



Nutritional Concerns for Exercising Horses

Dr. David W. Freeman

Oklahoma Extension Equine Specialist

The horse is a unique specie of livestock in that its primary purpose is for pleasure or work. Equine nutritionists have long been concerned with supplying the correct amounts and types of nutrients in order to achieve maximum exercise performance. It is the nutritionists' goal to maximize the nutritional impact on exercise, so owners can prioritize exercise and breeding programs which produce and maintain the desired equine athlete.

Categorizing Different Types of Exercise

Different uses require horses to perform different types of exercise. Exercise types differ in duration and intensities, and these differences affect usage of energy. In general, exercise is classified into two categories: aerobic and anaerobic. Aerobic exercise is typical of low intensity, long duration performance in which the horse's heart rate stays below the range of 150 beats per minute. Walking would be an example of a nearly pure aerobic exercise. On the other end of the exercise spectrum are those types of high intensity, short duration such as sprinting or draft work. These types of exercise are termed anaerobic and are characteristic of heart rates above 150 beats per minute.

Most horse uses are combinations of aerobic and anaerobic exercise or fall between the intensities and durations to be classified as purely one type or the other. Detailed descriptions of exercise programs can be obtained by contacting Oklahoma Cooperative Extension Offices for OSU Facts: *F-3983 Concepts of Equine Exercise Physiology*, *F-3984 Specific Event Training Programs* and *F-9118 Monitoring Fitness of Horses by Heart Rate*.

While it is evident that different types of exercise impose distinctive demands on the horse's body, exercise in general will increase energy use for muscular activity, increase protein use if actively increasing muscle mass, increase the loss of minerals through sweat, and increase the use of vitamins for catalyzing energetic pathways.

Energy Needs for Exercising Horses

Performance horses have unique nutritional needs imposed on their bodies. Exercise can create a change in requirements for all types of nutrients; however, energy is usually the nutrient of most concern. It has long been understood that as work level increases, so does the need for more feed to supply increase in energy. However, it has been only recently that research efforts have been made to identify

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how different types of exercise specifically affect the horse's energy requirements.

During aerobic exercise, energy is supplied in part to the muscle by energy pathways that use oxygen to assist in nutrient breakdown. During anaerobic exercise, the intense demands for energy overwhelm the nutrient breakdown pathways which use oxygen; so non-oxygen using pathways must supply energy to the muscle.

Energy Containing Compounds in Feedstuffs. Energy containing compounds that are produced through nutrient breakdown include glucose and fatty acids. Glucose can be broken down aerobically and anaerobically; fatty acids rely on aerobic pathways. Energy is supplied to the body through the breakdown of protein, carbohydrates, fat, and fiber. Carbohydrates are the sugars and starches found in feedstuffs. Grains have relatively large amounts of starches as compared with forages. Carbohydrates are the major contributor for glucose. Fats supply fatty acids. Fats are found mainly in grains and grain byproducts. Protein is not considered a primary energy source in horses consuming adequate energy from other sources; however, net energy deficiencies such as fasting can cause large amounts of protein to be degraded to supply glucose to the body.

Fiber is supplied in large amounts by forages. Fiber is processed by the microbes in the horse's large intestine to produce volatile fatty acids. Volatile fatty acids are absorbed through the large intestine of the body and are used in various energy pathways in the body. Some types of these fatty acids are used exclusively aerobically, while others are processed by the liver to produce glucose which can be used anaerobically. Although fiber is not considered a source to supply large amounts of energy for quick replenishment from exercise depletion, it is an important contributor of energy throughout the day and has added benefits of assisting in proper flow of digesta through the digestive tract.

Use of Energy Containing Compounds. Horses in net negative energy load are not receiving adequate dietary replacement of energy losses resulting from exercise. In efforts to meet the energy demands, the horse will mobilize body fat to supply energy to the heart, kidney, and muscle. Glucose stored as glycogen in the liver and muscle will be mobilized, and protein will be broken down to supply glucose to the brain and constituents of the blood.

