Water and Electrolytes for Athletic Performance

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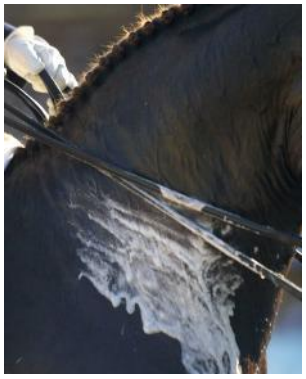
How hot is too hot?

About 75-80% of energy used in the body is given off as heat. Even at gentle exercise, heat production increases 10 to 20 times that produced at rest, and during sprinting increases 10 to 20 times. Without heat loss, this would increase the horse's body temperature about 0.6 to 0.7°C/min, or to a life threatening level within 4 to 6 minutes.

The evaporative cooling of sweat accounts for about 55 to 60%, and evaporative cooling from the respiratory tract about 25% of heat dissipation in the horse, and is greatly impaired as the humidity increases. When the sum of the ambient temperature in degrees Fahrenheit and the percent relative humidity combined are under 130, heat loss should not be a problem. When the sum exceeds 150, especially if humidity contributes over 50% of the sum, heat loss is severely compromised; and when the sum is over 180, little heat dissipation can occur. Neither equine nor human competition or exertion should occur when the value is over 170, and at values between 150 and 170 they should be done with caution. Heat loss is further impaired in the poorly conditioned horse, the fleshy horse, and the horse that still has its winter coat.

Why is sweat frothy?



Horse's sweat contains protein, whose concentration decreases after the early stages of sweating. This protein has detergent like properties that help disperse sweat droplets into a thin film along the hairs; this helps evaporation. This is the reason horse's sweat lathers. With prolonged or frequent sweating, this protein becomes depleted, resulting in a more watery sweat, more likely to run off the horse instead of evaporating and thus cooling the animal. Wiping sweat off is counterproductive, as it prevents its evaporative cooling effect, whereas putting water on the horse and enhancing its evaporation enhances cooling.

How much water does the horse lose as sweat?

The horse's maximum sweating rate is 10 to 15L/hr and is 6.5 to 9L/hr at endurance racing speeds. An extensive amount of body water is lost during athletic performance by the horse resulting in up to a 50L sweat loss, an amount equal to the horse's total blood volume. If not replaced, this would result in 7 to 11% dehydration or decrease in body weight. From 12 to 15% dehydration is fatal. Typically, body weight falls by 5-9%, mostly from evaporative losses, but the extent of the loss depends on the level of fitness and the availability of water and electrolytes during the exercise. Figure 1 below demonstrates a greater rate of bodyweight loss and of sweat production by an unfit horse than by a fit one.

