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Pulse changeability of trotters depending on motion pace

Zmienność tętna kłusaków w zależności od tempa ich ruchu

Summary. This study has attempted to define the influence of movement pace of trotters onto their heart rate (HR). This influence is one of the basic problems in the selecting of training methods. Additionally, the pace level was determined to keep the horse's organism on the level of safe oxygen transformations. A telemetric recorder of heart rate was used in the research to define the HR in trotters within the movement pace between 15 and 35 km/h. Based on the analysed cases, three levels of HR scores were distinguished: 100–140 beats/minute „safe", 141–170 beats/minute „threatening" and over 170 beats/minute „dangerous". An increase of movement pace causing the growth of HR in trotters was noted, which was proved by average HR scores in particular speed ranges as well as the correlation coefficient. Their range was significant at $P \leq 0.01$ in each case and reached the level between 0.785 and 0.951 (mares) and 0.849 to 0.984 (stallions). Trotters' sex did not have a decisive influence on the pulse level at work with changing velocity, which mainly pertained to the second and third levels. Minimum velocity ranges causing anaerobic transformations in the organism were also distinguished. Based on that, it was established that training which includes the speed up to 17.5 km/h should keep the organism on the level of oxygen transformations. The threat of organism acidifying may occur at 18–21.5 km/h and anaerobic conversion may occur at 22 km/h.

Key words: trotters, training, pulse

INTRODUCTION

An early evaluation of the racing predispositions of horses is necessary in the case of all forms of their utilization [Novikov 1994, Thery 1981]. Taking care of the good shape of these animals, combined with appropriate training, can ensure reaching a success. Maintain a good shape is, on the one hand, the combination of selected training methods and trainer's experience but, on the other, it is a possibility of an objective and accurate analysis of the training degree, capacity level and overall health of the organism [Szarska 1990, Evans *et al*. 1996, Janczarek 2003, Podolak *et al*. 2004].

One of the simplest methods of this kind of evaluation is to register and analyse the rest, effort and restitution HR using telemetric recorders [Melerecki 1981, Kaproń *et al*. 1999]. This type of characteristics should be particularly useful in the case of breeding trotters, whose specification of training depends on an early start to work, a lot of training and participation in numerous races together with many years of courage attempts on race – courses [Thery 1981, Saastamoinen and Ojala 1991]. This kind of utilization causes a necessity to care for and control the functioning of such horses [Clayton 1991]. There have been some studies of the relationships between physiological variables and trotters race performance [Courouce *et al*. 2002, Leleu *et al*. 2005]. Various measurements such as heart rate during exercise and blood lactate level after exercise may be registered on the track and lead to the calculation of physiological variables such as V_{200} (velocity corresponding to a 200 bpm heart rate) and V_4 (velocity corresponding to a 4 mmol/l blood lactate level). However, to perform the exercise tests for assessing V_{200} or V_4 in horses, the velocity of trot should exceed 36 km/h [Courouce 1999]. This speed can be too high for young horses, which start their training process [Kędzierski *et al*. 2007b].

Taking the above reasons into consideration, an effort has been made in this research to define the influence of the motion pace of the trotters on their HR, which is one of the basic problems in the selection of appropriate training methods. Moreover, it has been the aim of this study was to define the level of pace used in daily training routine, which maintains the horse organism on the level of safe oxygen conversion.

MATERIAL AND METHODS

Research included 51 stallions and 50 mares of the Danish and German Standardbred trotters. The age of investigated horses, which were in the initial training phase of races within soulky courage attempts, was between 18 and 22 months. Training was held on sandy tracks in West Poland centres. The HR and corresponding pace were registered with the use of Finnish telemetric HR recorders POLAR ELECTRO OY S 725 with a built – in speed sensor. During the registration of the above parameters, trotters moved on a special straight part of the track with an increasing speed between 15 and 35 km/h (velocity blocks I from 15 to 20 km/h; II – from 20.5 to 27 km/h; III from 27.5 to 35 km/h). The measurement apparatus were working together with the Polar Precision Performance programme, allowed to read the HR value in successively increasing speed ranges (every 0.5 km/h). Data analysis was done based on three pulse ranges:

– range I from 100 to 140 beats per minute, safe, based in oxygen conversion,

– range II from 141 to 170 beats per minute, "treatening" which could arise anaerobic conversion,

– range III, over 170 beats/min. "dangerous" bringing about anaerobic conversion [Melerecki 1981, Art and Lekeux 1993, Barrey *et al*. 1993].

