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S. V. Karamayev[1], L. N. Bakayeva[2], N. A. Balakirev[3], V. A. Demin[4], A. S. Karamayeva[1], N. V. Soboleva[2], L. V. Sycheva[4], Yu. A. Yuldashbayev[5], D. A. Baimukanov[6]

[1]FSBEI HE «Samara State Agricultural Academy», Ust-Kinelsky, Samara region, Russia,
[2]FSBEI HE «Orenburg State Agrarian University», Orenburg, Russia,
[3]FSBEI HE «Moscow State Academy of Veterinary Medicine and Biotechnology», Moscow, Russia,
[4]FSBEI HE «Perm State Agrarian-Technological University named after academician D. N. Pryanishnikov», Perm, Russia,
[5]FSBEI HE «Russian State Agrarian University – Moscow Agricultural Academy named after K.A. Timiryazev», Moscow, Russia,
[6]NJSC "Kazakh National Agrarian University", Almaty, Kazakhstan.
E-mail: KaramaevSV@mail.ru, Bakaeva.lora@mail.ru, ovismgavm@mail.ru, demin@rgau-msha.ru, annakaramaeva@rambler.ru, Natalya.soboleva12@mail.ru, lvsycheva@mail.ru, zoo@rgau-msha.ru, dbaimukanov@mail.ru

QUALITY OF COLOSTRUM IN DAIRY BREED COWS WITH DIFFERENT DAIRY PRODUCTIVITY

Abstract. When the primary immunity is formed in the body of a newborn calf, the main source of immunoglobulins, lysozyme, functionally active leukocytes, and lymphocytes is colostrum. A very important condition for the formation of complete immunity is the quality of colostrum. A number of scientists claim that cows of different dairy breeds differ significantly in terms of dairy productivity, while the mass fraction of immunoglobulins negatively correlates with the amount of colostrum during the first milking.

The main task of research was to study the dynamics of the quality of colostrum, depending on the size of the milk yield of cows for lactation. The object of the research was the cows of four breeds ща the Samara region: Black-and-white, Bestuzhev, Holstein, Ayrshire. It has been established that the content of immunoglobulins in the colostrum of the first milk yield in cows of different breeds changes under the influence of the level of dairy productivity, as well as with the age of animals. The highest content of immunoglobulins was in the colostrum of the Bestuzhev breed - 103.35-81.38 g/l, and the lowest in the Holstein breed - 74.52-42.29 g/l.

Colostrum immunoglobulins are divided into three classes - IgG, IgA, IgM. In the colostrum of the first milk yield of the Black-and-white cows, the IgG level is 84.1-85.5%, Bestuzhev - 85.7-86.3%, Holstein 83.9-84.4%, Ayrshire - 85.7-86, 6%. There is a tendency to increase of IgG level, with increasing milk yields of cows for lactation. It was found that with an increase in the dairy productivity of cows, the quality of colostrum decreases and the incidence of calves grows. As a result, the average daily gain in live weight of the young stock is reduced proportionally. Based on the obtained results, we recommend assessing the quality of colostrum of the first milk yield using an optical or digital refractometer as well as to conduct targeted breeding work in the direction of improving the quality of colostrum.

Keywords: breed, cow, calves, colostrum, quality, lactation, milk yield, immunoglobulins, incidence.

The relevance of the topic. From birth of calf until the moment it reaches physiological maturity, significant changes occur in the structure of all organs and body systems. The principal and responsible is the neonatal period. It is important, first of all, as an adaptation, associated with the activation of the immune system of the body, which protects the calf from the negative effects of the environment and pathogenic microflora. A calf is born almost sterile, while there is completely no immune in its body, since antibodies are not transmitted to the calf directly in the mother's organism. The placenta, being a natural biological barrier, not only protects the body of the fetus from pathogenic microbes, but also blocks the flow of antibodies to it, which are the basis of calf immunity. Antibodies enter the calf organism with colostrum, where they get from the mother's blood several days before calving [1, 2-7].

Colostrum is the staple food for newborn calves. Colostrum contains all the components necessary for the functioning of the calf body: proteins, fats, macro and microelements, vitamins, enzymes, water. For the formation of the initial colostral immunity, colostrum is the main source of immunoglobulins, lysozyme, functionally active leukocytes, and lymphocytes. In addition, it contains a large number of growth factors and cytokines. Therefore, the calf should receive the first portion of colostrum as early as possible and no later than one hour after the birth. Getting into the digestive tract, colostrum creates favorable conditions for the development of lactic acid bacteria, the product of which is lactic acid, inhibits the development of putrefactive and pathogenic microflora. At the same time, the colostrum itself has a high active acidity of 40-60 °T, which also inhibits the activity of pathogenic microflora [8-16].

A crucial condition for the immunity formation in the calf body is the quality of colostrum. This is especially true for the first portion of colostrum after calving. A number of scientists claim that the quality of colostrum is influenced by various genotypic and paratypical factors. In the experiments of Hartmann P.E. (1973), Scammell A.W. (2001), Akers R.M. (2006) it was found that in cows of different breeds, the volume of the first milk yield varies from 2.2 to 17.6 kg. Herewith Morin D.E. (1997) claims that the mass fraction of immunoglobulins negatively correlates with the amount of colostrum during the first milking. In Pritchett L.C. experiments (1991) in cows with milk yield in the first milking of 8 kg, in 23% of animals in colostrum, the IgG level was below the physiological norm (60 g/l). With an increase in milk yield of more than 8 kg, the percentage of cows with colostrum of this quality increased [2, 15, 17-20].

Since the productivity of cows all over the world is constantly growing, this is accompanied by an expansion in the amount of colostrum with a reduced content of immunoglobulins in the first milk yield. According to Zarcula et al. (2010), in the colostrum of local Romanian cows, the mass fraction of protein was 22.1-23.6%, and in the colostrum of Holstein breed selected for high yields - only 13.4-17.6%. A number of scholars have come to the conclusion that long-term breeding for increasing the level of dairy productivity affects the quality of the offspring, its viability as well as indicators of the reproductive function of cows. In some herds of the United States, up to 10% of calves die in the first days after birth. About 80% of the dead animals do not have anatomical abnormalities. These facts are related to the breed of cows and the level of their dairy production. On large dairy complexes, the overall incidence of calves reaches 91.32%, including respiratory organs - 50.98% and digestive organs - 31.96% [21-25].

