ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Environment And Genotype Effect On Morphological And Biochemical Composition Of Blood In Kalmyk Cattle.

Foat Galimovich Kayumov[1], Nikolay Pavlovich Gerasimov[1]*, Ruziya Foatovna Tret'yakova[1], Ivan Ivanovich Sleptsov[2], Elena Nikolaevnall'ina[2], and Lyudmila Guchaevna Moiseykina[3].

[1]Federal Research Centre of Biological Systems and Agro-technologies of the Russian Academy of Sciences, 29, 9 Yanvarya St, Orenburg 460000, Russia
[2]Yakut State Agricultural Academy, Yakutsk, Russia
[3]Kalmyk State University named after B.B. Gorodovikov, Republic of Kalmykia, Elista, Pushkin street, 11.

ABSTRACT

The change in temperature regimes during the beef cattle rearing has a complex effect on the body, including the morphological and biochemical composition of blood, serving as indicators of the general physiological status of animal.The aim of the research was the adaptive flexibility assessment based on the seasonal variability of haemotological parameters in Kalmyk bulls of different zonal types.Studies of morphological and biochemical composition of blood were carried out in different temperature seasons (autumn, winter, spring) in Kalmyk bulls of 2 zonal types: "Aita" (Republic of Kalmykia) and "Voznesenovsky" (Stavropol Territory).The heredity of young animals have not a significant impact on the variability of blood parameters. The seasonal changing of temperature regime significantly ($P < 0.05$) determined the variability of erythrocytes, haemoglobin and leucocytes. The maximum content of red and white blood cells were observed in the cold period of the year (winter).The effect of rearing season had no significant effect ($P > 0.05$) on the variability of the total protein in blood serum.The content of albumin fraction was more determined by the seasonal changing of the year ($P<0.05$). In winter, there was a minimum concentration of albumin in blood serum.The variability of globulin fraction was inversely directed in comparison with albumin content. A significant effect ($P<0.01$) of the season was established in aspartate aminotransferase activity in the blood serum of bull-calves. The highest level was observed in spring period, the minimum was recorded in winter.The activity of alanine aminotransferase is poorlydetermined by both genotype and environmental conditions.All changes in composition of blood were within physiological ranges for cattle.The results indicate a good adaptive flexibility of Kalmyk bulls of different genotypes.

Keywords: beef cattle, Kalmyk breed, blood, blood serum, season of the year, adaptive flexibility.

Corresponding author

ISSN: 0975-8585

INTRODUCTION

The variety of climatic zones in Russia, as well as significant seasonal fluctuations in temperature regime during the year, impose the strict requirements for the adaptive and acclimatization abilities in beef cattle [1].In addition, the season of the year determines the feedingtype, the usefulness and balance of rations for animals [2].In this regard, breeding programs in beef cattle should take into account the assessment of animals according to adaptive abilities to environmental and technological conditions of rearing area.The change in temperature regimes during the beef cattle breeding has a complex effect on the body, including the morphological and biochemical composition of blood, which are indicators of general physiological status of animal [3-4].Deviations in hematological parameters from reference values indicate abnormalities in metabolism of individuals and weak resistance to environmental factors. Thereby, the assessment of variability in morphological and biochemical composition of blood in beef cattle is a reliable criterion in the study of adaptive abilities [5].

Zoning of animals in different breeding areas is based on the unequal adaptability of different types to environmental conditions, which is fixed in the process of natural and artificial selection.This leads to intrabreed differentiation of animals into specific structural elements of the breed [6-7].The Kalmyk breed of cattle is widespread in all ecological and climatic zones of Russia.This was facilitated by excellent acclimatization qualities, unpretentiousness to the feeding and maintenanceconditions.The wide range of distribution of Kalmyk cattle predetermined its division into several zonal types with unique genealogy and differing in productivity, body conformation type and reproductive abilities [8].

Thus, the aim of our research was to assess the adaptive flexibility by seasonal variability of morphological and biochemical parameters of blood and its serum in Kalmyk bulls of different zonal types.