The results were subject to statistical characteristics. Comparisons between the means of HR obtained for following pace speeds were done using Tukey's t-test (Statistica 6.0). Relations pace – HR scores were calculated by using simple correlations; the per cent figures of the above arrangement were also prepared.

RESULTS

In the analysed speed ranges, HR fell between 98.39 (pace to 15 km/h) and 191.16 beats/minute (pace 35 km/h). For BLOCK I of movement speed (Tab. 1) the highest level was 138.65 beats/minute and within the BLOCK II (Tab. 2) – 169.87 beats/minute. Statistically significant differences were not found for the first two pace ranges (15 and 15.5 km/h), 5 pace ranges of BLOCK II or 5 ranges of BLOCK III (Tab. 3).

Table 1. Statistical characteristics of pulse of analysed trotters in BLOCK I of movement speed
Tabela 1. Statystyczne cechy tętna badanych kłusaków w bloku I szybkości ruchu

Speed Szybkość	Stallions – Ogiery		Mares – Klacze		Together – Razem	
	x	S	x	S	x	S
15.0	96.24	8.11	99.56	6.82	98.39A'	8.11
15.5	98.78 A	6.59	100.54 A	7.46	99.65 A'	6.59
16.0	101.75 B	6.75	102.62 B	6.96	102.18	6.75
16.5	106.65 C	6.33	107.90 C	7.48	107.27	6.33
17.0	109.16 D	6.00	109.48 D	7.50	109.32	6.00
17.5	113.53 E	6.53	114.44 E	7.08	113.98	6.53
18.0	119.73 F	8.57	121.26 F	7.72	120.49	8.57
18.5	126.41 G	7.75	127.62 G	8.33	127.01	7.75
19.0	134.19 H	7.90	137.58 H	9.66	134.7	7.90
19.5	136.12 I	7.22	136.12 I	8.37	136.84	7.22
20.0	138.78 J	8.49	138.52 J	8.97	138.65	8.49

Means with the same letter (AA, BB… – in versus, A'A'… – in columns) are not significantly different
Średnie oznaczone tą samą literą (AA, BB… – w przeciwieństwie do A'A'... w kolumnach) nie różnią się istotnie

Each time, HR increase accompanied pace increase of trotters. On analysing these changes, the first level of HR was found for all the horses, ranging between 15 and 20 km/h (BLOCK I). It was observed that increasing the pace by 0.5 km/h caused the pulse increase by about 2.7%, and the smallest changes were found for speed values within 15–17 km/h. The second level was exceeded at the speed of 20.5 km/h where the average HR of the examined horses amounted to 140.83 beats/minute and gradually increased, approaching Level III at 27 km/h (169.87 beats/minute). Increasing the speed by another 0.5 km/h caused the exceeding of the HR by 170 beats/minute, which was automatically defined as the beginning of Level III. The last speed range was closed by the HR value equal to 191.16 beats/minute (v = 35 km/h).

Table 2. Statistical characteristics of pulse of analysed trotters in BLOCK II of movement speed
Tabela 2. Statystyczne cechy tętna badanych kłusaków w bloku II szybkości ruchu

Speed Szybkość	Stallions – Ogiery		Mares – Klacze		Together – Razem	
	x	S	x	S	x	S
20.5	141.02 A	9.07	140.64 A	9.44	140.83	9.21
21.0	143.78 B	8.95	143.5 B	9.96	143.64	9.42
21.5	147.33 C	9.49	147.34 C	9.38	147.34	9.39
22.0	150.61 D	10.32	150.78 D	9.56	150.69	9.90
22.5	154.90 E	10.38	154.8 E	9.48	154.85	9.89
23.0	157.84 F	10.58	157.96 F	9.93	157.90	10.22
23.5	161.61 G	10.22	162.04 G	9.35	161.82	9.75
24.0	165.78 H	9.79	165.66 H	8.87	165.72 A'B'C'	9.30
24.5	165.08 I	8.63	165.34 I	8.03	165.21 A'B'C'	8.29
25.0	165.47 J	8.64	166.30 J	7.51	165.88 A'B'C'	8.07
25.5	166.75 K	8.43	167.64 K	7.97	167.19	8.18
26.0	167.78 L	8.32	168.70 L	8.23	169.24 D'	8.25
26.5	169.12 M	8.46	170.16 M	8.18	169.63 D'	8.29
27.0	169.75 N	7.91	170.00 N	8.41	169.87 D'	8.12