Despite the considerable study of the problem of the quality of colostrum and the influence of various factors on it, the results are rather contradictory. The mechanisms regulating the composition of colostrum and allowing to affect its quality have not yet been deciphered, although the influence of many factors on this indicator is considered proven.

Therefore, this topic is still relevant and requires additional research.

Material and methods. Scientific and economic experiment was carried out in the breeding farms of the Samara region and the Republic of Bashkortostan. The object of the research was the cows of four dairy breeds, 50 animals in each group: Group I - Black-and-white breed, Group II - Bestuzhev breed, Group III - Holstein breed, Group IV - Ayrshire breed. Black-and-white and Bestuzhev breeds were bred in the climatic zone of the Middle Volga region, Holstein breed was brought to Russia from Germany, Ayrshire - from Finland.

Studies were conducted in the conditions of modern complexes for milk production. The maintenance of cows is free stall, in sections with access to the loafing area. The calvings are held in special maternity wards. Milking of cows was carried out in the maternity ward on the "Yolochka" milking machine, in the "Europarallel" milk production workshop with a quick yield. The feeding of cows is of the same type year-round, the type of ration is hay-silage. The ration of cows consists of hay, alfalfa haylage, corn silage, grain mixture, sunflower cake, soybean meal, molasses, and premix.

Calving took place in October - November. On the first day after birth, the calves were kept with the mother in the delivery room. Calves received the first portion of colostrum by the suckling method no later than 45 minutes after the birth. During the first day, the calves sucked their mother 5-7 times. In the colostral period, the young stock was weighed daily. The first weighing was carried out immediately after the birth, then at the end of each working day on electronic scales.

Laboratory studies of the quality of cow colostrum were conducted in a licensed animal husbandry laboratory at the Faculty of Biotechnology and Veterinary Medicine of the Samara State Agricultural Academy within the common standards [26]. The selection of medium samples of colostrum for labo-

ratory studies was performed on the first day after calving until the first calf sucking, on the following days in the morning after the first milking.

Research results. Studies were conducted on first-calf heifers until complete retirement from the group with age. It was established that from the first to the sixth lactation for various reasons in the group of Black-and-white, Holstein and Ayrshire cows, all 100% of the animals dropped out. In the Bestuzhev breed group, by the 7th lactation, 9 heads (18%) remained, the last two heads (4%) were rejected after the 10th lactation (table 1).

Table 1 – Dynamics of livestock and milk yield of cows for lactation in experimental groups with age

Lactation	Breed							
	Black-and-white		Bestuzhev		Holstein		Ayrshire	
	n	Milk yield, kg	n	Milk yield, kg	n	Milk yield, kg	n	Milk yield, kg
1	50	4365±187	50	4047±148	50	6553±214	50	5267±178
2	42	4748±169	46	4293±156	34	7281±179	41	5739±217
3	34	5164±154	41	4545±132	21	7768±236	36	6347±244
4	19	5497±176	32	5031±169	14	7487±253	23	6744±192
5	13	5534±211	27	5267±157	10	6802±188	19	6441±210
6	5	4918±183	15	5050±171	–	–	7	5830±189

Table 2 – Dynamics of livestock and milk yield of cows for the lactation in the experimental subgroups with age

Lactation	Breed							
	Black-and-white		Bestuzhev		Holstein		Ayrshire	
	n	Milk yield, kg	n	Milk yield, kg	n	Milk yield, kg	n	Milk yield, kg
1st lactation								
Up to 4000	14	3524	15	3052	1	3847	3	3654
4001-5000	22	4230	30	4365	7	4913	15	4669
5001-6000	11	5103	5	5129	10	5796	22	5481
6001-7000	3	6218	–	–	23	6918	10	6175
7001-8000	–	–	–	–	8	7934	–	–
More than 8000	–	–	–	–	1	8879	–	–
3rd lactation								
Up to 4000	3	3756	6	3110	1	3990	1	3879
4001-5000	9	4331	25	4487	1	4981	3	4795
5001-6000	14	5248	7	5315	1	5899	6	5624
6001-7000	5	6119	3	6092	2	6934	20	6576
7001-8000	3	7088	–	–	12	7958	6	7493
More than 8000	–	–	–	–	4	9246	–	–
5th lactation								
Up to 4000	3	3580	4	3445	–	–	–	–
4001-5000	4	4754	7	4511	1	4879	3	4953
5001-6000	4	5361	12	5979	2	5796	3	5815
6001-7000	1	6173	3	6032	4	6990	9	6587
7001-8000	1	7099	1	7018	3	7864	4	7698
6th lactation								
Up to 4000	3	3947	4	3881	–	–	–	–
4001-5000	2	4913	5	4895	–	–	3	4536
5001-6000	–	–	4	5658	–	–	4	5748
6001-7000	–	–	2	6572	–	–	–	–

In groups, different dynamics in the dairy productivity level of cows are observed with age. In Black-and-white and Bestuzhev breeds, the milk yield per lactation increases to the 5th lactation, respectively, by 1169 and 1220 kg of milk (26.8-30.1%; P<0.001). Holstein cows show maximum milk yield for the 3rd lactation, Ayrshire - for the 4 lactation. The increase in milk yield is 1215 and 1477 kg of milk, respectively (18.5-28.0; P<0.001). The maximum productivity was observed in animals of the Holstein breed - 7768 kg of milk, which exceeded their mates of the Black-and-white breed by 2234 kg of milk (40.4%; P<0.001), of the Bestuzhev breed - by 2501 kg (47.5%; P<0.001), of the Ayrshire breed (15.2%; P<0.001).

By the moment of maximum milk yield in the Black-and-white breed group, 13 heads (26%) remained, in Bestuzhev group - 27 heads (54%), in Holstein group - 21 heads (42%), in Ayrshire group - 23 heads (46%) of cows. It should be noted that by the third lactation, when the cows become full-aged, 68%, 82%, 42% and 72% of the animals remain from the initial population in the groups, respectively.

Having distributed cows for the first lactation by the volume of milk yield, it is stated that the studied breeds vary considerably in terms of the level of dairy productivity (table 2).

In the group of cows with milk yield up to 4000 kg, 28% of animals of the Black-and-white breed are registered, 30% of the Bestuzhev, 2% of the Holstein, and 6% of the Ayrshire breed. The productivity of more than 5000 kg of milk was respectively in 28%, 10%, 84%, 64% of cows in groups, more than 6000 kg - 6%, 0%, 64%, 20%. The productivity of more than 7000 kg of milk for the first lactation was observed only in 18% of Holstein cows.

