HEMATOLOGICAL AND BIOCHEMICAL BLOOD COUNT OF SIMMENTAL CATTLE OF KAZAKHSTAN BREEDING WITH DIFFERENT GENOTYPE FOR CANDIDATE GENES FOR PROTEIN METABOLISM

[a]TOKTAR BEKSEITOV, [b]RUSTEM ABELDINOV, [c]ZHANAT MUKATAEVA, [d]LYAILYA USSENOVA, [e]TOLEGEN ASANBAEV

[a-e]S. Toraighyrov Pavlodar State University, 140008, 64 Lomova Str., Pavlodar, Kazakhstan
email: [a]atf_psu@mail.ru, [b]abrustem@mail.ru, [c]abrustem@mail.ru, [d]lm_usenova@mail.ru, [e]asanbaev.50@mail.ru

Abstract: The scientific article noted that with the development of molecular genetics, it became possible to identify the genes directly or indirectly associated with economically useful traits, which makes it possible to carry out the selection in view of genetic markers in addition to the existing methods of selecting animals. The animal's organism is a complex biological system and the realization of the genetic potential of the animal represents a variety of different realizations. In this connection, the aim of the research was to study hematological and biochemical indices of blood composition of Simmental cattle with different genotype at candidate genes for protein metabolism. According to the results of the studies, it was found that the highest content of erythrocytes, platelets, and hemoglobin for the kappa-casein gene (CSN3) was observed in animals in the BB genotype. The content of leukocytes was within the limits of physiological norms. According to the beta-lactoglobulin gene (bLGB), superiority in the studied parameters was observed in animals with the BB genotype, which also indicates the conjugation of symptoms and the increased flow of metabolic processes in the animals. According to the prolactin gene (PRL), a high erythrocyte content was observed in animals in the BB genotype, which was detected in 5 cows. A high value of leukocytes and platelets was detected in animals in the homozygous genotype AA. The highest hemoglobin value was obtained in animals with heterozygous genotype AB. For the effective introduction of selection work in dairy cattle breeding it is necessary to know the mechanisms of obtaining high milk productivity and, accordingly, their application in the practice of dairy cattle breeding. The conducted research made it possible to conclude that the studied hematological and biochemical blood counts are interrelated with the level of productivity and genotype of cows, and they can also be used as tests for the early prediction of milk productivity of cows.

Keywords: biology, selection, genotype, kappa-casein gene (CSN3), beta-lactoglobulin gene (bLGB), prolactin gene (PRL), biochemistry, physiology, hematology, correlation, productivity.

1 Introduction

The selection in dairy cattle breeding is one of the determinants of effective management of the industry. Traditional methods in breeding cannot ensure its sufficient effectiveness. At present, with the development of molecular genetics, it becomes possible to identify genes directly or indirectly associated with economically useful traits, which makes it possible to carry out the selection in addition to the existing methods of selecting animals taking into account genetic markers.

The advantage of DNA technology lies in the fact that it is possible to determine the genotype of an animal regardless of sex, age, physiological state of individuals at an early age, almost immediately after birth. This significantly speeds up the selection process, making it more predictable. The use of the method of genetic markers in breeding animals has a number of advantages over traditional methods of selection. (1)

The introduction of DNA technologies into livestock farming makes it possible to monitor and predict economically useful signs in animals, which is extremely important for determining the further use of each animal. (2)

The increase in the level of milk productivity is one of the main goals in breed selection of cattle that produce milk. (3)

An animal's organism is a complex biological system and the realization of the animal's genetic potential in productive qualities represents a variety of different realizations.

Allelic variants of milk protein genes are the most important markers of dairy productivity of cattle. In connection with the increased market demands for the quality of dairy products, in particular, the amount and composition of milk protein, as well as the cheese-making characteristics of milk, there is an urgent need to identify and use in breeding genetic markers directly or indirectly related to qualitative and quantitative signs of dairy productivity.

Different alleles of genes directly involved in the regulation of lactation can be considered as potential markers of milk productivity: beta-lactoglobulin (β-LGB), the growth hormone (GH) gene, the prolactin gene (PRL), and the casein (CSN) genes, the main milk proteins. (4)

The first group includes the genes of proteins that make up milk, such as casein, lactalbumin, and the second group includes genes whose products are involved in regulatory or metabolic processes. (5,6) There are known test systems, allowing to judge its genetically determined milk potential in the early stages of development of the animal. Such DNA diagnostics mainly take into account the polymorphism of individual genes, among which the kappa-casein (CSN3), beta-lactoglobulin (bLGB), prolactin (PRL) genes occupy a special place because of their high influence on lactation and associated metabolic processes.

In this regard, the purpose of our research was the study of the hematological and biochemical blood composition of Simmental breed cows with different genotype at candidate genes for protein metabolism.

