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Electrocardiographic Analysis of the Cardiac Activity of Large-Horned Cattle in the Ecological Conditions of the Republic of Karakalpakstan

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ABSTRACT:
In this article, the physiological basis of natural resistance in unfavorable environmental conditions of the Republic of Karakalpakstan, as well as indicators of bioelectric activity and effectiveness of the heart of cattle belonging to the black and Latvian brown breeds of different ages are determined. The study of the electrocardiogram of large-horned cattle was carried out under the influence of different intensity and duration of air temperature and solar radiation. To increase the fertility of large-horned cattle, the physiological mechanisms of adaptation of brought breeding animals to extreme conditions of the Republic of Karakalpakstan have been studied. Changes in the bioelectric activity of the heart have been detected in cows of different breeds (black, Latvian brown cattle, Zebu cattle) and calves that are now born and up to 6 months old. In this article, it is indicated that the functional state of the cardiovascular system of agriculture animals is one of the main physiological indicators through which it is possible to determine the nature of the impact of the environment on the body.

Keywords: Cardiovascular, Lactation, Electrocardiogram, Homeostasis, R-R Cycle, High Temperature, Arid Zone.

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INTRODUCTION

Currently, it is of great importance to study the functional state of the cardiovascular system of farm animals and the nature of the environmental impact on the animal body in various large scientific centers of the world. Adaptation of cattle and other farm animals to new conditions of care and feeding, the need to study the effect of high temperatures on the body are one of the urgent problems of modern physiology.

Research in the field of industrial development of livestock all over the world requires the creation of optimal conditions for the improvement of physiological standards and the system of veterinary service. The nature of the electrocardiographic curve is determined not only by the animal's age, the influence of

pregnancy and lactation, but also, in a certain case, by the conditions of preservation and feeding of the external environment, temperature, humidity, air, meteorological factors.

The functional state of the cardiovascular system of animals is one of the main physiological indicators, based on which it is possible to think about the effect of the environment on the organism. The character of the electrocardiographic curve is determined not only by the animal's age, pregnancy, lactation period, but also by the influence of the external environment (temperature, humidity, air, daily seasonal cycle of meteorological factors), storage and feeding conditions (Azhibekov M. A. et al., 1987; Aronov, D.M., 1979). The influence of the temperature factor on the heart function of bighorn cattle was studied in the low temperature range. Studies on the effect of high temperature on the cardiovascular system of animals are rare (Verbovik, E.V., 2006; Goltsman A.V., 2006). The degree of functional tension of the heart depends on the ecogenesis of animals under different temperature conditions, specific characteristics of the type of nervous system, age and fertility, feeding and storage conditions. However, most aspects of blood circulation are not well studied. Among them, it is necessary to include the functional activity of the cardiovascular system of large horned cattle in hot climates (Dvornikov, A. V., 2002).

Changing the circulatory system in farm animals is related to energy consumption and affects their productivity. Therefore, in the conditions of the arid zone, it is necessary to know the nature of the circulatory homeostasis maintenance and restoration under the influence of extreme factors (Azhibekov M. A. et all., 1987; Zakharov, V. A., 1982). When the ambient temperature exceeds the limit of the thermal neutral zone -15.60 C, the pulse accelerates in animals of European breeds. In older animals, the systolic volume decreases, and in young animals, the duration of diastole decreases due to the acceleration of the pulse (T-R) (Heart rate variability, 2000; Brusentsev I.A., 2013) the diastolic coefficient decreases, the S-T interval shortens, the amplitude of the T teeth decreases (the minute volume of the heart), the MVH increases. However, among agricultural animals, it is known that young cattle are more affected by high temperature (Seytkamalov Kh.M., 2019).

MATERIALS AND METHODS

Experiments were carried out on large-horned cattle raised on farms of Nukus, Kanlikul districts of the Republic of Karakalpakstan. The number of animals in groups was selected on the basis of the purpose of the experiments and the variability of the characters. To increase the productivity of cattle, it is necessary to study the physiological mechanisms of adaptation of imported breeding animals to the extreme conditions of the Republic of Karakalpakstan. 60 heads of animals of various breeds (black, Latvian and Zebusiman cattle) and calves born and reached 6 months were tested. In addition, seasonal changes in the bioelectric activity of the heart were studied in cows of different breeds: Zebu cows, Latvian brown cows and black in total 15 heads from 5 heads of each breed. Changes in the electrocardiogram in these dairy cows were examined under different temperature conditions. Electrocardiograms were recorded in the electrocardiographs hot writer one-channel Salyut-1, EKGT-03m2.