How much the different types of compounds are used for energy depends on the intensity of exercise and amounts supplied in the diet. During highly aerobic exercise such as walking, fat and carbohydrates supply the majority of the needed energy. As intensity of exercise increases, the ability of the body to use fat as energy becomes limited because of the overwhelming of oxygen dependant pathways. During highly anaerobic exercise, carbohydrates, or more accurately glucose, is responsible for supplying energy needs. The intensity of exercise which causes the oxygen using pathways to become overwhelmed varies among horses and with the physical conditioning of a specific horse. As horses become more fit, the time the horse becomes anaerobic is delayed, allowing for more efficient use of energy.

Research has also indicated the dietary supply of different types of energy containing compounds, i.e. carbohydrates and fats, can affect energy usage. Research has shown that rations containing fat at levels up to 15% can be utilized by horses. Typical examples of commercially available grain mixes with added fat contain about 14% total fat. The overall fat content would be lower than 14% when you feed the grain mix with hay or forage.

Fat added rations have benefits in supplying large amounts of energy per pound. The energy concentration in fat is about 2 1/2 times that of carbohydrates. Moreover, some evidence exists that fat added rations will assist in maintaining higher levels of glucose containing compounds for exercising horses because of increased use of fat during the aerobic part of exercise. By using more fat during the aerobic phase of exercise, the amount of available glucose for use during anaerobic exercise would be greater.

Ration Analysis of Energy Containing Feedstuffs.

Feedstuffs not only differ in energy concentration (i.e. Megacalories of Digestible Energy per pound-Mcal DE/lb), but also in the concentration of starch, fat, and fiber (Table 1). For example, corn is expected to contain about 1.6 Mcal DE/lb, 70% starch and 3% fiber while oats are expected to contain around 1.3 Mcal DE per pound, 45% starch, and 10% fiber. These relative concentrations are useful when you analyze the total intake of different rations fed at levels to meet the same digestible energy needs.

The oats and hay ration is lower in amount of starch fed per day as compared with the oat-corn ration. More of the energy in this ration would be in the form of fiber which is a slower digested energy substrate as compared with fat and

starch. This provides some basis for the subjective evidence that horses on oats and hay do not perform well during heavy conditioning or intense physical exertion. Not only does the ration require the most pounds per day of consumption to meet a specific energy need, but the lower starch level might delay replenishing of glucose containing compounds in the muscle. Combining a mixed feed with hay such as the second ration in Table 1 increases the starch content of the diet by about a pound per day. Adding fat decreases the amount of starch fed per day and increases the amount of fat.

Both fat and starch can be efficiently used as energy substrate, but the ability of each to replenish different fuels for muscular exercise is specific (i.e., fat cannot produce glucose). The added fat diet has the benefit of supplying larger amounts of a safer energy type in smaller ration amounts, thus aiding as a guard against weight loss from net negative energy load during intense conditioning programs. Whether or not athletic performance is negatively affected by the lower starch content of the added fat ration depends on the type of athletic performance, the intensity of exercise, and probably individual horse differences in utilizing the different substrate. The exact needs for different energy components of rations designed for horses performing different types of exercise are not fully agreed upon by nutritionists.

Feeding Energy. There are several considerations for supplying energy to exercising horses. First, ideal body weight and condition for maximizing performance varies between individuals and conformation types. Most successful trainers condition horses into fitness and body condition through exercise programs while maintaining generous supplies of energy instead of restricting energy intake to keep body weight off. Starch supplies the horse with a source of glucose, the energy source for anaerobic exercise. Large amounts of starch at a single feeding increase the incidence of colic and founder, so three a day feedings are recommended when you feed horses large quantities of grain. Fat supplies large amounts of energy per unit weight and is used as an energy source for aerobic exercise. Fat may have its best benefit by maintaining the horse in energy balance during the long hours of conditioning, thus sparing the amount of glucose containing compounds in the muscle for the day of performance. Mixed grain diets with and without added fat have been used successfully to meet energy demands for exercising horses. Oats used alone with hay may be deficient and adversely affect athletic performance.