Observations have shown that with age, primarily the most productive animals leave the herd. At the same time, as noted above, with age, there is an increase in milk yields in accordance with the breed characteristics and the level of the genetic potential of the dairy productivity of cows. As a result, for the third lactation, more than 6000 kg of milk in the Black-and-white breed group showed 23.5% of animals, in the Bestuzhev breed group - 7.3%, in the Holstein - 85.7%, in the Ayrshire - 72.2%. The level of more than 8000 kg of milk was overcome only by 4 Holstein cows with an average yield of 9246 kg.

With age, along with the amount of milk yield, the quality of colostrum and milk changes. Variations also occur in accordance with the biological and breed characteristics of the animals of the studied breeds (table 3).

Colostrum, especially the first after calving, is a major product for newborn calves, providing them with a full set of nutrients necessary for the maintenance of vital functions, as well as antibodies that provide in the organism colostral immunity.

It is established that the chemical composition of colostrum varies significantly under the impact of the dairy productivity level of cows. Since the amount of milk yield and the mass fraction of fat in colostrum have an inverse correlation, the fat content decreases with increasing milk yield per lactation.

The data for the third lactation were studied, because, at this age, cows become adults, reaching physiological maturity. The difference in the fat mass fraction in colostrum between cows with a yield of up to 4,000 kg and a maximum yield of up to 8,000 kg and more was 1.0% (P<0.001) in the group of the Black-and-white breed, 1.0% in Bestuzhev (P<0.001), in Holstein - 1.5% (P<0.001), in Ayrshire breed - 1.4% (P<0.001). The highest fat content of colostrum was in the Ayrshire and the Bestuzhev cows, and the lowest in the Black-and-white and the Holstein cows.

Even more significant differences between the breeds were identified by the protein mass fraction in the colostrum of the first milk yield. The highest content of total protein is found in the colostrum of Bestuzhev (24.5-22.5%) and Ayrshire (23.9-22.1%) breeds, and the lowest among Holstein (18.4-16.3%) and Black-and-white (18.9-16.6%) breeds. At the same time, in the colostrum of cows with milk yield up to 4000 kg the highest protein content was established, and with milk yield up to 8000 kg and more - the lowest content. The difference was, respectively, by breed, 2.3% (P<0.001), 2.3% (P<0.001), 2.1% (P<0.001), 1.8% (P<0.001).

Colostrum protein is a very complex substance in its structure and composition, which can be divided into three main fractions: caseins, albumins, and globulins. Caseins are acidic and well coagulated with rennet, forming a casein clot. Albumins and globulins belong to the group of whey proteins, which do not coagulate under the action of rennet, but are well digested in the stomach of calves and are absorbed by the body. In addition, globulins provide for the formation of colostral immunity, performing a protective function and protecting the body of newborns from the effects of opportunistic pathogenic microflora.

Table 3 – The chemical composition of colostrum of the first milk yield in cows with different levels of dairy productivity (III-lactation)

Milk yield per lactation, kg	Fat mass fraction, %	Protein mass fraction, %	Including, %			Lactose, %
			casein	albumin	globulin	
Black-and-white						
Up to 4000	6.9±0.08	18.9±0.09	6.4±0.05	5.3±0.04	7.2±0.05	1.9±0.01
4001-5000	6.7±0.05	18.3±0.11	6.3±0.06	5.1±0.03	6.9±0.07	2.1±0.01
5001-6000	6.4±0.06	17.8±0.13	6.1±0.04	4.9±0.06	6.8±0.10	2.0±0.01
6001-7000	6.3±0.05	17.1±0.10	6.0±0.05	4.7±0.04	6.4±0.06	2.2±0.01
7001-8000	5.9±0.03	16.6±0.07	5.8±0.03	4.6±0.03	6.2±0.04	2.1±0.01
Bestuzhev						
Up to 4000	8.4±0.04	24.2±0.10	7.0±0.05	6.7±0.05	10.5±0.12	2.2±0.01
4001-5000	8.1±0.06	23.7 ±0.13	6.8±0.07	6.6±0.06	10.3±0.13	2.0±0.01
5001-6000	7.9±0.05	23.3±0.15	6.7±0.08	6.3±0.04	10.3±0.15	2.1±0.01
6001-7000	7.4±0.05	22.5±0.11	6.5±0.06	6.1±0.05	9.9±0.08	2.3±0.01
Holstein						
Up to 4000	7.5	18.4	5.9	5.1	7.4	2.3
4001-5000	7.3	17.9	5.7	5.0	7.2	2.1
5001-6000	7.1	17.5	5.6	4.8	7.1	2.3
6001-7000	6.8	16.8	5.4	4.6	6.8	2.3
7001-8000	6.4±0.06	16.4±0.12	5.4±0.05	4.5±0.05	6.5±0.13	2.4±0.01
More than 8000	6.0±0.04	16.3±0.13	5.4±0.06	4.4±0.03	6.5±0.10	2.6±0.01
Ayrshire						
Up to 4000	8.5	23.9	7.0	7.1	9.8	2.0
4001-5000	8.3±0.06	23.6±0.14	7.0±0.03	7.1±0.05	9.5±0.07	2.2±0.01
5001-6000	8.2±0.08	22.9±0.18	6.9±0.04	6.8±0.06	9.2±0.10	2.3±0.01
6001-7000	7.7±0.06	22.6±0.17	6.8±0.07	6.9±0.04	8.9±0.09	2.4±0.02
7001-8000	7.1±0.03	22.1±0.13	6.8±0.04	6.7±0.03	8.6±0.08	2.5±0.01

It is established that the colostrum of cows of the studied breeds differs widely in the structure of protein and protein fractions depending on the amount of milk yield per lactation. In the colostrum of the first milk yield, the casein content decreases with increasing dairy productivity level of cows in the Black-and-white breed group by 0.6% ($P<0.001$), in Bestuzhev - by 0.5% ($P<0.001$), in Holstein - by 0.5 % ($P<0.005$), in Ayrshire - by 0.2% ($P<0.005$). At the same time, the proportion of casein in the structure of a total protein is, respectively by breed, 33.9-35.1%; 28.7-28.9%; 31.8-33.1%; 29.7-30.8%. The mass fraction of albumins and globulins also decreases with the increase in milk yields per lactation. In the structure of the total protein, in contrast to casein, there is a tendency to decrease the share of albumin in the Black-and-white breed from 28.0 to 27.5%, in Bestuzhev - from 27.7 to 27.1%, in Holstein - from 40.2 to 39.6%, in Ayrshire - from 41.0 to 38.9%. In the first days of the life of calves, the globulin fraction plays a crucial role in the life support of the body and protecting it from the negative environmental effects. In the structure of colostrum proteins, the globulin fraction is the largest and ranges from 37.3% (Black-and-white) to 44.2% (Bestuzhev). Compared with other proteins, the dynamics of globulins under the effect of milk yield in cows of different breeds occurs in different ways. In the Black-and-white breed, an insignificant but stable decrease in the share of globulins is observed, in Bestuzhev, on the contrary, there is an increase in the share of globulins from 43.4 to 44.2%, in Holstein cows with a yield of up to 6000 kg of milk, the highest proportion of globulins is noted - 40.6 %, after which it decreases to 39.6%, and Ayrshire cows have a dynamic tendency to reduce the share of globulins from 41.0 to 38.9%.

