	100

[a] From The National Research Council (1989)

[b] Requirements from recent research by Nielson et al. (1998) and Stephens et al. (2001)

bohydrate in the diet to support the short bursts of high-intensity, anaerobic work they encounter.

Short-duration, high-velocity athletic horses must have enough **carbohydrates** in the diet and stored in the muscles to meet the sudden energy demands of all-out anaerobic work. It is critically important that owners make sure to feed these horses enough readily available energy in the form of carbohydrates. Supplemental dietary fat can play an important role in high-carbohydrate diets for these horses by direct support of lower intensity, aerobic "practice" work.

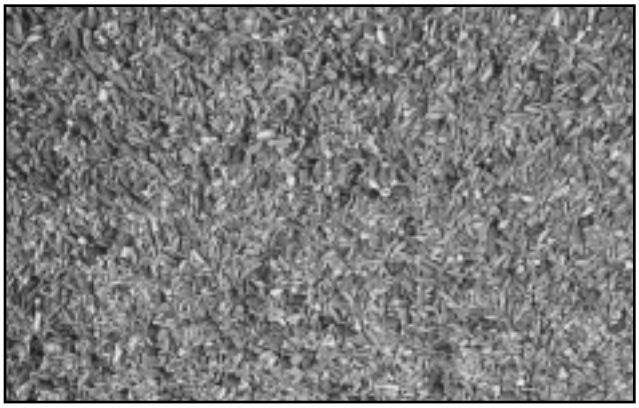
High-performance horses, such as cutting horses, reining horses and other athletes, routinely perform both aerobic and anaerobic work while competing in a particular event. Recent research indicates that the performance of such horses can be improved by adding **fat** to a **high-carbohydrate diet**. With proper adaptation time, fat supplementation can influence the amount of stored muscle energy in the form of muscle glycogen, which is the fuel supply for anaerobic work.

Some performance horses work hard enough to classify the work load as "intense."

A horse must take in energy each day from a reasonable amount of feed that it can consume safely. Depending on the activity level of the horse and the energy concentration of the diet, a horse will usually need a combination of forage and concentrate ranging from 1.5 percent to 3.0 percent of its body weight daily.

For example, horses with a light workload might receive hay at 1 percent of body weight and concentrate at 0.5 percent of body weight. Other horses doing daily and intense work could require 1 percent of body weight in hay and up to 2 percent of body weight in concentrate. The percentage depends on the workload, energy density of the feed, desired body condition and individual horse variation.

At a moderate workload, the horse will consume on average a total amount of daily feed (hay plus grain) of between 1.75 and 2.5 percent of its body weight. Feed intake will vary according to the energy density of the concentrate, not the protein percentage.



Concentrate feeds must be balanced to provide adequate energy, minerals, vitamins and protein. Concentrate feeds may be textured (sweet feeds), pelleted or extruded.

The daily feed intake (hay plus concentrate) of a performance horse should range from 1.5 to 2.5 percent of its body weight. In some cases, extremely hardworking horses may require feed at 3 percent of their body weight, and they must always be given that feed in two or more feedings per day.

Most owners are accustomed to feeding concentrates to their horses to supply carbohydrates for energy. Concentrates contain cereal grains such as oats, barley and corn, which can be mixed together in a variety of ways to produce feeds of differing energy concentrations.

Grain feeds provide carbohydrates that can be either used directly as glucose or stored in the muscles and liver in the form of glycogen, to be used during all-out exercise performance. Ideally, cereal grains should be processed so the starches in them can be digested more easily in the small intestine and more glucose can be absorbed. Cereal grains contain very little fat, and a typical grain mix often has no more than 3 percent total fat.

Providing energy for performance horses

During anaerobic work in a challenging performance, a horse must be able to get its energy primari-

ly from glycogen stored in the muscle. That glycogen is synthesized from the glucose made available for absorption in the small intestine. The source of that glucose is dietary carbohydrates.

Blood glucose and glycogen contribute directly to the energy needs of horses, especially those doing high-heart-rate, anaerobic work. When actually cutting or working a cow or running a barrel race, horses rely significantly on anaerobic energy production.

Horses that do not get enough carbohydrates while in high levels of training will deplete their muscle glycogen stores and become unable to work at a high level. But by manipulating a horse's diet and exercise regimens[23], horse owners can dramatically "spare" or save the amount of glycogen stored in the muscles of exercising horses, and eventually improve their work performance.