Means with the same letter (AA, BB… – in versus, A'A'… – in columns) are not significantly different
Średnie oznaczone tą samą literą (AA, BB... – w przeciwieństwie do A'A'... w kolumnach) nie różnią się istotnie

Table 3. Statistical characteristics of pulse of analysed trotters in BLOCK III of movement speed
Tabela 3. Statystyczne cechy tętna badanych kłusaków w bloku III szybkości ruchu

Speed Szybkość	Stallions – Ogiery		Mares – Klacze		Together – Razem	
	x	S	x	S	x	S
27.5	170.61 A	8.02	171.18 A	7.18	170.89A'	7.58
28.0	170.86 B	7.95	172.42 B	7.37	171.63A'	7.67
285	172.29 C	8.02	1733 C	7.64	172.79	7.81
29.0	173.24 D	8.42	174.5 D	7.85	173.86	8.13
29.5	175.20 E	8.19	175.54 E	7.83	175.01	7.98
30.0	176.70 F	8.18	176.94 F	7.99	176.99 B'C'D'	8.05
30.5	176.82 G	7.23	176.72 G	7.10	176.77 B'C'D	7.13
31.0	177.47 H	6.76	177.38 H	7.39	177.13 B'C'D	7.05
31.5	178.67 I	6.91	178.26 I	7.34	178.47	7.09
32.0	179.63 J	7.18	179.26 J	7.09	179.45	7.11
32.5	180.27 K	6.72	180.6 K	6.83	180.44	6.74
33.0	181.75 L	6.76	181.28 L	7.00	181.51	6.85
33.5	182.96 M	6.33	182.64 M	6.83	182.80	6.55
34.0	183.86 N	6.86	184.86 N	6.72	184.36	6.78
34.5	187.59 O	6.86	188.42 O	5.68	188.00	6.28
35.0	191.04 P	6.22	191.28 P	5.31	191.16	5.76

Means with the same letter (AA, BB… – in versus, A'A'… – in columns) are not significantly different
Średnie oznaczone tą samą literą (AA, BB… – w przeciwieństwie do A'A'... w kolumnach) nie różnią się istotnie

Table 4. Percent share of analysed horses with approximate pulse range in particular speed ranges
Tabela 4. Procentowy udział badanych koni z przybliżonym zakresem tętna w poszczególnych zakresach prędkości

