EXTENSION

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Nutritional concerns for exercising horses

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Introduction

The horse is a unique species of livestock because its primary purpose is for pleasure or work. Equine nutritionists have long been concerned with supplying the correct amounts and types of nutrients 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 that 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 typically 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 high-intensity, short-duration workouts, such as sprinting or pulling heavy loads at maximum intensities. These types of exercise are termed anaerobic and are characteristic of heart rates above 150 beats per minute. Most equine athletic events are combinations of aerobic and anaerobic exercise or fall between the intensities and durations to be classified as purely one type or the other. While 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

Exercising horses have unique nutritional needs imposed on their bodies. Exercise creates changes in requirements for all nutrients; however, energy demands are affected the most. Exercising horses need to be fed according to the workload, which is defined by the intensity and duration of their work. The Nutrient Requirements of Horses (sixth edition) lists four categories of exercise to guide nutritional planning. These include light, moderate, heavy and very heavy. In general, energy needs increase about 20% for each category beyond maintenance needs. Therefore, horses in light exercise will require 20% more calories than adult horses at rest, moderate 40%, heavy 60% and very heavy 80% beyond maintenance requirements.

Light exercise can be described as exercising one to three hours per week with a mixture of walking, trotting and minimal cantering. A good example of this type of horse is one that is used for light trail riding on a limited basis. Energy needs increase as exercise frequency, length and intensity increase. Moderate exercise typically involves three to five hours per week with small increases in intensity. Typically, these horses are being physically conditioned or trained for some type of event. Horses will spend more time at the trot and canter and may be performing specific skill work. This could include jumping low fences, beginning work on barrels, dressage maneuvers, etc. Heavy exercise is characterized by work that requires more anaerobic work, such as jumping higher fences or more speed work, or for horses working prolonged hours. They may still be ridden the same amount of days or time, but the intensity of the exercise has increased. Examples of these types of horses include reining horses, three-day evening horse, jumpers, polo horses and some ranch horses. Energy needs for very heavy exercise, i.e. one hour of speed work with six to 12 hours of slow work, require twice the energy of a similar horse at maintenance with no exercise.

Table 1. Example energy requirements in Mcals per day for a 1,100-pound horse varying by work load.

Weight of Horse	Light Work	Moderate Work	Heavy Work	Very Heavy Work
1,100	19.6	22.9	26.2	33.9

Feedstuffs contain various compounds that supply energy to the horse. Feedstuffs are broken down by the digestive system into smaller energy containing compounds, which the body uses to supply fuel. Different types of exercise intensities affect how and which compounds will be broken down to supply energy. Aerobic levels of exercise with heart rates of 150 beats per minute or less allow for the production of energy through oxidative pathways, which require the presence of oxygen. When the cardiovascular and respiratory systems can supply sufficient oxygen for these pathways to function and match energy needs with energy production, these types of exercise are referred to as aerobic. A large variety of energy-containing substances (fatty acids, carbohydrates, amino acids, etc.) can be broken down to fuel aerobic exercise. Some substances can be broken down for energy via both aerobic and anaerobic pathways, but energy production is larger or more sustainable when aerobic metabolism can occur. Oxygen-dependent pathways alone will not meet energy needs in times of intense or prolonged work or a sudden increase in energy demand. The additional amount of energy needed during these times will be supported by anaerobic pathways. The variety of substances that can be broken down and the efficiency of energy production is less at these higher rates of exercise and cannot be sustained for long durations.

Energy containing compounds in feedstuffs

Energy containing compounds are produced through nutrient breakdown to simpler forms, such as 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 metabolism of dietary non-fibrous and fibrous carbohydrates, fat and protein. Non-fibrous carbohydrates are supplied mainly from grains, including starches and sugars, and are broken down to supply glucose for use in energetic pathways. Fats supply fatty acids. Fats are found mainly in grains and grain by-products or through direct inclusion in the diet via supplementation. Protein is not considered a primary energy source in horses consuming adequate energy from other sources; however, net energy deficiencies, can cause large amounts of protein to be degraded to supply glucose to the body. Protein will also be used for energy or stored as fat if fed in excessive quantities, as amino acids cannot simply be stored in the body.

Fibrous carbohydrates are supplied in large amounts from hays, pasture and grain by-products. 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.

Use of energy-containing compounds

Exercise increases the demand for energy, which is supplied from the breakdown of energy-containing compounds in the body. Glucose stored as glycogen in the liver and muscle will be broken down to supply energy by aerobic and anaerobic pathways. The horse will also mobilize fat stores and break down protein stores to supply energy to maintain the body and replenish losses occurring from increased use for exercise.