To enable more muscle glycogen to be stored, performance horses should be exercised properly and fed high-energy diets with available carbohydrates. Conventional diets of hay and other fibrous feedstuffs do not provide enough energy for horses that perform at intense levels of activity. These horses must be fed grain-based concentrates and a comparatively large amount of highly digestible starch to meet their demands for both aerobic and anaerobic energy production.

High-performance horses cannot eat enough hay to get the amount of energy they need, and cereal grain can cause digestive upsets when fed in large amounts at any one feeding. Fortunately, research shows that adding fat to diets of performance horses gives them a more concentrated supply of energy in an amount of feed they can safely consume.

Feeding fat-supplemented diets to horses in athletic training can improve muscle glycogen storage and work performance[11, 16, 20, 26]. A horse expected to do short-term, high-velocity anaerobic work needs not only to be fed enough energy, but also to receive significant amounts of that energy in the form of fat, which enables its body to spare glucose and thus produce and store muscle glycogen.

Arena horses are in a nutritional status to perform at their best when they are fed a fat-supplemented, high-carbohydrate diet — *not a high-fat, high-fiber diet.*

Sources of dietary fat include feed-grade rendered animal fat, corn oil and other vegetable oils. These sources are 99 percent fat[15]. Another fat source, rice bran, is only 13 to 15 percent fat in its stabilized form. The concentrate portion of a horse's diet can contain up to 10 percent supplemental fat from animal or vegetable sources.

Consideration should be given to the source of fat used. Although the digestible energy density of animal fat and vegetable oils are similar, they are made up of different fatty acids. Animal fat is made up primarily of saturated fatty acids, while vegetable oils contain primarily unsaturated fatty acids including several polyunsaturated fatty acids (PUFA).

Some of the PUFAs in vegetable oil are the omega 6 (n-6) fatty acids. The PUFAs in corn oil and solvent extracted soybean oil are primarilly n-6. The n-6 fatty acids tend to aggravate subclinical inflammatory responses in hard-working horses[30].

However, some vegetable oils have higher concentrations of omega 3 (n-3) PUFAs that do not aggravate the inflammatory process. In fact, there are indications that feeding increased amounts of n-3 PUFAs may even reduce subclinical inflammation[30]. Therefore, you need to consider using either animal fat or vegetable oils that contain n-3 PUFAs.

Vegetable oils with higher concentrations of n-3 PUFAs include cold-processed, mechanically extracted soybean oil, flax oil and fish oil. Fish oil has the highest concentration of n-3 PUFAs, but feeding too much fish oil can cause palatability problems and needs to be researched further.

Importance of body condition

Maintaining adequate body condition is vital. A horse should be fed enough calories, regardless of their source[29], to meet its requirements for work and to sustain sufficient body condition to offset the energy it uses for aerobic and anaerobic metabolism.

A horse's energy requirements for work take precedence over the storage of energy as fat or glycogen in his body. If a horse is not fed enough energy to maintain its body weight, it will use the energy it has stored in the body tissues to do the work, and it will become thin.

A thin horse will not be physiologically able to exercise strenuously because it does not have enough stored energy available for hard, anaerobic work. To maintain reasonable levels of body fat in horses that are being worked hard, you must increase the energy density in the diet and adjust the amounts of feed proportionally.

Feeding some fat to equine athletes has been shown to help protect them from fatigue even when their body condition is reduced. Research has demonstrated that thin, exercising horses have higher concentrations of muscle glycogen if fat is added to a high-carbohydrate diet than if they are given conventional diets[8, 20].

For optimum performance and termal regulation, performance horses should be neither thin nor fat. They should be in Body Condition Score 5, Moderate Condition.

When trying to meet the nutritional needs of a performance horse, focus on the number of calories it uses for a given amount of exercise. Horses that have not been provided enough calories cannot perform at the same level as those that have enough energy in the diet and stored in the muscles.

Horses that have abnormally low body weights often deplete their body energy reserves and have too few calories to perform at a high level. Your aim should be to provide the horse enough calories to maintain sufficient body condition and muscle glycogen reserves, but not so much to cause thermal stress[21].

Performance horses should be maintained in lean condition, but their ribs should not be showing[21]. Conversely, having too much body fat can also cause problems — it can result in thermal (heat) stress on the horse[27]. To reduce thermal stress, feed your performance horse a fat-supplemented diet[17, 21], regardless of the horse's body condition.

