ELECTROLYTES, A DAILY MANAGEMENT

CATHERINE DELGUSTE, DVM, MSC, PHD, DIPL. ECEIM

Electrolytes are substances which disintegrate into ions when dissolved in water or body liquids (plasma, sweat, intra- and extra-cellular liquids). Ions can be positively charged- for example sodium (Na+), potassium (K+), hydrogen (H+), calcium (Ca++) or magnesium (Mg++) -, and are called cations. Ions can be negatively charged- for example chloride (Cl-), bicarbonate (HCO3-) or phosphate (PO4-) -, and are called anions.

Ions are involved in complex mechanisms such as the transmission of nerve impulses or muscular contractions.

These various ions play a major role in all living beings because their distribution and their maintained presence in physiological concentrations ensure the hydro-ion and acid-base balance of their body. Thus, under physiological conditions, they enable the regulation of cell hydration by osmotic effect; they keep the intra-cellular pH up on a survival base; and they ensure a trouble-free functioning of all cells and metabolisms.

The most important ions in those homeostatic functions are definitely sodium and chloride, and also potassium. Furthermore, by manipulating the plasma concentrations of these electrolytes, and considering the principle of electro-neutrality, an animal can modify its pH by the production of bicarbonate. An increase in the sodium/chloride-ratio increases the plasma pH to a level which is higher (and more basic) and which (mainly by producing lactates) is potentially more capable of neutralising the acidogenic effect resulting from the horse's effort (Waller, 2007).

Besides their major role in keeping a hydro-electric balance in the body, ions are also in charge of managing the variations in the trans-membrane potentials of the so-called

INDICATIVE CONTENT OF THE MAIN ELECTROLYTES IN EQUINE SWEAT

Electrolytes	Sweat concentration (g/L)
Sodium (Na)	3.1
Potassium (K)	1.6
Chloride (Cl)	5.3

excitable cells (neurones and muscle cells). There they are involved in complex mechanisms such as the transmission of the nerve influx or the muscular contraction (in a broad sense of the terms, i.e. not only the contraction of locomotive or respiratory muscles but also of the heart or of the muscles of the intestinal wall) via their movements in the cell membranes.

Here, calcium and magnesium are in charge of a very important task. All these ion movements are thoroughly regulated in the cell via a highly complex vector system, but they are also controlled by a global regulation system of their respective plasma concentration coming mainly from the kidney.

Frequent supplementation with electrolytes is necessary for the nutritional balance of a sport horse even if the horse's feeding is deemed adequate.

Two main characteristics of horses must be considered in relation to electrolytes. On the one hand, their digestive tract may be used as a reservoir to address the horses' extra needs in cases of high mobilisation. On the other hand, horses' sweat contains a higher concentration of electrolytes compared to other species (See above Table). Considering that horses may sweat up to 15 litres/hour (Sosa Leon, 1998), it follows that race horses' need of electrolytes is particularly high.

Additionally extreme temperature and/or moisture conditions may increase this need. Furthermore, it is important to realise that horses' basic feed – hay – is known to be rich in chloride and potassium but proportionally poor in sodium. Frequent supplementation is therefore required for the nutritional balance of any sport animal, even under conditions of adequate feeding.

The importance of electrolytes for horses was observed in cases where elite endurance horses (160 km) who reached the finish line presented signs of hyponatremia, hypochloremia, hypokaliemia and hypocalcaemia (Schott, 2006), though they had received a comprehensive supplementation during the competition.

Electrolyte losses and acid-base imbalances are also involved in the syndrome of exhaustion observed with horses (Foreman, 1998), a syndrome mainly occurring in extended heavy-load disciplines such as endurance race, full competition and hunting.

This syndrome is characterised by hyperthermia. tachycardia (a too high heart rate), tachypnea (a too low heart rate), exhaustion, anorexia, refusal of effort, dehydration, weakness, stiffness, hypovolemic shock (a shock state causing a critical decrease in the volume of blood circulating, generally as a result of severe dehydration), myopathy (degeneration of the locomotive muscles), diaphragmatic flutter ("hiccup" due to diaphragm contractions synchronic to the ones of the heart beats in cases of hypocalcaemia), atrial fibrillation (abnormal heart rhythm), diarrhoea, colic or laminitis.

In severe cases, this can jeopardise the horse's life so the effort must be stopped immediately and the horse treated by a veterinary doctor.

Giving the horses frequent physiological doses covering their daily needs seems to be preferable to occasional doses in high concentrations during competitions.

While the usefulness of electrolytes for sport horses needs no further demonstration, one main question still remains about their mode and frequency of administration. On the one hand, it has been shown that a too high concentration of electrolytes can damage the stomach wall and cause ulcers. On the other hand, while such concentrated solutions enable water consumption and, thus, the potential recovery of a reasonable volume of circulating blood during intensive efforts, there also is evidence that they cause significant temporary modifications of the acid-base balance in the body as well as acidosis which has a negative effect on performances (Sampieri, 2006).

Finally, it seems logical that a horse's digestive tract can perfectly play its role as a reservoir only if the horse's daily feeding is rich enough in these elements. For all those reasons, a frequent administration of ordinary physiological quantities corresponding to the horse's needs for its daily activities seems preferable to occasional concentrated administrations in competition times.

CATHERINE DELGUSTE DVM, MSc, PhD, dipl. ECEIM

Born on March 4, 1976 in Tournai.
Did her Doctor of Veterinary Medicine in 1999 at the ULg (PGD)
1 year mixed practical experience (dogs/horses) in various veterinary clinics in Belgium and in France; then Assistant position at the ULg since October 2000
Postgraduate thesis ("DEA") on the topic "Myoglobinurie atypique chez les chevaux au pré: une série de cas en Belgique" ("Atypical myoglobinuria in grassland horses: a case study in Belgium")
PhD in 2008 on the topic "Contribution à l'étude pharmacologique et clinique du tiludronate chez le cheval" ("Contribution to the pharmacological and clinical study of tiludronate in horses".

BIBLIOGRAPHY

Foreman JH. (1998) The exhausted horse syndrome. Vet Clin North Am Equine Pract. 14:205-19
Sampieri F, Schott HC 2nd, Hinchcliff KW, Geor RJ, Jose-Cunilleras E (2006) Effects of oral electrolyte supplementation on endurance horses competing in 80 km rides. Equine Vet J Suppl. 36:19-26
Schott HC 2nd, Marlin DJ, Geor RJ, Holbrook TC, Deaton CM, Vincent T, Dacre K, Schroter RC, Jose-Cunilleras E, Cornelisse CJ.(2006) Changes in selected physiological and laboratory measurements in elite horses competing in a 160 km endurance ride. Equine Vet J Suppl. 36:37-42
Sosa León LA. (1998) Treatment of exercise-induced dehydration. Vet Clin North Am Equine Pract. 14:159-73
Waller A, Lindinger MI. (2007) The effect of oral sodium acetate administration on plasma acetate concentration and acid-base state in horses. Acta Vet Scand. 49:38-49