2 Materials and Methods

The work on the allocation of genes was carried out in 2016 in a certified DNA technology laboratory "Biotechnology of Animals" on the basis of S. Toraighyrov Pavlodar State University. The laboratory was certified by the National Center for Expertise and Certification, the certificate No. 370. In order to establish target genes for dairy cattle, 123 heads of cows and 3-4 lactations were selected in Galitskoe LLP of Pavlodar region when their genetic potential was fully manifested.

To conduct DNA diagnostics in animals in the number of 123 heads, blood samples were taken. The blood was obtained from the jugular vein of animals, introduced into tubes with 100 mM EDTA to a final concentration of 10 mM.

The gene polymorphism was determined in each cow: kappa-casein (CSN3), β-lactoglobulin (bLGB), prolactin (PRL).

For all loci in the study of DNA polymorphism, a polymerase chain reaction method was used, followed by restriction analysis of product amplification (PCR-RFLP).

The reaction was carried out in the thermocycler "Terzik" of "DNA technology" company. The DNA was denatured at 94°C for 4 minutes, and then 35 amplification cycles were performed in the following mode: 94°C – 1 min., an annealing of the primers – 1 min, 72°C – 1 min. The final stage of the synthesis was carried out at 72°C during 4 minutes.

The electrophoretic analysis of DNA fragments after the restriction was carried out in 6% polyacrylamide gel and in 1% agarose gel. A standard set of M27 (SibEnzyme) was used as a marker of molecular weights.

To determine the biological status of animals with different genotype by polymorphic genes, hematological and biochemical blood values were studied in experimental animals.

The study of blood composition was carried out in the laboratory of the Department of Zootechnology, Genetics and Selection of S. Toraighyrov Pavlodar State University on the automatic hematological analyzer Mindray BC - 3200 and the biochemical analyzer Biochem SA.

The level of total immunoglobulins in the blood reflects the degree of antimicrobial protection of the animal's organism. The concentration of immunoglobulins in the blood is subject to significant changes and depends on external factors and the physiological state of the animal organism. In addition, there is information that indicates that the immune system is also susceptible to genetic influence. (1) Therefore, the study of the level of common immunoglobulins in the blood of cows belonging to different lines is relevant. In connection with this, the task was to study the level of common immunoglobulins in lactating Simmental cows that belong to different genetic lines. Studies were carried out on lactating cows of Simmental cattle of German breeding belonging to four different lines: Romulus, Redad, Haxle, Honig. From each genetic group, 10 cows were allocated, which were analogous in age and had approximately the same milk productivity at a level between 10 and 11 thousand kilograms per lactation. Conditions for feeding and keeping lactating cows were the same. Blood samples from the experimental cows were collected from the tail vein before the morning feeding. In the blood samples, the total immunoglobulins were determined by the zinc sulfate method.

The concentration of total immunoglobulins during this lactation period was in the range between 12 and 14 mg/mL. Later in the course of lactation, the level of this indicator gradually increased. Between the level of milk productivity of cows and the concentration of common immunoglobulins, a negative correlation was established in all lines of cows, which was from g=-0.63 to g=-0.69. In cows belonging to the Romulus line, in the second half of the lactation the level of immunoglobulins was insignificantly higher in comparison with the compared groups.

Thus, a negative correlation is established between the level of milk productivity of cows of different genetic origin and the concentration of common immunoglobulins. Higher values of total immunoglobulins in the second half of the lactation were found in the cows of the Romulus line.

During the study period, rations of two types were tested: concentrates (coarse fodder - 35%, juicy feeds - 18%, concentrates - 15% and pasture grass - 32%) - control group (p = 15) and concentrate-free (45, 20, 0 and 35% respectively) - experimental group (p = 15). The basis of rations was hay meadow, straw and silage, which are the main food for feeding animals.

Table 1. Number of Blood Elements (M±m)

Age, months	Indicators		
	Hemoglobin, g/L	Erythrocytes $10^{12}l^{-1}$	Leukocytes $10^{9}l^{-1}$
Control group			
6	11,43±0,32	6,92±0,13	9,43±0,22
12	11,12±0,04	7,52±0,20	8,74±0,15
15	11,32±0,40	7,94±0,30	9,59±0,30
18	11,28±1,13	6,55±0,15	9,40±0,50
Experimental group			
6	11,44±0,33	6,91±0,12	8,91±0,6
12	11,48±0,34	7,08±0,16	8,73±0,15
15	11,00±0,21	8,34±0,18	9,52±0,14
18	10,84±0,20	7,09±0,20	10,59±0,50

The weight of the animals in the control group at the age of 18 months was 326.5 kg; in the experienced group - 323.9 kg. The animals of both groups grew and developed in the same way. There was no significant difference between the groups of experimental heifers. With the age of heifers, a gradual decrease in their average daily growth was observed, which confirms the well-known regularity.

