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## MORPHOLOGICAL AND BIOCHEMICAL BLOOD PARAMETERS OF THE STUDIED ANIMAL GROUPS

### ANNOTATION

The hematological parameters of animals to a certain extent characterize their breeding and productive qualities.

The article presents the results of a study of morphological and biochemical parameters of the blood of sheep of the Akzhaik meat and wool breed on fattening at the ages of 4 and 8 months. The first group is represented by sheep of the BALI-1395 line, which has a large live weight, the second group is represented by sheep of the BAK-4087 line, selected for longhair, the third group is represented by sheep of the related group No. 7082. As a control group, the experiment involved sheep of non-linear origin, that is, which did not belong to these two tested lines.

The morphological and biochemical composition of the blood of sheep at the ages of 4 and 8 months shows that all blood parameters (morphological and biochemical) were within physiological norms. The sheep of the first group were superior to other groups in terms of the number of red blood cells, hemoglobin, total protein, calcium and phosphorus. The rams of other factory lines also had an advantage in these indicators over the rams of the control group. This can explain the higher productivity of young animals in these lines compared to the young of the nonlinear group.

**Key words:** *akzhaikskaya, hematology, erythrocytes, leukocytes, hemoglobin, calcium, phosphorus*

**Introduction.** The study of morphological and biochemical blood parameters allows us to assess the intensity of physiological processes occurring in the body. Blood is a direct participant in metabolism [1,2, 3, 4].

Blood is the only liquid tissue of the body that performs a variety of functions. Including trophic (nutrient), transport (transfer of nutrients), respiratory (oxygen delivery and removal of carbon dioxide), protective and others. At the same time, the biochemical and morphological composition of blood changes depending on the age and sex of the animal, feeding and housing conditions, physiological state, time of year and other factors. The blood picture quite fully reflects the nature of metabolism in the body and allows one to judge the state of health of animals [5].

Different breeds of animals differ in a number of important blood parameters, and these differences are often hereditary. The authors write that the offspring obtained from different selection options differ at the morphological level in the manifestation of meat and wool productivity, i.e. the

obtained indicators of meat productivity are not random, but are based on the morphological composition of the blood and the predisposition of animals to metabolism [6,7,8].

Innovative methods for studying interior indicators can play the role of genetic markers, which will make it possible to predict the productive qualities of animals at an earlier age [9,10,11,12,13,14].

The main indicators by which the properties of blood are studied are its total quantity, the number of erythrocytes and leukocytes, the content of hemoglobin, protein and its fractions, reserve alkalinity, the content of sugar, lactic acid, enzymes and others. A number of authors have devoted their research to studying the composition of the blood of animals in connection with productivity, sex, age, genetic and breed characteristics, fertility, environmental factors and feeding and housing conditions [15,16,17,18].

It was found that sheep whose blood contained more red blood cells and hemoglobin had the greatest reproductive ability [17,18,19,20,21].

In order to better understand the constitutional characteristics and physiological state, on which the productivity and breeding qualities of animals largely depend, some hematological parameters of experimental groups of young Akzhaik meat and wool sheep were studied.

**Materials and research methods.** To study hematological parameters, four groups of rams of the Akzhaik meat and wool breed were formed for fattening. The first group is represented by rams of the BALI-1395 line, which has a large live weight, the second group - by rams of the long-haired line BAK-4087, the third group - by rams of the related group No. 7082. As a control group, the experiment included rams of non-linear origin, that is, those that did not belong to these two tested lines.

Blood was collected from the jugular vein before feeding in the morning.

**Results and its discussion.** The morphological and biochemical composition of blood is normally quite constant and in the animal body it performs a variety of functions (respiratory, nutritional, excretory, regulatory, protective), creating the most favorable conditions for the life of individual tissues. Therefore, blood, like a mirror, reflects all the processes that occur in the body of animals. In this regard, the study of hematological parameters provides invaluable information about all processes occurring in the body.

We studied the hematological parameters of 10 lambs from each group in fattening at the age of 4 and 8 months.

