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The European Proceedings of
Social & Behavioural Sciences
EpSBS

eISSN: 2357-1330

WLC 2016 : World LUMEN Congress. Logos Universality Mentality Education Novelty 2016 | LUMEN 15th Anniversary Edition

Research Over Blood pH Dynamic Values in Horses used in Complete Trial Competitions

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Abstract

http://dx.doi.org/10.15405/epsbs.2016.09.112

The purpose of this study was to reveal the pH content of blood in sport horses, in order to sustain the importance of equestrian sports for multidimensional education, as a interdisciplinary combination of veterinary medicine and sport. During equestrian competition, the chemical energy necessary to sustain the horse effort is synthesized in an overwhelming proportion through lactic anaerobe metabolic path. Biologic material used for research was represented by sport horses well trained for complete trials competitions (Eventing). To determine pH values, the test was conducted over 2 days (1-steeplechase and cross-country trials, 2-jumping trial). These kinds of trials require maximal and sub-maximal effort intensity and need both speed and jumping skills. From the horses participating in the test there were collected venous blood sample. The obtained values were statistically calculated and also there were determined the difference significations. pH values were based on the intensity of effort so that the maximal and sub-maximal efforts leans towards acidity (acidosis tendency), low and middle efforts towards alkalinity. The statistics allowed understanding the biochemical and physiological mechanisms that lead to poor results in horse sports. This phenomenon is common and represents a constant challenge for the physician, coach and horse owner for finding new training methods appropriate to obtain sports performance. On international level the importance of this topic is seen in the necessity of knowing the dynamic pH levels. These modifications appear during different types of training and trials. These researches lead to obtain horse performances but also to avoid illness situation.

Keywords: Cross-country; horse-jumping; pH; steeplechase; sport.

1. Introduction

Hipic sport is seen by some authors as a science or an art, but the most horse lovers consider the hipic sport as something more complex and complete, based on deep communication between horses and humans.

Hipic sports or ridding art is helping to physical development of the riders, maintaining their health and also to create good and moral features (courage, skills, optimism, and patience).

Lactic anaerobic metabolism path represents the basic source to support the chemical energy needed to develop intense effort made by the sport horses during steeplechase and cross-country trials. Sanguine pH decreasing, more pronounced in jumping horses, came to support this idea

After some authors blood pH tendency in similar conditions, is to decrease even below 7 (Snow, Ricketts & Douglas, 1983).

There were obtained differences in pH values depending on the effort intensity, so that in maximal and sub-maximal efforts the pH values tends to acidity and in low and medium effort intensity the trend is to alkalinity. It can be said that in physical effort there is a metabolic acidosis.

These kinds of effort types require an increased intake of carbohydrate energy precursors available in concentrated feed, but it must not be forgotten the negative consequences of carbohydrate hiper-feeding such as: lowering the caecum-colic pH with destruction of cellulosolytic flora and reducing of volunteer consumption of fibrouses along with consecutive decreasing of water and electrolyte intestinal reserve. These can increase the risk of dehydration during effort (Reid Hanson, Pugh & Schumacher, 1996). After some authors carbohydrate hiper-feeding favour overloading the muscle fiber in glycogen, increasing the risk of rhabdomyolysis (Beech, 2000; Ghergariu, Giurgiu &Muscă, 1997; Harris, 1998).

2. Materials and methods

To determine the blood pH the complete trial competition was carried during two days. In the first day, there was steeplechase and cross-country trials and in the second day there was horse-jumping trial. The reason for choosing these trials was the maximal and sub-maximal effort intensity and the exercises complexity, which meet both speed (over 600 m/minute) and enduring parts. Steeplechase and cross-country are the most solicitant trials in complete trial competition.

During competition the weather was sunny with an average temperature of 24°C and relative humidity of 48%. These meteorological dates were communicated by local meteorological station in the competition day. From sport horses there were taken venous blood samples in 2 ml Li-heparin vacuum tubes, 1 hour before trial and immediately after effort. There was avoided air bubbles and atmospheric air contact. The samples for pH dosing were transported to the laboratory in cooler bags (0-4 °C) and processed within 30 minutes after collection. Biologic material used for research was represented by horses from Dinamo Club-Bucharest, animals which come from Jegălia and Cislău livestock studs (table 1, fig. 1, 2 and, 3). The horses, Romanian Sport horse and English thoroughbred, were well trained for complete trials competitions (Eventing).

http://dx.doi.org/10.15405/epsbs.2016.09.112
eISSN: 2357-1330 / Corresponding Author:Eugenia Şovarel
Selection and peer-review under responsibility of the Organizing Committee of the conference