During the scientific and economic experience on the Simmental cattle, the study of the blood composition was carried out: hemoglobin, erythrocytes, leukocytes, macro- and microelements, vitamins, amino acids, protein fractions.

Despite the relatively constant composition of blood, a number of its biochemical indicators undergo changes under the influence of external and internal factors. One of the main factors affecting the composition of blood is feeding. (2) It was found that with an increased level of feeding, the number and size of erythrocytes, the concentration of hemoglobin, the leukocyte formula is changing. The increase in these indicators is the result of an increase in general and especially protein feeding.

The study of the chemical composition of animals' blood serum is of great importance for the characterization of metabolism, especially when it is disturbed.

Table 1 shows the data on the number of blood elements during different periods of life of experimental heifers. Significant differences in these indicators, caused by a concentrate, concentrate-free diet between the experimental groups of heifers was not found. The difference between groups in the content of uniform elements is unreliable (P<0.95). At a physiologically normal state, the blood of animal hemoglobin contains 10 g/L with fluctuations from 9 to 11 g/L. The content of hemoglobin in the blood of heifers from 6 to 18 months did not change. The content of hemoglobin and erythrocytes, in the blood indicates a high level of metabolism occurring in the animal organism. The content of hemoglobin, erythrocytes and leukocytes in the blood of the experimental heifers was within the physiological form.

The data obtained by us agree with the results of studies of such scientists as H.F. Kushner (1938) (1), E.A. Petukhova (1983). (3)

In the animal organism, the importance of mineral substances is extremely great. This is explained by the role that minerals play in all metabolic processes. Heifers of experimental groups had insignificant (P<0.95) difference in the content of calcium and phosphorus in the blood. It should be noted that in the pasture period, an increase in the content of calcium and phosphorus in the blood serum (calcium in the range of 11,34-12,61 mg %, phosphorus varied 5.14-5.73 mg %).

The resistance of the animal organism to infectious diseases is associated with its physiological state, which is directly dependent on age, season, feeding conditions and content. (1)

The leading place in the metabolism is assigned to blood proteins and its fractions. Most of the proteins contained in the plasma consist of albumin and globulin. In our studies, the content of the total protein and its albumin fraction differed insignificantly, irrespective of the growth rate and the development of animals in the experimental groups. (3)

The characteristics of the blood serum of heifers in the experimental groups are given in Table 2.

Table 2. The Content of the Total Protein and Its Fractions in the Blood, (M±т)

Age, months	Total protein, g/L	Albumins, g/%	Globulins, g/L		
			a	ß	Y
Control group					
6	60,8±0,40	22,1±0,21	10,5±0,05	18,4±0,12	9,8±0,24
12	70,9±0,19	29,6±0,11	9,5±0,05	23,4±0,26	8,4±0,07
15	79,6±0,19	32,6±0,14	8,6±0,06	25,4±0,10	13,0±0,15
18	70,2±0,29	27,2±1,54	10,5±0,58	21,5±0,66	11,0±0,58
Experimental group					
6	61,8±0,12	21,0±0,23	13,0±0,22	14,5±0,20	13,3±0,07
12	69,6±0,32	32,1±0,21	10,5±0,05	18,4±0,12	8,6±0,08
15	74,9±0,25	28,5±0,26	10,0±0,14	20,9±0,142	15,5±0,24
18	74,0±0,29	31,5±1,36	12,0±0,63	10,0±0,47	9,5±0,74

The dynamics of the total protein and its fractions in the blood showed no significant differences between the groups. According to modern ideas, the proteins, fats, carbohydrates and salts received by the animal body from food, in order to join the metabolism and turn into body tissues, they must be subjected to deep chemical transformations with the obligatory participation of the substances that catalyze these transformations. These components are protein-enzymes, consisting of two components: a specific protein synthesized by the body and an active grouping (coenzyme), which is a derivative of the compounds of various vitamins that come with feed. If there are no individual vitamins in the feed or they are not enough, the activity of enzymes is reduced and a metabolic disorder and a decrease in productivity occur in animals.

Vitamin A is involved in oxidation reactions taking place in cells of epithelial tissues, promotes biosynthesis of cholesterol, accelerates the exchange of phosphorus compounds, and also stimulates the growth and development of animals. Normally, the content of vitamin A (carotene) in the ration should be from 40.0 to 150.0 μg/100 ml. In the winter stall period of feed, according to our research, partially lose the content of vitamins, and therefore an avitaminosis of animals is often observed in many farms. Our studies showed that the vitamin A content in the blood serum of animals was normal. The animals of the experimental group had a vitamin A content of 18.8 μg% less than in the control group. The difference between groups is not significant (P<0.95). Vitamin E (tocopherol) provides reproduction of animals, participates in the metabolism of muscle and nerve tissue. Vitamin E has the property of an antioxidant, it promotes the assimilation and preservation of vitamin A and carotene in the animal's body. There was a difference in the content of vitamin E, which was insignificant (by 0.32 μg%). Thus, the balanced feeding of experimental groups did not affect the content of vitamins A and E in the blood.