Along with proper training, feeding a fat-supplemented diet with adequate carbohydrates and other nutrients can improve performance, delay fatigue and reduce injuries in normal horses.

A word of caution: Certain horses that are prone to "tying up" have a disorder known as polysaccharide storage myopathy syndrome (PSSM), and those horses should not be fed large amounts of carbohydrates. But in normal horses, the most effective way to achieve peak performance is to feed a fat-supplemented, high-carbohydrate diet.

Several factors need to be considered when supplementing fat:

- Horses need time to adjust to having fats added to their diets, sometimes as much as 4 weeks.
- Because a fat-supplemented diet provides more energy, you will need to give the horse less feed overall daily if its work level and body condition are to remain the same.
- If you plan to topdress fat or oil on the feed, begin adding a small amount of fat and increase the amounts gradually, keeping an eye on the horse's eating behavior and general well-being. Do not add more than 10 percent of the grain mix by weight.
- When you supplement fats or oils, be sure to reassess the horses' total dietary nutrient balance (see the section on protein below), especially for young, growing horses that receive exercise. Table 2 shows how to determine if a commercial feed already has supplemental fat added to it. This table also estimates the expected digestible energy (calories) of feeds with varying amounts of crude fiber. The table does not always hold true, but it can be relied on in many instances. Consider these tips when selecting commercial feeds:
- Check the fat and fiber amounts listed on the feed tag. These listings can help you estimate the energy density of the grain mix. There is an inverse relationship between fiber content and the expected digestible energy content (Table 2) — the more fiber, the lower the amount of digestible energy in the feed, and vice versa. This information can help you select concentrates that are a better buy per unit of energy: Lower fiber feeds usually contain more energy than higher fiber feeds. If you feed good-quality hay, there is no need to spend more money on additional fiber in a bagged horse feed.
- Some manufacturers produce fat-supplemented feeds. If a feed tag lists a fat level of 8 percent, in most cases about 4 percent to 5 percent additional fat has been included. This

Table 2. Relationship of crude fiber to expected digestible energy in conventional and fat-supplemented grain mixes.

	Digestible Energy (Megacalories per pound)	
Crude Fiber (percent)	Conventional Diet (With about 3 percent fat)	Fat-Supplemented Diet (7-8 percent fat)
2	1.62	1.72
4	1.55	1.65
6	1.45	1.55
8	1.35	1.45
10	1.25	1.35
12	1.15	1.25

supplemental fat affects the relationship between crude fiber and expected digestible energy content by about 0.10 megacalories (or 100 kilocalories) per pound of feed. So, the same amount of concentrate will provide significantly more energy if that concentrate contains supplemental fat.

Protein

Overfeeding of protein is a common practice in the performance horse industry. One misconception is that as a horse's level of activity increases, you should increase the percentage of crude protein in its grain or concentrate mix.

Although it is true that performance horses require somewhat more protein in the diet to perform at their best[4], it is not true that the most important consideration in the diet is a high level of protein, particularly for mature hard-working performance horses.

A mature working horse needs much less protein than a lactating mare or a young, growing horse. Mature horses need comparatively low amounts of protein — 10 percent of the total diet or less, depending on the level of feed intake.

In more simple terms, most performance horses can eat a grain mix containing 10 to 12 percent crude protein, provided the mix contains no more than about 3 percent crude fat. But with fat supplementation, the grain mix or concentrate may need to contain 14 percent crude protein to provide the horse with 40 grams of protein for every megacalorie of digestible energy.

You must consider the horse's protein intake in relation to its energy intake. As long as the percentage of protein in the feed is correct, the horse will get enough crude protein at increasing levels of work if you increase the amounts of feed to provide the energy needed to do the work and maintain body condition.

Research has shown that exercising horses do require a little more protein than do sedentary horses, particularly during the conditioning period[4]. After conditioning has been achieved and the level of work reduced, working horses require very little more protein than do idle horses. Although exercising horses already in a high state of condition need a little more protein than sedentary horses[7], the additional requirement is very small.

Studies have also looked at how varying levels of protein affect the muscle composition of conditioned horses[3]. This research determined that training and conditioning increase the diameter of certain muscle fibers, which is one of the mechanisms that gives the horse more power. Training and conditioning also stimulate protein synthesis in the muscle to repair damaged muscle and increase muscle size. These effects result in a small increase in the actual protein requirement of exercising horses.