Table 1 – Morphological blood parameters of rams at the age of 4 months

Index	Group			
	BALI -1395	BAK -4087	kin group №7082	nonlinear
Red blood cells, million/mm <sup>3</sup>	10,62±0,30	9,68±0,23	9,05±0,27	8,09±0,21
Leukocytes, thousand/mm <sup>3</sup>	7,86±0,54	7,74±0,27	7,65±0,24	7,36±0,31
Hemoglobin, g/l	10,96±0,14	10,01±0,22	9,86±0,19	8,96±0,13
Hematocrit, %	37,88±1,13	36,77±1,16	37,06±0,98	36,62±0,96
Quantity hemoglobin in 1 red blood cell, pg	10,28±0,31	10,21±0,22	10,14±0,24	10,10±0,36
Volume of 1 red blood cell, mcm <sup>3</sup>	36,17±0,10	36,86±0,16	37,12±0,44	36,44±0,44
Medium Cellular concentration hemoglobin in erythrocytes, g%	28,86±0,42	27,03±0,29	24,76±0,62	24,88±0,81

A study of the morphological parameters of sheep blood showed that when compared between lines, there are some differences (Table 1). The largest number of erythrocytes was contained in the blood of rams of the BALI-1395 line - 10.62 million/mm<sup>3</sup>, which is more than in the group of non-linear rams by 2.53 million/mm<sup>3</sup> or 31.3%, with P>0.999. The rams of the second group of animals of

the control group ( $P>0.999$ ) are significantly higher (by 19.61%) in terms of the content of erythrocytes in the blood, as well as the third group of rams, which are 11.1% higher than the rams of the control group. There were no significant differences between the groups in the content of leukocytes, and the content of leukocytes in all groups was within the physiological norm. The highest concentration of hemoglobin was observed in the blood of rams of the first group - 10.96%, which is more by 2.0 g% or 22.3%, with  $P>0.999$ . Also, the rams of the second and third groups ( $P>0.99$ ) outperformed the control group by a significant amount ( $P>0.999$ ).

There were no significant differences between the groups in terms of the volume of formed elements (cells) of the blood, that is, in hematocrit.

Significant differences were established when comparing the first group with the control group of rams in terms of the average cellular concentration of hemoglobin in erythrocytes. In the blood of animals of the massive line, the concentration of hemoglobin in erythrocytes was higher by 3.98 g% or 16.0%,  $P>0.999$ . According to this indicator, the rams of the second group were superior to the control group. In this case, the difference was 2.15 g% or 8.6%, with  $P>0.95$ . The superiority of the third group was insignificant. There were no significant differences between the groups in other studied indicators.

In addition to the morphological composition of the blood, the biochemical composition of the blood was also studied (Table 2).

Table 2 – Biochemical composition of blood serum of rams at the age of 4 months

Index	Group			
	BALI -1395	BAK -4087	kin group №7082	Nonlinear
Total protein, g/l	88,1±0,15	76,7±0,21	74,4±0,10	72,3±0,13
Phosphorus, mg%	4,58±0,08	4,47±0,07	4,41±0,06	4,22±0,03
Calcium, mg%	12,17±0,22	11,36±0,31	11,27±0,36	10,60±0,26
Carotene, mg/l	0,373±0,01	0,361±0,01	0,328±0,02	0,308±0,01
Alkaline reserve, cm <sup>3</sup>	56,62±0,46	55,78±0,42	55,56±0,38	55,46±0,44

The amount of total protein in the blood serum indicates the level of protein metabolism in the body. The higher the protein content, the higher the protein metabolism and productivity of animals. In terms of the concentration of total protein in the blood serum, rams of the first group are superior to all groups. At the same time, their superiority over the rams of the control group reached 15.8 g/l or 21.8%, with a significant difference of  $P>0.999$ , over animals of the third group - 13.7 g/l or 18.4%, with  $P>0.999$ , over animals of the second group – 11.4 g/l or 14.8%,  $P>0.999$ .

Animals of the second group are superior in total protein content to rams of the control group by 4.4 g/l or 6.1%, but this difference is not significant. The superiority of the third group over the control group was 2.1 g/l or 2.9%, the difference is also significant.

Our studies have shown that in the blood serum of experimental animals there is sufficient protein to fulfill all the physiological needs of the body. After all, blood, in addition to participating in metabolism, also performs other functions, such as: helping to maintain isotonic plasma pressure; preventing the transition of an aqueous blood solution into the surrounding tissue fluid, which means maintaining the body's water balance; ensuring optimal blood viscosity; transfer of biologically active substances - hormones, enzymes, vitamins, pigments, metabolites, microelements; participation in the regulation of acid-base balance; ensuring blood clotting; protection of the body [22].

