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ИММУНОГЕНЕТИЧЕСКАЯ ХАРАКТЕРИСТИКА ПОРОД ОВЕЦ СИБИРСКО-ДАЛЬНЕВОСТОЧНОГО РЕГИОНА

(✉)**Гончаренко Г.М.[1], Хамируев Т.Н.[2], Дашинимаев С.М.[2], Хорошилова Т.С.[1], Халина О.Л.[1], Гришина Н.Б.[1]**
[1] Сибирский федеральный научный центр агробиотехнологий Российской академии наук
Новосибирская область, р.п. Краснообск, Россия
[2]Научно-исследовательский институт ветеринарии Восточной Сибири – филиал Сибирского федерального научного центра агробиотехнологий Российской академии наук
Чита, Россия
(✉)e-mail: gal.goncharenko@maiI.ru

Проведен сравнительный анализ восьми пород овец (полугрубошерстных, грубошерстных, полутонкорунных и тонкорунных), разводимых в Сибирско-Дальневосточном регионе. В исследованиях использовали данные по иммуногенетическому тестированию овец в племенных хозяйствах за ряд лет. Тестирование проводилось с применением 14 специфических сывороток – реагентов. Изучены аллельный профиль овец, их сходство и различие, связанные с филогенезом и предшествующей селекцией. Все исследованные породы имели отличительный аллельный профиль. В каждой породе выявлены как часто, так и редко встречающиеся антигены. На основании частот антигенов рассчитан индекс генетического сходства (*r*), который был выше в породах одного направления продуктивности, например между породами буубэй и эдильбаевской (r = 0,912), и ниже – между породами, селекция которых проводилась изолированно друг от друга. Самый низкий индекс генетического сходства выявлен между бурятской и западно-сибирской мясной (r = 0,707). Породы одного направления продуктивности из разных регионов также имеют отличительные особенности. Индекс генетического сходства между грубошерстными породами (буубэй и эдильбаевская) составляет 0,912; между полугрубошерстными (бурятская и агинская) он находится на уровне 0,739; между полутонкорунными (горноалтайская и западно-сибирская мясная) – 0,845; между тонкорунными (кулундинская и забайкальская) – 0,902. С использованием кластерного анализа генетических дистанций определены взаимоотношения пород, их происхождение, филогенез. Западно-сибирская мясная и кулундинская образовали один кластер, буубэй и бурятская также вошли в один кластер. Более отдаленными породами оказались агинская (зугалайский тип) и эдильбаевская.

Ключевые слова: овца, порода, антиген, частота, индекс генетического сходства

IMMUNOGENETIC CHARACTERISTICS OF SHEEP BREEDS OF THE SIBERIAN-FAR EASTERN REGION

(✉)**Goncharenko G.M.[1], Khamiruev T.N.[2], Dashinimaev S.M.[2], Khoroshilova T.S.[1], Khalina O.L.[1], Grishina N.B.[1]**
[1]Siberian Federal Scientific Centre of Agro-BioTechnologies of the Russian Academy of Sciences
Krasnoobsk, Nobosibirsk Region, Russia
[2]Research Institute of Veterinary Medicine of Eastern Siberia - Branch of the Siberian Federal Scientific Centre of AgroBioTechnologies of the Russian Academy of Sciences
Chita, Russia
(✉)e-mail: gal.goncharenko@maiI.ru

A comparative analysis of eight breeds of sheep (medium-wool, coarse-wooled, semifine-wool and fine-wool) bred in the Siberian-Far Eastern region was carried out. The research used the data on immunogenetic testing of sheep in breeding farms for a number of years. The testing was performed using 14 specific sera – reagents. The allelic profile of sheep, their similarities and differences related to phylogeny and previous selection were studied. All breeds studied had a distinctive allelic profile. Both frequent and infrequent antigens were identified in each breed. Based on antigen frequencies, an index of genetic similarity (*r)* was calculated, which was higher in the breeds of the same productivity direction, e.g. between Buubei and Edilbaevskaya breeds (r = 0.912), and lower between

