

INFLUENCE OF THE ENVIRONMENTAL TEMPERATURE AND HUMIDITY REGIME DURING WINTER OVER SOME ADAPTIVE REACTIONS OF CALVES¹

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Abstract: The current study aims to examine the influence of the environmental temperature and humidity regime during winter on some adaptive reactions in the organism of five-month-old calves of the Bulgarian Black and White breed, kept in O.K. and in cattle-shed in Bulgaria.

The temperature and the relative humidity of the production environment have been studied for a period of three months. The changes in the length, weight, density and percent ratio of the coat, transitional and prickly hairs and the changes in the haemoglobin (HBB), haematocrit (PCV), the inorganic phosphorus (P) and the number of erythrocytes (Er) were examined. The hair and blood tests were taken once at the end of the winter when the calves were five months old. 30 animals divided in two groups of 15 were studied.

After the results were analysed it became clear that the abiotic factors – low temperature and increased humidity of the environment – are main preconditions for the increase of the coat hairs from 11.8 % of the calves kept in the hutch to 26.2 % of the calves kept in O.K., their length (from 24.395 mm to 29.941 mm), density (from 3567.3 n/4cm² to 5423.8 n/4cm²) and weight (from 7.629 mg/cm² to 15.466 mg/cm²). The level of haemoglobin **HBB** (from 5.23 mmol/l to 5.48 mmol/l), haematocrit **PCV** (from 0.33 l/l to 0.35l/l) and the number of erythrocytes **Er** (from 8.6x10¹²/l to 8.8x10¹²/l) raised, while the level of inorganic phosphorus **P** fell (from 4.92 mmol/l to 4.71 mmol/l).

Key words: calves, temperature, relative humidity, coat hair cover, and haematological indexes

Introduction

The question for the influence of the seasonal changes over the adaptive reactions in the organism of calves, kept in the open air and in cattle-shed, under the impact of the abiotic factors – temperature and relative humidity of the surroundings – is complicated and not cleared up /Fencke, 1983; Kovalcikova, Kovalcik, 1984; Motycka et al., 1995; Baykov 1995; Krastev 1999; Zimmermann et al., 2000/. Physiological mechanisms of

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adaptive character, reducing the impact of the different factors of the environment, provide for the maintenance of the temperature equilibrium.

The low temperature and the high air humidity affect a number of adaptive reactions, which aim to increase the physiological effectiveness of the thermoregulation. The current concepts for the energetics of thermo genesis show that any reconstruction of the structures of the reaction towards low temperature and high humidity results in improvement of the energy balance of the calves' organism in the changing surroundings. *Krastev et al., 1999/*. The morphological and haematological mutations, which increase the heat insulation, play a significant role in the structure of the adaptive reaction. The results achieved by *Dragnev et al. /1978/* confirm the significance of the changes in the morphological indexes of the hair cover in their adaptation to cold. Similar is the significance of the changes in some haematological indexes according to the researches of *Kolb /1992/* and *Vladov /1998/*.

Krastev and Vladov /1999/ determined that under the impact of the abiotic factors of the surroundings in winter time the new-born calves of the Black and White breed reared in hutches in the open air have a higher level of the haemoglobin and haematocrit and lower level of the inorganic phosphorus.

Material and Methods

The study took place in the *Retkin* Farm in the region of Sofia. Two-month-old \pm 12 days/ calves reared in hutches were used in the experiment. Two groups, each consisting of 15 animals, were formed.

The calves from the 1st group were kept in the open air, fenced in light metal construction. The floor was of concrete with inclination of 3°. 10m² were assured for each animal. During the experiment the straw has not been changed, only additional straw has been put on a 4-5-day period. The calves were fed from a common concrete manger, and were watered from a metal automatic watering trough.

The calves from the 2nd group were kept free in covered cattle-shed, built on a stone basis and with brick walls. Inside and outside the walls were painted with whitewash. The roof was two-layered with covered with wood and tiles. The straw was not changed, only some straw was added, depending on how soiled it was. The building assures 10 m² for each animal. The calves were fed in group manger and automatically watered from concrete trough.

