Horses' Adaption to the Training Over the Racing Season

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Summary

The aim of the paper was to show the adaptations possibilities of the younger horses in relation to older horses in training during the competition season. The training analysis has been conducted during the competition period in two repetitions. During these periods, horse training. The study involved two groups: younger horses (inexperienced) that enter the Jumping and older horses (experienced) who supposed to achieve the full development of the motor movements on the parkour. Following parameters were examined: heart rate before, during and after jumping, the temperature of the seat, and concentrations of cortisol, glucose and lactate in saliva before and after. The study showed that the analysed physiological parameters of both horses groups decreased at the end of the competitive season. The heart rate equally decreased in both groups of horses. The analysed physiological parameters in saliva were always higher in the younger group of horses compared to the older ones. Also, their concentration at the end of the competition season compared to season beginning decreased more. Monitoring of the physiological parameters in horses saliva could be recommended for evaluation of the horses' sports condition.

Key words

horses, training, heartbeat, saliva

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Introduction

Generally, training could be defined as complex process of different working activities aiming the realisation of progress in condition status as well as in oriented movements during work. In any form of the horses training, in order to avoid any health problems, it is important to find the balance between the period of work and rest. The goal of horse training is to achieve adequate horse concentration and condition for a particular sport. At the same time, the health, mental and physical status as well as longevity in horse sport and further exploitation, such as breeding needs to be preserved. During work with sport horses, the daily, weekly and monthly rhythm of the training is planned in accordance to the competitions where the horse will participate. In the Republic of Croatia, the competition calendar is created by the Croatian Horse Society (CHS, 2015; Baban et al., 2011). During the year, the horses in the jumping sport pass through three different stages: preparatory, competitive and final (Perinović and Milanović, 2013). Every stage require specific condition of the horse. Furthermore, horses are under the different training intensity in order maintain their condition or to increase it to the required level. The specificity of the jumping sport requires a specific plan and training program. The preparatory stage supposed to start in December, at the latest in January and last until the end of March. At the beginning of April, horses enter to the competition stage. At that stage, it is necessary to carry out the first control competitions that gives information about the physical and psychological readiness of the competition horses. Most of the horse racing competitions take place in June and July, when it is expected that horses are at maximum condition level (Perinović and Milanović, 2013; Gregić, 2016). Horses' condition level could be estimated by different approaches in accordance of the condition that is estimated and required accuracy of the results of estimation. Horses, in period from one to another competitive season, pass through adaptation to the transport (Schmidt et al., 2010), stress (Gregić et al., 2012, Gregić, 2016), and microclimate changes (Janczarek et al., 2015). Furthermore, horses develop the precision and strength of the motor movements necessary to overcome the parkour. In addition, they get used to the competition and the presence of the audience (von Lewinski et al., 2013). The development of techniques provides a number of possible advantages, rapid and non-invasive methods of monitoring of physiological parameters in horses. At the beginning of the century thermography becomes more accessible and begins to be applied in horse breeding. Redaelli et al. (2014) described the use of thermography in diagnosis and treatment, while Bartolomé et al. (2013) used thermography to estimate stress level in horses. Furthermore, Bobić et al. (2017) used thermography in prevention of hoof disease in cattle. Today, thermography is used in many branches of horse breeding with different goals. For instance, checking the development of the suture and the effect of the subfolder (training, competition) could be successfully determined by the thermovision (Racic, 2012). Another method, for detection of horse stress, defined by Schmidt et al. (2010) is determination of cortisol in horse saliva. Same method was used in studies by Becker-Birck et al. (2013), Ille et al. (2013), Lewinski et al. (2013), Redaelli et al. (2014), Ille et al. (2014), and Christensen et al. (2014). A widespread method for extracting saliva according to Schmidt et al. (2010) is use of the tampon with the associated storage tank. Since the lactate, which is formed in the muscles, arrives in the saliva of the horse (Covalesky et al., 1992, Kroner, 2006, Kędzierski et al., 2014, Gregić, 2016) its concertation is accurate indicator of the horses' sports condition. There are many factors that influence the concentration of lactate, such as sports condition, age, gender, breeding conditions and all of these factors needs to be taken into account during the determination of lactate concentration. Kroner (2006) determined the correlation between the physical exertion and glucose concentrations in saliva and plasma. Eckersall et al. (1985) stated that glucose is the least variable ingredient of saliva. Furthermore, heartbeat is an indispensable parameter when assessing the horse's sports condition. Technology has enabled us to easily, quickly and economically monitor the value of heart rate during training. Horses can raise their heart rate by 7-8 times, while human only get 3.5 times. Horse during the period (resting) has 30-40 beats per minute, and during maximum effort it is raised to 200-250 beats per minute (Witt, 2004). The aim of the paper was to show the adaptations possibilities of the younger horses in relation to older horses in training during the competition season.