It is known that during metabolic processes in the body a large amount of acidic and alkaline products are formed. But the amount of acidic products formed is always greater than alkaline ones. Therefore, there is a danger of the pH shifting towards the acidic side. At the same time, the total charge of alkaline ions is greater than that of acidic ones and their ratio is called the acid-base balance of the blood. As a result, the blood reaction is always slightly alkaline and the pH is 7.35. This indicator is one of the most "hard" constants in the animal body. At the same time, blood is a very mobile system; it constantly receives substances that can disrupt the pH of the blood. But despite this, the blood pH level remains constant. How is this possible? There are various mechanisms to regulate

the acid-base balance. These are complex neurohumoral (physiological) and chemical mechanisms (alkaline and acidic blood reserves, carbonate and phosphorus buffer systems, etc.).

The alkaline reserve of the blood is the sum of all alkaline substances in the blood, mainly potassium and sodium bicarbonates. The greater the body's alkaline reserve, the better protected it is from acidic foods. For sheep, the norm is 56 cm<sup>3</sup> of carbon dioxide in 100 ml of blood plasma.

In our studies, the alkaline reserve of the blood of rams in different groups ranges from 55.46 to 56.62 cm<sup>3</sup>. Moreover, the highest value was in the group of rams of the BALI-1395 line, and the lowest in the group of non-linear animals. In other groups these values were intermediate. No significant differences have been established between different genotypes. The increased level of reserve alkalinity of the first group can be explained by the fact that they are more highly productive and their metabolic rate is at a higher level.

Studying the content of calcium and phosphorus in blood serum allows one to judge the state of mineral metabolism in the animal's body. The mineral components of the body are in a molecularly dispersed or ionically dispersed state, as well as in the form of complexes with colloids, often with proteins. In clinically healthy animals, a constant level of ash elements - calcium, potassium, sodium, phosphorus and others - is strictly maintained in the blood serum. Even if salt solutions of mineral substances are added to the blood, their content in the blood is quickly restored.

Diagnosing the level of calcium in the blood serum is very important, since calcium salts contribute to the compaction of cell and tissue membranes; with its deficiency, osteomalacia occurs, the permeability of blood vessels increases, and the excitability of the central and peripheral nervous systems increases. Typically, calcium in the blood is found in the form of an ionized part, constituting 45-55% of the total calcium content, and a non-ionizing part, which is in a combined state with blood plasma proteins.

In the blood serum of rams of the experimental groups, the calcium content met the requirements of the physiological norm. The largest amount of calcium was contained in the blood of rams of the first group, which indicates a higher level of mineral metabolism in them. In these animals, the calcium content was 1.57 mg% higher than in the rams of the control group (by 14.8%), with  $P > 0.999$ . Animals of the second group outperformed the control group rams by 7.2%, and the third group - by 6.3%. But in these comparison cases the difference is unreliable.

One of the main indicators of the level of mineral metabolism in the body is the phosphorus content in the blood serum. In the body, more precisely in the blood serum, phosphorus is found in the form of organic and inorganic compounds. In this case, we study the content of inorganic phosphorus.

A low level of phosphorus in the body can lead to rickets in young animals, and osteomalacia in adult animals. At the same time, excess phosphorus occurs with fever, uremia, oxygen starvation, and dysfunction of the parathyroid glands. The phosphorus content in the blood serum of the experimental rams was at the level of 4.22-4.58 mg%, which corresponds to the physiological norm. The largest amount of phosphorus was in the blood serum of rams of the first group - 4.58 mg%, which is more than in the blood serum of rams of the control group by 0.36 mg% or 8.5%, with  $P > 0.999$ . Also, the rams of the second group are superior to the rams of the control group by a significant amount (0.25 mg% or 5.9%) ( $P > 0.99$ ). The superiority of the third group over the control group was 0.19 mg% or 4.5%, with  $P > 0.95$ .

The carotene content in feed, and subsequently in the blood serum of animals, plays an extremely important role. Vitamin A is formed from carotene in the small intestine of animals, which plays an important role as a catalyst for many processes in the body. Vitamin A is also called the growth vitamin. A deficiency of this substance leads to growth retardation, decreased reproductive functions and the onset of a disease - decreased vision ("night blindness"). Excess carotene is deposited in adipose tissue. The normal content of carotene in sheep blood serum is 0.300-0.520 mg/l.