In contrast to the protein and fat content in the colostrum of cows, the mass fraction of lactose in the dry matter is 2.4-1.8 times less than that in natural milk. This is very important from a biological point of view since the body of calves does not yet produce the lactase enzyme, which helps digest lactose. The high content of lactose in colostrum leads to digestive disorders and the emergence of various gastrointestinal diseases.

The high content in the colostrum of the first milk yield of the main components provides a high content of dry matter in it (table 4).

Table 4 – Dynamics of density and acidity of cow colostrum depending on the dairy productivity level (III lactation)

Milk yield per lactation, kg	Breed			
	Black-and-white	Bestuzhev	Holstein	Ayrshire
Colostrum density, ^{0}A				
Up to 4000	57.1	78.5	52.7	78.6
4001-5000	56.8	78.2	51.9	78.4
5001-6000	56.6	77.6	51.5	77.5
6001-7000	56.5	76.8	51.3	77.0
7001-8000	56.3	–	51.1	76.4
More than 8000	–	–	51.0	–
Colostrum acidity, ^{0}T				
Up to 4000	53.5	60.4	52.8	58.5
4001-5000	52.8	59.6	51.7	57.3
5001-6000	51.3	60.2	50.1	56.7
6001-7000	50.5	58.9	48.5	55.8
7001-8000	49.4	–	48.0	54.5
More than 8000	–	–	47.3	–

The analysis of the obtained results showed that the colostrum of the first milk yield of cows of different dairy breeds has significant differences in the dry matter content. The highest density of colostrum, on average of 78.2°A was in animals of the Bestuzhev breed, which exceeded the Black-and-white breed in this indicator by 21.7°A (38.4%; P<0.001), Holstein - by 26.9°A (52.4 %; P<0.001), Ayrshire - by 0.6°A (0.8%).

Along with the breed characteristics, the colostrum density is significantly affected by the amount of the milk yield of cows during lactation, i.e. the level of dairy productivity of animals, due to the intensity of activity of all organs and body systems. It was established that as milk yields increase in cows, the colostrum density decreases in the group of Black-and-white breed by 0.8oA (1.4%), in Bestuzhev breed - by 1.7oA (2.2%), in Holstein - by 1.7oA (3.2%), in Ayrshire - by 2.2oA (2.8%). This again explains the difference between the breeds on the dry matter of colostrum, since the breeds vary considerably in the amount of milk yield per lactation (table 1).

Due to the fact that most of the dry matter of colostrum are proteins, respectively, by breeds of 63.5%; 67.4%; 61.5%; 65.8%, which have an acid reaction, its active acidity is quite high. Since as milk yield increases, the protein mass fraction in colostrum decreases, there is a reduction in titrated acidity in the Black-and-white breed by 4.1 °T (7.7%; P<0.001), in Bestuzhev- by 5.0 °T (8.3%; P<0.001), in Holstein - by 5.5 °T (10.4%; P<0.001), in Ayrshire - by 4.0 °T (6.8%; P<0.001). At the same time, the colostrum acidity decreased below the maximum permissible rate (48 °T) in the group of Holstein cows with a yield of more than 8000 kg of milk per lactation.

In the globulin fraction of colostrum proteins, a special role is given to immunoglobulins, which entering the calf organism contribute to the formation of colostral immunity, thereby ensuring a protective function, preserving the newborn from the negative effects of the environment and the effects of pathogenic microflora (table 5).

Table 5 – Changes in the content of immunoglobulins in colostrum with the age of cows, depending on the dairy productivity level, g/l

Milk yield per lactation, kg	Breed			
	Black-and-white	Bestuzhev	Holstein	Ayrshire
1st lactation				
Up to 4000	41.50±0.53	69.73±0.64	42.11	67.84±0.36
4001-5000	35.84±0.39	62.95±0.57	35.26±0.48	60.15±0.69
5001-6000	31.68±0.44	56.39±0.51	30.18±0.63	55.47±0.73
6001-7000	26.80±0.75	–	25.94±0.79	48.81±0.57
7001-8000	–	–	21.73±0.56	–
More than 8000	–	–	19.36	–
3rd lactation				
Up to 4000	79.06±0.42	103.35±0.53	74.52	99.03
4001-5000	70.57±0.64	99.24±0.69	64.74	93.78±0.81
5001-6000	65.21±0.59	92.27±0.83	55.76	86.88±0.73
6001-7000	60.38±0.68	81.38±0.71	52.65	78.45±0.64
7001-8000	53.06±0.76	–	47.66±0.69	65.35±0.52
More than 8000	–	–	42.29±0.38	–
5th lactation				
Up to 4000	83.84±0.49	131.36±0.88	–	110.88
4001-5000	79.90±0.55	126.12±0.93	66.91	101.76±0.69
5001-6000	68.73±0.61	118.57±0.79	61.66	94.11±0.78
6001-7000	61.35	109.68	57.94±0.54	87.49±0.47
7001-8000	58.86	96.53	48.59±0.45	79.37±0.39
6th lactation				
Up to 4000	64.31±0.67	108.57±0.54	–	–
4001-5000	58.64	100.39±0.62	–	98.17±0.46
5001-6000	–	94.76±0.59	–	83.95±0.55
6001-7000	–	88.48	–	–

It has been established that the content of immunoglobulins in the colostrum of the first milk yield in cows of different breeds changes under the influence of the level of dairy productivity, as well as with the age of animals. The highest content of immunoglobulins for the first lactation was in the colostrum of Bestuzhev cows (63.4 g/l), and the lowest - in the Holstein breed (29.8 g/l). The difference is 33.6 g/l (112.8%; $P<0.001$), which is caused by the difference between these breeds in milk yield per lactation, which was 2506 kg of milk (61.9%; $P<0.001$). It should be noted that the minimum threshold for the content of immunoglobulins in high-quality colostrum is 60 g/l. According to the first lactation, these requirements only met colostrum of Bestuzhev and Ayrshire breeds with a milk yield per lactation of up to 5000 kg. This again confirms that the colostrum of cows after the first and second calving is not recommended to feed calves due to the low content of immunoglobulins.