MATERIAL AND METHODS

Studies of morphological and biochemical composition of blood were carried out in different temperature seasons (autumn, winter, spring) in Kalmyk bulls of 2 zonal types: "Aita" (Republic of Kalmykia) and "Voznesenovsky" (Stavropol Territory).Animals were under observation in APCPlemzavod "Druzhba" in Stavropol territory.Meteorological conditions for the periods of the year are presented in Table 1.

Table 1: Characteristics of climatic conditions by monitoring periods

Month	Temperature, ºC		Number of sunny days	Precipitation, mm
	Day	night		
November (autumn)	+7.2	-0.2	9	46.7
January (winter)	-5.8	-8.4	3	48.6
April (spring)	+13.0	+6.8	11	67.8

Blood samples from the jugular vein (n = 5heads from each group) were taken to determine hematological analysis in experimental animals. Biosubstrates were collected into the tubes with 600 µl of ethylene diamintetraacetic acid (EDTA) to obtain a volume of 10 ml. Tubes with a coagulation activator (SiO2) were usedfor the biochemical analysis.

The results were calculated by the formulas according to the method based on the measurements of the automatic biochemical analyzer Dirui CS – T240: total protein – biuret method; albumin – photometric method with bromocresol green; ALT, AST – photometric method; inorganic calcium – photometric test using arsenazo III; phosphorus – photometric method. Haemato logical parameters were determined: the number of erythrocytes and leucocytes in 1 cm^3 of blood in Goryaevcell, haemoglobin with Salihemometer.

The maintenance and feeding of experimental bulls were the same and depended on the season of the year.The structure of rations for bull-calves was balancedfrom feeds of own production depending on the season of the year and expected growth rate.

ISSN: 0975-8585

The genotype and seasonal effects on the variability of haemotological and biochemical indiceswere studied by analysis of variance using the ANOVA procedure of Statistical 10.0 program according to the following model:

$$Y_{ij} = \mu + A_i + B_j + (AB)_{ij} + e_{ij}$$

Y_{ij} – value of the analyzed indicator,
μ - population value,
A_i – effect of igenotype (1, 2),
B_j– effect of j season of year (1, 2),
$(AB)_{ij}$ – interaction father×mother
e_{ij} – random error.
Tukey'shonestly significant differencetestwas applied for post hoc comparison.

RESULTS

The dynamics of blood morphological and biochemical analysisin bull-calves are shown in Table 2. The heredity of young animals have not a significant impact on the variability of blood parameters. Thus, the intergroup differences in the content of erythrocytes reached 0.05-0.21 × 10^{12} / l (0.74-0.21%, P> 0.05), and haemoglobin 0.3-2.6 g / l (0.28-2.34%, P> 0.05), depending on the control period. The maximum concentration of the studied parameters was observed in winter and followed the highest average daily gain in bulls of "Voznesenovsky" genotype.

Table 2: Morphological and biochemical values in blood (Mean ± SE)

Parameter	Season of the year	Group	
		Aita	Voznesenovsky
Erythrocytes (10^{12}/ l)	Autumn	6.11±0.288	6.00±0.185
	Winter	6.79±0.178	6.84±0.190
	Spring	6.33±0.306	6.54±0.223
Haemoglobin(g / l)	Autumn	106.0±1.924	105.7±1.068
	Winter	112.6±1.631	114.2±1.463
	Spring	111.2±1.985	113.8±1.744
Leucocytes(10^9/ l)	Autumn	7.27±0.217	7.35±0.165
	Winter	8.19±0.282	8.08±0.156
	Spring	6.90±0.244	7.05±0.337
Calcium (mmol / l)	Autumn	2.33±0.025	2.30±0.065
	Winter	2.19±0.068	2.13±0.072
	Spring	2.64±0.064	2.64±0.075
Phosphorus (mmol / l)	Autumn	1.93±0.037	1.92±0.060
	Winter	1.95±0.069	1.91±0.080
	Spring	2.24±0.100	2.21±0.068
Acidcapacity(mmol / l)	Autumn	107.4±1.122	108.0±1.414
	Winter	118.2±1.158	118.4±1.363
	Spring	114.6±1.631	115.2±1.319
Vitamin A (μmol / l)	Autumn	5.13±0.034	5.07±0.054
	Winter	4.82±0.056	4.93±0.085
	Spring	6.41±0.076	6.75±0.139

