

SRSTI 34.41.37

DOI: <https://doi.org/10.62724/202530502>

**Baimishev Khamidulla Baltukhanovich\*<sup>1</sup>**

Doctor of Biological Sciences, Professor,

Honored Scientist of the Russian Federation, Academician of the Russian Academy of Natural Sciences, FSBEI HE «Samara State Agrarian University», Samara region, Kinel, Ust-Kinelsky settlement, 2a Energetikov str., 446442, Russia,  
[Baimishev\\_HB@mail.ru](mailto:Baimishev_HB@mail.ru), ORCID ID: 0000-0003-1944-5651

## HEMATOLOGICAL AND BIOCHEMICAL PROFILES OF YOUNG AKZHAIK MEAT-AND-WOOL SHEEP AT 4 AND 8 MONTHS

**Abstract.** Hematological parameters are widely recognized as indicators that partially reflect the breeding value, adaptive capacity, and productive qualities of farm animals. In this study, we investigated blood morphology and serum biochemical traits of Akzhaik meat-and-wool lambs during the fattening period at 4 and 8 months of age. The experimental design included three linebred groups—BALI-1395, selected for greater live weight; BAK-4087, selected for longer fleece; and related group No. 7082—together with a non-linebred control group. All measured hematological and biochemical values were within the established physiological ranges for sheep. Among the groups, lambs of the BALI-1395 line displayed the highest red blood cell counts and hemoglobin concentrations, as well as increased levels of serum total protein, calcium, and phosphorus. Animals from the other linebred groups also outperformed controls, showing more favorable blood indices. These findings confirm that linebreeding contributes to improved physiological and productive potential compared with non-line animals. The results not only demonstrate the genetic advantages of linebreeding but also emphasize the importance of using hemato-biochemical markers as reliable selection criteria for the sustainable development of sheep husbandry in Kazakhstan and Russia.

**Key words.** Akzhaik breed; hematology; erythrocytes; leukocytes; hemoglobin; calcium; phosphorus.

**Баймишев Хамидулла Балтұқанұлы\*<sup>1</sup>**

биология ғылымдарының докторы, профессор,

Ресей Федерациясының еңбек сіңірген ғылым қайраткері, Ресей Ғылым академиясының академигі, "Самара мемлекеттік аграрлық университеті" ФМББМ ЖПК, Самара облысы, Кинель қаласы, Усть-Кинельский кенті, Энергетиков көшесі, 2а, 446442, Ресей,

[Baimishev\\_HB@mail.ru](mailto:Baimishev_HB@mail.ru), ORCID ID: 0000-0003-1944-5651

## 4 ЖӘНЕ 8 АЙЛЫҚ ЖАС АҚЖАЙЫҚ ЕТ-ЖҮНДІ ҚОЙЛАРЫНЫҢ ГЕМАТОЛОГИЯЛЫҚ ЖӘНЕ БИОХИМИЯЛЫҚ СИПАТТАМАЛАРЫ

**Аңдатпа.** Гематологиялық белгілер ішінара малдың асыл тұқымдық құндылығы мен өнімділігін көрсетеді. Біз 4 және 8 айлық жастағы Ақжайық ет-жүн тұқымды қозылардағы қан морфологиясын және Сарысу биохимиясын бағаладық. Үш сызықтық

топ зерттелді — ВАЛИ-1395 (үлкен тірі массасы бар), ВАК-4087 (ұзын руна алу үшін таңдалған) және № 7082 туыстық топ, сондай-ақ сызықтық емес бақылау тобы. Барлық өлшенген көрсеткіштер физиологиялық нормалар шегінде болды. Бали-1395 қозыларында эритроциттер мен гемоглобиннің ең көп мөлшері болды, сонымен қатар қан сарысуындағы жалпы ақуыз, кальций және фосфор көп болды. Басқа зауыттық желілердің қозылары да бақылаудан асып түсті, бұл тұқымсыз жануарлармен салыстырғанда сызықтық топтағы жануарлардың жоғары өнімділігін көрсетеді.

