Influence of climatic seasons and the origin of animals on indicators of cattle productivity

V Kolpakov¹, A Ruchay¹,², K Dzhulamanov¹ and D Kosyan¹

¹ Federal Research Centre of Biological Systems and Agro-technologies of the Russian Academy of Sciences, 29, 9 Yanvarya str., Orenburg, 460000, Russia
² Department of Mathematics, Chelyabinsk State University, 129, Bratiev Kashirinykh str., Chelyabinsk, 454001, Russia

E-mail: vkolpakov056@yandex.ru, ran@csu.ru, kinispai.d@yandex.ru, kosyan.diana@mail.ru

Abstract. The processes of life of the body, as well as its physiological functions, are largely characterized by the biochemical and morphological compositions of blood. Studying the level and direction of metabolic processes in animals under the influence of genotypic and paratypical factors is of great practical interest. The object of the study was bull-calves from cows of different productive values of the created hornless type of Hereford breed cattle. We found an increased level of β-globulins in experimental bulls of groups III and V in the winter as well as a significant (in 1.2 times) increase (p≤0.05) of the vitamin A content in group II, compared to the first group. A significant increase in the concentration of carotene in the II experimental group reached a 1.3 times point (p≤0.05) and, at the same time, found its decrease in the IV group by 17.1 % (p≤0.05) compared to the first group. It was noted that the more massive calves had higher levels of hemoglobin and red blood cells in temperature-contrast periods of the year. The superiority of bulls from group III over peers in these indices was 5.05–16.29 % and 5.1–13.5 %. All changes in the values of the morphological and biochemical compositions of blood were at the optimal level changing by seasons of the year. In most cases, the high values corresponded to a higher growth rate of the live mass of the bulls of studied genotypes.

1. Introduction
The basis for improving the efficiency of meat breeding and productive qualities is the perfection of breeding and pedigree work [1–3]. An analysis of previous years shows that there is a gradual increase in the rate of breeding and pedigree work, its intensification, which is caused primarily by the implementation of new methods of biotechnology and population genetics and the use of the world's best gene pool of the world's meat breeds.

One of the indicators of the consistent improvement of Hereford cattle herds of the Southern Urals bred by the All-Russian Scientific Research Institute of Beef Cattle Breeding is the approval of a new intra-pedigree type “Ural Hereford” in 2008 [4–7].

One of the most important tasks of breeding work is to develop ways of action on animals to change their hereditary qualities in the direction the breeder needs [8–9].

The processes of life of the body, as well as its physiological functions, are largely characterized by the biochemical and morphological compositions of blood.
Studying the level and direction of metabolic processes in animals under the influence of genotypic and paratypical factors is of great practical interest.

An extensive physiological evaluation allows the most fully disclosing capabilities of animals and controlling the selection for the formation of desirable constitutional types of animals. The physiological state and intensity of metabolism in animals are mostly characterized by morphological and biochemical blood compositions. The physiological state and intensity of the metabolism in animals are mostly characterized by morphological and biochemical blood compositions.

2. Materials and methods

The object of the study was bull-calves from cows of different productive values of the created hornless type of Hereford breed cattle. We formed five groups of animals with ten heads in each. Group I consisted of calves derived from cows of “elite-record” and “elite” classes in live weight, group II – from cows of the “live-weight” first class, group III – from cows of “elite-record” and “elite” classes in milk producing, IV – from cows of the “milk-producing” first class, V – from cows corresponding to the first class on a set of signs. Animals of all groups were kept in the same conditions of housing and feeding. To monitor the physiological state of the animals, three heads from each group were subjected to study of the morphological and biochemical compositions of blood according to conventional methods. During the experiment, all the calves were under constant veterinary control. No illnesses were identified.

3. Results and discussion

Bull-calf progenies of cows different in the production value were inherent in different nature of the change in the content of the total protein in the serum by the seasons of the year and in the age aspect (Table 1). At the same time, its increased content was revealed in heavier bulls during all periods of observation, which is a biochemical confirmation of a higher average daily increase in live mass.