The concentration of inorganic calcium and phosphorus, vitamin A in blood of animals were largely dependent on their alimentary ingestion.Therefore, the increase of these indicators content was natural in spring period with full and balanced feeding of young animals.Thus, the calcium amount in blood increased in

spring by 0.45-0.51 mmol/l (20.55-23.94%; P<0.001), phosphorus – by 0.29-0.30 mmol/l (14.87-15.71%; P<0.001), vitamin A – by 1.59-1.82 mmol/l (32.99-36.92%; p<0.001)compared to the winter period.At the same time, there were no significant differences between the studied genotypes by hematological parameters.

The serum total protein content was more stable for the periods of the year (Table. 3).The rearing season impact have no a significant effect (P>0.05) in variability of this component.The genotype of young animals also had determined insignificant differences in total protein content.However, there was some advantage in serum total protein amount of Voznesenovsky type of bulls.Thus, the superiority reached 0.34 g/l (0.43%; P>0.05)in winter, in spring – 0.19 g / l (0.24%; P>0.05).

Table 3: Serum protein composition of Kalmyk bull-calves in different periods (Mean ± SE)

Parameter	Season of the year	Group	
		Aita	Voznesenovsky
Total protein (g / l)	Autumn	78.64±0.860	77.45±1.122
	Winter	78.92±1.005	79.26±0.841
	Spring	79.77±0.801	79.96±0.553
Albumin (g / l)	Autumn	36.71±0.805	35.86±0.700
	Winter	34.57±0.919	35.20±0.421
	Spring	36.46±0.930	37.07±0.387
Globulin (g / l)	Autumn	41.93±0.653	41.59±0.821
	Winter	44.35±0.426	44.06±0.706
	Spring	43.31±0.415	42.89±0.326
α-globulin (g / l)	Autumn	10.03±0.249	9.70±0.272
	Winter	10.39±0.292	10.47±0.338
	Spring	11.46±0.308	11.55±0.367
β-globulin (g / l)	Autumn	11.35±0.294	10.93±0.377
	Winter	13.98±0.237	13.48±0.410
	Spring	13.51±0.304	13.31±0.313
γ-globulin (g / l)	Autumn	20.55±0.694	20.96±0.646
	Winter	19.98±0.262	20.11±0.767
	Spring	18.34±0.178	18.02±0.446
A / G	Autumn	0.88±0.026	0.86±0.022
	Winter	0.78±0.022	0.80±0.015
	Spring	0.84±0.026	0.86±0.010

The albumin fraction content was more influenced by the seasonal changesduring the year (P <0.05).In this case, the minimum amount of albumin in blood serum was observed in winter. In spring, the fraction content had increased by 1.87-1.89 g / l (5.31-5.47%).

The globulin fraction variability was inversely directed in comparison with albumin content.The maximum concentration of globulins was observed in winter, and the minimum in autumn. The number of globulins had increased by 2.42-2.47 g / l (5.77-5.94%, P <0.01)at this stage.At the same time, superiority (P> 0.05) was noted on the side of "Aita"bulls in all seasons of the year.

The intergroup differences in albumin/globulin ratio were not statistically significant.At the same time, the control season reliably (P<0.01) determined the variability of the parameter.The maximum of albumin/globulin coefficient was established in the autumn period.In winter, the studied ratio decreased by 0.06-0.10 units (7.50-12.82%).

