

Feeding the Endurance Horse

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The sport of endurance riding began many years ago as a pursuit by military groups to establish the "best" horse for cavalry purposes. The first modern endurance ride, held in 1955, was a one-day, 100-mile race from Lake Tahoe, California to Auburn, California. From this beginning, thousands of endurance rides are held annually throughout the world. Most endurance rides range in distance from 25 to 100 miles per day, for one or more days, over a multitude of different terrains. An endurance horse ridden at a medium trot (250 meters/min) could potentially complete a 25-mile endurance course in about 3 hours of riding time, a 50-mile endurance course in just over 5 hours and a 100-mile course in approximately 11 hours. Given these estimates for "competition time," a tremendous opportunity exists for nutrition to influence the performance of an endurance horse. In addition, endurance horses are routinely rested and fed during the ride, further increasing the impact that proper nutrition would have on performance.

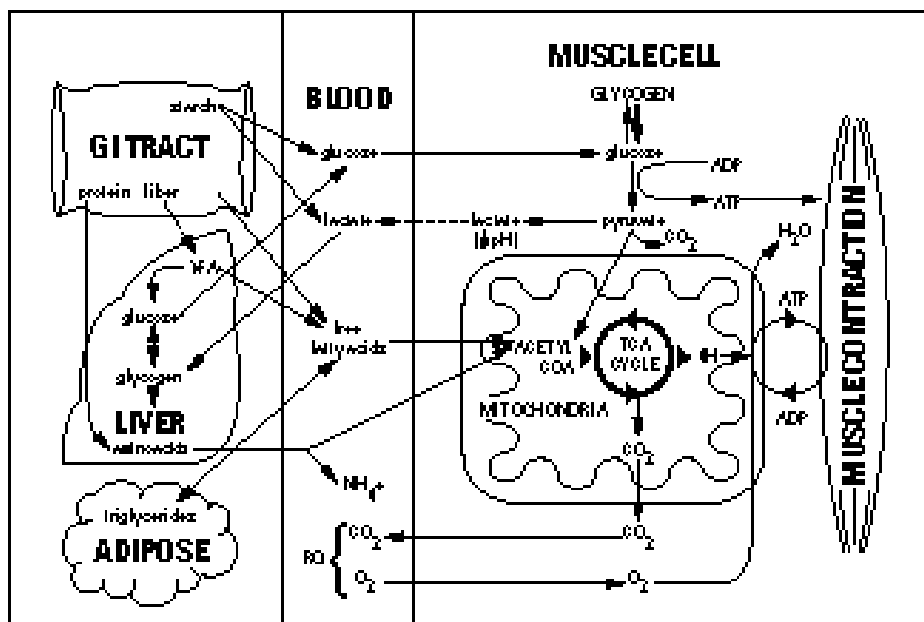
CRITICAL NUTRIENTS - There are several key nutrients that will directly influence the performance capability of the endurance horse. These nutrients include energy, electrolytes and water.

ENERGY - The main productive function in endurance horses is work. This work may vary from relatively slow speed exercise over long distances, common in 100-mile rides, to exercise conducted at faster speeds over the shorter (25- to 50-mile) endurance courses. Energy is the dietary factor that will directly influence whether an endurance horse can go the distance. Energy is not a nutrient per se, but rather a measure of a feed's potential to fuel body functions and muscle contraction during exercise. Muscle contraction, in turn, will move the legs and ultimately the horse across the ground during the ride. The endurance

horse takes in, via the digestive system, a variety of potential energy sources (fiber, starch, fat, protein) that can be used to fuel muscle contraction (Figure 1). Since horses are not able to eat continuously during a ride, feed must be digested and energy stored within the body to be used later as fuel during exercise.

STARCH - The major source of starch in a horse's diet is grain (oats, corn and barley). Starch is the dietary energy source of choice for glycogen synthesis. Its digestion results in a direct rise in blood glucose and insulin, two of the most important factors involved in glycogen synthesis. Muscle glycogen is a versatile fuel for energy generation during endurance exercise since glycogen can be metabolized either aerobically (with oxygen) or anaerobically (in the absence of oxygen). In addition, glycogen stored in the liver is available for the production and release of glucose into the blood during exercise. Maintaining blood glucose levels during exercise is of prime importance since glucose is the only fuel that is available to the central nervous system. In endurance horses, hypoglycemia (low blood sugar), as a result of prolonged exercise, can cause fatigue.