**Кілт сөздер.** Ақжайық тұқымы; гематология; эритроциттер; лейкоциттер; гемоглобин; кальций; фосфор.

**Баймишев Хамидулла Балтуханович**\*<sup>1</sup>

доктор биологических наук, профессор,  
заслуженный деятель науки Российской Федерации, Академик Российской академии наук, ФГБОУ ВПО "Самарский государственный аграрный университет", Самарская область, г. Кинель, п. Усть-Кинельский, ул. Энергетиков, 2А, 446442, Россия,  
[Vaimischev\\_HB@mail.ru](mailto:Vaimischev_HB@mail.ru), ORCID ID: 0000-0003-1944-5651

## ГЕМАТОЛОГИЧЕСКИЕ И БИОХИМИЧЕСКИЕ ХАРАКТЕРИСТИКИ МОЛОДНЯКА АКЖАЙКСКИХ МЯСО-ШЕРСТНЫХ ОВЕЦ В ВОЗРАСТЕ 4 И 8 МЕСЯЦЕВ

**Аннотация.** Гематологические признаки частично отражают племенную ценность и продуктивность скота. Мы оценили морфологию крови и биохимию сыворотки у ягнят мясо-шерстной породы Акжайк на откорме в возрасте 4 и 8 месяцев. Были изучены три линейные группы — ВАЛИ-1395 (с большей живой массой), ВАК-4087 (отобранные для получения длинного руна) и родственная группа № 7082, а также контрольная группа, не являющаяся линейной. Все измеренные показатели находились в пределах физиологических норм. У ягнят породы БАЛИ-1395 было самое высокое количество эритроцитов и гемоглобина, а также больше общего белка, кальция и фосфора в сыворотке крови. Ягнята других заводских линий также превосходили контрольных, что свидетельствует о более высокой продуктивности животных линейной группы по сравнению с беспородной.

**Ключевые слова.** акжайкская порода; гематология; эритроциты; лейкоциты; гемоглобин; кальций; фосфор.

**Introduction.** Blood morphology and biochemistry are informative indicators of metabolic intensity and overall physiological status. As a fluid connective tissue, blood supports trophic, transport, respiratory, regulatory, and immune functions. Its composition varies with age, sex, diet, housing, season, and physiological state. Breed- and line-specific differences in blood parameters are often heritable and may serve as early markers for predicting meat and wool performance. Expanding selection criteria to include interior traits—protein fractions and mineral metabolism—enhances breeding assessment. Recent studies have shown that hematological and biochemical traits are closely associated with productive and adaptive capacities in sheep, goats, and cattle, making them valuable indicators for evaluating genetic

progress [1,2,3]. In addition to their role in animal health monitoring, blood parameters are increasingly considered in animal selection programs. For example, higher levels of hemoglobin and red blood cells are linked to better oxygen transport and improved growth rates, while serum proteins and mineral elements play a key role in immunity and tissue development. Linebreeding, which aims at fixing desirable traits within a population, has been proven to enhance certain physiological characteristics. However, the degree of improvement largely depends on the genetic background and breeding goals of each line [4,5].

The Akzhaik meat-and-wool breed, developed in Kazakhstan, is known for its dual-purpose productivity, providing both high-quality meat and fleece. Yet, limited studies have focused on the detailed hemato-biochemical characterization of this breed under different breeding strategies. This research aims to fill this gap by comparing three linebred groups with a non-linebred control, evaluating their hematological and biochemical profiles at critical fattening ages—4 and 8 months. The findings are expected to provide practical insights for breeders and contribute to refining selection criteria for improving both physiological resilience and productivity.