The study of the chemical composition of blood serum is of great importance for the characteristics of metabolism. When studying the effect of feeding different levels of mixed fodders on the digestibility of nutrients in the diet, we found that the types of rations tested had practically the same effect on their digestibility. So the digestibility in heifers of the control group was 64.13% for dry matter, 64.02% for experimental, 65.50% and 65.42% for organic matter, for raw protein - 66.66%, and 61.78%, for raw fat - 88.57% and 75.90%, for raw fiber 63.83% and 64.48%, for nitrogen-free extractives - 69.20% and 67.60% respectively.

The natural resistance of the organism in agricultural animals or the natural non-specific resistance of the organism is provided by the animal hair, the mucous membranes of the digestive tract, the respiratory tract, blood, lymph, and from the conditions of feeding and maintenance. Protective functions of the organism are provided by the phenomenon of phagocytosis, bactericidal and bacteriostatic activity of blood serum, the presence of natural antibodies, lysozyme, acid-alkaline, buffer systems and enzymes. The protective factors underlying the natural resistance are complex.

Table 3. Indicators of Natural Resistance in Experimental Heifers

Indicators	Control group	Experimental group
Leukocyte formula, 10^9 l^{-1}:		
Basophils	0,3	0,3
Eosinophils	7,5	7,2
Neutrophils	28,9	25,8
Lymphocytes	63,1	62,4
Monocytes	4,8	4,9
The intensity of phagocytosis:	1,98	1,96
The total absorption effect, thousand mm^3	17,0	16,7
Active neutrophils, %	5,8	5,5
Average absorptive capacity of cells	0,170	0,167
General hemolytic activity, %		

The degree of their expression is influenced by individuality, breed and animal species. (4) An assessment of natural resistance in heifers aged 16 months, in the number of 10 animals in each group, was made. At the same time, phagocytosis, hemolytic activity and neutrophil activity were determined.

From the data in Table 3, it can be seen that the number of eosinophils, neutrophils, lymphocytes, monocytes in the blood of the experimental animals were normal, due to the high level of feeding and the balanced ration for protein, fat, carbohydrates, vitamins, minerals. The difference between groups in terms of natural resistance is not reliable (P <0.95). The fluctuation of the total effect of active neutrophils absorption in the animals of the control group was observed in the range 9.5-23.6 109 l-1, and the experimental - 9.4-22.3 109 l-1, the total hemolytic activity in the control group averaged 0.170 %, the experimental - 0.167%.

The above data indicate that the blood composition of the experimental animals was within the physiological norm. There were no significant differences in blood composition and dynamics of its basic elements in the age aspect between groups, depending on the level of mixed fodder in rations.

An analysis of the data on the blood count of the experimental animals of the Simmental cattle shows that there are no deviations from the norm of the course of the physiological processes in the body. The dynamics of the total protein and blood fractions did not distinguish between groups.

Indices of natural resistance of the organism of the experimental animals were within the limits of physiological norms and showed the stability of their organisms to various kinds of diseases.

The increase in protein and its fractions occurs up to 15 months and then goes down. The amount of albumin increases until the age of 15 months and then decreases. The same regularity is noted for fractions of globulins. An increase in the total to its fractions is observed in the pasture period.

3 Results and Discussion

The intensification of livestock farming involves achieving a high level of production, which should be based on modern achievements of science and innovate experience.

The productivity, as a result of the complex interaction of genotype with technological factors, depends in a certain way on the level of metabolic processes in the organism. Therefore, an important component in improving the efficiency of livestock breeding is the identification of the relationship between individual blood values and the productivity of animals.

Fundamental importance in this direction belongs to physiological research. A great deal of attention is devoted to the study of the physiology and biochemistry of blood, as well as to the identification of exchange bonds between the constituent parts of the blood and the level of animal productivity. In this regard, it seems promising to study the specific features of protein metabolism by candidate genes for protein metabolism in highly productive animals by hematologic blood indices.

Table 4. Hematologic Blood Values of Cows with Different Genotype by Candidate Genes for Protein Metabolism

Genes under study	Genotype	n	Hematologic blood values			
			Erythrocyte 10^{12}/l	Leukocyte 10^{9} /l	Platelet 10^{9} /l	Hemoglobin g/l
Kappa-Casein	AA	28	6,6±0,18	9,2±0,65	608,2±36,72	111,8±2,44
	AB	50	6,6±0,12	8,8±0,35	626,1±25,78	113,2±1,93
	BB	25	6,7±0,17	9,0±0,54	627,5±42,91	116,8±2,11
Beta-lactoglobulin	AA	14	6,7±0,48	8,4±0,88	557,7±62,33	106,3±8,18
	AB	57	6,5±0,13	8,8±0,40	598,1±25,76	112,4±1,72
	BB	44	6,8±0,11	9,2±0,38	638,5±27,88	113,9±1,88
Prolactin	AA	32	6,5±0,16	8,6±0,49	645,8±22,80	112,8±2,39
	AB	40	6,6±0,14	7,8±0,40	592,5±35,21	114,4±1,88
	BB	5	6,9±0,46	7,4±0,95	627,6±61,41	110,5±5,33