The animals from both groups were fed with maize silage with 25-35% contents of dry matter and food mixture in accordance to the Bulgarian State Standards.

The temperature and the relative humidity were measured with digital hydro-thermometer CTHM – 02 for three months, divided in periods of ten days. The average day temperature and the humidity we calculated as we added the values from 7am and 2pm with the doubled value from 9pm and amount we received we divided into 4. The average 10-days values we received as we divided the average day values into 10. The measurements were made simultaneously at six opposite points, situated at 0.80 m from the floor.

At the end of the three-month temperature-humidity regime we took the hairs and the blood tests at a temperature at moment of taking was 3.1° C and the humidity was 84% outside and their own was - 12.8°C temperature and 90% humidity. The hairs were taken from four different parts of the calve's trunk each 1 cm².

The blood for the blood test was taken from V. Jugularis, and heparin, mixed with 1:4 distilled water, was used for anticoagulant. The haemoglobin was defined through the Cyanhaemoglobin method. The haematocrit (PCV) was defined with micro-twirler.

Results and Discussion

The studied farm is situated in the foot of the Vitosha Mountain. Character peculiarity for the winter season there is the sudden change of the weather during the twenty-four-hour period, accompanied by frequent raining and strong winds. From the analysis of the abiotic parameters (table 1.) it becomes obvious that the average 10-days temperature of the surroundings at the open air for the studied period is from -3.5° C during the first 10 days of January to 8.7° C during the last 10 days of March. In the cattle-shed the temperatures were from 5.1° C during the third 10-day period of January to 13.3° C during the last 10 days of March. At the same time the value of the absolute minimal temperature of the air reaches -9.7° C during the third 10-day period of January, and in the cattle-shed it was 3.8° C. The absolute maximal temperature for 10-day period at the open air reached 16.1° C, and in the cattle-shed CAPut!'.2° C during the last 10 days of the reported period.

Table 1. Average 10-day parameters of the temperature-humidity regime
 Tabela 1. Prosečna dnevna temperatura i vlažnost

Reporting Period / Period	In the open air (First Group)/na otvorenom (prva grupa)						In the cattle-shed (Second Group)/u objektu (druga grupa)					
	Temp.,o C			Relative humidity/ relativna vlažnost %			Temp.,o C			Relative humidity/ relativna vlažnost, %		
	min	max	av.prosek	min	max	av/prosek	min	max	av.pros.	min	max	av.pros.
1-10.1.2000	-7,2	4,8	-3,5	76	82	80	5,2	14,3	10,2	78	85	83
11-20.1.2000	-8,5	4,1	-2,2	79	84	83	4,9	13,3	9,3	81	87	86
21-31.1.2000	9,7	1,8	-0,3	80	85	84	3,8	7,2	5,1	83	86	87
1-10.2.2000	-6,3	5,5	1,6	81	87	85	5,8	14	6,1	84	90	89
11-20.2.2000	-2,9	9,1	2,5	83	88	86	6,2	15,3	6,7	86	93	90
21-29.2.2000	0,5	11,7	5,8	78	80	79	7,9	18,2	9,1	81	84	82
1-10.3.2000	0,1	10,8	4,7	76	80	78	7,2	16,5	8,3	78	82	80
11-20.3.2000	1,1	13,3	7,1	80	88	84	8,4	17,1	10,2	82	90	86
21-31.3.2000	2,8	16,1	8,7	82	90	86	8,9	19,2	13,3	85	94	91
at the day of taking the tests:na dan testa			3,1			84			12,8			90

The average 10-day relative humidity of the environment was between 78-86%, in the cattle-shed it was from 80% to 91%. The minimal 10-day values of this index varied at the open air from 76 to 83%, while the maximal was from 80 to 90%. In the cattle-shed they were respectively: minimal – from 78 to 86%, maximal – from 82 to 94%.