RESULTS AND DISCUSSION

As a result of research it was shown that the functional state of the cardiovascular system of agricultural animals is one of the main physiological indicators and that it is possible to determine the effect of the environment on the organism through it. The study of the electrocardiogram of cows was carried out under the influence of air temperature (18-43°C) and solar radiation (2065-3294 kDj m2.s.) of different intensity and duration. 18-20°C was adopted for the initial ambient temperature (optimal). The results of the study showed the specific nature of the effect of adaptation of the cardiovascular system to temperature factors in cows of different breeds.

Experimental data show that at an air temperature of 18-20°C, the frequency of heart contractions in local Zebu breed cattle is 57.69 ± 2.32 beats/min, in black breed 61.78 ± 2.14

beats / min and in Latvian brown breed 59.94 ± 2.22 times / min. With an increase in air temperature to 36-40°C, this indicator increased by 14.3% in black cows, and by 11.4% in Latvian brown cows ($p<0.05$). With an increase in the average air temperature to 40-43°C, the frequency of heart contractions in black cows increased by 12.6%, and in Latvian brown cows by 16.4% ($p=0.05$).

The analysis of the duration of the R-R cycle showed that at a temperature of 30-35°C, this indicator is 0.851 ± 0.089 s in domestic Zebu cattle, 0.701 ± 0.071 and 0.780 ± 0.062 s in black and Latvian brown cattle.

As the air temperature increased by 30-35°C compared to local Zebu cattle, the duration of the R-R cycle decreased by 16.3% for black breed cattle and 14.4% for Latvian brown cattle ($p<0.05$).

At a temperature of 18-20°C, the diastolic phase T-P became: 0.321 ± 0.041 C in Zebu cattle, in the black and Latvian brown cattle breeds, 0.360 ± 0.41 s, respectively and 0,310 ± 0,039 P. When the air temperature in relation to Zebu cattle increased to 43°C, this figure decreased by 14.5% in the black breed, and by 13.0% in the Latvian brown cattle breed ($p <0.05$). The time of electric systole (Q-T) for zebu cattle at a temperature of 18-20°C is 0.472 ± 0.05 C. while black and Latvian brown cattle breeds were 0.430 ± 0.02 s and 0.469 ± 0.02 p.

During the studies, the following was defined, in the relatively stable temperature in livestock conditions in the autumn-winter and spring seasons of the year, with the precise change of day and night the daily rhythm of the functional activity of the heart, the biological rhythm of the organism of large-horned cattle is determined by diet regimen, maintenance and calorie content

The degree of adaptation of disposable feed parts, as well as animals in arid zone conditions, was determined in the study of large-horned cattle, which are adapted to the same feeding regime and to different degrees. The amplitude of the change in the heart rate during the day will depend on the magnitude of the reaction of the specific dynamic effect of the feed and the biological rhythm of the functional parameters of the animals, as well as the risk factor.

The maximum functional activity of the heart of large-horned cattle during the day is observed during feeding, at a minimum in the morning, after milking, before feeding.

In particular. in the winter period. the maximum heart rate of large horned Zebu cattle was recorded at 20-22 o'clock and amounted to 61.35 ± 2.14 beats / min. in the Latvian Beetle breed. Respectively, at 20-22 o'clock it was maximum 73.16 ± 2.28 beats / min, and in cattle of the black breed, at 20-22 o'clock it was maximum 72.98 ± 2.38 at 8-10 o'clock it was minimum 61.74 ± 6.53 beats / min (Table 1).

Table 1: Seasonal changes in the bioelectric activity of the heart of moles of the Zebu breed (M ± m) n=5

Season	Research time	Leads	The duration of ECG - s				
			P-Q	QRS	Q-T	T-P	R-R
Spring	May	I	0.234 ± 0.041	0.077 ± 0.004	0.440 ± 0.081	0.341 ± 0.061	1.090 ± 0.083
		II	0.246 ± 0.054	0.067 ± 0.005	0.439 ± 0.074	0.372 ± 0.074	1.085 ± 0.079
		III	0.225 ± 0.041	0.091 ± 0.003	0.450 ± 0.056	0.346 ± 0.081	1.089 ± 0.082
Summer	July	I	0.285 ± 0.043	0.089 ± 0.004	0.410 ± 0.041	0.345 ± 0.033	1.098 ± 0.076
		II	0.290 ± 0.054	0.080 ± 0.005	0.408 ± 0.054	0.307 ± 0.057	1.100 ± 0.091
		III	0.250 ± 0.048	0.075 ± 0.003	0.398 ± 0.043	0.304 ± 0.042	1.105 ± 0.087
Autumn	October	I	0.297 ± 0.048	0.095 ± 0.004	0.450 ± 0.051	0.360 ± 0.071	1.204 ± 0.087
		II	0.289 ± 0.057	0.090 ± 0.005	0.430 ± 0.074	0.385 ± 0.068	1.195 ± 0.091
		III	0.285 ± 0.018	0.093 ± 0.003	0.425 ± 0.061	0.328 ± 0.047	1.187 ± 0.083
Winter	January	I	0.301 ± 0.043	0.098 ± 0.007	0.449 ± 0.061	0.385 ± 0.078	1.258 ± 0.091
		II	0.295 ± 0.074	0.095 ± 0.004	0.430 ± 0.054	0.310 ± 0.061	1.250 ± 0.087
		III	0.260 ± 0.063	0.089 ± 0.004	0.425 ± 0.061	0.305 ± 0.048	1.220 ± 0.091

Note: Reliability – R<0.01; -R<0.001.