A study of serum aspartate aminotransferaseactivity in bull-calves showed a significant seasonal effect (P <0.01) of the year (Fig. 1).At the same time, the highest level was observed in spring period, the minimum was recorded in winter. The activity changes was 0.04-0.05 mmol/h•l (3.39-4.31%)in the specified period."Voznesenovsky" type differed by a slightly increased activity of aspartate aminotransferase compared to their peers, but this superiority was not characterized by statistical significance.In contrast, the maximum

ISSN: 0975-8585

alanine aminotransferase activity was observed in young animals of “Aita” type.However, the season factor had no a significant effect on the variability of ALT activity.

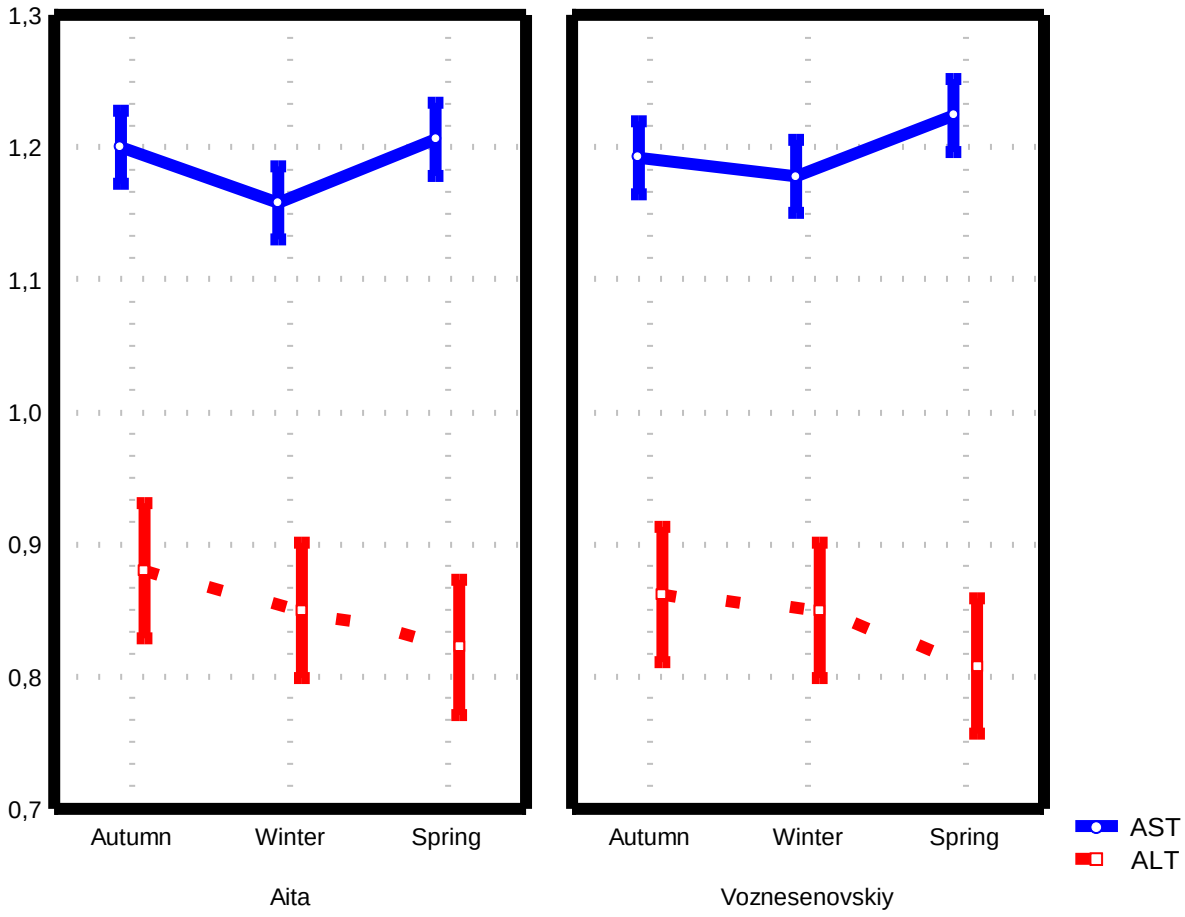

Figure 1: The dynamics of serum aminotransferase activity in Kalmyk bulls (mmol / h • l)