According to Table 4, we observe that the highest content of erythrocytes, platelets, and hemoglobin for the kappa-casein gene (CSN3) was observed in animals in the BB genotype. The studied index in animals of this genotype by the content of erythrocytes was higher by 0.1^{12}/l, of platelets by 19.3 and 1.4^{9}/l, of hemoglobin by 5 and 3.6 g/l than in peers of other genotypes. The content of leukocytes was within the limits of physiological norms. The studied indicator exceeded the similar index in animals with the genotype AB and BB by 0.4 and 0.2 ^{9}/l. The high content of erythrocyte and hemoglobin values in the blood of cows with a homozygous BB genotype indicates a high productivity and lactation intensity of cows of this group.

According to the beta-lactoglobulin gene (bLGB), the superiority in studied parameters was observed in animals with the BB genotype, which also indicates the conjugation of symptoms and the increased flow of metabolic processes in animals' organisms.

Another equally important gene is the prolactin gene, which is considered as one of the central candidate genes. For this gene, a high erythrocyte content was observed in animals in the BB genotype - 6.9 ^{12}/l, which was detected in 5 cows, their result exceeded that of other genotypes by 0.4 and 0.3 ^{12}/l. A high leukocyte and platelet count was detected in animals in the homozygous AA genotype and amounted to 8.6 ^{9}/l and 645.8 ^{9}/l. The highest hemoglobin value was obtained in animals with a heterozygous AB genotype, 114.4 g/l, which is 1.6 and 3.9 g/l more than in homozygous genotypes (AA and BB).

The blood that is in constant contact with all organs and tissues, under the influence of various factors on the organism (feeding, maintenance, physiological state, etc.) reflects all the processes occurring in it, changing itself both qualitatively and quantitatively. Biochemical indicators play an important role in protein, lipid and mineral metabolism of animals. So, aspartate and alanine amine transferases (ACT and ALT) take an active part in nitrogen metabolism, carrying out a connection between protein, carbohydrate, and fat metabolism.

In order to control metabolic processes and the state of animals under the conditions of Galitskoe LLP, a study was made of the state of their immuno-biochemical status. Table 5 contains data on the study of biochemical blood values, depending on the gene and the genotype of cows.

Table 5. Biochemical Blood Values of Cows with Different Genotype for Candidate Genes of Protein Metabolism

Genes under study	Genotype	n	Biochemical blood values				
			Cholesterol, g/l	Common protein, g/l	ALT, Unit/l	ACT, Unit/l	Glucose, mmol/L
Kappa-casein	AA	28	3,9±0,99	82,5±6,61	31,6±1,85	72,8±3,38	3,6±0,83
	AB	50	3,4±0,50	79,5±2,78	34,8±1,82	71,9±2,15	2,9±0,08
	BB	25	2,4±0,23	100,2±17,6	35,3±1,92	75,6±3,95	3,8±0,97

Beta-lactoglobulin	AA	14	2,6±0,19	75,9±7,52	32,1±3,13	64,6±5,31	2,9±0,23
	AB	57	3,8±0,67	81,7±5,74	35,0±1,16	73,1±1,83	3,6±0,58
	BB	44	2,6±0,15	88,0±8,65	37,8±2,20	73,6±3,10	2,8±0,11
Prolactin	AA	32	3,2±0,27	80,7±5,61	36,4±1,80	72,4±2,44	2,9±0,11
	AB	40	3,2±0,67	85,9±8,01	36,2±1,52	71,1±2,40	3,4±0,58
	BB	5	2,9±0,38	85,2±11,40	37,7±3,81	78,5±11,1	2,7±0,33

On the basis of experimental data, it was established that with an increase in the amount of sorbent KM-1a from 0.02 to 1.0 w.p. regardless of the process temperature, the degree of treatment of water from oil increases. For example, for 30 minutes of the process when the concentration of oil in water is 200 mg/l by using the KM-1a preparation in an amount of 0.02 w.p., the degree of water treatment is 27.42%, and by the amount of 1.0 w.p. - 98.03%.