After the third calving, when the cow becomes full-grown, the quality of colostrum is significantly improved. Colostrum of the first milk yield in cows of Bestuzhev and Ayrshire breeds fully satisfies the requirements for the content of immunoglobulins. At the same time, there is a tendency to decrease the content of immunoglobulins with the increase in milk yield per lactation. In Black-and-white cows with a yield of more than 7,000 kg, the content of immunoglobulins was below the minimum threshold for quality requirements. In the Holstein breed group, only cows with a yield of up to 5,000 kg of milk met the requirements for the quality of colostrum. The difference between the maximum and minimum values for the content of immunoglobulins in colostrum was 26.0 g/l in Black-and-white cows (49.0%; $P<0.001$), in

Bestuzhev - 21.97 g/l (27.0%; P<0.001), in Holstein - 32.23 g/l (76.2%; P<0.001), in Ayrshire - 33.68 g/l (51.5%; P<0.001). The highest content of immunoglobulins was in the colostrum of the Bestuzhev breed cows - 103.35-81.38 g/l, and the lowest in the Holstein breed - 74.52-42.29 g/l. The difference between the maximum immunoglobulin content was 28.83 g/l (38.7%; P<0.001), the minimum - 39.09 g/l (92.4%; P<0.001). Consequently, with the increase in milk yield for lactation, not only the content of immunoglobulins in the colostrum of cows decreases, but also the difference between breeds increases.

Investigations have shown that the increase in the content of immunoglobulins in the colostrum of the first milk yield of cows continues until the fifth lactation. It should be mentioned that before the fifth lactation the number of cows in the groups decreased by 74%, 46%, 80%, 62%, respectively. At the same time, all highly productive animals, which are characterized by a low content of immunoglobulins in colostrum, first of all, dropped out of the groups. In the group with milk yield up to 4,000 kg, the content of immunoglobulins increased in Black-and-white breed by 4.78 g/l (6.1%; P<0.001), in Bestuzhev - by 28.01 g/l (27.1%; P<0.001), in Holstein - all animals droped out, in Ayrshire - by 11.85 g/l (12.0%); in the group with a yield of up to 5,000 kg - by 9.33 g/l (13.2%; P<0.001), 26.88 g/l (27.1%; P<0.001), 2.17 g/l (3.4%), 7.98 g/l (8.5%; P<0.001) respectively, in the group with a milk yield of up to 7000 kg - by 0.97 g/l (1.6%), 28.30 g/l (34.8%; P<0.001), 5.29 g/l (10.1%), 9.4 g/l (11.5%; P<0.001) respectively, in the group with 8000 kg milk yield - by 5.80 g/l (10.9%), in the group there was one cow which indicator increased by 15.15 g/l (18.6%), 0.9 g/l (2.0%), 14.02 g/l (21.5%). By the sixth lactation in the Black-and-white cows group, 5 heads remained (10%), in Bestuzhev group - 15 heads (30%), in Ayrshire group - 7 heads (14%), in the Holstein breed group, for various reasons, 100% of the animals dropped out. The content of immunoglobulins in the colostrum of cows began to decline, regardless of the breed and level of dairy productivity. The minimum requirements for the content of immunoglobulins in the colostrum were met by cows of all groups of Bestuzhev and Ayrshire breeds, and Black-and-white breed with a yield of up to 4000 kg.

Colostrum immunoglobulins are divided into three main classes - IgG, IgA, IgM. It has been established that about 81% of immunoglobulins (antibodies) of colostrum are synthesized from the blood serum of cows (table 6).

Table 6 – The content of immunoglobulins in colostrum, depending on the dairy productivity level of cows (III lactation)

Milk yield per lactation, kg	Breed			
	Black-and-white	Bestuzhev	Holstein	Ayrshire
G class immunoglobulins, g/l				
Up to 4000	66.72±0,38	88,53±0,73	62,85	85,76
4001-5000	59.46±0,47	85,39±0,69	54,62	80,37±0,56
5001-6000	54.81±0,63	79,61±0,78	46,94	74,59±0,64
6001-7000	51.10±0,59	70,12±0,62	44,36	67,84±0,70
7001-8000	45.34±0,44	–	40,22±0,47	56,44±0,53
More than 8000	–	–	35,49±0,52	–
A class immunoglobulins, g/l				
Up to 4000	8.24±0.31	9.33±0.22	7.69	9.04
4001-5000	7.58±0.27	8.79±0.30	6.75	8.53±0.32
5001-6000	7.11±0.36	8.24±0.27	5.93	7.95±0.27
6001-7000	6.40±0.33	7.56±0.31	5.64	7.10±0.38
7001-8000	5.36±0.24	–	5.13±0.25	6.22±0.26
More than 8000	–	–	4.68±0.42	–
M class immunoglobulins, g/l				
Up to 4000	4.10±0.25	5.49±0.34	3.98	4.23
4001-5000	3.53±0.29	5.06±0.31	3.37	4.88±0.4,3
5001-6000	3.29±0.33	4.42±0.25	2.89	4.34±0.35
6001-7000	2.88±0.27	3.70±0.29	2.65	3.51±0.42
7001-8000	2.36±0.21	–	2.31±0.33	2.69±0.29
More than 8000	–	–	2.12±0.24	–

The main part of colostrum immunoglobulins is G class immunoglobulins. It has been established that in the colostrum of the first milk yield of Black-and-white cows, the IgG level of the total content of immunoglobulins is 84.1-85.5%, in Bestuzhev breed - 85.7-86.3 %, in Holstein - 83.9-84.4%, in Ayrshire - 85.7-86.6%. At the same time, there is a tendency to increase the IgG level with increasing milk yields of cows for lactation. This is a kind of protective reaction of the body to the increase in the dairy productivity of cows. The higher the milk yield in cows, the more weak calves are born, with a low level of natural resistance of the organism, which are more susceptible to the influence of the environment and pathogenic microflora. Many scientists have found that it is IgG that is the main protective factor neutralizing up to 98% of infectious pathogens that enter the body of an animal.