DISCUSSION

Environmental conditions significantly affect the productive traits and biological characteristics of beef cattle [9-10].Including the hematological profile of animals is significantly determined by seasonal changes in temperature regime [11].In our studies, control over the dynamics of blood and serum composition was carried out on 2 groups of Kalmyk bull-calves in climatic conditions of the temperate steppes in Stavropol territory.The first group of bull-calves consisted of an introduced genotype from the semiarid zone of Republic of Kalmykia.The results of blood morphological and biochemical composition analysis were within the physiological limits in experimental bulls [12-13].At the same time, the origin and genotype of young animals had not a significant impact on the intergroup differences in hematological parameters.This testifies to the good adaptive abilities of the studied groups of Kalmyk bull-calves [14].On the contrary, the seasonal changes in the temperature regime during the year significantly ($P < 0.05$) determined the variability of red blood cells.The maximum erythrocyte content was observed in cold period of the year (winter), which is consistent with the studies of Mazzullo et al. (2014).The highest concentration of haemoglobin was also observed in winter.These changes are associated with water balance regulation by bulls and body temperature.Thus, water compensation by animals led to the haemodilution effect during hot season of the year [16].Specificityof feeding, which depended on climatic conditions, also determined the biochemical composition of blood [17].Grass of natural pastures rich in vitamins and microelements predetermined the high content of inorganic calcium, phosphorus and vitamin A in blood during the spring period.In contrastseasons by the temperature regime, the amount of serum total protein in Kalmyk bulls was quite stable and did not depend ($P<0.05$) on environmental conditions.However, the periodicitywas revealedin individual fractions content.Thus, a decrease in the albumin concentration was observedat a low atmospheric temperature, and the maximum

amount was recorded in spring period of the year.The variability of globulin content was opposite to that of the albumin fraction.In this case, the influence of feeding level and feed quality on the fluctuations in the concentration of serum total protein and its fractions was noted, which agrees with numerous studies [18-23].

CONCLUSION

The study showed a weak influence of animal origin and a strong impact of environmental conditions on variability of morphological and biochemical composition of blood and its serum in different temperature seasons of the year in Kalmyk bull-calves of different zonal types. All changes in blood parameters were within the physiological range. The results indicate a good adaptive flexibility of Kalmyk animals of different genotypes.

ACKNOWLEDGEMENTS

This research work was carried out according the task №0761-2018-0006.