How much the different types of compounds are broken down for supplying energy depends partially on the intensity of exercise. Fats and carbohydrates supply the majority of energy needs during highly aerobic exercise as both these types of compounds can be broken down by oxygen-dependent pathways. As intensity of exercise increases, so does the demand for immediate sources of energy, which must be supplied from carbohydrates. The ability of the body to break down fat stores as an energy source becomes limited because of the need for oxygen in pathways that break down fat. In addition, these pathways are relatively longer and more complex, resulting in a lower rate of energy conversion, thus a sudden increase in energy demands will result in a shift to anaerobic metabolism.

Carbohydrates can be partially metabolized from pathways that do not require oxygen. Carbohydrates, or more accurately, the stored forms of glucose from carbohydrates, are the main source of energy during highly anaerobic exercise. The intensity of exercise, which causes the oxygen-dependent pathways to become overwhelmed, varies among horses and the physical conditioning of the horse. Horses that have been adequately conditioned will be able to use aerobic energy systems to a much greater extent, even with heavy demands. Horses will vary both by fitness and genetics in how they are able to use these energy systems during exercise.

The dietary supply of different types of energy-containing compounds, i.e. carbohydrates and fats, can affect energy usage. Research shows that rations containing fat at levels up to 15% can be used by horses. Typical examples of commercially available grain mixes with added fat contain about half that amount. However different processing methods, such as extrusion, allow for higher concentrations of fat. Even though some specialized fat supplements may be as high as 30% fat, forages typically have low levels of fat, and when fed together, do not exceed the recommendation of 15% total fat in the diet.

Fat added rations have benefits in supplying large amounts of energy per pound. The energy concentration in fat is about 2.5 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. It is important when using this strategy to still offer sufficient quantities of carbohydrates in the diet.

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 and fat. For example, corn is expected to contain about 1.6 Mcal DE/lb and 70% starch, while oats are expected to contain around 1.3 Mcal DE per pound and 45% starch. These relative concentrations are useful when analyzing the total intake of different rations fed at levels to meet the same digestible energy needs.

Table 2 provides a comparison of how energy-supplying compounds can vary with different rations. The rations are estimated to supply the same amount of digestible energy and contain different grain mixes with the same hay fed at the same ratios (70/30 ratio of hay to grain). The diet will meet the energy needs of an 1,100-pound horse in heavy exercise. The oats and hay ration in Table 2 requires the highest amount to be fed to meet energy needs, and the horse would have to reach its upper limits of dry matter intake at 2.5% of body weight. The addition of corn to the oats-hay ration requires 1 pound less per day in feeding and increases the nonfibrous carbohydrates (NFC). Nonfibrous carbohydrates are mainly starch and sugar compounds. Adding corn to oats increases the energy concentration of the second ration so less has to be fed. The additional nonfibrous carbohydrate from corn may enhance the metabolic efficiency to replenish glucose supplies when workloads are large or intense, or it simply may be more advantageous than the oat-hay ration because less feed is needed to supply the needed energy, it may be more cost efficient. Adding fat to the grain mix, as in the last ration, increases the amount of fat and decreases the amount of NFC fed per day. In addition, adding fat at 6% of the concentrate now requires only 27.4 pounds of feed and brings our total dry matter intake to 2.2%, which may be more easily achieved.

Both fat and nonfibrous carbohydrates 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 with using different substrates. The exact needs for different energy components of rations designed for horses performing different types of exercise are not fully agreed upon by nutritionists. However, it is generally assumed that exercise of short, high intensity is better fueled by adequate concentrations of sugars and starches, while higher fat and fiber support the slower, longer term energy pathways needed for moderate or prolonged exercise.

Table 2. Comparison of energy content of three sample rations.

Ration Description[a]	Energy density of the diet (Mcal/lb)	As fed intake lb/day	NFC[b]		Fat	
			%	lbs/day	%	lbs/day
Oats + Hay	0.9	30	24.2	7.2	3.4	0.7
Oats + Corn + Hay[c]	0.93	29	27.1	7.8	3.2	0.9
Oats/Corn/Fat + Hay[d]	0.99	27.4	25.9	7.1	4.9	1.4

a All rations fed in a 70 – 30 ration with grass hay at levels to meet an example digestible energy requirement for a 1100 lb horse in Heavy Exercise of 27 Mcals per day

b NFC – Non fiber carbohydrates which include sugars and starches.

c Corn will now be substituted for oats, and the entire concentrate will be 60% oats and 40% corn. Grass hay will still comprise 70% of the diet.

d Concentrate is now supplemented at 6% fat.

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. However, no horses will benefit by being too thin (less than BCS of 3) or overweight (BCS over 6). Horses that are too thin will not have the energy stores or muscle mass to perform, while excessive weight places undue stress on the joints, impairs thermoregulation and increases the burden on the body for work. Successful trainers condition horses into fitness and body condition through exercise programs while maintaining appropriate supplies of energy. Nonfibrous carbohydrates supply the horse with a source of glucose, the energy source for anaerobic exercise. Large amounts of nonfibrous carbohydrates at a single feeding increase the incidence of ulcers, colic and founder, so three-a-day feedings are recommended when feeding horses large quantities of grain. Ideally, meals with high levels of starch should be limited to 3 to 4 pounds per feeding. 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. Single grain sources, such as just oats or just corn, used to only supply energy may be deficient in protein, vitamins or minerals and may adversely affect athletic performance.