Figure 1.



FAT - Corn oil and soybean oil, along with animal fat, are the most common sources of fat in the horse's diet. These fat products contain roughly 2.25 times as much energy as an equal weight of corn, oats or barley. Numerous digestion studies have confirmed that fat is both very palatable and easily digestible. Fat is an extremely useful dietary energy source. Research studies have concluded that feeding fat to horses resulted in a greater mobilization and utilization of fat during long distance exercise. In essence, it appears horses trained their enzyme systems to utilize fat, thereby sparing the use of muscle and liver glycogen. Further, endurance horses in heavy training have a very high daily energy requirement. Often these endurance horses cannot or will not eat enough feed to meet their energy requirements. The result is a steady decrease in body condition. In these instances, adding fat will increase the energy density of the diet so that less feed is required to maintain body weight.

FIBER - Fiber, found in hay and pasture, is an energy source that is often overlooked in horse nutrition. Horses have a highly developed hindgut which houses billions of bacteria capable of fermenting large quantities of plant fiber. Volatile fatty acids (VFA), the end product of fiber fermentation, are absorbed from the hindgut and transported to the liver. Once in the liver, VFA can be converted to glucose and be stored as liver glycogen or be converted to fat, and be used immediately for energy or to fortify the body's fat stores. Therefore, fiber can be used as an energy source throughout the endurance ride since fermentation of fiber and absorption of VFA continue long after a meal has been eaten.

An endurance horse's intestinal health is critical to success. Normally, the digestive system of the horse is active, moving feed ingredients through the length of the tract. Inactivity of the digestive system during a competition, due to dehydration and/or electrolyte imbalances, can cause severe colic and even death. Diets high in fiber result in increased water and electrolyte intake. The water and electrolyte pool created by a high fiber diet can be used to combat dehydration and electrolyte imbalances which derail so many endurance horses. Another important attribute of a digestive system full of fiber is maintenance of blood flow to the digestive system during exercise. The physical presence of fiber in the digestive system will help insure that blood is not totally diverted away from the digestive system with the onset of exercise. For an

endurance horse, maintenance of blood flow to the digestive system will aid in the ability of gut tissue to remain active and could prevent colic. In addition to forage (hay/pasture) fiber sources, there are so-called "super fibers." These super fibers have the same beneficial aspects of forage fibers for maintaining gut health and fluid and electrolyte balance, but contain more energy. The additional energy is the result of both a high fiber content and a low lignin (non-digestible fiber) component. Therefore, these ingredients have more fiber available for microbial digestion. Super fibers such as beet pulp and soybean hulls contain energy equivalent to oats, but they are safer to feed because they do not produce the symptoms of grain overload from starch.

PROTEIN - If the protein intake of an endurance horse exceeds its requirement, then the extra protein can be used as a source of energy. The amino acids associated with the extra protein are broken down by the liver, and the nitrogen is excreted as ammonia. Excessive protein intake should be avoided in endurance horses for a number of reasons. Primarily, water requirements increase with increased protein intake. This can be devastating for endurance horses that typically struggle to maintain proper hydration. Second, accumulation of nitrogen end products (ammonia and urea) in the blood can lead to nerve irritability and disturbances in intestinal function and carbohydrate metabolism.

ELECTROLYTES AND WATER - In order for the horse to remain healthy and continue to exercise, heat generated during exercise must be dissipated from the body. If the horse is unable to rid itself of this heat, body temperature can rise to the point where it becomes life-threatening. For horses, the main route of heat dissipation is through a form of evaporative cooling known as sweating. In evaporative cooling, the sweat gland takes fluid from the circulatory system and secretes it out to the surface of the skin. Once the hot fluid (sweat) is on the skin, it spreads out and evaporates. This takes heat away from the body. Unfortunately, sweating also takes water and electrolytes away from the body. The average non-working horse requires two to three liters of water/kg of dry matter intake. This would equate to 20-30 liters (6 to 8 gallons) of water for a 1000 lb horse. It is thought that endurance exercise conducted in a hot, humid environment may increase the water requirement by 300 percent, making the possible total water requirement 90 liters (24 gallons per day).