The carotene content in the blood serum of experimental rams of all groups was within physiological norms. The highest content of carotene was in the blood of rams of the BALI-1395 line - 0.373 mg/l, which is 0.065 mg/l more than in the blood of non-linear rams. This is 21.1%, with  $P > 0.999$ . The blood of rams of the long-haired line contained 0.361 mg/l of carotene, which is more than in the blood of rams of the fourth group by 0.053 mg/l or 17.2%, with  $P > 0.99$ . The greatest advantage of carotene content in the blood serum of thick-haired rams over the control group was observed by 0.020 mg/l or 6.5%, but this difference is not significant.

Thus, summarizing the results of studying the biochemical parameters of blood serum, we can conclude that all indicators were within the physiological norms for sheep in all groups. Linear rams are superior in the content of total protein, calcium, phosphorus, and carotene to the content of these substances in the blood serum of control rams.

In the process of protein metabolism in the body, not only the total amount of protein plays an important role, but also individual protein fractions. Determining the content of individual protein fractions is of great importance, since their content reflects not only the clinical health of the animal, but also its productivity [23].

Albumins and globulins are the main protein fractions that take part in the metabolism of animals. They are in constant exchange with protein molecules of the body's tissues, accordingly they influence various functions of the body and, therefore, have a certain information content [24].

A particularly important function in protecting the body is given to gamma globulins, which also enhance metabolic processes, take part in enzymatic-hormonal reactions of the body and have immune properties. In this regard, studying the content of individual fractions is of great importance.

Analysis of blood serum samples from rams of various genealogical groups showed that there are intergroup differences in the content of individual protein fractions in the blood serum (Table 3). The highest amount of albumin was in the blood serum of rams of the first group - 48.6 g/l. This is 9.6 g/l or 24.6% more, at  $P > 0.999$ , than in non-linear animals. The rams of the second group contained 3.0 g/l more albumin in the blood serum than the rams of the control group (7.7%,  $P > 0.99$ ).

Animals of the dense-haired line outperformed rams of the control group by 1.3 g/l or 3.3%,  $P > 0.95$ . The rams of the first group contained the highest amount of globulins compared to other rams - 39.5 g/l, but in relative terms their globulin content was the lowest - 44.8%.

Table 3 – Content of protein fractions in the blood serum of rams

Index	Group			
	BALI -1395	BAK -4087	kin group №7082	nonlinear
Total protein, g/l	88,1±0,15	76,7±0,21	74,4±0,10	72,3±0,13
Albumins:				
g/l	48,6±0,41	42,0±0,38	40,3±0,44	39,0±0,37
%	55,2±0,46	54,8±0,32	54,3±0,42	54,0±0,38
Globulins:				
g/l	39,5±0,41	34,7±0,37	34,1±0,43	33,3±0,37
%	44,8±0,46	45,2±0,33	45,7±0,42	46,0±0,38
including:				
Alpha globulins, g/l	12,2±0,80	12,6±0,43	11,8±0,32	10,8±0,35
Beta globulins, g/l	9,3±0,86	8,7±0,31	8,5±0,36	8,0±0,39
Gamma globulins, g/l	18,0±1,16	13,4±0,88	13,8±0,41	14,5±0,42

In terms of the total amount of globulins, they exceeded their peers in the control group by 13.8 g/l or 18.6%,  $P > 0.999$ . In the blood of rams of the second group, the content of globulins was higher than in the blood of rams of the control group by 1.4 g/l or 4.2%, with  $P > 0.95$ . The superiority of rams of the third group over control animals in this indicator was unreliable. There are differences between groups in globulin fractions. For alpha globulins, the highest content was in the blood serum of rams of the second group - 12.6 g/l. This is 1.8 g/l or 16.7% more than in the blood of control group rams,  $P > 0.99$ . In second place were the rams of the first group - 12.2 g/l, which is 1.4 g/l more than the control group (12.9%), but this difference is not significant. There were no significant differences between the groups in beta globulins. There is a tendency for linear lambs to be superior in this indicator to their peers from the control group.

In terms of the content of gamma globulins in the blood, the rams of the first group differed favorably. They were significantly superior to all groups: rams of the second group - by 4.6 g/l; third group – by 4.2 g/l; control group – by 3.5 g/l. This makes it possible to assume that their body has

good resistance. In second place in terms of the content of gamma globulins in the blood serum were rams from the control group. Their advantage over other groups was unreliable.