On the other hand, the results showed that the breed belonging of cows and the level of their dairy productivity have a significant effect on the content of immunoglobulins. The highest content of IgG in the colostrum is noted in cows of Bestuzhev breed, and the lowest in Holstein. It was found that in all breeds there is a reduction in the IgG content with increasing milk yields per lactation. The difference between the maximum and minimum IgG content in Black-and-white breed is 21.38 g/l (47.2%; $P<0.001$), in Bestuzhev - 18.41 g/l (26.3%; $P<0.001$), in Holstein 27.36 g/l (77.1%; $P<0.001$), in Ayrshire 29.32 g/l (51.9%; $P<0.001$).

A Class immunoglobulins are considered to be a factor in the primary response, as they are contained in the mucous secretion of the eyes, mouth and nasal cavity, respiratory tract, gastrointestinal tract, urinary system, linking microbes and viruses on these areas of the body and preventing them from penetrating into the internal organs (lungs, heart, liver, kidneys).

The highest IgA level is found in the colostrum of Bestuzhev breed cows, and the lowest - in Holstein breed. The difference was 1.64-2.88 g/l (21.3-61.5%; $P<0.001$). As the milk yield for cows increases, the IgA level of the Black-and-white breed reduces by 2.88 g/l (35.0%; $P<0.001$), in Bestuzhev breed - by 1.77 g/l (19.0%; $P<0.001$), in Holstein breed - by 3.01 g/l (39.1%; $P<0.001$), in Ayrshire breed - by 2.82 g/l (31.2%; $P<0.001$). At the same time, the IgA level from all immunoglobulins, on the contrary, slightly increases, in the Black-and-white breed - from 10.4 to 10.9%, in Bestuzhev - from 8.9 to 9.3%, in Holstein - from 10.3 to 11.1 %, in Ayrshire - from 9.1 to 9.5%.

M Class immunoglobulins are protected from the initial encounter with bacteria and viruses, preventing the infection from developing, i.e. blocking it in the early stages of development. The peculiarity of IgM is that they have an immunological memory, and when they meet again with the same infection, class M antibodies are able to recognize the microbe and give it a powerful rebuff. The graft reaction mechanism is based on this property.

M Class immunoglobulins are the smallest ones. The IgM level in the total structure of colostrum immunoglobulins of Black-and-white cows is 5.2-4.5%, of Bestuzhev cows - 5.3-4.6%, of Holstein - 5.3-4.8%, of Ayrshire - 5.2- 4.1%. The highest IgM level is found in the colostrum of Bestuzhev breed cows, and the lowest - in Holstein breed cows. The IgM level reduces as milk yields per lactation increase, but, in contrast to IgG and IgA, the level in the total content of immunoglobulins also decreases. The difference between the maximum and minimum IgM levels in the Black-and-white breed is 1.74 g/l (73.7%; $P<0.01$), in Bestuzhev - by 1.79 g/l (48.4%; $P<0.05$), in Holstein - by 1.86 g/l (87.7%; $P<0.01$), in Ayrshire - by 1.54 g/l (57.2%; $P<0.05$).

The various quality of the colostrum of the studied breed cows, due to the amount of milk yield per lactation, differently influenced the formation of colostral immunity in newborn calves and, as a result, their health in the colostral period (table 7).

The poor quality of colostrum of the first milk yield in the first-calf heifers did not provide the necessary protection of the body of newborn calves from the negative impact of the environment and pathogenic microflora. Of 50 calves obtained in the group of Black-and-white cows, 44.0% of the animals became ill, in the Bestuzhev group - 18.0% of cows became ill, in Holstein - 60.0%, in Ayrshire - 32.0%. At the same time, the number of diseased calves in the subgroups increased with the growth in the dairy productivity level of the cows, respectively by breed, from 21.4% to 100%; from 6.7 to 60.0%; from 57.1 to 100%; from 36.7 to 60.0%.

As noted above, the quality of colostrum in cows improves with age, but it also has breed differences depending on the amount of milk yield per lactation. On the other hand, by the third calving in the experimental group, for various reasons, most of the highly productive cows dropped out, the quality of

Table 7 – The number of calves from cows with different yields, sick during the colostral period

Milk yield per lactation, kg	Breed							
	Black-and-white		Bestuzhev		Holstein		Ayrshire	
	heads	%	heads	%	heads	%	heads	%
1st lactation								
Up to 4000	3	21.4	1	6.7		0		0
4001-5000	9	40.9	5	16.7	4	57.1	4	26.7
5001-6000	7	63.6	3	60.0	6	60.0	6	27.3
6001-7000	3	100.0	–	–	14	60.9	6	60.0
7001-8000	–	–	–	–	5	62.5	–	–
More than 8000	–	–	–	–	1	100.0	–	–
Total in the group	22	44.0	9	18.0	30	60.0	16	32.0
3rd lactation								
Up to 4000		0		0		0		0
4001-5000		0		0		0		0
5001-6000	4	28.6	2	28.6		0	1	16.7
6001-7000	4	80.0	3	100.0	2	100.0	4	20.0
7001-8000	3	100.0	–	–	8	66.7	3	50.0
More than 8000	–	–	–	–	4	100.0	–	–
Total in the group	11	32.4	5	12.2	14	66.7	8	22.2

colostrum in which was below the physiological norm [26]. It has been established that from cows with a milk yield up to 5,000 kg per lactation, a stronger young stock is born. In addition, the high quality of colostrum provides newborns with 100% protection from the negative effects of the environment and pathogenic microflora.

The increase in milk yield of more than 6000 kg per lactation is accompanied by a significant decrease in the quality of colostrum and the birth of weaker young stock, which leads to enhancing in the incidence of calves in the experimental groups. Even among the calves of Bestuzhev and Ayrshire breeds, of which in the colostrum of mothers, the content of immunoglobulins does not decrease less than 60 g/l, the number of cases reaches 50-100%. This suggests that an increase in milk yields to the maximum level due to the genetic potential of cows is achieved by using internal reserves and the hard work of all organs and body systems. As a result, there is a weakening of the immune system of cows, a decrease in the concentration of antibodies in the blood and, as a result, a reduction of their content in colostrum, where they arrive several days before calving.

Being born, the calf gets into aggressive environmental conditions. Being almost sterile, the body of newborns begins to intensively adapt to these conditions [27]. Therefore, how intensively the initial immunity will be formed in the body depends on further growth, development, and resistance to diseases in the calf (table 8).