Speed Szybkość	Pulse – Tętno										
	≤100	101–110	111–120	121–130	131–140	141–150	151–160	161–170	171–180	181–190	>190
15.0	64	28	8	-	-	-	-	-	-	-	-
15.5	64	25	11	-	-	-	-	-	-	-	-
16.0	50	39	11	1	-	-	-	-	-	-	-
16.5	25	44	31	1	-	-	-	-	-	-	-
17.0	11	45	40	5	-	-	-	-	-	-	-
17.5	1	34	49	17	-	-	-	-	-	-	-
18.0	-	13	39	40	6	3	-	-	-	-	-
18.5	-	3	23	43	28	4	-	-	-	-	-
19.0	-	-	6	26	47	16	5	1	-	-	-
19.5	-	-	1	20	48	23	9	-	-	-	-
20.0	-	-	1	15	44	29	12	-	-	-	-
20.5	-	-	1	13	43	26	16	2	-	-	-
21.0	-	-	-	7	32	36	22	4	-	-	-
21.5	-	-	-	3	25	34	29	10	-	-	-
22.0	-	-	-	1	15	32	35	15	3	-	-
22.5	-	-	-	-	8	24	42	21	6	-	-
23.0	-	-	-	-	5	15	41	29	11	-	-
23.5	-	-	-	-	3	10	28	44	15	1	-
24.0	-	-	-	-	-	6	22	46	18	9	-
24.5	-	-	-	-	-	5	22	51	21	2	-
25.0	-	-	-	-	-	3	19	52	21	5	-
25.5	-	-	-	-	-	2	16	50	27	6	-
26.0	-	-	-	-	-	1	8	55	26	10	-
26.5	-	-	-	-	-	-	11	47	31	12	-
27.0	-	-	-	-	-	-	9	50	32	8	2
27.5	-	-	-	-	-	1	4	43	42	11	-
28.0	-	-	-	-	-	-	4	41	45	11	-
28.5	-	-	-	-	-	-	5	34	50	9	3
29.0	-	-	-	-	-	-	3	34	42	19	3
29.5	-	-	-	-	-	-	1	30	46	21	3
30.0	-	-	-	-	-	-	1	18	49	26	7
30.5	-	-	-	-	-	-	-	19	54	25	2
31.0	-	-	-	-	-	-	-	17	51	29	3
31.5	-	-	-	-	-	-	-	12	50	35	4
32.0	-	-	-	-	-	-	-	11	46	37	7
32.5	-	-	-	-	-	-	-	7	45	43	6
33.0	-	-	-	-	-	-	-	6	37	49	9
33.5	-	-	-	-	-	-	-	3	33	51	13
34.0	-	-	-	-	-	-	-	2	27	51	20
34.5	-	-	-	-	-	-	-	1	15	42	43
35.0	-	-	-	-	-	-	-	-	5	34	61

On evaluating the above data, with regard to sex, a slightly smaller tolerance to the pace growth was found for mares. This was mainly related to Level III of the HR which appeared in this group for the first time at 26.5 km/h.

Comparing the results within the same sex in 11 pace ranges (15–20 km/h), no statistically significant changes were noted between average pulse values in 10 cases (90.9%), where each time its lower level was related to stallions.

In subsequent 14 speed ranges, such differences occurred 14 times (100%) and in the remaining sixteen (up to 35 km/h) statistically significant differences were not found in as many as 16 pace ranges, which amounted to 100%.

The highest pulse level (at V + 35 km/h) was almost identical for mares and stallions and reached 191 beats/minute.

The first HR level was not exceeded before 17.5 km/h (100% of examined horses), and the last time appeared at 23.5 km/h in 2.97% of tested trotters (Tab. 4). The lowest speed related to the HR value qualified to Level 2, was 18 km/h for 2.96% of trotters. The highest value amounted to 34.5 km/h, where merely 0.99% of all analysed cases fell within 140–170 beats/minute. The greatest amount of trotters, over 80%, reached the above HR ranges at the speed 22–23.5 km/h. The third level of HR first occurred at the speed equal to 22 km/h and reached the value of 100% of cases only at V + 35 km/h. It was also stated that increasing the speed over 30 km/h caused the continuous HR on the level higher than 170 beats/minute in over 80% of horses.

Considering sex of the analysed horses, it was found that 100% mares and stallions were in the first HR level and the velocity range was between 15 km/h and 17.5 and 18 km/h, respectively. The analysis of sex confirmed similar levels of the first HR level.

The second level was noted for the first time within the mare group at V + 18 km/h (2% of cases) and, within the stallion group, the pace was higher by only 0.5 km/h (1.96%). The HR level did not occur at V = 34.5 km/h for mares and V + 35 km/h for stallions. The third level started at V + 22 km/h and pertained to 4% of mares and 1.96% of stallions, respectively.

Highly statistically significant dependencies between the pace of trotter movement and their HR were confirmed by the results of correlation coefficient. Their scope was significant in each case at $P < 0.01$ and fell within 0.785–0.951 (mares) and 0.849–0.984 (stallions).

DISCUSSION

Standardbred trotters begin their training very early, when they are about 1.5 year old. An exercise used in daily training routine caused significant increase in their HR and some biochemical parameters [Janczarek *et al*. 2006, Kędzierski *et al*. 2007a]. The study made by Kędzierski *et al*. [2007b] indicated that trotters aged less than two years were not fully prepared to the training workload. It can lead to an overload of work and injures [Szarska 1990, Clayton 1991].

