HAEMATOLOGICAL CHANGES INDUCED BY EFFORT IN SPORT HORSES

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Abstract

The study was conducted on 24 sport horses in best shape as result of the previous intensive training sessions. The variability of the haematological parameters was monitored in relation to the individual physiological particularities of age and sex before and after the routine training sessions. The adult horses displayed after the training exercise a 32.4% increase of the erythrocytes number, a 29.4% increase of the neutrophils number and a 23% increase of the hematocrit; the lymphocytes number decreased by 14.3%. The erythrocytes number increased after the training exercise by 18.5% in males horses and by 16.6% in female horses, the hematocrit increased by 20% in the male horses and by 16% in the female horses, while the N/L ratio increased by 56% in the males and by 26% in the females.

***Key words*:** *sport horse, adaptative capacity, haematological indices*

Introduction

The superior athletic performances of the Romanian sport horses, as force, resistance and capacity to jump over obstacles is a corollary of the functional integration of the major systems of the organism involved in the production and release of energy. Horse adaptation to standardized physical effort requires complex physiological modifications of the cardiovascular, respiratory, locomotor apparatuses, accompanied by the intervention of the neuro-hormonal activity.

Many studies (Szarska, 2001; Piccione et al., 2001; Fazio et al., 2002; Krumrych, 2006) have shown that the parameters of the training exercises (intensity, duration and frequency) determine, according to the individual reactivity, changes in the value of the haematological parameters.

The importance of this study resides in the evaluation of the efficiency by type of training exercise in relation to the adaptative potential expressed by haematological parameters.

Materials and methods

The experiment was conducted on 24 sport horses (12 males and 12 females) from a private equitation club. Two groups were formed, one consisting of 14 horses aged 3.5 to 5 years and one group consisting of 10 horses aged 5 to 8 years. These horses underwent daily exercise practices adequate to their age and stage of training. A progressive training session includes three stages. The first stage is warming up: normal walk – 10 minutes; trotting – 10 minutes; gallop alternating with trotting – 10 minutes; jumping over separate obstacles, 80-90 cm high, for 10 minutes. The second stage was the stage of intense effort in which the horses from the first group had to jump over obstacles 100-110 cm high, and the horses from the second group had to jump over obstacles 120-130 cm high along a distance of 600 m within 90 seconds, similar to the conditions of competition. The last stage was relaxation, 10-15 minutes of normal walk; over the following 15 minutes all effort ceased by rest in the stable. Before the training started (at the stable) and

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thereafter for the first 3 minutes after the effort (the stage of relaxation) and after the period of recovery, blood sample were collected from the jugular vein, in syringes on heparin. The blood was assayed on a performing haematological analyser for red blood cells (RBC), haemoglobin (Hb), hematocrit (PCV), white blood cells (WBC), neutrophils count (N) and lymphocytes count (L).

The experiment was conducted during the first decade of July 2007; the training exercises were conducted on a sandy trail, at 22-26°C, 36-48% humidity and 1012-1023 hPa atmospheric pressure.

The experimental results were interpreted with the Student test.

Results and discussions

The clinical parameters recorded before and after the effort, at the stable, were as follows: for group I – the average value of the pulse was 32 heart beats per minute and the respiration rate was 16 breathings per minute; for group II – 31 heart beats per minute and 12 breathings per minute. In the first 3 minutes after effort, group I had 82 heart beats per minute 80 breathings per minute; group II had 78 heart beats per minute 66 breathings per minute. After 30 minutes from ending the effort, group I had 38 heart beats per minute 18 breathings per minute; group II had 35 heart beats per minute 18 breathings per minute. These values characterise the optimal physical condition for competition of the horses involved in the experiment.

Important changes were noticed, for the surveyed haematological parameters, compared to the values recorded before the effort, which were induced by the intensive exercise of the training session.

Within the first 3 minutes after effort (Table 1) an increase was noticed in the value of the surveyed haematological parameters: RBC, Hb, PCV, WBC, N and L; after the end of the effort, the indicators showed a trend to return to the values they had before the training exercises. The post-exercise increase of RBC was 28.8% in group I and 32.4% in group II, which shows a faster and higher mobilization of the erythrocytes stored in the spleen of the adult trained horses adapted to physical effort. The increase of the erythrocytes count was accompanied by the 19.4% increase of the total haemoglobin in group I and 17.9% in group II, the difference between groups not being significant.

A significant increase of PCV value was observed in group II, both during the post-exercise period (23%) and during the recovery period (12.8%). This is explained by the translocation of the blood serum water outside of the vascular system, towards the muscles, due to the intensive, long training exercises (Persson et al., 1996).

The requirement of the organism for oxygen is met by a two-fold increase of the number of capillaries and arteriolar anastomoses, by the release in the peripheral blood of a higher volume of erythrocytes by the contraction of the spleen smooth muscles triggered by the increase of sympathetic vegetative nervous system activity and by the increase of the circulating catecholamines concentration. The higher number of red blood cells accomplishes an important supply of oxygen, mainly through the haemoglobin, from the lungs towards the muscles, to support the oxidative degradation of the glycogen and triglycerides during cell respiration (Kunugiyama et al., 1997).