REFERENCES

[1] AmerkhanovKh.A., Kayumov F.G. Breeding resources in development of the specialized beef cattle // The Herald of beef cattle breeding. 2009. Vol. 3. № 62. P. 3-7.
[2] Levakhin G.I., Duskaev G.K. The phosphorus digestion during different feeding types in ruminants // Vestnik of the Orenburg State University. 2004. № S4. P. 49-50.
[3] Dzhulamanov K.M. The influence of some environmental factors on the weight gain of the Kazakh white-headed bulls // The Herald of Beef Cattle Breeding. 2006. Vol. 1. № 59. P. 76-79.
[4] Kayumov F.G., Lebedev S.V., Maevskaya L.A. Morphological and biochemical haematological indicators of heifers of Kalmyk breed // The Herald of beef cattle breeding. 2008. Vol. 1. № 61. P. 164-167.
[5] Miroshnikov S.A., Lebedev S.V. Range of chemical elements concentration (reference values) in animals body // Vestnik of the Orenburg State University. 2009. № 6 (112). P. 241-243.
[6] Kayumov F.G., Kudasheva A.V., Dxhulamanov K.M., Tyulebaev S.D. Beef cattle breeding in our country, new breed and types created in recent years // Zootechniya. 2014. № 8. P. 18-19.
[7] Slepsov I.I., Chugunov A.V., Ilina E.N. Tasks of Intensification of Meat Calves Growing in Yakutia // Dostizheniyanaukiitekhniki APK. 2017. Vol. 31. № 2. P. 52-54.
[8] Khainatsky V.Y., Kayumov F.G., Tikhonov P.T. Evaluation of beef cattle exterior // Izvestia Orenburg State Agrarian University. 2012. Vol. 4. № 36-1. P. 120-123.
[9] Isaac, L. J., Abah, G., Akpan, B., &Ekaette, I. U. (2013). Haematological properties of different breeds and sexes of rabbits (p.24-27). Proceedings of the 18th Annual Conference of Animal Science Association of Nigeria.
[10] Mmereole, F. U. C. (2008). The Effects of Replacing Groundnut Cake with Rubber Seed Meal on the Haematological and Serological Indices of Broilers. International Journal of Poultry Science, 7(6), 622-624.
[11] Bogatova O.V., Dzhulamanov K.M. Meat efficiency and factors its determining // Vestnik of the Orenburg State University. 2005. № 10-2. P. 156-161.9.
[12] Research Animal Resources (2009). Reference values for laboratory animals: Normal haemotologyical values. RAR Websites, RAR, University of Minnesota. Retrieved from http://www.ahc.umn.edu/rar/refvalues.html.
[13] B. Feldman, J. Zinkl, N. Jain, and S. Schalm, Veterinary Hematology, Williams & Wilkins, Philadelphia, Pa, USA, 5th edition, 2000.
[14] Wood D., Quiroz-Rocha G.F. (2010). Normal hematology of cattle. In: Schalm's veterinary hematology. Weiss D.G., Wardrop K.J. (eds), 6th ad. Wiдey, Philadelphia, pp. 829-835.
[15] Mazzullo G., Rifici C., Cammarata F., Caccamo G., Rizzo M., Piccione G. (2014). Effect of different environmental conditions on some haemotological parameters in cows. Ann. Anim. Sci., Vol. 14, No. 4. pp. 947-954.
[16] El-Nouty F.D., Al-Haidary A.A., Salah M.S. (1990). Seasonal variation in hematological values of high- and average yielding Holstein cattle in semi-arid environment. J. King Saud. Univ., 2: 173–182.
[17] Koubkova M., Knizkova I., Kunc P., Hartlova H., Flusser J., Dolezal O. (2002). Influence of high environmental temperatures and evaporative cooling on some physiological, hematological and biochemical parameters in high-yielding dairy cows. Czech J. Anim. Sci., 47: 309–318.

[18] Herdt, T. H. 2000. Variability characteristics and test selection in herd-level nutritional and metabolic profile testing. Vet. Clin. North Am. Food Anim. Pract. 16: 387–403.
[19] Otomaru K., Wataya K., Uto T., Kasai K. (2016). Blood biochemical values in Japanese Black calves in Kagoshima Prefecture, Japan. J. Vet. Med. Sci. 78(2): 301-303.
[20] Dzhulamanov K.M., Dubovskova M.P. Ecological adaptation and immunologic markers in selection // Zootechniya. 2003. № 7. P. 9-10.
[21] Kayumov F.G., Dubovskova M.P., Kuzin A.V. Morphological structure, biochemical blood parameters and factors of humoral protection of different genotypes of Kazakhskaya White Head young bulls // Izvestia Orenburg State Agrarian University. 2006. Vol. 3. № 11-1. P. 23-26.
[22] Dzhulamanov K.M., Kolpakov V.I., Vorozheikin A.M., Baktygalieva A.T., Natyrov A.K. Hematological indicators of young animals of different genotypes // The Herald of Beef Cattle Breeding. 2017. Vol. 3 (99). P. 76-79.
[23] Kvan O.V., Lebedev S.V., Rusakova Y.A. Modeling of chemical elements deficiency in an animal organism // Izvestia Orenburg State Agrarian University. 2009. № 6 (112). P. 201-203.
[24] Chugunov A.V., Sleptsov I.I., Chernogradskaya N.M., Ilina E.N., Tarabukin N.I. Intensity of Growth and Some Biological Features of Young Animals of Different Cattle Breeds in Yakutia // Science and Education. 2017. №4. P. 141-146.