Protein requirements

Long yearlings and 2-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 10% to 20% 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 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 3. As with energy, the protein and lysine content of different feedstuffs varies (Table 4).

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

Table 3. Protein requirements for different classes of exercising horses with mature weights of 1,200 pounds.

Class of horse	Protein/day	Lysine gm/day
Mature, maintenance	1.4	27
Mature, light work	1.5	30
Mature, moderate work	1.7	33
Long yearling, no work	1.8	37
Long yearling, light work	1.9	37
Long yearling, moderate work	2.0	39

Table 4. Protein and lysine content (% as fed) of selected feedstuffs.

Feedstuff	Protein (%)	Lysine (%)
Oat	12	0.39
Corn	9	0.25
Prairie Hay	6	–
Alfalfa Hay	18	0.80
Soybean Meal	44	2.87
Cottonseed Meal	41	1.68

Vitamin requirements

Vitamins are probably the least understood but 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. Exercise and growth increase the estimated requirements for most vitamins; however, increasing the vitamin concentration in rations for exercising horses may not be necessary (Table 5). The increased need for vitamins may be more than met with the increased intake of ration in response to meeting energy needs.

The B vitamins are classified as water-soluble. 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, many feeds designed for performance horses will have additional B vitamins, especially thiamine and riboflavin.

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. The routine use of injectable sources of vitamins has not been shown to be warranted.

There may be some consideration for supplementation of additional antioxidants for heavily exercising horses. Additional vitamin E and vitamin C may be beneficial. Both of these vitamins act as powerful antioxidants. Vitamin E absorption does vary by source (natural versus synthetic), and sudden cessation of supplementation of vitamin C may be detrimental. It may be advisable to consult with a nutritionist before supplementing either at great quantities.

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 that promote sweating (Table 6).

Table 5. Recommended daily vitamin requirements for exercising horses with mature weights of 1,100 pounds.

Weight and Class of Horse	Vitamin A (IU/day)	Vitamin D (IU/day)	Vitamin E (IU/day)	Thiamin mg/day	Ribflavin mg/day
1,100 pounds, maintenance	15,000	3,300	500	30	20
1,100 pounds, moderate exercise	22,500	3,300	900	56.5	22
Long yearling; maintenance or in work	17,437	7,750	775	29.1	19.4

Table 6. Recommended daily mineral requirements for exercising horses with mature weights of 1,200 pounds.

Class of Horse	Calcium gm	Phosphorus gm	Sodium gm	Potassium gm	Magnesium gm
Mature, maintenance	20	14	10	25	8
Mature, moderate work	35	21	18	32	11
Long Yearling, no work	37	21	8	19	6
Long Yearling, light work	37	21	11	22	11

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. However, salt intake can vary widely among horses and should be monitored to ensure an adequate level of intake. The form of salt offered may also affect intake with loose salt typically resulting in greater intake than salt blocks. Most feeds designed for performance horses will contain additional minerals to ensure adequate intake. Owners can also offer additional salt by top dressing rations. In general, 2 tablespoons of salt will be sufficient for exercising horses but may need to be increased if working in hot and humid conditions. 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 that disrupt the horse's normal schedule can depress the horse's appetite. 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 or NFC at one time overwhelm the capacity of the horse's stomach and small intestine. High starch diets are also linked to the development of gastric ulcer disease. 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 with some researchers recommending only 0.2% to 0.4% of body weight at one time. However, it must be remembered that these values depend on the amount of starch contained within the feed. Many current horse feeds actually contain a higher concentration of fiber and may be safer to feed than traditional concentrates. However, if high levels of grain are needed for heavily exercising horses to meet energy demands, it is still recommended to be split into multiple feedings.

Timing of feeding

Another concern among trainers is the timing of feeding in relation to exercise, especially in relation to high-intensity, single-bout exercise, such as racing. It is good management to allow the horse to digest its ration at least two to four 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, therefore, 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. For horses competing in less strenuous activities, time of feeding may not be as critical, and normal routines should be maintained.

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 with maintaining their ideal weight. While body condition can be assessed visually, unnoticeable changes may be large enough to cause differences in performance. For that reason, some race tracks and training facilities provide scales. Comparison of athletic performance at different body weights, 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. Restriction of water intake until horses are cool after work is a frequently repeated myth. However, research has confirmed that offering horses water after exercise is often the best time to encourage water intake. Ensure adequate water intake rather than water restriction, especially in hot, humid environments or prolonged bouts of exercise.

Quality of feedstuffs

Heavily exercising horses must consume large amounts of feed per day to meet nutrient needs. Feedstuffs must be 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.

Peer Reviewed

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