**Materials and Methods.** Four groups of Akzhaik ram lambs under fattening were formed: (1) BALI-1395 (greater live weight); (2) BAK-4087 (long-fleece selection); (3) related group No. 7082; (4) non-linebred control. Blood was drawn from the jugular vein in the morning before feeding. Standard hematology (erythrocytes, leukocytes, hemoglobin, hematocrit, erythrocyte indices) and serum biochemistry (total protein, inorganic phosphorus, calcium, carotene, reserve alkalinity) were measured; serum protein fractions (albumin; globulins with  $\alpha/\beta/\gamma$  distribution) were also determined. At both 4 and 8 months, 10 lambs per group were sampled [6]. Animals were raised under semi-intensive conditions in the Samara region. Feeding was based on hay, silage, and concentrates, balanced to meet the nutritional requirements of growing lambs. Clean water and mineral licks were provided ad libitum. Housing included well-ventilated barns with access to outdoor paddocks, ensuring natural light and controlled microclimate. Veterinary supervision was carried out regularly, and all lambs were clinically healthy throughout the trial.

Hematological parameters were measured using an automatic hematology analyzer calibrated for ovine blood, while serum biochemical indices were determined by spectrophotometric and colorimetric assays. Protein fractions were separated using electrophoresis. All data were statistically processed using standard software packages. Mean values and standard errors were calculated, and significance of differences between groups was determined by ANOVA followed by post-hoc tests at  $p < 0.05$ .

## Results and Discussion

**Table 1. Hematological parameters at 4 months (mean  $\pm$  SEM)**

Index	BALI-1395	BAK-4087	Related No. 7082	Non-line
RBC, million/mm <sup>3</sup>	10.62 $\pm$ 0.30	9.68 $\pm$ 0.23	9.05 $\pm$ 0.27	8.09 $\pm$ 0.21
WBC, thousand/mm <sup>3</sup>	7.86 $\pm$ 0.54	7.74 $\pm$ 0.27	7.65 $\pm$ 0.24	7.36 $\pm$ 0.31
Hemoglobin, g/L	10.96 $\pm$ 0.14	10.01 $\pm$ 0.22	9.86 $\pm$ 0.19	8.96 $\pm$ 0.13
Hematocrit, %	37.88 $\pm$ 1.13	36.77 $\pm$ 1.16	37.06 $\pm$ 0.98	36.62 $\pm$ 0.96
Hb per RBC, pg	10.28 $\pm$ 0.31	10.21 $\pm$ 0.22	10.14 $\pm$ 0.24	10.10 $\pm$ 0.36
MCV, $\mu\text{m}^3$	36.17 $\pm$ 0.10	36.86 $\pm$ 0.16	37.12 $\pm$ 0.44	36.44 $\pm$ 0.44
MCHC, g <sup>0</sup> %	28.86 $\pm$ 0.42	27.03 $\pm$ 0.29	24.76 $\pm$ 0.62	24.88 $\pm$ 0.81

At 4 months of age, lambs from the BALI-1395 line showed significantly greater red blood cell (RBC) counts and hemoglobin levels compared to non-linebred controls. This suggests that genetic selection for higher body weight is accompanied by improved oxygen-carrying capacity, which may directly support enhanced growth performance. Leukocyte counts and hematocrit values were within physiological ranges and did not differ significantly among groups, indicating that immune status remained stable across genetic lines. However, the higher mean corpuscular hemoglobin concentration (MCHC) observed in BALI-1395 provides further evidence of superior erythropoietic activity.

Serum biochemical parameters revealed that BALI-1395 lambs also had the highest total protein, calcium, phosphorus, and carotene levels. Elevated protein fractions—particularly albumin and  $\gamma$ -globulins—reflect both improved nutritional status and stronger immune competence. This finding is consistent with previous reports on other sheep breeds, where superior productive traits were linked to higher serum protein concentrations [7,8].

By 8 months, differences between groups persisted, although the relative magnitude of change varied. RBC and hemoglobin remained significantly higher in BALI-1395, confirming a sustained physiological advantage in oxygen metabolism. Serum protein levels decreased slightly with age across all groups, reflecting the natural progression of growth and metabolism, yet linebred lambs still maintained higher values than controls. Calcium and phosphorus concentrations were also higher in BALI-1395, suggesting more efficient mineral utilization, which is critical for bone development and wool growth.