Protein Requirements

Long yearlings and two year olds need protein for maintenance and growth of muscle tissue. Exercise may increase the rate of muscle deposition, thus increasing the protein demand in young, exercising horses 1 to 2% above amounts needed for maintenance and normal growth. Proteins are large compounds made of individual amino acids. Several of the amino acids necessary for muscle deposition cannot be synthesized by the horse's body, and they must be supplied by the diet. As such, the balance of these amino acids or protein quality is an important consideration for exercising horse diets. Lysine is the amino acid thought most limiting for growth in horses. Comparisons of protein and lysine requirements for different classes of horses are given in Table 2. As with energy, the protein and lysine content of different feedstuffs vary (Table 3).

Table 1. Comparison of Energy Content of Three Different Rations

Ration Description*	Pounds per Day	Starch % lb/day	Fat % lb/day
Oats + Hay	31	24 7.2	4.3 1.3
60% Oat-40% Corn + Hay	30	28 8.1	3.9 1.2
58% Oat-40% Corn-4 % added Fat + Hay	28	26 6.5	8.0 2.2

*All rations fed in a 60-40 ratio with grass hay at levels to meet an energy requirement of 35 Mcal of DE per Day.

Table 2. Protein Requirements for Different Classes of Exercising Horses with Mature Weights of 1200 Pounds

Class of Horse	Protein lb/day	%	Lysine gm/day	%
Mature, Light Work	2.0	9	34	.32
Mature, Heavy Work	3.0	10	54	.36
Long Yearling	3.0	11	60	.45
Two Year Old	3.0	10	55	.41

Table 3. Protein and Lysine Content (% as fed) of Selected Feedstuffs

Feedstuff	Protein	Lysine
Oat	12	.39
Corn	9	.25
Prairie Hay	6	—
Alfalfa Hay	18	.80
Soybean Meal	44	2.87
Cottonseed Meal	41	1.68

Most commercially prepared grain mixes are formulated for exercising horses to contain between 12 and 14% protein with soybean meal supplementing the protein in the grains. Protein deficiency in exercising horse diets should not be a concern if adequate amounts of grain mixes and hays are fed to meet energy needs. Protein quality rather than total protein content should be of more concern when you formulate rations for exercising horses. Low quality hays combined with grain mixes low in lysine can restrict muscle deposition in young horses, thus limiting athletic performance.

Vitamin Requirements

Vitamins are probably the least understood, most supplemented class of nutrients in horse rations. There are two general classes of vitamins, fat soluble and water soluble. The fat soluble vitamins are stored in the horse's body for long periods of time. Vitamins A, D, and E are the fat soluble vitamins of concern in horse rations. While recommendations do not suggest needed increases in dietary concentration of Vitamins A and D above those concentrations necessary for maintenance, the recommendation for Vitamin E concentration is increased slightly (Table 4).

Table 4. Recommended Vitamin Concentrations in Rations for Exercising Horses

Vitamin Concentration	Maintenance	Exercise
Vit A, IU/lb	910	910
Vit D, IU/lb	136	136
Vit E, IU/lb	23	36
Thiamin, mg/lb	1.5	2.5
Riboflavin, mg/lb	1	1

The B vitamins are classified as water soluble. Thiamin and riboflavin are the two B vitamins most recommended to supplement in horse rations. The microbes in the horse's large intestine produce large quantities of B vitamins, and supplementation of most is considered unnecessary. Nonetheless, because of the close relationship of B vitamins with energy supplying pathways in the body, most trainers supplement B vitamins to exercising horses.

Many commercially prepared grain mixes have vitamin premixes added at levels to meet or exceed requirements for all classes of horses. If desired, an orally administered B vitamin supplement may be added to the feed. Most supplements have combinations of vitamins and minerals, so selection and use of only one supplement is desired to decrease the chance of excess feeding. Although practiced commonly, the use of injectable sources of vitamins has not been shown to be warranted.

Mineral Requirements

The need for additional minerals in rations formulated for exercising horses is largely related to the increased mineral loss through sweat. Sweat contains appreciable amounts of sodium, potassium, chloride, calcium, and magnesium. As such, recommendations call for increases in these minerals for horses in environments or exercise conditions which promote sweating (Table 5).