Material and methods

Studies have been conducted on stallions that are used in jumping horse sports or on stallions that are in preparation for jumping. All the horses were healthy and were not subjected to the treatment. The horses were kept in the same conditions, in separate boxes. Horse feeding was also alike, but slightly different between the winter and the summer season. One person was concerned about the sports condition of the horses. Through the winter period horses regularly spent at least 20 minutes per day on the treadmill, occasionally at lunge and work under saddle. In their preparation, competition and final stage, training consisted of running a runway, lining, squatting and jumping. The age interval of studied horses is shown in Table 1. The study involved two groups: younger horses (inexperienced) that enter the inguinal equestrian sport and older horses (experienced) who supposed to achieve the full development of the motor movements on the parkour.

Table 1. The age structure of studied horses

Horses group	Age (interval in years)	Age structure	Number of horses
1.	4-5	younger *	n=7
2.	8-9	elder **	n=7

* inexperienced horses ** experienced horses

Training analyses were conducted in a competitive season during two periods of the same repetitions in July and September. During these periods, horse training was followed in jumping in parkour. Microclimate parameters of the environment, training space and horse accommodation was measured using a USB datalogger PCE-HT71 (PCE Instruments, England). Saliva sampling

and measurement of the back temperature were performed at the same time intervals prior to training, and immediately after training. The number of heart rate was also measured during the training. The horses during measurement and sampling were located in its standalone boxes, high bound. In each of the two periods each individual jumped with an equally set park, with eight obstacle at a height of 83 to 90 cm. There was dry sand on the ground surfaces. The equipment of horses was individual, adjusted to each horse, and the saddle pads was always cotton. Preparation and jumping parkour was always performed by the same person who cares for the sports condition of horses on the farm. Before entering a park where grooms were placed, each horse was subjected to the same warming intensity. All the horses in the competition period in two repetitions (May and September) passed the same training intensity jumping a obstacle in the course. Measurement of heart rate or heart rate per minute was performed using a heart rate monitor (Polar RS800CX N G3 clock, Polar Electro Oy, Finland), the associated equinox for equine electrodes for H2 sensor, Polar Electro Oy , Finland), and mobile clock with stationary sensor (equine health check FT1 hour, Polar Electro Oy, Finland). The results of the measurements during the training were demonstrated with the help of the associated software (polar equine software, Polar Electro Oy, Finland). The clock RS800CX N G3 polar with the associated equine belt was used before, during and after the training. The FT1 polar clock was used because of the ability to track multiple horses at a time so that all horses would be subjected to training in the same conditions. The temperature of the saddle was measured by a thermal camera (Flir and 7, FLIR Systems, Inc., Boston, USA) and additionally processed with the corresponding software (Flir and 7 software, FLIR Systems, Inc., Boston, USA). The saliva specimen was taken with the tampon (Salivette Cortisol, code blue), which was fixed with the pean, embedded in the mouth cavity of the horse, between the teeth and the cheeks, and held for about one minute and adequately stored. The concentration of cortisol in saliva was determined by ELISA kit Enzyme Linked Immunosorbent Assay (ELISA), Cortisol free in Saliva, tests (DES6611). The lactate concentrations in horse saliva were photometrical analysed on a biochemical analyzer (Beckman Coulter AU400, Japan), while the concentration of glucose in horse saliva was determined by enzymatic method on a biochemical analyzer (Beckman Coulter AU400, Japan). All determined values (n = 1708) during the conducted study were transferred to Microsoft Excel and statistically analysed in SAS/STAT (SAS Institute Inc., 2009).