In the determination of the pH, the indicator electrode is the glass electrode and the reference one is the calomel electrode. There is measured the potential difference which occur between the two electrodes, that are immersed in researched solution and are separated from each other by a porous membrane, establishing the electromotric force of formed galvanic cell. Thus, the pH is determined by the potential difference occurring between the two electrodes, based on Nernst's equation

$$E_2 - E_1 = \frac{2,3RT}{Z_{H^+}F}(pH_2 - pH_1)$$

, where:

Z_H + is the electric charge of hydrogen ions (= 1)

F is Faraday's number

R is the universal gas constant

T is the absolute temperature in Kelvin degree

Table 1. The biological material

SPECIFICATION		Total	n	%
Breed	Romanian Race Horse Sport	15	9	60,00
	English thoroughbred		6	40,00
Age	5-10 years old	15	7	46,67
	over 10 years old		8	53,33
Gender	Males	15	10	66,67
	Females		5	33,33

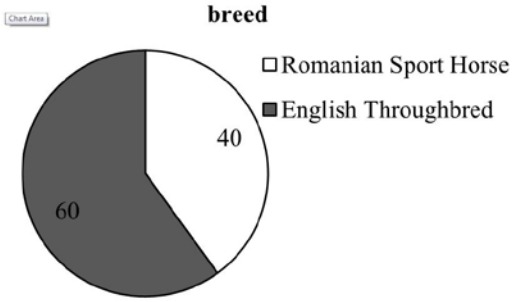

Fig. 1. The used biological material, depending on breed

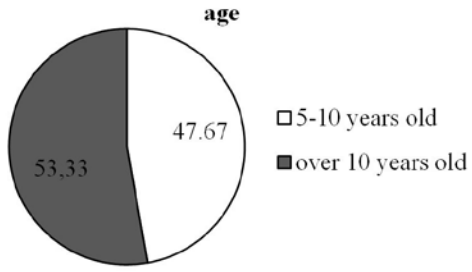

Fig. 2. The used biological material, depending on the age

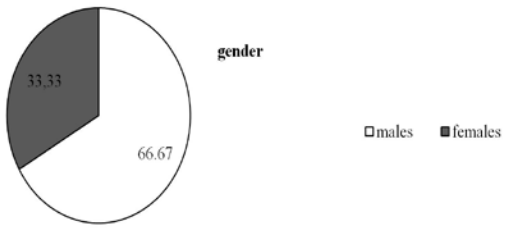

Fig. 3. The used biological material, depending on gender

3. Results and discussions

pH values in blood samples from horses were determined before and after complete trial competition (steeplechase, cross-country and jumping trials). The values were statistically analysed (table 2, fig. 4). There were also calculated the differences signification.

Table 2. Average values for pH, in horses, before and after effort, in steeplechase, cross-country and jumping trials

Specification	Before effort		After effort	
	$\overline{x} \pm s_{\overline{x}}$	v %	$\overline{x} \pm s_{\overline{x}}$	v %
Steeplechase	7,37 ± 0,006	0,36	7,16 ± 0,011	0,61
Cross-country	7,38 ± 0,01	0,49	7,16 ± 0,018	0,72
Jumping	7,37 ± 0,008	0,39	7,28 ± 0,02	1,33

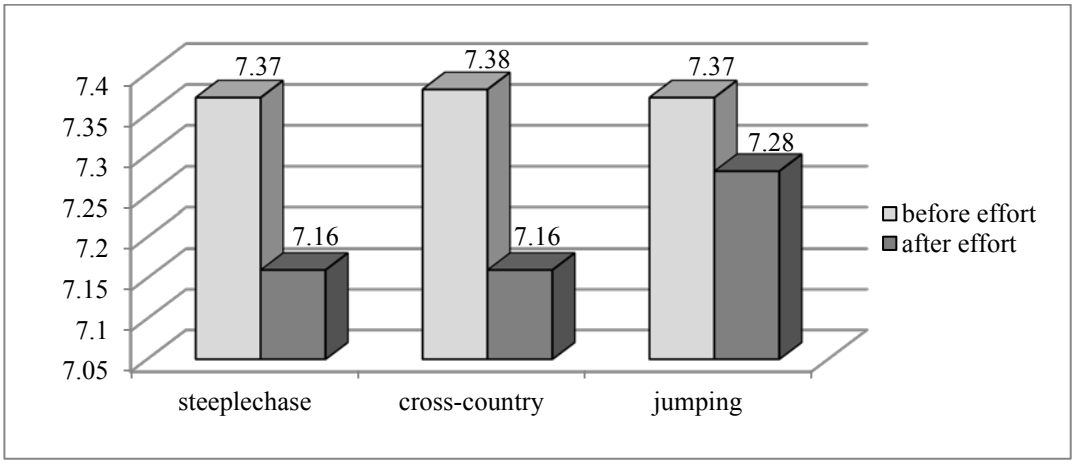

Fig. 4. Average values for pH, in horses, before and after effort, in steeplechase, cross-country and jumping trials

The pH values decrease from 7,37 ± 0,006 before effort to 7,16 ± 0,011 after effort, at steeplechase, from 7,38 ±0,01 to 7;16 ± 0,018 in cross-country. In horse-jumping, the pH value decreases a little less, from 7,37± 0,008 to 7,28 ± 0,02.