The maximum heart rate in cattle of the Zebu breed during the spring is 62.05 ± 2.11 beats / min at 20-22 o'clock, the minimum is 57.48 ± 2.14 beats / min at 2-4 o'clock, in cattle of the Latvian brown breed 72.36 ± 2.14 beats / min at 20-22 o'clock, 66.17 ± 2.12 beats / min at 8-10, respectively. In summer, the maximum heart rate in cattle of the Zebu breed was 70.98 ± 2.37 beats / minutes at 14-16 o'clock. The minimum is 60.05 ± 2.01 beats / min at 2-4 o'clock, in Latvian brown breed cattle, respectively, the maximum heart rate is 79.97 ± 3.04 beats / min at 14-16 o'clock, the minimum is 69.87 ± 2.01 beats / min at 2-4 o'clock in the morning, the maximum heart rate in cattle of the black breed is 82.85 ± 3.04 beats / min. minimum at 2-4 o'clock it was 68.84 ± 2.16 beats / min (Table 2).

Table 2: Seasonal changes in bioelectric activity of the heart of cattle of the black breed (M ± m) n=5

Season	Research time	Leads	The duration of ECG - s				
			P-Q	QRS	Q-T	T-P	R-R
Spring	May	I	0.208 ± 0.021	0.074 ± 0.005	0.451 ± 0.071	0.293 ± 0.045	1.090 ± 0.075
		II	0.010 ± 0.025	0.075 ± 0.003	0.445 ± 0.065	0.291 ± 0.030	1.043 ± 0.055
		III	0.215 ± 0.030	0.076 ± 0.004	0.441 ± 0.077	0.298 ± 0.035	1.143 ± 0.082
Summer	July	I	0.274 ± 0.021	0.087 ± 0.003	0.413 ± 0.065	0.352 ± 0.065	1.155 ± 0.065
		II	0.220 ± 0.027	0.079 ± 0.005	0.385 ± 0.087	0.091 ± 0.054	1.109 ± 0.084
		III	0.274 ± 0.041	0.090 ± 0.004	0.391 ± 0.070	0.304 ± 0.062	1.187 ± 0.090
Autumn	October	I	0.258 ± 0.025	0.089 ± 0.003	0.460 ± 0.081	0.311 ± 0.048	1.210 ± 0.087
		II	0.291 ± 0.022	0.087 ± 0.004	0.452 ± 0.054	0.305 ± 0.057	1.205 ± 0.074
		III	0.255 ± 0.038	0.085 ± 0.003	0.385 ± 0.050	0.294 ± 0.054	1.250 ± 0.065
Winter	January	I	0.280 ± 0.020	0.090 ± 0.007	0.459 ± 0.071	0.391 ± 0.044	1.260 ± 0.079
		II	0.289 ± 0.021	0.097 ± 0.003	0.441 ± 0.068	0.347 ± 0.054	1.258 ± 0.074
		III	0.062 ± 0.019	0.084 ± 0.003	0.468 ± 0.074	0.395 ± 0.061	1.278 ± 0.068

Note: Reliability – R<0.01; -R<0.001.

The maximum heart rate in cattle of the Zebu breed in the autumn period is 61.09 ± 2.12 beats / min at 14-16 o'clock, The minimum is 59.48 ± 2.14 beats / min at 2-4 o'clock, the maximum heart rate in cattle of the Latvian brown breed is 70.41 ± 2.24 beats / min at 14-16 the minimum is 65.53 ± 2.18 beats / min at 2-4 o'clock, the maximum heart rate in cattle of black breed was 78.41 ± 3.00 beats / min. with a minimum of 64.44 ± 2.16 beats / min at 2-4 o'clock.

CONCLUSION

Studies carried out by us have shown that one of the important conditions for the adaptation of the animal's body to environmental changes is the effective control of the circulatory system and, in particular, the hemodynamic fertility of the heart. Adaptation of the organism as a whole and its energy dynamics, as well as thermoregulatory mechanisms, keeps the body in balance at different ambient temperatures. Thus, in cows of different breeds, when exposed to different hot temperatures, unilateral functional changes in heart activity occur. It should be noted that these changes are less pronounced in domestic Zebu cattle than in large-horned cattle imported from abroad (black cattle, Latvian brown cattle).

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