Results

During the study period, maximum value of determined ambient temperature was 25°C, while the lowest determined value was 20°C. Relative humidity varied in interval 60-70%.

At the beginning of the competition season, younger horses had almost 7% higher heart rate compared to the end of the competition season, similarly as older horses. Concentration of cortisol concentrations in saliva in younger horse decreased by 18%, while in older horses experience smaller decrease (11%). The concentration of glucose in saliva at the end of the competitive season in September compared with the beginning of the competitive season (May) decreased by 8% in the younger horse group and by 5% in the older horse group. Furthermore, the concentration of lactate in saliva decreased at the end of the competitive season compared to the beginning in younger horse by 16% and in the older group of horses by 8%. The back temperature in both groups of horses was lower by 3% in September compared to May. The highest concentration of cortisol in saliva in the older horses was 3.88 ng / ml during the jumping in September. Younger horses had 31% higher values of concentration of cortisol in saliva in May compared to September (end season), while in older horses increase was lower and amounted 6.8%. The highest number of heart rate was recorded in the younger group of horses at the beginning of the competition season (217 beats per minute).

The age of horses statistically significant influenced the analysed physiological parameters. The difference in heat beat

Table 2. Basic statistical parameters of the analysed physiological parameters of horses depending on the month of measurement during the competition season

	$\bar{X}$		SD		CV		MIN		MAX	
May (running track)	Y	E	Y	E	Y	E	Y	E	Y	E
Heart (beat/min)	75.24	63.67	51.05	41.50	67.85	65.18	32	27	217	173
Cortisol (ng/ml)	1.36	0.97	1.00	0.63	73.53	65.76	0.04	0.07	4.65	2.99
Glucose (mg/dl)	56.82	34.87	69.64	38.31	122.56	109.86	0.71	0.55	361.92	166.95
Lactate (mmol/l)	1.23	0.74	0.69	0.47	56.26	64.07	0.18	0.15	3.36	2.49
T. seat (°C)	32.04	32.01	3.93	4.03	12.28	12.58	26.30	26.10	40.70	40.10
September (running track)	Y	E	Y	E	Y	E	Y	E	Y	E
Heart (beat/min)	70.30	59.10	48.12	37.48	68.45	63.42	27	27	203	171
Cortisol (ng/ml)	1.11	0.86	0.85	0.69	76.71	79.94	0.14	0.14	3.99	3.88
Glucose (mg/dl)	52.07	33.18	62.77	33.73	120.54	101.66	0.91	0.59	342.19	125.95
Lactate (mmol/l)	1.03	0.68	0.52	0.38	50.19	56.59	0.36	0.10	2.54	2.51
T. seat (°C)	31.08	31.66	4.18	3.77	13.44	11.90	24.10	26.50	40.70	40.00

Y – younger, E – elder, $\bar{X}$ – mean value, SD – standard deviation, CV – variation coefficient, MIN – minimum, MAX – maximum, Younger – horse age group 4 -5 years old, Elder – horse age group 8 – 9 years old, T. seat (°C) – temperature of the seat

Table 3. The effect of age on the analysed physiological parameters of horses

Physiological parameters /age group	Younger	Elder	p
Heart (beat/min)	72.77	61.38	**
Cortisol (ng/ml)	1.23	0.91	***
Glucose (mg/dl)	54.44	34.02	***
Lactate (mmol/l)	1.13	0.71	***
T. seat (°C)	31.56	31.83	*

*p<0.005; **p<0.001; ***p<0.0001

between the younger and older horses was significant (p<0.001) and amounted 11.39 beat/minute (almost 16%). Younger horses on average have a higher heart rate than older, but in this study, this is largely a difference due to the state of condition of the horse. The younger horses are inexperienced with less sporty condition for the show jumping in comparison to older horses that gained experience and condition through the previous three to four competition season.

