Horse Feeding Management

Water Intake, Sweat Production, and Electrolyte Supplementation in the Horse

Of the five basic nutrient groups—protein, carbohydrates and fats (energy sources), water, minerals, and vitamins—water is the most essential to your horse. Research has clearly shown that horses deprived of water for three to four days will not consume feed. A minor reduction in water intake or an increase in sweat loss will eventually cause dehydration, which can result in decreased performance, shock, and possibly death. This fact sheet will clarify the water requirements of your horse and provide guidelines for effective electrolyte supplementation.

Water Requirements

A horse's body consists mainly of water, which plays an important role in the following:

- Regulating body temperature
- Transporting nutrients
- Removing waste
- Digesting, absorbing, and using nutrients.

Under ideal conditions, horses should have free access to water comparable in quality to human drinking water. Water should be free of chemical contaminants, bacteria, and protozoa; acceptable levels of trace minerals and heavy metals should not be exceeded (Table 1). Numerous commercial companies and many local health departments offer water quality tests at a nominal fee.

Water intake levels vary greatly from horse to horse, depending on the dry-matter content of the diet, the environmental temperature, and the production stage or activity (Table 2). Normally, a horse will consume one gallon of water daily per 100 pounds of body weight. A 1,100 pound horse will thus consume an average of

Table 1. Recommended safe level of water contaminants[a]

Contaminant[b]	Upper safe level recommended
Arsenic (ppm)	0.2
Cadmium (ppm)	0.05
Calcium (ppm)	500
Chloride (ppm)	3,000
Chromium (ppm)	1
Copper (ppm)	1
Fluoride (ppm)	6
Hardness (ppm)	200
Iron (ppm)	0.3
Lead (ppm)	0.1
Magnesium (ppm)	125
Mercury (ppm)	0.01
Nitrate (ppm)	200
pH (ppm)	6.0-8.5
Potassium (ppm)	1,400
Selenium (ppb)	10
Sodium (ppm)	2,500
Sulfate (ppm)	250
TDS[c] (ppm)	6,500
Zinc (ppm)	15

[a] Adapted from National Academy of Sciences (1974).
[b] Contaminants listed in parts per million (ppm), except selenium, which is listed in parts per billion (ppb).
[c] Total Dissolved Solids. The sum of all constituents dissolved in water. A measurement of water quality.

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Table 2. Estimated water intake for horses[a]

Activity	Gallons/day
Non-working	4 to 8
Gestation	7 to 9
Peak lactation	9 to 11
Medium work	9 to 15
Heavy work	12 to 15

[a] Estimates based on 1,000 pound body weight and an environmental temperature of 60 to 70° F.

10 to 12 gallons of water per day.

The water content of feeds varies greatly. Most stored grains, commercial grain mixes, and hays contain approximately 10 to 12 percent water. Fresh forages in a pasture contain as much as 80 percent water. A horse requires two quarts of water per pound of dry matter consumed. Thus, a 1,000 pound horse consuming 20 pounds of hay per day would require 36 quarts or 9 gallons of water per day (20 pounds of hay consists of 18 pounds of dry matter).

Diets with an extremely high dry-matter content cause a horse to consume more water than under normal conditions. Feedstuffs such as salt, wheat bran, wheat middlings, rice hulls, beet pulp, high-mineral feeds, and fibrous (mature) hays encourage additional water intake during extremely cold weather. Horses typically reduce their water intake during cold, freezing conditions, which reduce saliva production and increase the incidence of impaction colic. Daily water intake may drop to levels as low as 0.2 gallon per 100 pounds of body weight. Such intake levels are not acceptable to maintain normal digestive-tract functioning and the moisture content of the feedstuffs undergoing digestion and transport through the gastrointestinal tract. In such instances, additional water intake should be encouraged prior to an expected dramatic reduction in water intake.

Water intake increases during hot, humid weather. Under such conditions, horses need to compensate for the additional body fluids lost in sweat. Studies have shown that increasing environmental temperature from 55 to 70° F will significantly increase the water requirements of horses: the same 1,100 pound horse that typically drinks 11 gallons per day may elevate its daily water intake to as high as 18 gallons.

Recent research indicates that horses prefer drinking-water temperature to range from 45 to 65° F. Although horses will still consume water at temperatures either lower or higher than the recommended range, they prefer a more moderate temperature. During freezing conditions, ice should be chipped and removed to maintain a more consistent water temperature. During hot weather, water tubs and buckets should be positioned in predominantly shaded areas to minimize contact with direct sunlight. Water temperature in excess of 85° F is not uncommon in water buckets during extremely hot days.