In practical horse feeding terms, here are some basic rules of thumb to use in selecting feed for performance horses.

If a performance horse receives average-quality grass hay (7 to 8 percent crude protein), you can ensure that it has enough additional protein by feeding a 12 percent crude protein grain or concentrate mix.

However, in two situations, a concentrate higher in crude protein may be warranted:

- When hay quality is poor.
- When the horse feeder topdresses fat onto the concentrate. When fat or oils are topdressed on the feed, the energy density is increased, but the protein concentration is diluted. If 5 to 10 percent fat is added to the grain mix, the basic concentrate needs to contain about 14 percent crude protein. This is especially important for 2- and 3-year-old horses that are working and still growing.

There is no justification for feeding high-protein feeds to the mature equine athlete. The feed is not an economical energy source, and overfeeding protein creates a metabolic stress on the horse.

Vitamins

Many performance horse owners are keenly interested in vitamin supplementation, to the extent that vitamins are often grossly overfed in the horse industry[6]. The oversupplementation of vitamins does not improve a horse's performance and in fact may be toxic and dangerous. If a horse receives a well-balanced diet containing enough vitamins to meet its requirements, oversupplementation of vitamins certainly will not enhance performance.

All vitamins are important, but the primary vitamins of concern for performance horses are vitamins A, E and the B-vitamins.

Vitamin A: In horses, vitamin A helps maintain normal eating behavior and the health of the respiratory system. However, excessive vitamin A can contribute to bone weakness.

Reputable feed manufacturers balance their concentrate rations by supplementing vitamin A, often in a vitamin premix. Horse owners who are having a feed mixed should usually have vitamin A added at about 1,500 to 2,000 international units (IU's) per pound of feed (see tables 3, 4 and 5 for examples).

Vitamin D: There is no known case of vitamin D deficiency in horses except under experimental conditions, and researchers have not identified the amount of vitamin D needed in the diets of horses. Horses that receive normal exposure to sunlight will have enough vitamin D for calcium homeostasis, which is the balance of calcium normally deposited in bone, kept in circulation, or excreted by the horse.

If horses are fed too much vitamin D, calcium deposits can be formed in tissues such as the lungs, kidneys and blood vessels.

Vitamin D is usually supplemented in commercial horse feeds at only one-tenth of the concentration of vitamin A. Be careful — too much vitamin D is toxic to horses.

Vitamin E: Scientists are paying more attention to vitamin E because of its role in the maintenance of cell membranes and as an antioxidant. Exercising horses form peroxides in the body, which can be toxic, and vitamin E protects the body from its harmful effects.

Most feed manufacturers provide supplemental vitamin E. See tables 3, 4 and 5 for examples of grain mixes fortified with vitamin E. If vitamin E is not added to the concentrate, it should be supplemented for heavily exercised horses.

Vitamin K: Vitamin K is important in the blood clotting mechanism and for other purposes, but because it is synthesized in the large intestine of the horse, there is no need for vitamin K in the diet. Research indicates that enough vitamin K is pro-

Table 3. Example of a performance horse diet for mature horses (designed to be fed with good-quality grass hay or grazing).

Ingredients	Percent	Pounds/Ton	Calculated Analyses
Cracked corn	45.00	900	**Crude protein = 12.0 percent**
Whole oats	42.50	850	**Digestible energy = 1.39 Mcal/lb**
Soybean meal	7.50	150	**Crude fiber = 6.0 percent**
Molasses	3.25	65	**Crude fat = 3.7 percent**
Calcium carbonate	0.75	15	**Calcium = .36 percent**
TM Salt	0.75	20	**Phosphorus = .32 percent**
Vitamin A	+	+	**Vitamin A added at 2,000 IU/lb**
Vitamin E	+	+	**Vitamin E added at 50 IU/lb**
B-vitamins	+	+	**Thiamin added at 5 mg/lb**
			Biotin added at 1 mg/lb

*Important: See Table 6 for expected feed consumption and always introduce new grain feeds gradually. This ration contains about 6 percent more energy than straight oats, so smaller amounts of this ration will usually maintain similar body condition.

+Percentages and weights of vitamins A, E, thiamin and biotin will vary, depending on the vitamin premix used.

Table 4. Example of a 5 percent fat-supplemented performance diet (to be fed with grass hay).