There were calculated the signification of differences for pH values before and after effort, comparing the three trials. The significant differences are presented in table 3 and 4.

Table 3. Signification of differences for pH values, before effort, in three trials

Specification		BEFORE EFFORT					
		$\overline{X}_1$	$\overline{X}_2$	d	calculated t	table t p<0.05	Signification
Steeplechase	**Cross-country**	7,37	7,38	0,01	**-0,38**	**2.08**	Insignificant differences
	Horse-jumping	7,37	7,37	0,00	**0,26**	**2.06**	Insignificant differences
Cross-country	**Horse-jumping**	7,38	7,37	-0,01	**0,53**	**2.10**	Insignificant differences

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Table 4. Signification of differences for pH values, before effort, in three trials

Specification		AFTER EFFORT							
		$\overline{X}_1$	$\overline{X}_2$	d	calculated t	table t (t α)			Signification
						p<0.05	p<0.01	p<0.001	
Steeplechase	**Cross-country**	7,16	7,16	0,00	**-0,07**	**2,08**	-	-	Insignificant differences
	Horse-jumping	7,16	7,28	0,12	**-4,34**	-	-	**3,72**	Important significant differences
Cross-country	**Horse-jumping**	7,16	7,28	0,12	**-3,18**	-	**2,87**	**3,72**	Distinct significant differences

The results show that before effort, between compared trials, the differences are insignificant

After effort, the significant differences are various depending on the compared trials. Between steeplechase and cross-country trials the differences remained insignificant, but between cross-country and horse-jumping there are distinct significant differences and between steeplechase and horse-jumping trials the differences are even very significant.

There was also calculated the signification of the differences between pH values, before and after effort, in the same trial (table 5).

Table 5. Signification of the differences between pH values, before and after effort, in the same trial

Specification	$\overline{X}_{\text{before effort}}$	$\overline{X}_{\text{after effort}}$	d	calculated t	table t (t α)		Signification
					p<0.01	p<0.001	
Steeplechase	7,37	7,16	-0,21	**16,13**		**3,67**	Important significant differences
Cross-country	7,38	7,16	-0,22	**9,69**	-	**4,14**	Important significant differences
Horse-jumping	7,37	7,28	-0,09	**3,03**	**2,81**	**3,79**	Distinct significant differences

In the same trial, before and after effort, there are very significant differences for steeplechase and cross-country trials and there are distinct significant differences for horse-jumping

Both in human sports medicine as in sports skills breeds medicine (horse, camel, dog), one has tried the scientific rationalization of training and physical activity methods, in order to objectively assess the biochemical and physiological processes which will lead to a precise dimensioning of trainings length and intensity. The blood ph changes may have an influence on the muscles activity, hence the necessity to identify the values of this parameter depending on the physical effort, so that the training intensity to be correlated with the requested sports performance. The awareness of these physiological and biochemical processes will lead to the preservment of the health status and the improvement of sports performances for the whole horse biologic material used for the equestrian performance sport, by establishing an optimal training programme (daily and monthly) with the progressive increase of the effort the animals are subjected to (the moving speed increase for the effort test or training for riding trials different stages).

The importance of this experiment is due to understanding the biochemical and physiological mechanisms that lead to poor results in horse sports. This phenomenon is common and represents a constant challenge for the physician, coach and horse owner for finding new training methods appropriate to obtain sports performance.

4. Conclusions

Analysing the result, there can be observed for all three trials, the metabolic acidosis tend for pH blood samples. The pH blood values decreased after effort compared to values before effort. Before effort the differences between pH blood values were insignificant, but after effort, in the same trial, the differences were distinct or even very significant, due to the maximal effort intensity of the trials. Between cross-country and steeplechase trials, after effort, the differences were insignificant because, the pH averages had close values, the acidosis being already set up, due to the high effort intensity. Horse-jumping trial presents the lowest differences between the pH values before and after effort. That means that this trial put the horses to a submaximal effort, compared to steeplechase and cross-country trials, but the effort has enough intensity in order for differences to obtain have distinct significations.

The data collected in this experiment allowed a better understanding of the biochemical and physiological mechanisms that lead to poor results in horse sports. This phenomenon is common and represents a constant challenge for the physician, coach and horse owner for finding new training methods appropriate in obtaining sports performance.

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