A study of the blood of rams at the age of 8 months showed that in the blood of rams of different lines some changes occurred both in the morphology of the blood and in the biochemical composition (Table 4).

The number of erythrocytes and leukocytes was within the physiological norm in all groups. The largest number of erythrocytes, as well as leukocytes, was in the blood of rams of the first group. The number of erythrocytes in them was 0.77 million/mm<sup>3</sup> higher than in the control group of animals, P>0.999. There were also more red blood cells in the blood of other groups of linear animals than in the control group. There were no significant differences between the groups in the content of leukocytes; there was a tendency for the number of leukocytes in linear rams to be superior to the number of leukocytes in control animals.

Table 4 – Morphological blood parameters of rams at the age of 8 months

Index	Group			
	BALI -1395	BAK -4087	kin group №7082	nonlinear
Red blood cells, million/mm <sup>3</sup>	9,64±0,38	9,32±0,41	9,03±0,32	8,87±0,44
Leukocytes, thousand/mm <sup>3</sup>	7,67±0,22	7,61±0,18	7,54±0,24	7,42±0,19
Hemoglobin, g%	12,7±0,17	12,6±0,22	11,6±0,19	11,0±0,24
Hematocrit, %	36,7±1,13	36,4±1,17	36,1±1,20	35,8±1,11
Amount of hemoglobin in 1 red blood cell, pg	13,4±0,31	13,1±0,33	12,8±0,28	12,7±0,37
Volume of 1 red blood cell, mcm <sup>3</sup>	36,8±0,10	36,4±0,09	36,2±0,11	36,4±0,13
Midcellular hemoglobin concentration in erythrocytes, g%	29,1±0,40	28,3±0,38	28,1±0,42	27,8±0,41

The hemoglobin content was also the highest in the blood of animals of the first group - 12.7 g%, with a color index of 1.27. In terms of hemoglobin content, the rams of the first group exceeded the rams of the control group by 1.7 g% or 15.4%, with P>0.999. And the rams of the second group were superior to the rams of the control group in this indicator by 1.6 g% or 14.5%, P>0.999. This means that these animals had higher redox processes, therefore, they had higher productivity. The study of biochemical parameters of the blood of rams at this age gave the following indicators (Table 5).

Table 5 – Biochemical blood parameters of rams at the age of 8 months

Index	Group			
	BALI -1395	BAK -4087	kin group №7082	nonlinear
Total protein, g/l	83,3±0,23	75,2±0,18	73,8±0,12	71,3±0,21
Phosphorus, mg%	5,12±0,07	4,82±0,06	4,91±0,09	4,81±0,08
Calcium, mg%	11,85±0,23	11,62±0,32	11,43±0,36	11,22±0,28
Carotene, mg/l	0,356±0,01	0,357±0,02	0,344±0,01	0,338±0,02
Alkaline reserve, cm <sup>3</sup>	55,16±0,52	54,87±0,48	54,42±0,41	54,16±0,50

In terms of total protein content, the BALI-1395 line is superior to all other groups. The difference in this indicator of the first line with the group of non-linear animals was 12 g/l or 16.8%, with P>0.999, with the second line the difference was 8.1 g/l or 10.8%, with P>0.999, with the third line – 9.5 g/l or 12.9%, P>0.999. It should be noted that the total protein in the blood of rams decreased by 1.4-5.4% compared to the protein content at the age of 4 months. This indicates a decrease in the level of protein metabolism with age of animals. Also, the level of calcium in the blood

of older rams decreased slightly compared to the level of calcium in the blood of 4-month-old rams, and the concentration of phosphorus increased slightly. Apparently, this is a consequence of the feeding habits of animals during this period. The carotene content was at a sufficient level in the blood of all rams. Reserve alkalinity in the blood was slightly lower than in the blood of 4-month-old rams. In general, the alkaline reserve in all groups was within physiological norms.

The content of individual protein fractions was also studied in the blood samples of rams (Table 6). Interesting changes occurred in the content of individual protein fractions. In all groups, the amount of albumin in the blood decreased with age and the amount of globulin fraction increased accordingly.