Table 5. Recommended Mineral Concentrations in Ration for Exercising Horses

Mineral	Maintenance	Exercising
Sodium, %	.10	.30
Sulfur, %	.15	.15
Iron, mg/kg	40	40
Calcium, %	.21	.27
Phosphorus, %	.15	.22
Magnesium, %	.08	.11
Potassium, %	.27	.36

In general, many of the mineral needs increase slightly with exercise. The need for additional salt (sodium chloride) is of most concern. Unlike most minerals, horses can self regulate salt needs by access to salt blocks as long as there is free access to water. Trace mineralized salt blocks should supply most if not all the additional mineral needs for exercising horses, although some types of intense, prolonged work such as endurance riding may necessitate oral supplementation with liquid or paste electrolyte mixtures. A sample daily electrolyte mix would contain approximately 4 grams sodium chloride, 2 grams potassium chloride, and 0.2 grams magnesium sulfate.

Special Concerns for Feeding Exercising Horses

How nutrients are supplied to exercising horses can be more of a factor to success than what is being fed. Changes in environment, hauling, and other factors which disrupt the horse's normal schedule can cause the horse's appetite to be depressed. As such, the potential for weight loss and poor performance is increased.

Starch Overload. One area of concern when feeding large amounts of grain daily is the potential for starch overload. Large amounts of starch at one time overwhelm the capacity of the horse's stomach and small intestine. The undigested starch passes into the large intestine where the normal microbial flora digest it. Large amounts of microbial digestion of starch can lead to colic and founder. As a general rule, grain mixes should be limited to levels of 0.5% of body weight at one feeding. Therefore, the high levels of grain inherently fed to exercising horses to meet energy demands should be split into three-a-day feedings.

Timing of Feeding. Another concern among trainers is the timing of feeding in relation to exercise. It is good management to allow the horse to digest its ration at least 2 to 4 hours before beginning any physical exertion. This delay would allow the majority of nutrients to pass from the stomach to the intestines of the horse. It is not recommended to restrict the horse's ration prior to the day of exercise. Restriction of diet for longer than 6 to 12 hours prior to exercise may decrease the availability of energy and hence decrease athletic performance. Trainers should be careful not to make abrupt changes in the composition of the ration by restricting grain or hay or changing feeding times immediately prior to exercise. It is likely that the horse's schedule will become disrupted on the day of performance, and the added change of diet may cause digestive tract disorders.

Body Weight Regulation. Horses like other athletes are individuals and must be managed as such if maximum athletic performance is to be achieved. Horses can be expected to have an "ideal performance weight", and body condition will vary slightly between individuals maintaining their ideal weight. Every trainer has a subjective ability to visually determine body weight, however unnoticeable changes may be large enough to cause differences in performance. For that reason, some race tracks and training facilities provide scales. Comparisons of athletic performance at different bodyweights, weight

changes before and after performance and general trends of weight changes through a conditioning program assist the trainers in regulating the nutritional and conditioning programs for each horse.

Water. Although water was not previously discussed, it is a nutrient of vital concern to horses. Dehydration leads to decreased performance or more serious health problems causing shock and death. The only time it is recommended to restrict water intake is immediately prior to exercise and during immediate recovery from exercise when heart and respiration rates are elevated. At these times small amounts of water given frequently will guard against dehydration without increasing the potential for digestive upset. Insuring adequate water intake rather than water restriction should be more of a concern, especially in hot, humid environments or prolonged bouts of exercise.

Quality of Feedstuffs. Exercising horses must consume large amounts of feed per day to meet nutrient needs. Feedstuffs must be of high quality, clean and fresh. It is not sufficient to feed large amounts of low quality or unbalanced rations in hopes that requirements will be met.

In summary, exercise can have a dramatic effect on the nutrient requirements of horses. Exercising horses can be expected to be highly individual in their needs for different nutrients and their acceptance of different rations. Exercise can place large nutrient demands on the horse, and intense management is necessary to ensure adequate intakes of balanced rations for exercising horses. Decreased athletic performance and feed related health disorders are significant problems that must be guarded against through proper ration selection and feeding management. Nutrition is but one part of athletic performance. It may be the easiest part to control; however, it will not overcome poor genetics or conditioning programs. On the other hand, it can be optimized and should not be limiting to athletic performance.