The results of the research showed that a high cholesterol content in the blood was observed in cows by the kappa-casein gene (CSN3). In cows with homozygous genotype AA - 3.9 g/L, their result was higher by 0.5 and 1.5 g/l than in peers of other genotypes. According to the beta-lactoglobulin gene (bLGB), a high cholesterol concentration was found in cows with a heterozygous genotype AB and amounted to 3.8 g/L. According to the prolactin gene (PRL) in the studied genotypes, the cholesterol content was almost the same and was within the range of 2.9-3.2 g/l. Based on the results of conducted studies, it can be concluded that the concentration of cholesterol in the blood of lactating cows depends on the level of productivity and their genotypic affiliation to the loci studied by the DNA.

In the opinion of T.A. Guseva, blood proteins have a leading role in the organism. They are used in the synthesis of enzymes, many hormones; they are involved in the transportation of nutrients and minerals, and are also responsible for nonspecific reactions and immunological reactivity of the organism, depending on environmental conditions. (7)

Analyzing the data given in Table 5, it can be seen that the highest concentration of total protein was observed in all animals with homozygous genotype BB. In cows with the kappa-casein gene (CSN3), it was 100.2 l/g, for the beta-lactoglobulin gene (bLGB) it was 88.0 g/L and 85.9-85.2 g/L for genotypes of the prolactin gene (PRL). Thus, during the studies, we found that the highest concentration of total protein in the blood was observed in a more highly productive group of animals with the BB genotype.

The activity of the enzymes ACT and ALT is an indicator of protein metabolism in the organism, which is used to control animal health. Investigations of the activity level of aminotransferase performed by us in the blood of cows in the kappa-casein (CSN3), beta-lactoglobulin (bLGB) and prolactin (PRL) genes showed that high activity of ALT and ACT was detected in blood of animals with BB genotype, which indicates a high protein metabolism in cows of this genotype. The glucose content was within the physiological norm. Some decrease in the activity of ALT and ACT in cows with heterozygous genotypes is apparently due to the periodicity of the processes of transamination and self-renewal of proteins in the organism during the animal pregnancy period.

The blood is rather a labile and plastic substance capable of maintaining the balance of its main components despite changing environmental conditions, as well as changes in the organism at the physiological level. The intensity of metabolism has a direct relationship with the dairy productivity and genotype of animals. This is confirmed by the fact that the metabolism of substances in the blood in highly productive cows is somewhat faster than in low productivity animals. (8)

Table 6. Correlation Dependencies Between the Indices of Productivity and Blood Composition in Cows with Different Genotype for Protein Candidate Genes

Genes under study	Genotype	n	Total protein of blood, g/L	Protein in milk, %	r
Kappa-casein	AA	28	82,5±6,61	3,20±0,03	0,66
	AB	50	79,5±2,78	3,25±0,05	0,55
	BB	25	100,2±17,46	3,26±0,06	0,65
Beta-lactoglobulin	AA	14	75,9±7,52	3,24±0,03	0,84
	AB	57	81,7±5,74	3,20±0,05	0,90
	BB	44	88,0±8,65	3,26±0,03	0,99
Prolactin	AA	32	80,7±5,61	3,23±0,08	0,58
	AB	40	85,9±8,01	3,22±0,02	0,94
	BB	5	85,2±11,40	3,16±0,06	0,55

As shown by the presented data, for all the genes and genotypes studied between the total protein content in the blood and the protein in milk, a high positive correlation relationship was found between 0.55 and 0.99. In kappa-casein (CSN3) and beta-lactoglobulin (bLGB) genes, the highest correlation indicator was obtained in cows with BB genotype (0.65 and 0.99).

According to the data of T.A. Guseva, in the breeding process, the correlation between the selection criteria in the population is of great importance, since in the case of positive correlation, selection can be conducted according to one of the interrelated characteristics, while improving the parameters of the other. On the contrary, if the connection is negative, other methods should be chosen to improve the herd. (7)

The strength and orientation of the connection of traits in groups of experimental animals are presented in Table 7.

Table 7. Correlation Dependencies Between the Indices of Productivity and Blood Composition in Cows with Different Genotype for Candidate Genes of Protein Metabolism

Genes under study	Genotype	n	Yield, kg	Act. ALT	r	Act. ACT	r
Kappa-casein	AA	28	5356,7±219,65	31,6±1,85	0,75	72,8±3,38	0,49
	AB	50	5387,8±248,32	39,8±1,82	0,45	71,9±2,15	0,04
	BB	25	5517,1±256,17	35,3±1,92	0,41	75,6±3,95	0,01
Beta-lactoglobulin	AA	14	5571,2±461,71	32,1±3,13	0,40	64,6±5,31	0,05
	AB	57	5316,6±155,98	35,0±1,16	0,75	73,1±1,83	0,17
	BB	44	5357,2±213,89	37,8±2,20	0,43	73,6±3,10	0,90
Prolactin	AA	32	5741,1±282,60	36,4±1,80	0,96	72,4±2,44	0,20
	AB	40	5457,6±204,18	36,2±1,52	0,33	71,1±2,40	0,10
	BB	5	4743,6±597,36	37,7±3,81	0,53	78,5±11,31	0,71

The presented materials show that the closest positive relationship is found in cows between the indices of milk yield and the activity of the ALT enzyme. In the kappa-casein (CSN3) and prolactin (PRL) genes, a high positive correlation was calculated in cows with a homozygous AA genotype amounted to 0.75 and 0.96, for the beta-lactoglobulin (bLGB) gene in the AB genotype it was 0.75. In the remaining pairs of studied signs, a weak positive correlation of different severity degree was observed. The presented results of biochemical research testify to the presence of interrelation in the activity of reamination enzymes and biochemical blood values of cows with their milk productivity.