Clean water should be freely available to horses except immediately after exercise. Extremely hot horses should be hand walked until their body temperature is reduced before offering them free access to water. Ideally, exercised horses should be walked a minimum of 30 to 90 minutes before watering. During this period, horses may receive small amounts of forage and several sips of water to guard against dehydration. During exercise, the digestive system remains relatively inactive. Consumption of long-stem forage encourages increased digestive-tract motility. Hot horses that rapidly consume cold water before their body temperature reaches an equilibrium run a risk of foundering. A horse's body temperature can be monitored by palpitating the pectoral (chest) muscle and the area behind the elbow. These are typically the last areas where a horse exhibits a cooler body temperature.

Sweat Production and Electrolyte Requirements

Electrolytes are the body salts that are involved in all biomechanical functions and that play essential roles in all body cells. Specifically, electrolytes regulate body fluids, blood pressure, muscle control, and nerve activity. They are interrelated minerals

Table 3. Effect of electrolyte depletion on body functions

Sodium (Na)	Impaired muscle contraction; body fluid depletion; fatigue
Chloride (Cl)	Kidneys secrete bicarbonate which decreases blood pH; fatigue
Potassium (K)	Constriction of arteries; decreased blood flow and oxygen to muscle; fatigue
Calcium (Ca)	Over contraction of muscle (hyper-irritability); nervousness; stiff limbs
Magnesium (Mg)	Over contraction of muscle (hyper-irritability); nervousness; stiff limbs

that affect the horse's body water and pH status. When introduced into water, electrolytes dissociate into positively and negatively charged particles called ions. The electrolytes calcium (Ca+), sodium (Na+), potassium (K+), chloride (Cl–) and magnesium (Mg++) are lost in urine and primarily sweat. When deficiencies of electrolytes are severe, the consequences can be life-threatening.

During exercise, the majority of all the electrolyte losses occur in sweat. Large fluid loss can result in varying degrees of dehydration. Symptoms of dehydration vary depending upon the percentage of body fluid loss (Table 3). Horses with mild dehydration (less than 4 percent body fluid loss) will show no visual symptoms. Horses that are moderately dehydrated (4 to 9 percent fluid loss) will exhibit reduced skin elasticity, poor capillary refill in the gums, saliva reduction, sunken eye sockets, muscle weakness, and fatigue. Unfortunately, significant amounts of fluid will be lost before the tell-tale symptoms are noticed. A 1,125 pound horse with five percent fluid loss would require as much as 22.5 liters of fluid to achieve rehydration.

The electrolytes lost in body fluids affect different body functions. Electrolytes lost in sweat will appear as a foamy white, sticky substance when released from the skin. Better conditioned horses will produce a "thinner" sweat. In general, electrolyte loss contributes to fatigue and neuromuscular depression. Additional effects involving specific minerals are shown in Table 3.

The mineral requirement for performance horses is related to the amount of electrolytes lost through sweat. Mineral losses vary according to environmental conditions, the sweating rate, and the availability of minerals in the diet. Electrolyte requirements for the horse at maintenance (rest) and at various work intensities are provided in Table 4.

Environmental temperature and humidity have a direct impact on a horse's sweating rate. Under normal environmental conditions, the electrolytes provided from a forage and a grain mix, with a properly balanced mineral premix, will replenish electrolyte losses during light or moderate exercise. However, during extreme heat and humidity, horses will sweat at a higher rate and require additional electrolyte

Table 4. Daily electrolyte requirements of performance horses[a]

	Work Intensity			
Electrolyte	Maintenance	Light[b]	Moderate[c]	Heavy[d]
	Grams per day			
Sodium	10	20	50	125
Chloride	10	25	70	175
Potassium	25	30	44	75
Magnesium	10	11	14	17
Calcium	20	25	30	40

[a] Source: Pagan (1992).
[b] Examples include horses used in pleasure classes and recreational trail riding.
[c] Examples include horses used in ranch work, gymkana events, jumping, hunting, and competitive driving.
[d] Examples include race, polo, and endurance trail riding.

Table 5. Daily electrolyte requirements as a function of sweat loss

Electrolyte requirements	Sweat loss (gallons/day)				
	Rest	1.3	2.6	6.6	10.6
	Grams per day				
Sodium (Na)	10	27	43	93	142
Chloride (Cl)	10	41	71	163	254
Potassium (K)	25	34	43	70	97
Magnesium (Mg)	10	12	13	19	24

Source: Pagan (1992).

supplementation. Riding in the early morning or evening hours will minimize the effect of temperature and humidity. Supplementation is recommended when:

the environmental temperature (in degrees Fahrenheit) + the percent relative humidity > 150.

An estimate of electrolyte loss at various sweating rates is necessary to develop an adequate feeding program. Body weight lost during exercise is an acceptable way to estimate fluid loss. One kilogram (2.2 pounds) of body weight loss equals one liter (0.2642 gallons) of fluid. Determine the horse's body weight before exercise and following exercise prior to drinking. The difference in weight represents weight loss due to exercise, which can be used to estimate body fluid loss.

