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# RESEARCHES ON SERUM ELECTROLYTE EVOLUTION IN SPORT HORSES, AT TREE-DAY EVENT COMPETITION EFFORT CORRELATED WITH BIOECOECONOMIC GROWTH AND TRAINING TECHNOLOGIES

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**Abstract.** *Using horses for sport requires preparation and optimization of physical and mental qualities, both contributing to achieving the desired performance. Energy metabolism in sport horses is strongly influenced by the intensity and duration of exercise. Thus, in short duration and high intensity efforts, most of the chemical energy needed for muscle contraction is supplied by lactic anaerobic metabolism. This metabolic pathway lead to lactic acid byproduct, whose accumulation, in muscle and blood, will influence the level of serum electrolytes .These imbalances lead to muscle fatigue phenomenon.80percentage of the mechanical energy is released as heat during exercise. On horse, heat is dissipated by evaporation during exercise mainly by the evaporation of perspiration. Through this mechanism, the horse makes thermal homeostasis, but the price of electrolyte losses often important. The magnitude of these losses is linked to the needs of thermoregulation, which will be influenced by the intensity and duration of effort and the impact on the horse of environmental factors. Biological material which is the subject of research, belongs to Sport Club Dinamo-Bucharest. Were studied both mares and stallions, Romanian Sport Horse and English Pure Blood, aged 5 to 10 years, specialized and well trained for full test riding. Calcium, at the end of the full test riding decreased at all trials, correlated with the loss phenomenon of the electrolyte through perspiration. Sodium values decrease at steeple and obstacles phases. At cross phase, sodium levels increased immediately after effort. Chloride values decrease insignificant statistically at cross and obstacles and increase also insignificantly at steeple phase. Phosphorous values had also insignificant differences but they decreased after effort. These results show a good training in sport horses,but is necessary to check the diet content in minerals, because they are eliminated through perspiration.*

***Keywords***: *serum electrolytes, sport horse, tree-day event competition*

## INTRODUCTION

Using horses for sport requires preparation and optimization of physical and mental qualities, both contributing to achieving the desired performance.

Energy metabolism in sport horses is influenced by the intensity and duration of exercise. Thus, in short duration and high intensity efforts, most of the chemical energy needed for muscle contraction is supplied by lactic anaerobic metabolism. This metabolic pathway lead to lactic acid byproduct, whose accumulation, in muscle and blood, will influence the level of serum electrolytes

These imbalances, along with depletion of energetic precursors and reducing efficiency of metabolites purge, lead to muscle fatigue phenomenon.

In view of the low yields of conversion of chemical energy into mechanical energy stored in the ATP of less than 20%, it follows that the rest of 80% is released during exercise, in the form of heat. On horse, heat is dissipated by evaporation during exercise mainly by the evaporation of perspiration. Through this mechanism, the sport horses make thermal homeostasis, but the price of electrolyte losses is often important. The magnitude of these losses is linked to the needs of thermoregulation, which will be influenced by the intensity and duration of effort and the impact on the horse of environmental factors. If in short-term intensive efforts these losses are minimal, in endurance efforts (marathon, raid), water and electrolyte depletion is massive and underlying electrolyte important imbalances.

In this study we aimed to follow the dynamic of plasma major electrolytes (Na, K, Cl, Ca, P) in sport horses specializing in submaximal and maximal efforts.

## MATERIALS AND METHODS

Biological material which is the subject of research are horses belongs to Sport Club Dinamo-Bucharest, but comes from Jegălia and Cislau stud, with a total of 326 heads. The biological material used for physiological measurements were determined randomly, as represented by a total of 30 horses for sport. Were studied both mares and stallions, Romanian Sport Horse and English Pure Blood, aged 5 to 10 years, specialized and well trained for tree-day event competition (steeplechase, cross-country and jumping). Horses were observed and examined during several stages of preparation: before exercise, during training and during competition and after effort.

To eliminate errors, there was used the same ground where horses were trained daily and the same riders. For the determination of pH plasma electrolytes, venous blood samples were collected in vacuum tubes with heparin (Vacutainer®) - Li-heparin), tightly closed, avoiding the formation of bubbles and the contact with atmospheric air, an hour before the competition and immediately after the end of trial. Samples were transported on ice, in thermos (0-4 $^{o}$C) and processed within 30 minutes after collection.

## RESULTS AND DISCUSSIONS

The electrolytes values obtained were statistically analyzed, calculating the differences significance in each training phase, during competition and after effort.

Potassium is the electrolyte that increase in effort conditions in all trial phases (table 1).