Furthermore, age statistically highly significant (p<0.0001) influenced analysed physiological parameters in saliva (concentration of cortisol, glucose and lactate). The highest differences were determined in glucose concentration. That is, glucose concentration was 37% higher in younger horses in comparison to older ones. Furthermore, younger horses had statistically highly significant (p<0.0001) higher concentration of lactate in saliva in comparison to elder horses. Higher lactate concentration indicate lower muscle condition of horses. Also, highly significant difference (p<0.0001) in cortisol concentration between the tested groups was determined with lower concentration determined in older more experienced horses (0.32 ng/ml). Younger, unexperienced horses experience training with 25% more effort comparable to the older group. When all of the analysed parameters (with exception of suture temperature) it could be pointed out that younger horses have 30% more demanding training in comparison to the older ones.

Discussion

The analysis of the training at the beginning and end of the competition season were carried out under the same microclimate conditions, so the impact of the environment on the differences between the horses was excluded. According to Janczarek et al. (2015) the air temperature up to 25°C do not affected the horse's organism. In accordance to Lindera (2010), heart rate and concentrations of lactate, glucose and cortisol in the horse's body are changing during the training period from season to season. In this research, during one competitive period, a decrease of all analysed traits was determined. The horses (younger end elder) were in the similar conditions in parkour in both repetitions (May and September). The results showed the real status of the horse's condition at the beginning and at the end of the competitive season without any additional environmental impacts. In this researc, horses regardless the age at the end of the season had a 7% lower heart rate, while the cortisol concentration in saliva was higher for 7% in younger than the older horses. Research by Christensen et al. (2014) reported no difference in the concentration of cortisol depending on the elements of training, while Ille et al. (2013) and Ille et al. (2014) found the difference in cortisol concentrations. In this research, the cortisol concentrations as leading stress indicator decreased in both groups of horses. In the younger group of horses, cortisol concentrations decreased by 18% in September compared to May due to adaptation tournament conditions. In the study Bartolomé et al. (2013), the younger horses also experienced the tournaments more stressfully. The highest concentration of cortisol in saliva in the older group of horses was 3.88 ng/ml during the parkour in September, indicating individual animal reactions to certain known situations. The temperature of seat, during May, was slightly higher in the younger horses compared to the older one. In September, seat temperature, equally decreased in both groups. The seat temperature does not indicate the condition of the horse because it is mostly affected by microclimates. The various actions in training horses differently heat individual muscle groups (Redaelli et al. 2014). In the study Bartolomé et al. (2013), younger had a higher eye temperature (measured by a thermal camera) compared to older horses as well as higher heart rate during the challenges of a tournaments. Similarly to results of that study, a higher number of heartbeats in younger horses compared to the older ones was also observed in this research. Von Lewinski et al. (2013) conclude that the presence of the viewers causes greater stress in horses. In this study, horses faces the parkour for the first time in May which was unknown situation. The horses jumped the same parkour that was more demanding for younger horses due to the first competitive season compared to the older ones who experienced several seasons of the competition. The concentration of lactate in saliva was higher in younger horses compared to older horses. Kędzierski et al. (2013) determined the changes in the concentration of lactate in saliva racing horses racing, and recommended it for evaluation of the work efficiency. In this study, according to the concentration of lactate in saliva, younger horses through season gained better competition condition for parkour, while the older horses improved their condition.

Conclusion

The study showed that the analysed physiological parameters of both horses groups decreased at the end of the competitive season compared to the start of the competitive season. The heart rate equally decreased in both groups of horses. The analysed physiological parameters in saliva were always higher in the younger group of horses compared to the older ones. Also, their concentration at the end of the competition season compared to season beginning decreased more. Monitoring of the physiological parameters in horses saliva could be recommended for evaluation of the horse's sports condition.

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