| Indicator                          | I            | II           | Group III  | IV           | V            |
|-----------------------------------|--------------|--------------|------------|--------------|--------------|
| **Winter**                        |              |              |            |              |              |
| Total protein, g/l                | 77.6±1.40    | 76.7±2.15    | 77.6±2.74  | 72.3±1.42    | 74.2±1.33    |
| Albumins, g/l                     | 44.6±0.23    | 45.2±0.21    | 44.3±0.19  | 44.7±0.17    | 44.9±0.21    |
| Globulins overall, g/l            | 54.6±2.02    | 54.8±2.25    | 55.7±2.46  | 55.3±1.90    | 55.1±1.98    |
| α                                 | 12.0±0.32    | 12.5±0.26    | 12.8±0.30  | 12.9±0.28    | 12.3±0.32    |
| β                                 | 16.9±0.38    | 17.7±0.35    | 18.4±0.73* | 17.9±0.83    | 18.2±0.72*   |
| γ                                 | 25.6±0.35    | 24.6±0.06    | 24.5±0.41  | 24.6±0.39    | 24.7±0.43    |
| Albumins/globulins ratio          | 0.82±0.05    | 0.82±0.08    | 0.79±0.11  | 0.80±0.07    | 0.8±0.05     |
| Vitamin A, mmol/l                 | 3.60±0.42    | 4.26±0.37*   | 3.45±0.08  | 3.31±0.37    | 3.87±0.21    |
| Carotene, mmol/l                  | 0.75±0.03    | 0.74±0.03    | 0.74±0.03  | 0.85±0.01    | 0.79±0.03    |
| **Summer**                        |              |              |            |              |              |
| Total protein, g/l                | 75.9±0.11    | 79.1±1.31    | 80.2±0.75  | 79.7±0.83    | 74.9±0.38    |
| Albumins, g/l                     | 43.6±0.32    | 42.9±0.17    | 42.4±0.02  | 43.2±0.12    | 43.7±0.25    |
| Globulins overall, g/l            | 56.6±2.62    | 57.3±2.06    | 57.9±1.66  | 56.6±1.78    | 56.0±2.24    |
| α                                 | 13.2±0.29    | 13.8±0.38    | 13.6±0.38  | 13.3±0.50    | 13.1±0.74    |
| β                                 | 16.9±0.53    | 17.8±0.37    | 19.7±0.41* | 17.7±0.31    | 16.8±0.08    |
| γ                                 | 26.6±0.49    | 25.7±0.18    | 24.6±0.04  | 25.6±0.08    | 26.2±0.45    |
| Albumins/globulins ratio          | 0.77±0.05    | 0.74±0.09    | 0.73±0.12  | 0.76±0.03    | 0.78±0.10    |
| Vitamin A, mmol/l                 | 4.01±0.03    | 3.87±0.07    | 4.19±0.01  | 3.91±0.11    | 4.11±0.03    |
| Carotene, mmol/l                  | 0.82±0.27    | 1.07±0.16*   | 1.22±0.22  | 0.68±0.08*   | 0.72±0.05    |
The excess of this indicator in group III over peers from other groups was 0.04–5.27 g/l in the winter and 0.54–5.25 g/l – in the summer.

Albumins and globulins are the main proteins that take part in the metabolism of animals. The intensity of the growth of the live mass of bulls was associated with the content of albumins and globulins in serum.

The higher the level of albumins was, the larger the average daily gain of live mass in bulls was reached. Apparently, this is due to their function of binding and transporting nutrients.

Intergroup differences on this basis were insignificant and statistically unreliable. We discovered certain differences in concentrations of globulins. Changes in its content were explained by the body's immunobiological response to environmental conditions.

We found an increased level of β-globulins in experimental bulls of groups III and V in the winter, which may to a certain extent indicate the activity of the fat formation process as age increases, so the III experimental group was characterized by a 14.5 % significant increase (p≤0.05) and the V experimental group – by 7.14 % (p≤0.05) compared to the first experimental group.

Differences in the concentration of vitamin A and carotene between the groups were minimal except the vitamin A content in group II, where we found a significant 1.2 times increase (p≤0.05) compared to the first group.

In the summer, the picture was similar in terms of the level of β-globulins in experimental groups and its true increase by 14.2 % (p.0.05) was recorded only in the III experimental group in comparison with the first group.

A significant increase in the concentration of carotene in the II experimental group reached a 1.3 times point (p≤0.05) and, at the same time, we found its decrease in the IV group by 17.1 % (p≤0.05) compared to the first group.

Depending on the season, the physiological state, and live mass of animals, the number of red blood cells varied between 6.29–7.27×1012/l, hemoglobin – from 99.33 to 126.66 g/l, white blood cells – between 6.28–7.23×109/l. It was noted that the more massive calves in temperature-contrast periods of the year had higher levels of hemoglobin and red blood cells (Table 2).

The superiority of bulls from group III over peers in these indices was 6.00–19.33 g/l (5.05–16.29 %) and 0.37–0.98×1012/l (5.1–13.5 %). All this indicates a higher metabolic rate in larger, heavier animals, which was confirmed by their superiority in the intensity of the average daily increase in live mass.

Differences in the concentration of white blood cells in the blood of experimental animals were statistically insignificant. No significant intergroup differences were observed in terms of the calcium and phosphorus content.

There was recorded a downward trend in these indicators with age. In general, blood indicators were within the physiological norm and showed normal metabolic processes in the body of experimental bulls of different genotypes.
Table 2. Morphological and biochemical compositions of blood

| Indicator          | I         | II        | III       | IV        | V         |
|--------------------|-----------|-----------|-----------|-----------|-----------|
|                    | Winter    | Summer    |           |           |           |
| Hemoglobin, g/l    | 112.66±0.54 | 104.66±1.08 | 118.66±1.44 | 109.33±0.54 | 99.33±0.54 |
| Erythrocytes, 1012/l | 6.90±0.20 | 6.44±0.19 | 7.27±0.08 | 6.58±0.12 | 6.29±0.01 |
| Leukocytes, 109/l  | 6.99±0.08 | 7.23±0.08 | 6.9±0.02  | 6.98±0.04 | 7.05±0.07 |
| Calcium, mmol/l    | 2.55±0.04 | 2.51±0.05 | 2.55±0.02 | 2.56±0.01 | 2.53±0.01 |
| Phosphorus, mmol/l | 2.00±0.08 | 1.92±0.11 | 2.0±0.07  | 2.1±0.02  | 2.07±0.05 |

4. Conclusion
Characteristically, all changes in the values of the morphological and biochemical compositions of blood were at the optimal level changing by seasons of the year. In most cases, the high values corresponded to a higher growth rate of the live mass of the bulls of studied genotypes.

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