Ingredients	Percent	Pounds/Ton	Calculated Analyses
Cracked corn	40.00	800	**Crude protein = 14.0 percent**
Whole oats	37.50	750	**Digestible energy = 1.50 Mcal/lb**
Fat or oil	5.00	100	**Crude fiber = 5.7 percent**
Soybean meal	12.25	245	**Crude fat = 8.25 percent**
Molasses	2.00	40	**Calcium = .42 percent**
Calcium carbonate	0.75	15	**Phosphorus = .38 percent**
Dicalcium phosphate	0.25	5	**Vitamin A added at 2,000 IU/lb**
Brewer's yeast	1.25	25	**Vitamin E added at 50 IU/lb**
TM salt	.75	20	**Thiamin added at 5 mg/lb**
Vitamin A	+	+	**Biotin added at 1 mg/lb**
Vitamin E	+	+	
B-vitamins	+	+	

*Important: See Table 6 on expected feed consumption and always introduce new grain feeds gradually. This ration contains 8 percent more energy than the ration shown in Table 3 and 20 percent more energy than straight oats, so smaller amounts of this ration will usually maintain similar body condition.

+Percentages and weights of vitamins A, E, thiamin and biotin will vary, depending on the vitamin premix used.

Table 5. Example of a 10-percent-fat-supplemented performance diet (to be fed with grass hay).

Ingredients	Percent	Pounds/Ton
Cracked corn	36.25	725
Whole oats	32.50	650
Fat or oil	10.00	200
Soybean meal	15.00	300
Molasses	3.00	60
Calcium carbonate	0.75	15
Dicalcium phosphate	0.25	5
Brewer's yeast	1.25	25
TM salt	0.75	20
Vitamin A	+	+
Vitamin E	+	+

Calculated Analyses
Crude protein = 14.5 percent
Digestible energy = 1.61 Mcal/lb
Crude fiber = 5.25 percent
Crude fat = 12.9 percent
Calcium = .47 percent
Phosphorus = .38 percent
Vitamin A added at 2,000 IU/lb
Vitamin E added at 50 IU/lb
Thiamin added at 5 mg/lb
Biotin addet at 1 mg/lb

*Important: See Table 6 on expected feed consumption and always introduce new grain feeds gradually. This ration contains 16 percent more energy than the ration shown in Table 3, 7 percent more energy than the ration shown in Table 4 and almost 25 percent more energy than straight oats, so smaller amounts of this ration will usually maintain similar body condition.

+Percentages and weights of vitamins A, E, biotin and thiamin will vary, depending on the vitamin premix used.

duced by bacteria in a horse's hindgut to meet the horse's requirements.

Although vitamin K has been administered to racehorses in an effort to treat or prevent exercise-induced pulmonary hemorrhage, its influence on "bleeding" has not been documented by equine research.

B-vitamins: Of all the nutrients, B-vitamins are the most widely used in the horse industry. Like vitamin K, the B-vitamins are synthesized in and absorbed from the large intestine of horses. Most horses do not need B-vitamin supplements, but extremely hard-working horses have responded to B-vitamin supplementation[25].

Horse owners often incorporate B-vitamins into feeding programs expecting some "blood building" to occur. But because vitamins such as B_{12} are water soluble, they are quickly voided in the urine and have no noticeable effect on blood parameters such as packed cell volume or hemoglobin concentration.

To improve the oxygen-carrying capacity and blood volume of their performance horses, owners should rely on conditioning and exercise instead of supplementing B-vitamins.

However, there are some situations in which B-vitamins do play a valuable role in equine performance, and they may need to be supplemented in a horse's diet if conditions warrant. Some industry evidence and research data indicate that exercising horses may need supplemental vitamin B_1 (thiamin) beyond what they would normally synthesize in the intestine[25].

It is not uncommon to see young performance horses in training become lethargic and depressed. This condition is characterized by a dull attitude, lowered appetite, general unthriftiness and decreased performance. Researchers have found that loss of appetite is one symptom of a thiamin deficiency. Horse trainers have learned that dull, depressed horses with a poor appetite respond to B-vitamin supplementation. This effect is likely from thiamin.

Although enough thiamin can be synthesized in the gut to meet the needs of most mature horses, it may not be synthesized or absorbed fast enough to meet the requirements of severely stressed exercising horses. Therefore, horses that do intense work and require high levels of energy could become deficient in thiamin if there is too little of it in their diets. Diets based on oats and grass hay typically do not have enough thiamin to meet the needs of a hardworking performance horse — those fed unbalanced diets can easily become thiamin deficient.