On the background of the abiotical parameters of the two technologies for calves' housing, it is interesting to monitor their adaptive reactions. It becomes clear from table 2., that the unprotected from the cold and humidity animals, i.e. the calves kept at the open air, have higher values of the studied morphological indexes of the hair cover compared to those, kept in the cattle-shed. The confirmed morphological changes prove that the lower temperature at which the calves from the first group were kept is a prerequisite for increase of the heat insulation qualities of the hair cover. Most indicative in this sense is the considerable increase of 11.8% in the 2nd group and 26.2% in the 1st group in the quantity of the fine hairs, which are typical for the winter hair cover. It was also concluded that the transitional and bristly hairs play a very small role in the support of the body temperature and that is the reason why in quantity proportion with the fine ones they did not show significant changes during the period of the study.

Due to the influence of the temperature-humidity regime a considerable increase in the length, weight and thickness of the hair cover is observed in the calves kept in the open air, compared to those kept in cattle-shed. (Table 2.)

Table 2. Average morphological indexes of the hair cover (n=30)

Tabela 2. Prosečni morfološki indeksi dlake (n=30)

Indexes/indeksi ($\bar{x} \pm S_x$)	In the open air/na otvorenom	In the cattle-shed/u objektu
Length of the hairs/ dužina dlake, mm	29,941±1,392	24,395±1,034
Weight of the hairs/težina dlake, mg/4cm ²	15,466±0,836	7,629±0,927
Density of the hairs/gustina dlake, n/4cm ²	5423,8±940,4	3567,3±446,2
Proportion of the types of hairs/odnos različitih tipova dlake, %		
a) fine/fina	26,2±6,79	11,8±2,93
b) transitional/prelazna	40,7±3,73	53,1±3,39
c) bristly/oštra	33,1±4,48	35,1±4,48

The average value of haemoglobin (table 3.) in the calves of the first group was 5.48 mmol/l, and in those kept in the cattle-shed – 5.23mmol/l. the average content of haematocrit was: 1st group – 0.35l/l and 2nd group – 0.33l/l. The established higher values of HBB (P<0.05) and PCV (P<0.001) in the calves, kept in the open air are statistically proved. The results achieved are corresponding to the researches of /Broucek et al., 1991/. This, to our opinion, is due to the direct impact of the temperature-humidity regime in the different housing technologies.

It is well known that the concentration of inorganic phosphorus is directly connected with the thermo stability of animals. Our studies show (table 3.) that the level of metabolite is higher in calves kept in cattle-shed (4.92 mmol/l). Lower values of P in the calves from the 1st group (4.71 mmol/l), kept in the open air ($P < 0.05$) could be explained from energy point of view with intensification of a system of ATP for the extended needs of thermo-production and of increase of the resistance of calves to the cold and humidity.

Table 3. Average haematological indexes (n=30)
Tabela 3. Prosečni hematološki indeksi (n=30)

Indexes/indeksi ($\bar{x} \pm S_x$)	In the open air/na otvorenom	In the cattle-shed/u objektu
Haemoglobin/hemoglobin (HBB), mmol/l	5,48±0,75	5,23±0,34
Hematocrit/hematokrit (PCV), l/l	0,35±0,03	0,33±0,07
Inorganic phosphorus/neorganski fosfor (P), mmol/l	4,71±0,54	4,92±0,78
Erythrocytes/eritrociti. (Er) x 10 ¹² /l	8,8±1,2	8,6±1,4

An increase of the number of erythrocytes is observed in the calves from the 1st group, kept in the open air.

The recorded changes in the morphological indexes of the hair cover and in the haematological parameters of the blood, examined from 5-month-old calves from the Bulgarian Black and White breed reflect the influence of the abiotical environmental factors in the open air and in cattle-shed on the adaptive abilities of the organism to the peculiar features of the continental climate during winter in Bulgaria. The reported data is additional information for the development of the calves' organism, kept in the upper described circumstances. They could be used as a comparison basis.