Table 8 - Growth intensity of calves in the colostral period, depending on the dairy productivity level of mothers (III lactation)

Milk yield per lactation, kg	Breed			
	Black-and-white	Bestuzhev	Holstein	Ayrshire
Average daily gain in live weight, g				
Up to 4000	186.3±4.38	253.8±5.67	169.5	238.1
4001-5000	188.1±5.64	236.0±6.45	164.6	217.4±5.47
5001-6000	164.5±5.93	199.4±4.79	155.8	181.3±5.93
6001-7000	137.2±3.21	187.5±5.88	121.7	166.8±4.80
7001-8000	101.4±4.39	–	99.8±4.26	139.9±5.34
More than 8000	–	–	87.9±5.61	–

Newborn calves of the studied breeds, by virtue of their breed characteristics, the dairy productivity level of mothers and the quality of colostrum, differed considerably in their adaptive abilities. The strongest and most viable were born from Bestuzhev and Ayrshire cows. In the colostral period, after the first calving, 18.0% of the calves of the Bestuzhev breed became ill, after the third calving - 12.2% of animals, in Ayrshire breed - 32.0% and 22.2%, respectively. Holstein calves were born weaker and melancholic, the incidence after the first calving was 60.0%, after the third - 66.7%. The situation with the Black-and-white breed is somewhat better; the incidence of calves is 44.0 and 32.4%, respectively.

The incidence of calves in subgroups, depending on the yield of mothers, significantly affected their growth and development. It has been established that with an increase in the dairy productivity of cows, the quality of colostrum decreases and the incidence of calves increases. As a result, the average daily gain in live weight of the young stock is reduced proportionally. In sick calves, especially in the case of gastrointestinal diseases, there is even a reduction in live weight due to dehydration.

Conclusion. Analysis of the research results showed that in dairy cows, the quality of the first milk yield of colostrum is affected by the genetic potential of animals, along with breed characteristics. The best in quality colostrum, with a high content of immunoglobulins, was noted in Bestuzhev breed cows. The lowest content of immunoglobulins was in the colostrum of Holstein cows. Regardless of the breed belonging of animals, the quality of colostrum decreased as their level of dairy productivity increased. It has been established that there is an inverse correlation dependence between the indicators characterizing the quality of colostrum and the yield amount. Reducing the quality of colostrum, especially a decrease in the content of immunoglobulins, leads to an increase in the incidence of newborn calves, which ultimately affects the growth and development of young animals. Therefore, to improve the quality of growing young stock, we recommend assessing the quality of colostrum of the first milk yield using an optical or digital refractometer as well as conducting targeted breeding work in the direction of improving the quality of colostrum.

С. В. Карамаев[1], Л. Н. Бакаева[2], Н. А. Балакирев[3], В. А. Демин[4], А. С. Карамаева[1], Н. В. Соболева[2], Л. В. Сычева[4], Ю. А. Юлдашбаев[5], Д. А. Баймұқанов[6]

[1]ФМБОМ ЖО Самар мемлекеттік ауылшаруашылық академиясы, Усть-Кинельский с., Самара облысы, Ресей,
[2]ФМБОМ ЖО «Орынбор мемлекеттік аграрлық университеті», Орынбор, Ресей,
[3]ФМБОМ ЖО «Мәскеу ветеринария және биотехнология академиясы», Мәскеу, Ресей,
[4]ФГБОУ ВО «Академик Д. Н.Прянишников атындағы Пермь мемлекеттік аграрлық университеті», Пермь, Ресей,
[5]ЖББСФМББ беру саласының мемлекеттік орталығы – К.А. Тимирязев атындағы Мәскеу аграрлық академиясы, Мәскеу, Ресей,
[6]Қазақ ұлттық аграрлық университеті, Алматы, Қазақстан

ТҮРЛІ ДЕҢГЕЙДЕГІ СҮТ ӨНІМДІЛІГІ БАР СҮТТІ ІРІ ҚАРАНЫҢ АҚУЫЗЫНЫҢ САПАСЫ

Аннотация. Бастапқы иммунитет жаңа туылған бұзаудың ағзасында қалыптасқанда, иммуноглобулиндердің, лизоцимнің, функционалды белсенді лейкоциттердің және лимфоциттердің негізгі көзі ақуыз болып табылады. Толық иммунитетті қалыптастырудың өте маңызды шарты - ауыз қуысының сапасы. Бірқатар ғалымдар сүтті ірі қараның түрлі сүт өнімділігі жағынан айтарлықтай ерекшеленетінін айтады, ал иммуноглобулиндердің жаппай үлесі алғашқы ауыру кезінде ішек ауруының мөлшерімен теріс байланысады. Зерттеудің басты мақсаты - сүтті сүт өнімдерінің лактация көлеміне байланысты ақуыз сапасының динамикасын зерттеу. Зерттеу нысаны Самара облысының төрт тұқымының сиыры болды: Қара-ала, Бестужевская, Гольштин, айршрская. Әртүрлі ірі қара тұқымдарындағы алғашқы сауын сүттің иммуноглобулиндердің көлемі сүт өнімділігінің деңгейімен, сондай-ақ жануарлардың жасы әсерімен өзгергені анықталды. Иммуноглобулиндердің ең көп мөлшері Бестужев тұқымының уызында - 103.35-81.38 г/л, ал ең төменгі голштиндік тұқымы - 74.52-42.29 г/л. Ақуыз иммуноглобулиндері үш класқа бөлінеді: IgG, IgA, IGM. Қара-ала сиырдың алғашқы сүтінен алынған ақуызIgG үлесі 84,1-85,5%, Бестужевская - 85,7-86,3%, гольштин 83,9-84,4%, айршир - 85,7-86,6%. Лактация кезінде сиыр сауынының сүт мөлшерінің жоғарылауы арқылы IgG үлесін ұлғайту үрдісі байқалады. Сиырдың сүт өнімділігінің артуымен уыздың сапасы төмендейді және бұзаулардың ауру саны артады деп анықталды. Нәтижесінде, жас төлдің тірі салмағының орташа күнделікті өсуі пропорционалды түрде төмендетіледі. Алынған нәтижелерге сүйене отырып, біз оптикалық немесе цифрлы рефрактометрді қолданып, сүт ақуызының сапасын бағалауды ұсынамыз. Ақуыз сапасын жақсарту бағытында тұқыммен сұрыптау мақсатты асыл тұқымды жұмыс жүргізу.

Түйін сөздер: тұқым, сиыр, бұзау, ақуыз, сапасы, лактация, сүт өнімділігі, иммуноглобулиндер, ауру.