It is interesting to note that in most cases when a horse becomes lethargic, adding brewer's yeast to the feed seems to stimulate appetite, restore an energetic attitude and improve work performance. One of the largest components of brewer's yeast is thiamin, among other B-vitamins.

If a horse is heavily worked and receives a traditional diet, supplemental thiamin[25] should be provided. Some performance horses should receive a good supplement containing the B-vitamins, particularly thiamin, at the feed manufacturer's recommendation. However, there is no benefit to oversupple-

mentation of B-vitamins, particularly if the manufactured feed already contains adequate amounts.

Another B-vitamin often supplemented is biotin, which is thought to enhance hoof growth or strength. Limited clinical reports have claimed **some improvement in about one-third of horses supplemented with biotin[2].**

More recent research has found that d-biotin supplementation:

- Reduces the incidence and severity of hoof-horn defects
- Increases tensile strength
- Improves the condition of the white line[9] in the foot

Please note that it takes from 9 months to more than a year before the benefits of biotin supplementation are observable. Although more research is needed before exact recommendations can be made about supplementing the diets of horses with poor hooves, a workable course of action is to provide 15 to 20 mg of biotin per day, or at least 1.5 ppm in the diet.

Minerals

Performance horses must have a balanced supply of minerals for maintenance of skeletal tissue, for muscular contraction and for regulation of acid/base and fluid balance. The major minerals for horse owners to consider are calcium, phosphorus and magnesium for the young, developing horse as well as sodium, chloride and sometimes potassium for the heavily sweating horse.

The often-stated argument about having an exact calcium-to-phosphorus ratio in horses is important, but no more important than making sure that athletic horses get enough calcium and phosphorus relative to their energy intake. Even so, the total daily diet of performance horses should always contain at least as much calcium as phosphorus and preferably 1.5 to 2 times as much calcium as phosphorus.

Inverted calcium-to-phosphorus ratios (that is, diets containing more phosphorus than calcium) can contribute to weakened bones and subsequent lameness in the stressed horse. Unfortunately, because cereal grains are higher in phosphorus than calcium, inverted ratios of calcium to phosphorus occur too frequently in the horse industry. To ensure proper calcium and phosphorus intake, **cafeteria-style or free-choice mineral feeding programs should not be used for stalled horses,** as they are ineffective in meeting the horses' requirements[19] for these minerals.

Also, large amounts of wheat bran and other high-phosphorus feeds should be corrected. The only reliable way to achieve mineral balance is to feed a balanced concentrate and good quality hay. The mineral imbalance in oats can easily be corrected by adding a well-formulated supplement that is designed for oats-based feeding programs.

Young horses: During the initial stages of training, young horses appear to need 30 to 35 percent more calcium and phosphorus and 80 to 100 percent more magnesium than is recommended in current National Research Council (NRC) guidelines[12, 13, 14, 22]. These increases in mineral requirements are caused by bone remodeling in early training that causes the bones to absorb less of these minerals than are needed, and because of some bone mineral matter being lost in the urine[13].

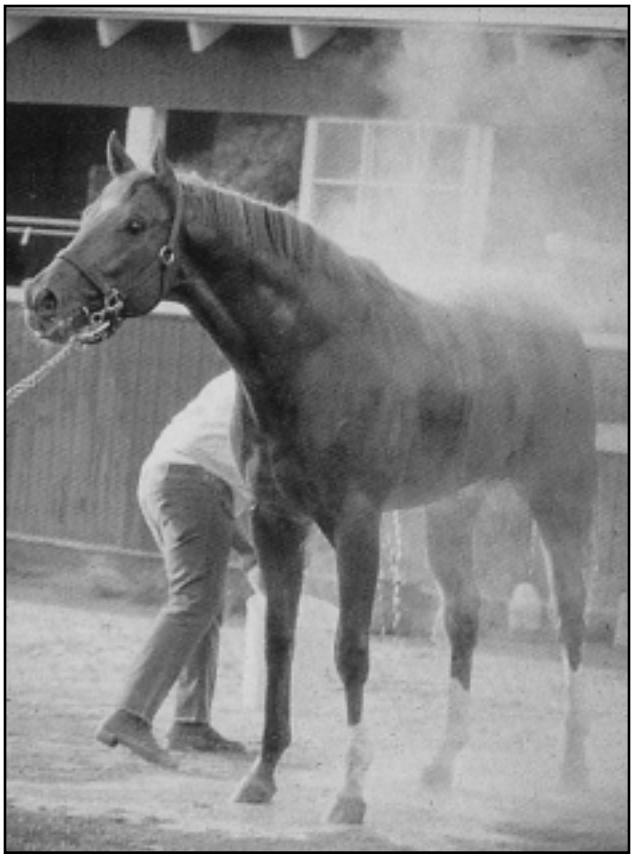
Thus, during the early stages of training, a 2-year-old horse needs total dietary concentrations of about 0.60 percent calcium; 0.35 percent of phosphorus; and 0.2 percent of magnesium. Refer to tables 3, 4 and 5 for examples of balanced grain mixes with suitable mineral levels.