To the control and dosage of effort, the HR measuring is helpful. This method has been used in galloping racehorses [Novikov 1994, Janczarek 2003, Podolak *et al*. 2004]. However, to use this method in practice in trotters, new study is necessary to assessing the relationship between motion pace and HR in young horses younger than two-years-old.

The characteristic growth of motion pace causing the growth of HR in horses studied, was confirmed in the studies concerning the race system of courage attempts of Purebred Arabian horses [Kaproń *et al*. 1999, Podolak *et al*. 2004]. This conclusion points to the fact that there are possibilities to take advantage of the earlier results in trotters training. Various reactions to the exercise are related to the sex of Standardbred and Purebred Arabian horses. Purebred Arabian mares were more subjected to stress and overtraining than stallions of this breed [Janczarek 2003, Podolak *et al*. 2004].

The lack of differences in the HR level related to trotters sex at work with changing speed seems to be close to the reaction to training which is a distinctive feature of Thoroughbred horses [Art and Lekeux 1993]. Research carried out in this respect, related to racing Arabian horses, clearly indicated to this kind of differences and considerably higher potential of stallion capacity [Kubo *et al*. 1984, Janczarek 2003, Podolak *et al*. 2004]. The results achieved by Kędzierski i Janczarek [2009] also indicated that HR registered in Standardbred colts and fillies did not differ while measuring at rest, just before exercise and during the motion at a speed amounted to 15.0–20.0 km/h. Lack of differences related to sex of trotters was also stated by Persson [1997] in the study involving HR and blood lactic acid level during endurance and interval training. The worth noting is fact that regardless of breed of race horses, the motion speed amounted to more than 18 km/h can lead to anaerobic metabolism [Barrey *et al*. 1993, Evans *et al*. 1996]. Moreover, the horse' tolerance of exercise increases only after the first season of races [Saastamoinen and Ojala 1991].

CONCLUSIONS

1. To plan the training workload of trotters on the basis of HR measuring, no need data for trotters. It can be use data obtained during HR study in Purebred Arabian horses. Training workload of Standardbred mares and stallions can be identical, but it should be adapted to their age and condition.

2. Using in practice the results of these studies and taking into account the development of each animal trained, special attention should be paid to ranges of minimum velocity. In such a case, HR can cause anaerobic conversions in the organism. Hence, it can be stated that training including the speed up to 17.5 km/h should maintain the organism on the level of oxygen transformations. A threat of acidifying of the organism may appear at 18–21.5 km/h and anaerobic transformations can appear at 22 km/h.

REFERENCES

Art T., Lekeux P., 1993. Induced modifications in cardiorespiratory and ventilatory measurements In thoroughbred horses. Equine Vet. J. 25 (6), 126–135.

Barrey E., Galloux P., Vallette J., Auvinet B., Wolter R., 1993. Determination of the optimal treadmill slope reproducing the same cardiac response in saddle horses as overground exercise conditions. Vet. Rec. 133, 183–185.

Clayton H. M., 1991. Conditioning sport horses. Sport Horse Publication, Canada.

Courouce A., 1999. Field exercise testing for assessing fitness in French Standardbred Trotters. Vet. J. 157, 112–122.

Courouce A., Chretien M., Valette J.P., 2002. Physiological variables measured under field conditions according to age and state of training in French trotters. Equine Vet. J. 34, 91–97.

Evans D.L., Harris R.C., Snow D.H., 1996. Correlation of racing performance with blood lactate and heart rate after exercise in thoroughbred horses. Equine Vet., J. 35 (7), 543–549.

Janczarek I., 2003. Parametry oceny zaawansowania treningowego koni wyścigowych. Rocz. Nauk. Zoot., Supl., 18, 205–210.

Janczarek I., Suska A., Marchel I., 2006. Próba opracowania wskaźnika oceny stopnia wytrenowania kłusaków. Rocz. Nauk. PTZ 2 (1), 41–51

Kaproń M., Janczarek I., Kaproń H., 1999. Korelacje między dystansem i tempem galopu przygotowawczego a wskaźnikami zaawansowania treningowego koni wyścigowych. Materiały Międzynarodowego Sympozjum „Aktualne kierunki hodowli i użytkowania koni w Europie", Wyd. AR Kraków, 350–353.