Due to the increase of the serum corticoadrenal hormone (cortizol mainly) concentration, the process of leokocytosis appeared. The cortizol stimulates the

production of neutrophils in the bone marrow and their release into the peripheral blood (neutrophils), but it suppresses the circulating lymphocytes (lymphopenia), (Shinkai et al., 1996). During the post-exercise period, the N/L ratio increased by 58.2% in group I due to a stronger emotional stress of the younger horses and by 51% in group II.

Table 1

Hematological parameters in the sport horses
from the two groups at different ages

Haematological indices	Groups	Before effort		During the first 3 minutes after effort		At 30 minutes after effort	
		M	SD	M	SD	M	SD
RBC $10^6/mm^3$	**I**	9.7 ± 1.15		12.5 ± 1.12		10.2 ± 1.05	
	II	10.8 ± 1.05		14.3 ± 1.14		11.2 ± 1.10	
Hb g/dl	**I**	13.4 ± 1.13		16.0 ± 1.15		14.2 ± 1.16	
	II	15.6 ± 1.48		18.4 ± 1.20		15.8 ± 1.18	
PCV %	**I**	38 ± 3.56		45 ± 4.25		40 ± 3.80	
	II	39 ± 3.65		48 ± 4.62		44 ± 4.24	
WBC $10^3/mm^3$	**I**	8.5 ± 1.01		12.4 ± 1.12		9.7 ± 1.01	
	II	9.7 ± 1.12		13.8 ± 1.14		10.8 ± 1.05	
N $10^3/mm^3$	**I**	4.6 ± 0.36		6.2 ± 0.58		5.7 ± 0.48	
	II	5.1 ± 0.46		6.6 ± 0.60		5.8 ± 0.52	
L $10^3/mm^3$	**I**	2.6 ± 0.20		2.2 ± 0.28		2.3 ± 0.23	
	II	2.8 ± 0.30		2.4 ± 0.32		2.6 ± 0.24	

Table 2 shows the differences observed in the dynamics of the values of the surveyed haematological indicators. Sex-related physiological differences were notices at rest, before the effort: RBC value was 13.7% higher in the males than in the females; Hb value was 12% higher in the males than in the females; PCV value was 16.6% higher in the males than in the females.

Table 2

Hematological parameters in the sport horses according to the sex

Haematological indices	**Sex**	**Before effort**		**During the first 3 minutes after effort**		**At 30 minutes after effort**	
		M	**SD**	**M**	**SD**	**M**	**SD**
RBC $10^6/mm^3$	**M**	10.8 ± 1.03		12.8 ± 1.13		10.3 ± 1.02	
	F	9.6 ± 1.10		11.2 ± 1.12		9.8 ± 1.01	
Hb g/dl	**M**	14.8 ± 1.15		18.2 ± 1.20		15.8 ± 1.16	
	F	13.4 ± 1.12		16.3 ± 1.14		14.2 ± 1.13	
PCV %	**M**	40 ± 3.85		48 ± 4.64		44 ± 4.20	
	F	38 ± 2.88		44 ± 4.46		40 ± 3.80	

Continuing table 2

WBC $10^3/mm^3$	**M**	9.1 ± 1.01	12.8 ± 1.12	10.5 ± 1.04
	F	9.5 ± 1.02	13.4 ± 1.13	11.2 ± 1.10
N $10^3/mm^3$	**M**	4.8 ± 0.38	6.2 ± 0.46	5.0 ± 0.42
	F	5.2 ± 0.50	5.8 ± 0.58	5.4 ± 0.52
L $10^3/mm^3$	**M**	2.2 ± 0.20	1.8 ± 0.26	2.5 ± 0.22
	F	2.6 ± 0.24	2.3 ± 0.28	2.8 ± 0.30

The increased values of these indicators in the males compared to the females are determined by the presence of the steroid hormones, testosterone and cortizol particularly, which have a higher concentration in the males. The testosterone stimulates the production of erythropoietin and the cortizol reduces the number of circulating lymphocytes and stimulates the production of neutrophils (Marc et al., 2000).

No significant differences were observed during the post-exercise period in the values of the surveyed haematological parameters according to the sex. RBC value increased by 18.5% in males and 16.6% in females; Hb value increased by 23% in males and 21.6% in females; PCV value increased by 20% in males and 16% in females; WBC increased by 40,6% in males and 41% in females; N/L ratio increased by 56% in males and 26% in females.

Conclusions

1. The modifications observed in the values of the surveyed haematological and clinical parameters were generated by the intensity and duration of the exercises conducted during the training, they appeared immediately after the effort and were short and transient.

2. The evaluation of the efficiency by type of training in sport horses must consider the correlation between the individual age and sex and the variability of some haematological indicators.

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