Sweating horses: Hard-working horses lose significant amounts of sodium, chloride and potassium in sweat[10]. It is usually easy to meet the increased requirements for these minerals from two sources: good quality forage and supplemental salt in the concentrate mix.

To compensate for the loss of these electrolytes in the sweat, the diets of exercising horses must be supplemented with sodium, chloride and sometimes potassium[28]. Commercially prepared horse feeds do not normally contain enough electrolytes for horses that sweat a lot, particularly in the summer. **Although almost all commercial feeds contain some salt, heavily sweating horses generally need from 1 to 3 ounces of supplemental salt per day in addition to that provided in the feed.**

Few studies have been conducted on the use of "drench dosed" electrolytes. This practice is questionable, and adding electrolytes to the drinking water could cause a horse to drink less water, which could dehydrate the horse and severely affect its performance.

The most effective way to meet the mineral needs of exercising horses is to select roughage and concentrates that have a good balance of all the minerals needed and to feed them in adequate amounts to meet the animal's energy requirements. Horses that sweat excessively will need additional salt — enough to total about 1 percent of the daily ration.



Performance horses lose electrolytes in the sweat. Water, good-quality hay and a well-formulated feed are important in maintaining electrolyte balance.

Some attention should be paid to the potassium requirement of exercising horses, which may be twice the requirement of those at maintenance. When low-quality forages are fed, horses may need potassium supplements. The total ration should contain about 1.2 percent potassium.

One particular concern regarding potassium is for horses that contain the gene for hyperkalemic periodic paralysis (HYPP). Clinical symptoms of this condition are related to high serum potassium concentrations. Horses that are HYPP positive require a diet very low in potassium[18]. When potassium intake is kept well below 1.0 percent of the ration, symptoms of HYPP can be minimized even in HYPP-positive horses.

Feeding management

For a horse to achieve its highest level of performance, it must be fed a balanced ration at regular intervals, and mismanagement that could impair digestion must be avoided.

Balancing rations: It makes no difference whether the horse owner chooses to balance rations by buying ingredients and mixing them or opts to buy formulated, finished feed, provided they know what they are doing. Several factors may influence the choice. The critical objective is to provide enough of the nutrients a horse needs to meet its daily requirement. Both approaches will work, but close attention must be paid in the formulation process when mixing feeds. Therefore, commercially prepared feeds usually work best for most horse owners.

Three example performance horse rations are shown in tables 3, 4 and 5. They contain differing sources and amounts of energy and are balanced for protein, minerals and vitamins.

Horses should not take in concentrate in amounts of more than 0.75 percent of body weight at one meal, and the intervals between all meals must be the same. So, if the horse can be maintained with concentrate intakes of 1.5 percent of body weight daily or less, it can be fed twice daily at 12-hour intervals. If it requires more feed, it must be fed three times daily at 8-hour intervals — not morning, noon and night.

See Table 6 for the amounts of feed horses **are expected** to consume at differing levels of activity. For a formula that uses a tape measure to estimate a horse's weight, see *Scientific Principles for Conditioning the Performance Horse* (available on the Web at *http://animalscience.tamu.edu* or from Texas A&M University. Ordering information is at the end of this publication).

Whatever method is chosen to provide the animals' nutritional needs, it is critically important to follow proper feeding management principles to promote high performance with a minimum of digestive disturbances. It is sometimes difficult to maintain appetite and normal feeding regularity for horses that are used in various performance events such as showing, rodeoing and other competitive activities.

However, there are some steps to take to minimize problems in these horses:

- Try to handle and work horses quietly and easily during transit and in the stall areas.

Individual feeding and carefully monitored feeding programs play a major role in maintaining arena performance horses.