Table 1. Potassium values, before and after effort, at triathlon competition

| Specification | n | Before effort | | After effort | |
|---|---|---|---|---|---|
| | | $\bar{x} \pm s_{\bar{x}}$ | v % | $\bar{x} \pm s_{\bar{x}}$ | v % |
| **Steeplechase** | 15 | 4,22 ± 0,12 | 11,22 | 4,57 ± 0,13 | 11,61 |
| **Cross-country** | 8 | 3,64 ± 0,18 | 14,42 | 4,1 ± 0,14 | 10,01 |
| **Jumping** | 12 | 4,55 ± 0,19 | 14,48 | 4,93 ± 0,19 | 13,86 |

Differences significations table, shows that, in all competition phases, after effort, there were insignificant differences (table 2)

Table 2. Differences significations of potassium, before and after effort, at the same trial of three-day event competition

| Specification | n | $\bar{X}$ before effort | $\bar{X}$ after effort | d | calculated t | table t ( t α) p<0.05 | Signification |
|---|---|---|---|---|---|---|---|
| **Steeplechase** | 30 | 4,22 | 4,57 | 0,35 | **-1,92** | **2,04** | N. S. D |
| **Cross-country** | 16 | 3,64 | 4,1 | 0,46 | **-1,94** | **2,14** | N. S. D |
| **Jumping** | 24 | 4,55 | 4,93 | 0,38 | **-1,37** | **2,07** | N. S. D |

N.S.D. – no significant differences

In addition, calcium average value decreases after effort in all three trials (table 3).

Table 3. Calcium values, before and after effort, at triathlon competition

| Specification | n | Before effort | | After effort | |
|---|---|---|---|---|---|
| | | $\bar{X} \pm s_{\bar{x}}$ | v % | $\bar{X} \pm s_{\bar{x}}$ | v % |
| **Steeplechase** | 15 | 2,99 ± 0,05 | 6,70 | 2,84 ± 0,05 | 8,17 |
| **Cross-country** | 8 | 2,96 ± 0,07 | 6,72 | 2,90 ± 0,07 | 5,82 |
| **Jumping** | 12 | 2,99 ± 0,05 | 6,39 | 2,95 ± 0,05 | 5,53 |

Significant differences analyze for calcium shows they are insignificant (table 4).

Table 4. Differences significations of calcium, before and after effort, at the same trial of three-day event competition

| Specification | n | $\bar{X}$ before effort | $\bar{X}$ after effort | d | calculated t | table t (t α) | Signification |
|---|---|---|---|---|---|---|---|
| | | | | | | p<0.05 | |
| **Steeplechase** | 30 | 2,99 | 2,84 | -0,15 | **1,94** | **2,04** | N. S. D |
| **Cross-country** | 16 | 2,96 | 2,90 | -0,06 | **0,56** | **2,14** | N. S. D |
| **Jumping** | 24 | 2,99 | 2,95 | 0,04 | **0,53** | **2,07** | N. S. D |

N.S.D. – no significant differences

Table 5. Sodium values, before and after effort, at triathlon competition

| Specification | n | Before effort | | After effort | |
|---|---|---|---|---|---|
| | | $\bar{X} \pm s_{\bar{x}}$ | v % | $\bar{X} \pm s_{\bar{x}}$ | v % |
| **Steeplechase** | 15 | 139,06 ± 0,74 | 2,07 | 137,6 ± 0,78 | 2,21 |
| **Cross-country** | 8 | 139,11 ± 0,89 | 1,81 | 141,37 ± 1,13 | 2,26 |
| **Jumping** | 12 | 140,41 ± 0,90 | 2,24 | 135,08 ± 1,11 | 2,84 |

Sodium values before and after effort, have the following trends: a slightly decreasing in steeplechase, from 139,06 ± 0,74 mmol/l to 137,6 ± 0,78 mmol/l, a little increasing in cross-country, from 139,11 ± 0,89 mmol/l to 141,37 ± 1,13 mmol/l and in jumping there was a decreasing from 140,41 ± 0,9 mmol/l to 135,08 ± 1,11 mmol/l (table 5).

As in potassium and calcium situation, in sodium there are insignificant differences in steeplechase and cross-country trials, but distinct differences in jumping trial (table 6).

Table 6. Differences significations of sodium, before and after effort, at the same trial of three-day event competition

| Specification | n | $\bar{X}$ before effort | $\bar{X}$ after effort | d | calculated t | t tabelar (t α) | | Signification |
|---|---|---|---|---|---|---|---|---|
| | | | | | | p<0.05 | p<0.01 | |
| **Steeplechase** | 30 | 139,06 | 137,6 | -1,46 | **1,35** | **2,04** | - | N. S. D |
| **Cross-country** | 16 | 139,11 | 141,37 | 2,26 | **-1,56** | **2,14** | - | N. S. D |
| **Jumping** | 24 | 140,41 | 135,08 | -5,33 | **3,71** | **2,07** | **2,81** | D.S.D. |

N.S.D. – no significant differences
D.S.D. – distinct significant differences

In steeplechase trial average values for chloride had a slightly increasing trend with 94,2 ± 1,76 mmol/l before effort and 95,26 ± 1,19 mmol/l, after effort.