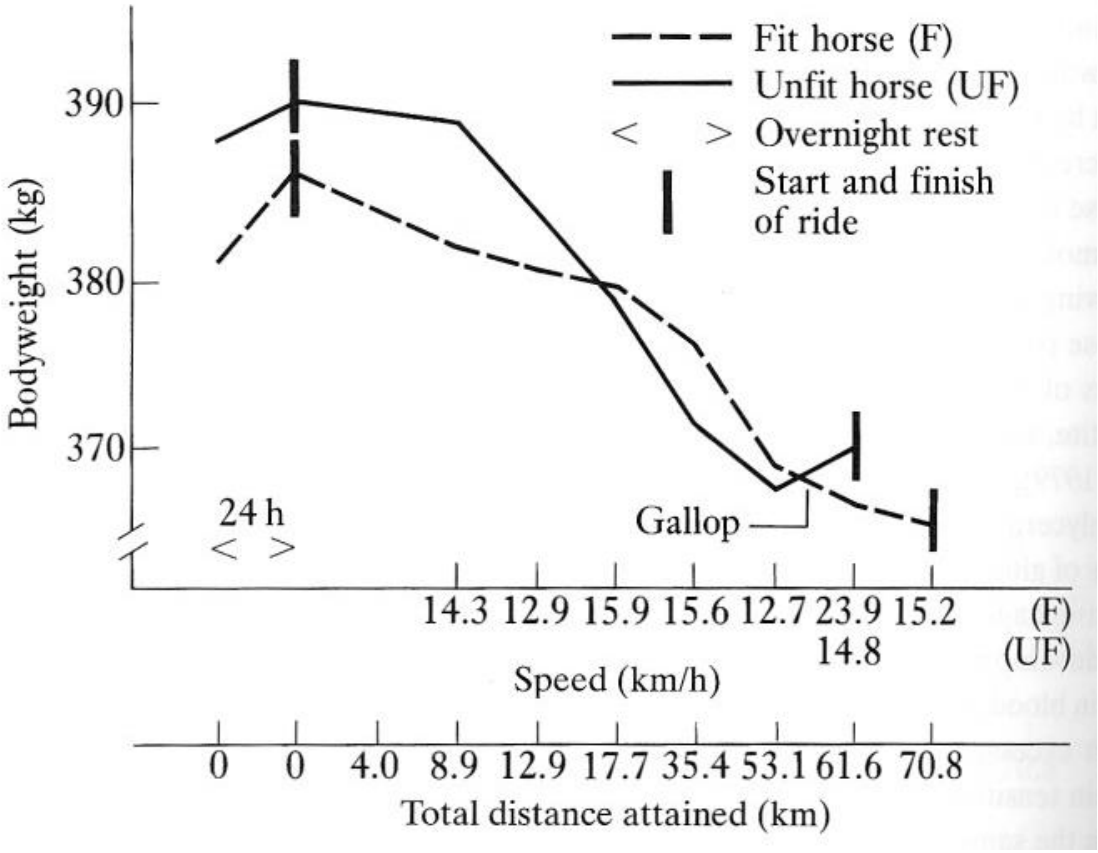


Fig 1. Effect on bodyweight of an endurance ride by a fit Arab stallion and a less-fit pony gelding in cool weather (Frape *et al., 1979,* Frape, 1998).

The effects of moderate dehydration in horses is probably similar to those in people, in which it has been shown that physical performance is impaired with fluid losses that decrease body weight by only 2 to 4%. A dehydration-induced decrease in blood volume decreases blood flow to both the muscle and the skin. Decreased blood flow to the muscles decreases muscle performance and leads to fatigue or exhaustion.

Electrolytes

Sweating results in the loss of not only water but also sodium, chloride, potassium and lesser amounts of calcium and magnesium, and if excessive may result in a significant body deficit of these electrolytes. Extended work, in hot dry weather, by a 450-500kg horse may yield losses of as much as 35L or water, 80g sodium, 59g potassium and 149g chloride. The loss of sodium, for example, represents over 200g of sodium chloride (salt) which is much more than a horse would eat in a day.

How do you know if your horse is dehydrated?

The presence of dehydration can be detected clinically by: dryness of the mucous membranes and eyes, and decreased jugular vein distensibility, rate of capillary refill, and skin elasticity. However, physical performance is reduced prior to any indication of dehydration. Dehydration of 4 to 5% or greater can de detected by delayed recoil of a fold of pinched-up skin, which is best observed in the skin over the shoulders. The skin over the neck is looser so when pinched, it stands up more readily, making it a less accurate indication of hydration. In the normally hydrated horse, a pinch of shoulder skin should return to its original position within 1 second, and capillary refill time should be less than 3 seconds. Both become increasingly delayed with increasing dehydration. With further dehydration, additional effects become noticeable, including sunken eyes, dry mouth, dry faeces and decreased urine volume. The plasma protein concentration is increased to 7.2g/dl or higher, which is a more accurate indication of dehydration than the hematocrit. A number of things may be done to minimize exercise-induced water and electrolyte deficits and, as a result, help prevent the decreased performance, fatigue, and exhaustion they cause.

Water and electrolyte deficit prevention

In contrast to many nutrients, there are no body stores of water or electrolytes other than those carried in the gastrointestinal tract. Any excess absorbed is rapidly excreted in the urine. Thus, body water and electrolyte deficits cannot be prevented by giving them before they are lost. However, severe deficits can be prevented by replacing them as they are lost. To do this, salt (sodium chloride), like water, should be always available for the horse to consume as much, as often, and whenever it wants.

Grains and chaffs are low in sodium and below that needed to meet the frequently sweating horse's needs. Fore the frequently or profusely sweating horse, loose salt may be preferred, as some horses may not lick enough from a block.

Horses need 125g of sodium and 175g of chloride (318g salt) per day of excessive sweating. The horse will consume this amount of salt if it is made available, but if it isn't, appropriately lesser amounts for shorter-duration or less-profuse sweating should be added to the grain mix at each feeding for 1 to 2 days afterwards. This amount of salt should not however, be continually present in the grain mix fed as consumption of excessive amounts of sodium is detrimental. It is recommended that if salt is added to the grain mix (which is also commonly done in premix feeds in Australia), it not exceed an amount equal to 0.5% of the total diet. If a premix feed is used as part of a ration, it is good practice to check the amount of sodium provided by the premix (details of the formulation should be shown on the back of the bag) and then calculate the amount of additional salt required. An equine nutritionist can help you with this calculation.