UTICAJ TEMPERATURE SREDINE I REŽIMA VLAŽNOSTI U ZIMSKOM PERIODU NA NEKE ADAPTIVNE REAKCIJE ORGANIZMA TELADI

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Rezime

Cilj ovog istraživanja je bio ispitivanje uticaja temperature sredine i režima vlažnosti u zimskom periodu na neke adaptivne reakcije organizma teladi crno-bele rase u uzrastu od pet meseci gajenih u Bugarskoj na otvorenom i u objektima za goveda.

Temperatura i relativna vlažnost proizvodne sredine su ispitivane tokom perioda od tri meseca. Promene u dužini, masi, gustini i procentualnom odnosu dlake, prelazne i

bodljikave dlake, kao i promene u vrednostima hemoglobina (HBB), hematokrita (PCV), neorganskog fosfora (P) i broja eritrocita (Er) su ispitivane. Uzorci dlake i krvi su uzeti jednom na kraju zimskog perioda kada je telad bila u uzrastu od pet meseci. Ispitivano je 30 životinja koje su bile podeljene u dve grupe po 15.

Nakon analiziranja rezultata bilo je jasno da su paragenetski faktori – niska temperatura i povećana vlažnost sredine – glavni preduslovi za povećanje dlake kod teladi i to za 11,8% kod životinja koje su držane u zatvorenim objektima za goveda, do 26,2% kod teladi koja je držana na otvorenom, dužina dlake (od 24.395 mm do 29.941 mm), gustina (od 3567.3 n/4cm² do 5423.8 n/4cm²) i masa (od 7.629 mg/cm² do 15.466 mg/cm²). Nivoi hemoglobina **HBB** (od 5.23 mmol/l do 5.48 mmol/l), hematokrita **PCV** (od 0.33 l/l do 0.35l/l), kao i broj eritrocita **Er** (od 8.6x10¹²/l do 8.8x10¹²/l) su povećani, dok je nivo neorganskog fosfora **P** smanjen (sa 4.92 mmol/l na 4.71 mmol/l).

Ključne reči: telad, temperatura, relativna vlažnost, prekrivenost dlakom, hematološki pokazatelji.

References

1. BAYCOV, B. (1995): Ecology of cattle breeding, Varna, Technical University, p.212.
2. BROUCEK, J. ET. AL. (1991): Zivoc Vyroba, 27, No.10, 835-840
3. DRAGNEV, H., RUSEV, N., ZDRAVKOV, G., HRISTOV, V. (1978): Character of the changes in the hair cover of calves fattened in born, in shed and on feedlot, Animal Science, Sofia, 18, No. 6, 8-13.
4. FENCKE, G. (1983): Tierhygiene in der intensiven Tierproduktion, Mh. Veter. Med. 38, No.20, 761-765.
5. KOLB, E. (1992): Lehrbuch der Physiologie der Haustiere, Gustav Fischer Verlag, Jena, p.317.
6. KOVALCIKOVA, M., KOVALCIK, K. (1984): Etologia hovädzieho dobytku. Bratislava, Priroda, 232s.
7. KRASTEVA, K., VLADOV, K. (1999): Seasonal changes of some biochemical and haematological measurements in the blood of newborn calves of blackpattered race, journal of Animal Science, Sofia, 36, No.5-6, 22-26.
8. KRASTEVA, K., BOYCHEV, K., YANCHEV, I. (1999): Influence of the microclimate under the ethological status of heifers kept in open three-wall shelter feedlot, Journal of Animal Science, Sofia, 36, No.2, 5-8.
9. KRASTEVA, K. (1999): Anthropogenic interference with the evolution of domestic animals, Agricultural Science, Sofia, 37, No.5, 35-37.
10. MOTYCKA, J., O. DOLEZAL, J. PYTLOUN (1995):: Problematika odchovu telat. Zivor. Vyr. c. 5, Praha, p.123.
11. VLADOV, K. (1998): The problem of East Friesian ewe acclimatization, physiological and biochemical aspects, Agricultural Science, Sofia, 36, No.4, 28-31
12. ZIMMERMANN V., P. JUHAS, O. DEBRECENI (2000): The behavior of cattle under permanent grazing, Biotechnology in Animal Husbandry, 16, No 3-4, 73 – 77.