Table 6. Expected daily feed consumption by performance horses (percent body weight)[a].

Type of diet	Level of Work		
	Light[b]	Moderate[c]	Intense[d]
Typical nonfat diet			
Concentrate	0.50-1.0	1.0 - 1.5	1.50 - 1.75
Hay	1.00-2.0	1.0 - 1.5	0.75 - 1.00
5-10 percent fat-supplemented diet			
Concentrate	0.5- 0.75	75 - 1.0	1.50 - 2.00
Hay	1.0-2.00	1.00 - 1.5	0.75 - 1.25

[a] Feed consumption by individual horses may vary further according to level of activity and energy density of the feeds being fed.

[b] Examples are English/western pleasure, arena trail equitation, etc.

[c] Examples are ranch work, roping, cutting, timed events, jumping, etc.

[d] Examples are endurance riding, race training, polo, some cutting and reining and cowhorses, etc.

- Use only the highest quality feeds with suitable energy density, and try to feed the hard-working horses three times a day at regularly spaced intervals around the clock, taking working sessions into account. Use good-quality hay to supply fiber to the performance horse every day.
- Do not feed concentrates or hay to hard-working horses within 3 hours before strenuous exercise. You can offer hay after exercise, but do not feed concentrates for 2 hours after strenuous exercise. **Offer water free choice, but make sure the horses initially drink slowly when they are hot or during or immediately after a ride or performance.** Do not withhold water from a hot, dehydrated horse.
- In the hot summer months, improve heat regulation in horses by feeding them a fat-supplemented feed. This will reduce their total feed intake and heat production. Regulate the horse's hay intake so that it is not less than 0.75 percent nor more than 1 percent of body weight daily. This produces less heat for the horse to deal with. Hay can be fed in two equal feedings per day.
- If the normal feeding time is interrupted by competition, reduce the concentrate portion of the ration at the next feeding, then resume the normal amount of feed at the second feeding after competition. If the feeding time is delayed for several hours after a very strenuous workout or because of transport, feed the horse only hay at the next feeding and then feed the normal concentrate allotments at the next regularly scheduled feeding time. **It is important to avoid feeding extra concentrate to compensate for feed that might have been missed because of travel or work during the previously scheduled feeding time!**

Water is important not only for replacing sweat loss, but also for maintaining blood volume and normal function of the digestive system.

- If you run out of feed on the road, buy feed in the following priority order:
  1. The same feed if possible
  2. Similar feed with the same nutrient composition and physical characteristics
  3. If none of those are available, buy good, clean oats.
- Horses that have been in strenuous training during the week with Sundays off should have their concentrate feed reduced accordingly on the off day. When combined with some free exercise, this can help to prevent metabolic disorders caused by feeding high-concentrate feeds in the absence of exercise. For best results, reduce the concentrates to about half the normal amount and increase the hay allowances. This will help prevent azoturia, feeding-related muscular soreness problems and the feeding-related "tying-up" syndrome.

- The rider should take adequate time to warm up the horse before strenuous work and take some time to cool the horse down after strenuous work. This increases blood flow and can minimize various types of "tying up" problems and muscle soreness.

Summary

Nutrition constitutes 40 to 45 percent of the annual cost to keep and manage a riding horse[5]. The primary focus should be on meeting the horse's energy and other nutrient needs in an amount of feed it can comfortably eat.

Haphazard feeding schedules and amounts and poor-quality concentrates or hay will impair the success of high-performance athletes. Although it can be challenging to feed a high-performance horse successfully, it can be done.

If the nutritional requirements are met accurately, performance will be improved over those horses that are fed imbalanced diets in irregular amounts. Making adjustments in ration formulation, feeding management and training regimens provides the horse owner/trainer a real opportunity to improve athletic performance, delay fatigue and reduce injuries to equine athletes.

For more information

Several other publications are available to help performance horse owners. Listed below are related publications available from your county Extension office or from the Equine Science Section in the Department of Animal Science at Texas A&M University:

- *Scientific Principles for Conditioning Race and Performance Horses*
- *Feeding Young Horses for Sound Development*
- *Feeding Race Prospects and Racehorses in Training*
- *Permanent Identification of Horses*
- *15 Steps to Minimize Theft of Horses, Facilities and Equipment*

The authors can be reached at Kleberg Center 249, TAMU 2471, College Station, Texas 77843. Many of these publications can also be found at http://animalscience.tamu.edu.

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