4 Conclusion

The effective conducting of selection work in dairy cattle breeding is impossible without the complex use of all achievements in the field of such sciences as genetics, physiology, and biochemistry. Therefore, it is necessary to know the mechanisms for obtaining high milk productivity and, accordingly, their application in the practice of dairy cattle breeding. The knowledge of such mechanisms in the early stages of animal development will allow predicting their future dairy productivity using DNA tests, which will allow to purposefully increase their dairy productivity. In this connection, it is necessary to study various mechanisms of DNA technology impact by studying the relationship between the biochemical blood values of lactating animals with the level of their milk production and to find the closest correlative relationships of these indicators with the dairy productivity value of cattle.

Thus, the conducted studies allow to conclude that the studied hematological and biochemical indicators of blood are interrelated with the genotype of cows, they can be used as tests for the early prediction of the dairy productivity of cows.

Literature:

1. Alekseeva NM, Borisova PP. The enzyme preparation influence on the milk productivity of the Simmental cows in the conditions of Yakutia. Bulletin of Krasnoyarsk State Agrarian. 2015; 10:197-201.
2. Belkov GI, Panin VA. Improvement of economically valuable traits of Holstein and Simmental first-calf heifers under the conditions of South Ural. Bulletin of Orenburg State Agrarian University. 2014; 5:143-6.
3. Bogatyreva IA, Smakuyev DR. The evaluation of growth, hematologic status and behavior of Simmental heifers of different breeding. Bulletin of Altai State Agrarian University. 2015; 7:102-7.
4. Borisova VV. Economic-biological peculiarities of different genotypes of Simmental cattle. Bulletin of Orenburg State Agrarian University. 2014; 5:135-7.
5. Fedorovych VV, Orikhivsky TV, et al. The characteristics of Simmental cattle by their economically useful traits in the conditions of Lviv region. The scientific bulletin of S.Z. Gzhytsky Veterinary and Biotech University of Lviv. 2016; 2(18):255-60.
6. Katmakov PS, Anisimova YeI. Milk and meat productivity of Simmental cows of different inter-breed types. Bulletin of Ulyanovsk State Agricultural Academy. 2014; 1:1-6.
7. Kharlamov AV, Nikonova YeA. Influence of genotype on weight growth of black-spotted and Simmental young bulls and their double and triple-cross hybrids. Bulletin of Orenburg State Agrarian University. 2015; 1:96-9.
8. Kibkalo LI, Zherebilov NI, et al. The influence of gene pool of the Aberdeen-Angus cattle on the growth, development, and dynamics of the living mass of Simmental cattle's bulls. Bulletin of Kursk State Agricultural Academy. 2014; 5:56-9.
9. Kodzokova ZL, Tkhashigugova MS, et al. Dynamics of live weight in young bulls of Simmental breed under different technology of rearing. The collection of scientific works of Stavropol Scientific Research Institute for Livestock and Fodder production. 2014; 7(3):1-3.
10. Konorev PV, Gromova TV. The relationship of milk performance and the main milk indices of Simmental cows obtained from domestic and imported stud bulls. Bulletin of Altai State Agrarian University. 2015; 7:112-5.
11. Konorev PV, Gromova TV. The evaluation results of stud bulls used in the selection of the Simmental cattle. 2014; 7(3):1-4.
12. Kosilov VI, Sivozhelezova NA, et al. Economic and biological peculiarities of the Kazakh White-Headed and Simmental cattle in South Ural. Bulletin of Orenburg State Agrarian University. 2016; 6:136-8.
13. Kosilov VI, Zhaimysheva SS, et al. Exterior peculiarities of young bulls of the Simmental breed and its crossbreeds with limousines of different generations. Bulletin of Orenburg State Agrarian University. 2016; 6.
14. Li SS, Bolotova YuA. The effectiveness of commercial crossing of Simmental and Hereford cattle in beef production. Bulletin of Altai State Agrarian University. 2014; 1:78-80.
15. Lukyanov VN, Prokhorov IP. Hormone status of Simmental breed bull-calves and their crosses with both Hereford and Charolais breeds. Bulletin of Timiryazev Agricultural Academy. 2015; 4:95-105.
16. Lyapina VO, Lyapin OA. The meat productivity of bulls-castrates of Kazakh white-headed. Kalmyk and Simmental cattle. Bulletin of Orenburg State Agrarian University. 2015; 2:133-5.
17. Mechenkov DA, Lebedeva NV, et al. The concentration of the total protein and cholesterol in the blood of lactating cows of Black-spotted and Simmental cattle. Bulletin of Kursk State Agricultural Academy. 2015; 2:1-2.
18. Medvedeva NS, Goncharenko GM, Podkorytov AT, Goryacheva TS. Method of selection Simmental cattle for protein milkiness using molecular-genetic markers. Gorno-Altaisk; 2013.
19. Mannen H. Effect of DNA polymorphisms related to fatty acid composition in adipose tissue of Holstein cattle. Anim Sci J. 2011.
20. Paska MZ, Koval GM, et al. Veterinary-Sanitary inspection of beef bulls received from Polissya meat and Simmental breeds. The scientific bulletin of S.Z. Gzhytsky National Veterinary and Biotech University of Lviv. 2015; 1-2(17):1-5.
21. Orikhovsky TV, Fedorovsky VV. The dependence of milk productivity of Simmental dairy cattle on their reproductive ability indicators. The scientific bulletin of S.Z. Gzhytsky