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Electrolytes are substances that dissociate in solution into electrically charged particles called ions. In horses, electrolytes play an important role in maintaining osmotic pressure, fluid balance and nerve and muscle activity. During exercise, sodium (Na+), potassium (K+), chloride (Cl-), calcium (Ca++) and magnesium (Mg++) are lost in the feces, urine and sweat. Loss of these electrolytes causes fatigue and muscle weakness and decreases the thirst response from dehydration. Therefore, it is vital to replenish electrolyte losses in competitive endurance horses.

Feeding Management Strategies

FORAGE - Of the feeds offered to endurance horses, forage is by far the most important. The horse, in concert with the bacteria in the hindgut, utilizes this forage primarily for energy production. The ability of the horse to effectively utilize forages is evident if one considers that many horses are maintained on all-forage (hay/pasture) diets. Occasionally, a competitive endurance horse can be maintained solely on good quality pasture, but this is certainly the exception and not the rule. In addition to being a steady source of energy for the endurance horse, forage is essential to maintain intestinal health through maintenance of gut blood flow and provides a reservoir for both water and electrolytes. Endurance horses are well suited to free-choice access to a good quality grass hay or pasture. A mixed alfalfa/grass hay is also acceptable provided it is predominantly grass.

GRAIN CONCENTRATES - Most competitive endurance horses are unable to maintain body weight on all-forage diets. These horses need additional sources of energy that come in the form of starch, fat, fiber and protein. These energy sources are found in most commercial grain concentrates. With the information presented in this article outlining the benefits of starch for energy production, it may sound like "the more starch the better." This is NOT the case. The equivalent of 5 lb of grain is the maximum amount of starch that an endurance horse's diet should ever contain in a single meal.

There is also a limit to the amount of fat which can be added to the diet. First, from a palatability standpoint, horses will indicate when they have exceeded their peak level of fat intake by refusing to eat the feed. The threshold level of fat necessary to reach this stage varies with the horse and the type of fat; however, grain concentrates with over 20% added fat (top-dressed) are prone to feed refusal. Grain concentrates which have between 7 and 10% added fat appear optimum for endurance horses. To obtain the best results with the addition of fat to the diet, supplementation should begin during the conditioning phase of

training and continue throughout the season. A product that has become quite popular among endurance riders is rice bran because of its high fat (20%) and low starch content. Rice bran is particularly helpful at increasing the dietary fat in horses that have a taste aversion to vegetable oil. Producers Rice Mill has a product on the market now, EQUI-JEWEL, that is a high fat stabilized rice bran with calcium carbonate. The balanced calcium-to-phosphorus ratio of EQUI-JEWEL makes it particularly valuable as it will not upset the balance of a horse's total daily ration.

Just as there were limitations in the amount of starch and fat appropriate for endurance horses, so are there limits on the amount of protein. The actual protein requirement for the endurance horse is only about 8-10% of the total diet. This is much lower than is actually fed to endurance horses because there are few ingredients that are this low in protein. For example, corn contains around 9% protein, oats 11.5%, timothy hay 6-10% and alfalfa hay 15-20% protein. Therefore, it is not practical to restrict protein intake to the horse's actual requirement. Instead, protein content of the ration should be monitored and not allowed to become extremely high.

ELECTROLYTE SUPPLEMENTATION - Because of the reservoir of electrolytes found in the cecum and colon of the horse, most endurance horses do not need electrolyte supplementation on a daily basis, providing horses have time between workouts to replenish body stores. However, electrolyte supplementation may be useful on hard training rides or on particularly hot and/or humid days. Electrolyte supplementation during a competition is highly recommended, especially if it takes place in the heat and humidity. The practice of "pre-loading" electrolytes (giving electrolytes to a horse before the race) has become commonplace among endurance riders. In fact, many horses are started on electrolytes from the time they are trailered to the competition until they complete.

Not all electrolyte supplements are created equal. Many commercial electrolyte supplements consist of up to 85% sugar in the form of dextrose or sucrose. Some sugar is appropriate to aid in the absorption of the electrolyte, but more than 10% is not necessary. When a horse is in need of electrolytes, giving large amounts of sugar instead of electrolytes will not help the horse recover sufficiently from electrolyte depletion. When selecting an electrolyte supplement, the first ingredient should be salt, not dextrose. Kentucky Equine Research has developed a product called Endura-Max that has been endorsed by Dr. Jeannie Waldron, a well-known and respected endurance competitor and treatment veterinarian. Endura-Max is an oral electrolyte especially designed for horses that sweat over a long period of time. It contains high levels of calcium and magnesium required by these equine athletes. 