The shift in protein fractions with age—decreasing albumin and increasing globulin proportions—was consistent with normal immune system maturation. The highest absolute levels of both albumins and globulins were recorded in BALI-1395, indicating superior protein metabolism and immunological resilience. In contrast, control lambs exhibited lower values, which may predispose them to reduced adaptability and productivity.

Overall, the results clearly demonstrate that linebreeding exerts a positive influence on hemato-biochemical profiles. The BALI-1395 line, in particular, showed consistent superiority across key physiological indicators, which strongly correlates with their enhanced growth and productive potential. These outcomes align with the principle that interior traits can be used as reliable predictors of external performance, supporting their use in selection programs [9,10].

**Table 2. Serum biochemistry at 4 months**

Index	BALI-1395	BAK-4087	Related No. 7082	Non-line
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
Reserve alkalinity, cm <sup>3</sup>	56.62 ± 0.46	55.78 ± 0.42	55.56 ± 0.38	55.46 ± 0.44

All variables were within physiological limits. BALI-1395 showed the highest total protein, calcium, phosphorus, and carotene; reserve alkalinity was close to reference values across groups and highest in BALI-1395. [7].

**Table 3. Serum protein fractions at 4 months**

Index	BALI-1395	BAK-4087	Related No. 7082	Non-line
-------	-----------	----------	------------------	----------

Total protein, g/L	88.1 ± 0.15	76.7 ± 0.21	74.4 ± 0.10	72.3 ± 0.13
Albumin, g/L	48.6 ± 0.41	42.0 ± 0.38	40.3 ± 0.44	39.0 ± 0.37
Albumin, %	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
Globulins, %	44.8 ± 0.46	45.2 ± 0.33	45.7 ± 0.42	46.0 ± 0.38
α-globulins, g/L	12.2 ± 0.80	12.6 ± 0.43	11.8 ± 0.32	10.8 ± 0.35
β-globulins, g/L	9.3 ± 0.86	8.7 ± 0.31	8.5 ± 0.36	8.0 ± 0.39
γ-globulins, g/L	18.0 ± 1.16	13.4 ± 0.88	13.8 ± 0.41	14.5 ± 0.42

BALI-1395 exhibited the highest absolute albumin and globulin concentrations; γ-globulins were particularly elevated, suggesting stronger immune competence.

**Table 4. Hematological parameters at 8 months**

Index	BALI-1395	BAK-4087	Related No. 7082	Non-line
RBC, million/mm <sup>3</sup>	9.64 ± 0.38	9.32 ± 0.41	9.03 ± 0.32	8.87 ± 0.44
WBC, 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
Hb per RBC, pg	13.4 ± 0.31	13.1 ± 0.33	12.8 ± 0.28	12.7 ± 0.37
MCV, μm <sup>3</sup>	36.8 ± 0.10	36.4 ± 0.09	36.2 ± 0.11	36.4 ± 0.13
MCHC, g%	29.1 ± 0.40	28.3 ± 0.38	28.1 ± 0.42	27.8 ± 0.41

At 8 months, BALI-1395 retained significant advantages in RBC and hemoglobin (color index ≈ 1.27), indicating higher red-ox intensity and likely better growth potential.

**Table 5. Serum biochemistry at 8 months**

Index	BALI-1395	BAK-4087	Related No. 7082	Non-line
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
Reserve alkalinity, cm <sup>3</sup>	55.16 ± 0.52	54.87 ± 0.48	54.42 ± 0.41	54.16 ± 0.50

Relative to 4 months, total protein and calcium slightly decreased, phosphorus slightly increased, and reserve alkalinity remained within normal limits with a small reduction—likely reflecting feeding and metabolic specifics during this phase. [8].