National Veterinary and Biotech University of Lviv. 2015; 3(17):263-268.
22. Semerikova AI, Mironova IV. Slaughter indices of Simmental steers fed the "Vetosporin Suspension" probiotic. Bulletin of Orenburg State Agrarian University. 2014; 1:108-10.
23. Shevkhuzhev AF, Smakuyev DR. Quality of muscle tissue of Simmental breed bulls of different interbreed types. The collection of scientific works of Stavropol Scientific Research Institute for Livestock and Fodder production. 2014; 7(3):1-6.
24. Smakuyev DR, Khubiyeva ZK, et al. Slaughter qualities and biochemical blood parameters of Simmental steers with different constitution types according to beef cattle breeding technology. Bulletin of Orenburg State Agrarian University. 2014; 4:111-5.
25. Stasenkova YuV. The overall level of antibodies in the blood of lactating Simmental cows of different genetic origin. Bulletin of agricultural development and social politics. 2016; 1:97-8.
26. Strekozov NI, Amerkhanov KhA, Pervov NG, et al. All-Russian Scientific Research Institute for Animal Husbandry of the Russian Academy of Agricultural Sciences. 2nd Ed. Moscow: Agronauchservis; 2013.
27. Tagirov KhKh, Iskhakov RS, et al. Beef performance of young black-spotted and Simmental cattle under the different care and management conditions. Bulletin of Orenburg State Agrarian University. 2015; 3:114-6.
28. Tuzov IN, Shcherbatov VI, et al. Genetic peculiarities of Simmental livestock dropped off into farms of the Krasnodar region. Polythematic Scientific Online E-Journal of Kuban State Agrarian University. 2015; 108:1-13.
29. Drozdov YeV, Nam IYa, Zayakin VV. Analysis of the polymorphism of the kappa-casein, β-lactoglobulin, prolactin, releasing factor and somatotropin genes in cows of different breeds in the Bryansk region. Scientific support for innovative development of cattle breeding. Zhodino, RUE "Scientific and Practical Center of the National Academy of Belarus for Animal Husbandry"; 2013:67-9.
30. Manga I, Riha J, Dvorak J. Comparison of influence markers CSN3 and CSN2 on milk performance traits in Czech spotted and Holstein cattle tested at first, fifth and higher lactation. Acta fytotechnica et zootechnica. 2006; 9:13-5.
31. Tikhonov PT, Senko AYa. Economic-biological peculiarities of Simmental cows of different genotypes in the South Ural. Bulletin of Orenburg State Agrarian University. 2014; 5:141-3.
32. Tsiaras AM, Bargouli GG, Banos G, et al. Effect of kappa-casein and betalactoglobulinloci on milk performance traits and reproductive performance of Holstein cows. J. Dairy Sci. 2005; 88(1):327-34.
33. Guseva TA. Adaptive qualities of black-and-white cattle of different ecogenesis in the conditions of the forest-steppe zone of the middle Volga region. Thesis for the degree of Candidate of Agricultural Sciences. Penza; 2016.
34. Rotmistrovskaya YeG. Functional reserves of the thyroid gland and a testosterone-synthesizing system in cows with different milk productivity and their calves. Thesis for the degree of Candidate of Biological Sciences. Kursk; 2014.
35. Velmatov AA, Gladilin VN, et al. Technological features of the udder of Simmental cows of different genotypes in the Republic of Mordovia. 2015; 1:1-5.
36. Ulimbashev MB, Kodzokova ZL. Hematologic indices of Simmental young cattle under different raising technologies. Bulletin of Altai State Agrarian University. 2015; 3:93-6.

Primary Paper Section: F

Secondary Paper Section: FB