Kędzierski W., Janczarek I., 2009. Sex – related of early training on stress in young trotters as expressed by heart rate. Anim. Sci. Pap. Rep. 27 (1), 23–32.

Kędzierski W., Kowalik S., Janczarek I., 2007a. Wpływ treningu typu interwałowego i wytrzymałościowego na wielkość wybranych wskaźników krwi i częstość skurczów serca kłusaków. Med. Wet. 63 (10), 1258–1261.

Kędzierski W., Kowalik S., Janczarek I., 2007b. Wybrane wskaźniki biochemiczne i hematologiczne oraz częstotliwość skurczów serca u koni rasy kłusak francuski w kolejnych etapach treningu. Acta Sci. Pol., Medicina Vetrinaria 6 (2), 15–24.

Kubo K., Takagi S.H., Murakami, M., Kai M., 1984. Heart rate and blood lactate concentration of horses during maximal work. Bull. Equine Res., Inst. 21, 39–45.

Leleu C., Cotrel C., Courouce-Malblanc A., 2005. Relationships between physiological variables and race performance in French Standardbred trotters. Vet. Rec. 156, 339–342.

Melerecki W., 1981. Zarys fizjologii wysiłku i treningu sportowego. Wyd. Sport i Turystyka.

Novikov A.A., 1994. Speed class of thoroughbred mares at studs in the Ukraine. Kharkow, Ukraine, Ukrainskaja Akademija Agrarnyh Nauk, Nauchno-Teknicieskij Biulletyn, Ukrainskij Institut Ziwotnowodstwa, 63 (1994), 83–89.

Persson S. G. B., 1997. Heart rate and blood lactate responses to submaximal treadmill exercise in normally performing Standardbred trotters – age and sex variations and predictability from the total blood cell volume. J. Vet. Med. 44, 125–132.

Podolak M., Kędzierski W., Janczarek I., 2004. Wpływ intensywnego treningu na poziom wybranych parametrów biochemicznych krwi i liczbę tętna u koni rasy arabskiej. Med. Wet. 60 (4), 403–406.

Saastamoinen M.T., Ojala, M.J., 1991. Influence of brith-month on age at first start and Racine performance in young trotters. Acta Agric. Scand. 41, 437–445.

Szarska E., 1990. Evaluation of horse efficiency based on changes of selected blood ratios tested at rest, after effort and restitution period. Med. Wet. 46, 11.

Thery C., 1981. Analyse génétique et statistique des performances des trotteurs français en course en 1979 et 1980. Mémorie du D.E.A. de génétique quantitative et appliquée, Paris XI, Polycop., C.N.R.N., 83.

Streszczenie. Niniejsze badania miały na celu próbę określenia wpływu tempa ruchu kłusaków na ich tętno (HR). Wpływ ten jest jednym z podstawowych problemów w doborze metod szkoleniowych. Określono także poziom tętna, przy którym rozpoczynają się przemiany beztlenowe. Do określenia HR w tempie ruchu między 15 a 35 km/h użyto rejestratorów telemetrycznych. Na podstawie analizowanych wyników wyróżniono trzy poziomy HR: 100–140 uderzeń na minutę „bezpieczne", 141–170 uderzeń na minutę „zagrożenie" i ponad 170 uderzeń na minutę „niebezpieczne". Stwierdzono, iż zwiększenie tempa ruchu powoduje wzrost HR, co było widoczne w obrębie jego średnich wartości w poszczególnych zakresach prędkości, jak również w obrębie korelacji prostych. Ich zakres był istotny przy $P \leq 0,01$ w każdym przypadku i osiągnął poziom od 0,785 do 0,951 (klacze) i od 0,849 do 0,984 (ogiery). Stwierdzono, że płeć kłusaków nie ma decydującego wpływu na poziom tętna w treningu ze zmienną prędkością, co odnosi się głównie do drugiego i trzeciego poziomu HR. Trening z prędkością do 17,5 km/h powinien zachować organizm na poziomie przemian tlenowych. Zagrożenie zakwaszenia może wystąpić przy prędkości między 18–21,5 km/h, natomiast przemiany beztlenowe towarzyszą prędkości od 22 km/h.

Słowa kluczowe: kłusaki, trening, tętno