**Table 6. Serum protein fractions at 8 months**

Index	BALI-1395	BAK-4087	Related No. 7082	Non-line
Total protein, g/L	83.3 ± 0.23	75.2 ± 0.18	73.8 ± 0.12	71.3 ± 0.21
Albumin, g/L	39.4 ± 0.33	35.9 ± 0.41	35.9 ± 0.37	33.4 ± 0.28
Albumin, %	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
Globulins, %	52.7 ± 0.44	52.2 ± 0.41	51.4 ± 0.39	53.1 ± 0.42

$\alpha$ -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

With age, albumin percentage decreased and globulin percentage increased across all groups. Absolute albumin and globulin levels were highest in BALI-1395, whereas the relative globulin share was greatest in controls. [9,10].

**Conclusion.** The present study evaluated hematological and biochemical parameters of Akzhaik meat-and-wool lambs at 4 and 8 months of age, comparing three linebred groups with a non-linebred control. Across both ages, all parameters remained within physiological limits. However, linebred lambs—especially BALI-1395—displayed significant advantages, including higher RBC counts, hemoglobin levels, serum proteins, calcium, and phosphorus. These findings confirm that linebreeding enhances physiological performance and provides a reliable basis for improved productivity.

From a practical perspective, these results highlight the value of incorporating hemato-biochemical markers into breeding programs. By monitoring blood traits, breeders can identify animals with superior adaptive capacity and growth potential at an early age, thereby improving the efficiency of selection. For the Akzhaik breed, this approach contributes to optimizing both meat and wool yields, ensuring genetic progress and supporting the sustainable development of sheep husbandry in Kazakhstan and neighboring regions.

Future studies should further explore the genetic mechanisms underlying these differences and investigate the long-term impact of linebreeding on reproductive performance, disease resistance, and wool quality. Integrating genomic tools with traditional blood-based selection may offer new opportunities for accelerating the genetic improvement of dual-purpose sheep breeds.

#### LITERATURE

1. Zaitsev, V.V., Zaitseva, L.M., Makhimova, Zh.N., Tulebaev, B. (2020). Morphological and biochemical parameters of the blood of chickens while taking a chlorella suspension. *Gylym zhane bilim*, 1(58), 56–59.
2. Zinullin, A.Z., Buralkhiev, B.A., Zhumaeva, A.K. (2018). Biochemical blood parameters of mares of the Kazakh breed of the ‘jabe’ type. *Gylym zhane bilim*, 3(52), 64–67.
3. Tajchman, K., et al. (2023). Basic haematological and biochemical parameters of farmed red deer and fallow deer blood. *Medycyna Weterynaryjna*, 79(5), 86–95.
4. Marynich, A.P., et al. (2022). Effects of high-protein feed supplements on lamb productivity. *Foods and Raw Materials*, 10(1), 185–194.
5. Irgashev, T.A., Karimova, M.O., Zhaimysheva, S.S. (2017). Hematological parameters of calves when using mineral feeds in the Gissar Valley of Tajikistan. *Gylym zhane bilim*, 3(48), 33–39.
6. Traisov, B.B., Yuldashbaev, Yu.A., Abdrakhmanova, M.S., Zhamalova, G.S. (2020). Hematological and biochemical blood parameters of semi-fine fleece sheep of different genotypes. *Gylym zhane bilim*, 4-1(61), 115–121.
7. Afanasyeva, A.I., Sarychev, V.A., Katamanov, S.G. (2018). Morphological and biochemical parameters of the blood of pregnant ewes using the probiotic ‘Vetom 4.24’. *Sheep Goats Wool Business*, (4), 53–56.

8. Arilov, A.N., Bazaev, S.O., Yuldashbaev, Yu.A., Savchuk, S.V. (2019). Biochemical blood parameters of Dorper rams during adaptation to the conditions of Kalmykia. *Sheep, Goats, Wool Business*, (4), 44–46.
9. Kour, D., Sharma, V.K., Sharma, R.K., Pathak, A.K., Rastogi, A. (2023). Evaluation of native medicinal plants as feed additives in the sheep ration. *Indian Journal of Animal Sciences*, 93(11), 1091–1097.
10. Pokhyl, V. (2023). Hematological parameters and production characteristics of novel Romanov × Hissar crossbred sheep adapted to European steppe climate. *Veterinarska Stanica*, 55(2), 181–194.