In cross-country and jumping trials the average values before effort (96,36 ± 2,49 mmol/l and 97,0 ± 1,87 mmol/l) are higher than the average values registered after effort (91,12 ± 2,54 mmol/l, respectively 96,5 ± 1,76 mmol/l) (table 7).

Table 7. Chloride values, before and after effort, at triathlon competition

| Specification | n | Before effort | | After effort | |
|---|---|---|---|---|---|
| | | $\bar{x} \pm s_{\bar{x}}$ | v % | $\bar{x} \pm s_{\bar{x}}$ | v % |
| **Steeplechase** | 15 | 94,20 ± 1,76 | 7,26 | 95,26 ± 1,19 | 4,85 |
| **Cross-country** | 8 | 96,36 ± 2,49 | 7,33 | 91,12 ± 2,54 | 7,90 |
| **Jumping** | 12 | 97,00 ± 1,87 | 6,68 | 96,5 ± 1,76 | 6,31 |

Differences signification for chloride values, estimated in the same trial, before and after effort shows insignificant differences (table 8)

Table 8. Differences significations of chloride, before and after effort, at the same trial of three-day event competition,

| Specification | n | $\bar{X}$ before effort | $\bar{X}$ after effort | d | calculated t | table t ( t α) p<0.05 | Signification |
|---|---|---|---|---|---|---|---|
| **Steeplechase** | 30 | 94,20 | 95,26 | 1,06 | **-0,5** | **2,04** | N. S. D |
| **Cross-country** | 16 | 96,36 | 91,12 | -5,24 | **1,46** | **2,14** | N. S. D |
| **Jumping** | 24 | 97,00 | 96,50 | -0,5 | **0,19** | **2,07** | N. S. D |

N.S.D. – no significant differences

Phosphorus average values do not suffer important modifications before and after effort and the differences are insignificant (table 9, table 10)

Table 9. Phosphorus values, before and after effort, at triathlon competition

| Specification | n | Before effort | | After effort | |
|---|---|---|---|---|---|
| | | $\bar{x} \pm s_{\bar{x}}$ | v % | $\bar{x} \pm s_{\bar{x}}$ | v % |
| **Steeplechase** | 15 | 1,30 ± 0,02 | 8,19 | 1,30 ± 0,02 | 6,88 |
| **Cross-country** | 8 | 1,32 ± 0,03 | 7,59 | 1,31 ± 0,03 | 7,59 |
| **Jumping** | 12 | 1,27 ± 0,02 | 8,00 | 1,28 ± 0,02 | 6,53 |

Differences signification estimated in the same trial, before and after effort shows insignificant differences (table 8)

Table 10. Differences significations of phosphorus, before and after effort, at the same trial of three-day event competition

| Specification | n | $\bar{X}$ before effort | $\bar{X}$ after effort | d | calculated t | table t ( t α) p<0.05 | Signification |
|---|---|---|---|---|---|---|---|
| **Steeplechase** | 30 | 2,99 | 2,84 | -0,15 | **-0,16** | **2,04** | N. S. D |
| **Cross-country** | 16 | 2,96 | 2,90 | -0,06 | **0,17** | **2,14** | N. S. D |
| **Jumping** | 24 | 2,99 | 2,95 | -0,04 | **-0,39** | **2,07** | N. S. D |

N.S.D. – no significant differences

## CONCLUSION

Blood analyze in anaerobe effort shows an increasing values for potassium, which relate to the non-gases metabolic acidosis and excess of extracellular hydrogen. The potassium value in steeplechase, after effort, was inferior to the values found in other authors. This can be for the reason that the other authors [1, 2] were studied the gallop horses, which have different kind of training than the 3-days trial competition horses. In gallop horses, the training targets the full speed in short distances, but in 3-days trial competition horses, the training targets the medium speeds and physical resistance. Being different specialized the horses have different type of energetic metabolism (aerobe in 3-days trial competition horses and anaerobe in gallop horses). The calcium values decreases after effort, this electrolyte being lost through perspiration [4]

Although it is known that in endurance effort there are massive loss of sodium through perspiration, in cross-country trial, sodium increase from 139,11 ± 0,89 mmol/l to 141,37 ± 1,13 mmol/l after effort [3, 4, 6, 7]

These results show a good training in sport horses, but are necessary to check the diet content in minerals, because they are eliminated through perspiration


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