Excess sodium consumption increases water and potassium excretion. This, particularly in conjunction with excessive sweating-induced potassium losses, may cause a harmful potassium deficit. A low potassium concentration, decreased performance, excessive urination, and mild dehydration have been reported in Thoroughbreds and Standardbreds at stables giving excessive amounts of salt mixtures that didn't contain potassium. The potassium deficit is worsened by a high-grain-low-forage diet which will be low in potassium, as potassium is low in grains and high in forages.

Before beginning endurance-type activity, the gastrointestinal tract should contain as much water and electrolytes as possible. The gastrointestinal tract contains an amount of water and electrolytes equal to 6 to 10% of the horse's body weight, or 30 to 50L. The amount is increased by the consumption of forage and decreased by the consumption of grain or a complete pelleted feed. Thus, both water and forage consumption before, and as frequently as possible during endurance activity is beneficial in preventing dehydration and electrolyte

deficits. To encourage drinking during prolonged competition, the horse should be offered water frequently during training. It has been noted that horses that drink little during endurance races, particularly races that are long, difficult or during hot humid weather, are less likely to finish the race, or more likely to finish slowly, than horses that drink sufficiently during the race to prevent excessive dehydration. Thus, the horse's learning to drink during prolonged activity is a helpful aspect of training.

Particularly during and following exercise, cold water is preferred over warm water as it help cool the horse and is emptied from the stomach, and thus absorbed faster. Drinking even large amounts of cold water during exercise does not lead to colic or any other detrimental effects, and in contrast may be quite helpful.

During endurance activity, if the temperature and humidity are high and it is more than 1 to 2 hours between watering places, carrying 8L of water and giving it to the horse in a hat or collapsible bucket between watering places may be warranted. If doing this in competition is anticipated, is should be done during training to encourage the horse to drink. Feeding a small amount of grain as a source of glucose, and replacing electrolyte losses during endurance activity may also be beneficial for some horses. Giving electrolytes is of little benefit unless sweating, but during endurance activities, drinking a glucose-electrolyte containing solution may be more beneficial than water, as glucose and electrolytes in conjunction with water may help delay fatigue. It has been noted that providing horse's water, sodium, potassium, chloride and glucose or grain during extended work in hot weather does seem to enhance their aerobic performance capacity and delay fatigue.

Suggested electrolyte supplementation

The major electrolytes in the 6.5 to 9L/hr of sweat the horse loses at endurance speeds may be replaced by giving the horse 6 level tablespoons or 85g/hr of a mixture of equal parts common salt (sodium chloride) and "lite" salt, which is low-sodium salt, (one-half sodium chloride and one-half potassium chloride). This should be given just before, every 1 to 2 hours during and after endurance activity by mixing it into about 1L or grain mix containing molasses. The molasses in the grain keeps the salt mixture from sifting out. The grain mix not only serves as a vehicle to get the horse to eat the electrolytes needed, it also provides glucose. Following its consumption, water should be offered. Consumption of the grain and the electrolytes stimulates drinking. Instead of "lite" salt, an identical mixture can be prepared by mixing 3 parts sodium chloride and 1 part potassium chloride, although potassium chloride is generally less readily available and more expensive than "lite" salt. Either salt mixture however, is an economical way to provide the major electrolytes lost in sweat. There are several electrolyte pastes, powders and liquids marketed by the various feed companies available also. The salts should not be added to the horse's drinking water, as they will decrease most horses' water consumption and, therefore, are counterproductive. In addition, if added to the horse's water, they prevent the horse from compensating if intake of any of the electrolytes is more than that needed. Providing that clean water is available for the horse to drink to satiety, there is little or no risk of giving too much of the salt or electrolyte mixture

suggested. Whether giving them is of benefit depends on the amount of sweating-induced losses. Thus, giving electrolytes as suggested, whether needed or not, will not be harmful; if not needed, they won't be of any benefit, but if needed, they may be quite beneficial and, therefore, are recommended in situations where there is prolonged, profuse, or frequent sweating.

Feeding a high fat diet as previously discussed and good physical conditioning (both of which decrease body heat production), cooling the horse and minimizing or avoiding the factors that cause or predispose to hypothermia are also quite helpful in minimizing sweating and therefore, water and electrolyte deficits.

References

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