Table 6 – Content of protein fractions in the blood serum of rams at the age of 8 months

Index	Group			
	BALI -1395	BAK -4087	kin group №7082	nonlinear
Total protein, g/l	83,3±0,23	75,2±0,18	73,8±0,12	71,3±0,21
Albumins:				
g/l	39,4±0,33	35,9±0,41	35,9±0,37	33,4±0,28
%	47,3±0,44	47,8±0,41	48,6±0,39	46,9±0,42
Globulins:				
g/l	43,9±0,36	39,3±0,31	37,9±0,33	37,9±0,35
%	52,7±0,44	52,2±0,41	51,4±0,39	53,1±0,42
including:				
Alpha globulins, g/l	14,6±0,80	13,3±0,49	12,6±0,41	12,1±0,41
Beta globulins, g/l	11,5±0,71	10,2±0,33	9,1±0,39	8,7±0,37
Gamma globulins, g/l	17,8±0,98	15,8±1,11	16,2±0,91	17,1±0,56

In terms of the amount of albumin and globulin, the leadership was in the rams of the first group, but in terms of relative content they were inferior to the animals of the second and third groups. And in terms of globulin content in relative value, rams of the fourth group (53.1%) were in first place.

In the globulin portion of the protein, there was an increase in all fractions, without major differences between groups.

**Conclusion.** Thus, by studying the morphological and biochemical composition of the blood of rams at the age of 4 and 8 months, we can conclude that all blood parameters (morphological and biochemical) were within physiological norms. The rams of the first group were superior to other groups in the number of red blood cells, hemoglobin, total protein, calcium and phosphorus. Lambs from other factory lines also had superiority in these indicators over rams from the control group. This can explain the higher productivity of young animals of different lines compared to young animals of the non-linear group.

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### ТҮЙІН

Жануарлардың гематологиялық көрсеткіштері белгілі бір дәрежеде болады, олардың асыл тұқымды және өнімділік қасиеттерін сипаттайды.

Мақалада 4 және 8 айлық жастағы бордақылаудағы ақжайық етті – жүнді қойлардың қанының морфологиялық және биохимиялық көрсеткіштерін зерттеу нәтижелері келтірілген. Бірінші топқа үлкен салмақты БАЛЛИ-1395 желісінің еркек қозылары, екінші топқа ұзын жүнді БАК - 4087 желісінің еркек қозылары, үшінші топқа №7082 туыстық тобының еркек қозылары кіреді. Бақылау тобы ретінде экспериментке аталық ізге жатпайтың еркек қозылары қатысты, яғни олар осы екі сыналатын желіге жатпайды.

4 және 8 айлық малдардың қанының морфологиялық және биохимиялық құрамы барлық қан көрсеткіштерінің (морфологиялық және биохимиялық) физиологиялық нормалар шегінде болғанын көрсетеді. Бірінші топтағы еркек қозылардың эритроциттер, гемоглобин, жалпы ақуыз, кальций және фосфор саны бойынша басқа топтардан асып түсті. Басқа зауыттық желілердегі еркек қозылары да осы көрсеткіштер бойынша бақылау тобындағы еркек қозылардан басым болды. Бұл аталық ізге жатпайтың топтағы жас жануарлармен салыстырғанда осы аталық желілердегі еркек қозылардың жоғары өнімділігін түсіндіруге болады.

### РЕЗЮМЕ

Гематологические показатели животных в определённой мере характеризуют их племенные и продуктивные качества.

В статье представлены результаты исследования морфологических и биохимических показателей крови баранчиков акжайкской мясо – шерстной породы на откорме в возрасте 4 и 8 месяцев. Первая группа представлена баранчиками линии БАЛЛИ-1395, имеющей большую живую массу, вторая группа - баранчиками длинношерстной линии БАК-4087, третья группа – баранчиками родственной группы №7082. В качестве контрольной группы в эксперименте участвовали баранчики нелинейного происхождения, то есть которые не принадлежали к этим двум апробируемым линиям.

Морфологический и биохимический состав крови баранчиков в возрасте 4 и 8 месяцев показывает, что все показатели крови (морфологические и биохимические) были в пределах физиологических норм. Баранчики первой группы превосходили другие группы по количеству эритроцитов, гемоглобина, общего белка, кальция и фосфора. Баранчики других заводских линий также имели превосходство по этим показателям над баранчиками контрольной группы. Этим можно объяснить более высокую продуктивность молодняка в этих линиях по сравнению с молодняком нелинейной группы.

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