С. В. Карамаев[1], Л. Н. Бакаева[2], Н. А. Балакирев[3], В. А. Демин[4], А. С. Карамаева[1], Н. В. Соболева[2], Л. В. Сычева[4], Ю. А. Юлдашбаев[5], Д. А. Баймуканов[6]

[1]ФГБОУ ВО «Самарская государственная сельскохозяйственная академия», п.г.т. Усть-Кинельский, Самарская область, Россия,
[2]ФГБОУ ВО «Оренбургский государственный аграрный университет», Оренбург, Россия,
[3]ФГБОУ ВО «Московская академия ветеринарной медицины и биотехнологии», Москва, Россия,
[4]ФГБОУ ВО «Пермский государственный аграрно-технологический университет им. академика Д.Н. Прянишникова», Пермь, Россия,
[5]ФГБОУ ВО «Российский государственный аграрный университет – Московская сельскохозяйственная академия им. К.А. Тимирязева», Москва, Россия,
[6]НАО "Казахский национальный аграрный университет, Алматы, Казахстан

КАЧЕСТВО МОЛОЗИВА КОРОВ МОЛОЧНЫХ ПОРОД С РАЗНЫМ УРОВНЕМ МОЛОЧНОЙ ПРОДУКТИВНОСТИ

Аннотация. При формировании в организме новорожденного теленка первоначального иммунитета основным источником иммуноглобулинов, лизоцима, функционально активных лейкоцитов и лимфоцитов является молозиво. Очень важным условием для формирования полноценного иммунитета является качество молозива. Ряд ученых утверждают, что коровы разных молочных пород значительно различаются по уровню молочной продуктивности, при этом массовая доля иммуноглобулинов отрицательно коррелирует с количеством молозива при первом доении. Основной задачей исследований было изучение динамики качества молозива в зависимости от величины удоя коров за лактацию. Объектом исследований служили коровы четырех пород, разводимых в Самарской области: черно-пестрая, бестужевская, голштинская, айрширская. Установлено, что содержание иммуноглобулинов в молозиве первого удоя у коров разных пород изменяется под влиянием уровня молочной продуктивности, а также с возрастом животных. Самое высокое содержание иммуноглобулинов было в молозиве бестужевской породы – 103,35-81,38 г/л, а самое низкое у голштинской породы – 74,52-42,29 г/л. Иммуноглобулины молозива делятся на три класса – IgG, IgA, IGM. В молозиве первого удоя коров черно-пестрой породы доля IgG составляет 84,1-85,5%, бестужевской – 85,7-86,3%, голштинской 83,9-84,4%, айрширской – 85,7-86,6%. Отмечена тенденция увеличения доли IgG, по мере увеличения удоев коров за лактацию. Установлено, что при увеличении уровня молочной продуктивности коров снижается качество молозива и увеличивается число заболеваемости телят. В результате величина среднесуточных приростов живой массы молодняка пропорционально снижается. На основании полученных результатов рекомендуем оценивать качество молозива первого удоя при помощи оптического или цифрового рефрактометра. Вести целенаправленную селекционную работу с породами в направлении повышения качества молозива.

Ключевые слова: порода, корова, телята, молозиво, качество, лактация, удой, иммуноглобулины, заболеваемость.

Information about authors:

Karamayev Sergey Vladimirovich, Doctor of Agricultural Sciences, Professor of the Department "Zootechnics", Federal State Budgetary Institution of Higher Education "Samara State Agricultural Academy", Ust-Kinelsky, Samara region, Russia; KaramaevSV@mail.ru; https://orcid.org/0000-0003-2930-6129

Bakaeva Larisa Nikolaevna, Candidate of Agricultural Sciences, Associate Professor of the Department "Technology of production and processing of livestock products", Federal State Budgetary Educational Institution of Higher Education "Orenburg State Agrarian University", Orenburg, Russia; Bakaeva.lora@mail.ru; https://orcid.org/0000-0001-6136-5044

Balakirev Nikolay Aleksandrovich, academician of RAS, Doctor of Agricultural Sciences, Professor, Head of the Department of Small Animal Breeding of the Moscow State Academy of Veterinary Medicine and Biotechnology named after K.I. Skryabin, Moscow, Russia; ovismgavm@mail.ru; https://orcid.org/0000-0003-4325-9904

Demin Vladimir Aleksandrovich, Doctor of Agricultural Sciences, Professor of the Department of Horse Breeding, Federal State Budgetary Educational Institution of Higher Education "Russian State Agrarian University – Moscow Agricultural Academy named after K.A. Timiryazev, Moscow, Russia; demin@rgau-msha.ru; https://orcid.org/0000-0003-3201-3618

Karamayeva Anna Sergeevna, Candidate of Biological Sciences, Associate Professor of the Department "Zootechnics", Federal State Budgetary Institution of Higher Education "Samara State Agricultural Academy", Ust-Kinelsky, Samara region, Russia; annakaramaeva@rambler.ru; https://orcid.org/0000-0002-0131-5042

Soboleva Natalia Vladimirovna, Candidate of Agricultural Sciences, Associate Professor of the Department "Technology of production and processing of livestock products", Federal State Budgetary Educational Institution of Higher Education "Orenburg State Agrarian University", Orenburg, Russia; Natalya.soboleva12@mail.ru; https://orcid.org/0000-0002-3688-2303

Sycheva Larisa Valenitinovna, Doctor of Agricultural Sciences, Professor of the Department "Animal breeding", Federal State Budgetary Educational Institution of Higher Education "Perm State Agrarian and Technological University named after academician D. N. Pryanishnikov", Perm; Perm region, Russia; lvsycheva@mail.ru; https://orcid.org/0000-0002-7818-7501

Yuldashbayev Yusupzhan Artykovich, Corresponding Member of the Russian Academy of Sciences, Doctor of Agricultural Sciences, Professor, Dean of the Faculty of Animal Science and Biology, Professor of the Department of Private Animal Science, Russian State University – Moscow Agricultural Academy named after K. A. Timiryazev, Moscow, Russia; zoo@rgau-msha.ru; https://orcid.org/0000-0002-7150-1131

Baimukanov Dastanbek Asylbekovich, Corresponding Member of the National Academy of Sciences of the Republic of Kazakhstan, Doctor of Agricultural Sciences, Professor of the Department of Physiology, Morphology, and Biochemistry named after academician N. U. Bazanova, NJSC "Kazakh National Agrarian University", Almaty, Kazakhstan; dbaimukanov@mail.ru; https://orcid.org/0000-0002-4684-7114

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