A horse's daily electrolyte requirement depends upon the level of exercise and the resulting sweat loss. Pagan (1992) compared fluid losses of horses at different exercise levels to electrolyte availability in a typical commercial grain and hay diet (Table 5). Most commercial grain mixes contain a trace mineral and macromineral premix or supplement. In addition, some additional electrolytes are available from the hay.

A typical 1,100 pound horse at moderate work, consuming 15 pounds of grass hay and 10 pounds of a grain mix and producing up to 10 gallons of sweat does not require additional potassium or magnesium supplementation. Sodium and chloride are the only electrolytes required through additional supplementation. When fed quality hay and a commercial grain mix properly fortified with minerals, horses excreting up to 6 gallons of fluid can meet their electrolyte requirements by having free access to table salt (NaCl).

High-protein gain mixes that provide more than the 11.5 percent protein requirement for exercising horses should be avoided. The digestion and metabolism of excess protein will raise internal body temperature and accelerate the onset of heat exhaustion, sweat production, and fatigue. Diets using fat as the predominant energy source (5 to 8 percent fat) produce less internal heat and delay the onset of heat exhaustion and fatigue.

The availability of minerals in a diet depends largely upon the sources and amounts supplied. Inorganic sources of minerals such as mineralized salt do not seem as readily available as mineral proteinates, referred to as chelated minerals. Mineral proteinates are small protein chains (peptides) which are bound to specific minerals and which improve the absorption rate. A deficiency or excess of one mineral may interact with another mineral to affect availability. To ensure that minerals are readily available to the horse, select mineral sources carefully. To minimize potential mineral interactions, avoid feeding from more than one supplemental mineral source.

Electrolyte Supplementation

A number of commercial electrolyte supplements are available. They are formulated to be fed with grain mixes to provide a specific level of each electrolyte. The overfeeding of electrolyte supplements serves no nutritional purpose since the excess electrolytes will be excreted in the urine. Two inexpensive electrolyte supplements are listed in Table 6. The

Table 6. Electrolyte supplements[a]

	Lite salt[b]	Ground limestone[c]	Table salt
	—Parts of each ingredient—		
Mixture #1	3	1	—
Mixture #2	1	1	3

[a] Provide two ounces per dosage via mouth syringe or top-dressed on grain. Provide drinking water with supplementation.
[b] 50 percent potassium chloride (KCl), 50 percent table salt (NaCl).
[c] Feed-grade ground limestone is available at most feed mills.

ingredients for the electrolyte mixes can be purchased at your neighborhood grocery, drug, or health food store. Two ounces of either electrolyte supplement could be top-dressed on grain or mixed with water and infused with a mouth syringe much like a paste dewormer. Supplementation should be given two to four hours before exercise, every two hours during exercise, and two hours after exercise. Limited drinking water should be offered with each electrolyte supplementation.

Electrolytes should not be added to the drinking water. Dehydrated horses have a reduced thirst response. They typically will not drink water containing electrolytes. Electrolyte supplementation actually helps to restore the thirst response and encourages water intake. Electrolytes can be added to the drinking water of hydrated horses, but plain water should also be available.

The health and performance of your horse can be enhanced through adequate routine intake of water. During critical periods of intense exercise resulting in excessive sweat loss, electrolyte supplementation is warranted.

Summary

- Monitor water intake daily. Modify diets to encourage water intake prior to and during cold weather. Regularly clean water buckets and automatic watering systems.
- Trace mineralized salt contains an assortment of macrominerals (sodium, chloride, magnesium, and potassium) and trace minerals (zinc, manganese, iron, copper, cobalt, and iodine). Allowing horses free access to salt in block or loose form will help to meet electrolyte requirements at moderate fluid loss. Plain salt (NaCl) can be fed free-choice with concentrates that are fortified with a trace mineral premix.
- Horses involved in intense prolonged work during strenuous environmental conditions may require oral supplementation immediately prior to, during, and following exercise.
- Maintaining proper hydration during strenuous exercise is the primary concern. Dietary mineral content or electrolyte supplementation is of secondary importance.
- Concentrate mixes fed to performance horses should contain a minimum of 1 percent salt as well as a trace mineral/macromineral premix.
- Do not exceed the protein recommendations established by the National Research Council since excess protein will increase excretion and fluid loss (see AG-558-1, Nutrient Requirements for Horses).

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For Additional Information

Other publications in this and a related series are available from your county North Carolina Cooperative Extension Center.

Horse Feed Management Series

- AG-558-1, *Nutrient Requirements for Horses*
- AG-558-2, *Estimating Body Weight of Horses*
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