the breeds that were selected in isolation from each other. The lowest index of genetic similarity was found between the Buryat and West Siberian meat breeds ($r = 0.707$). Breeds of the same productivity direction from different regions also have distinctive features. The index of genetic similarity between coarse-wooled breeds (Buubei and Edilbaevskaya) is 0.912; between medium-wool breeds (Buryat and Aginskaya) it is at the level of 0.739; between semifine-wool breeds (Gorno Altai and West Siberian meat breeds) – 0.845; between fine-wool breeds (Kulunda and Zabaikalskaya) – 0.902. Using the cluster analysis of genetic distances, the relationships of breeds, their origin, and phylogeny were determined. West Siberian Meat and Kulunda breeds formed one cluster, Buubei and Buryat breeds were also included in one cluster. More distant breeds were Aginskaya (Zugalai type) and Edilbaevskaya.

Keywords: sheep, breed, antigen, frequency, index of genetic similarity

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INTRODUCTION

In Russia during the 2000s, there was a partial shift in sheep breeding due to the reduction in the sheep population. Due to market conditions, the number of fine-wool sheep breeds decreased by 2.3 times, semifine-wool by 4.3 times, while the population of coarse-wooled sheep breeds increased by 4.1 times. However, the most numerous sheep population belongs to the fine-wool productivity direction, with 15 breeds representing 54% of the total sheep population in Russia. Semifine-wool breeds account for only 4.6%, and the population of semi-coarse-wooled sheep is even smaller at 1.2%. In Russia, 17 breeds fall under the coarse-wooled productivity direction, accounting for 33% of the sheep population[1].

The observed annual decrease in the sheep population may lead to the loss of adaptive qualities to local climate and feeding conditions, as well as a reduction in genetic diversity. To study these processes, various types of genetic markers are used, including blood groups, protein polymorphism, microsatellite profiles, and whole-genome analysis, which can be used to study the population-genetic structure of individual breeds, populations, their variability during crossbreeding, and generational monitoring. Currently, microsatellite profiling [1, 2] is considered one of the most convenient, informative, and suitable for mass analysis.

The use of blood groups, which were in demand due to their informativeness, codominant inheritance type, and suitability for mass analysis, allowed solving some problems in the selection of farm animals, such as verifying the accuracy of recording the origin of young animals. In addition, immunogenetic analysis was widely used in establishing the phylogeny of breeds, similarities, and differences between populations, herds, and age-sex groups.

Studies [3] have shown that the highest genetic similarity is found between Black-and-White Holsteinized bulls and Ayrshire bulls (0.902), while the lowest is between Jersey and

[1] *Shichkin G.I., Safina G.F., Amerkhanov H.A., Chernov V.V., Grigoryan L.N., Khmelevskaya G.N., Ravicheva A.V., Stepanova N.G.* Yearbook on breeding work in sheep and goat breeding in farms of the Russian Federation (2021). FSBSI ARRIPW, Moscow, 2022, 325 p.

Ayrshire bulls (0.561). Immunogenetic analysis demonstrated differences in an isolated population of French Rambouillet sheep and Spanish Merinos, from which they originated. In a closed herd, only those alleles were fixed that were detected in Spanish Merinos with frequencies of 0.90 and 0.80[2].

With the help of blood groups and other genetic markers, one of the best domestic fur-bearing breeds, the Romanov breed, has been thoroughly characterized in comparative assessment with other breeds[3].

Immunogenetic analysis has found application in determining mono- and dizygosity of offspring of farm animals [4]. Studies [5] have shown the influence of the environment on the level of homozygosity of a herd for serum blood proteins, which may be a consequence of the mechanism of maintaining polymorphism, having adaptive value in unfavorable conditions.

The paper shows the allele profile of sheep crossbreeds and identifies desirable alleles associated with live weight, meat productivity, and productive longevity [6, 7]. There are reports of using blood groups for effective selection of mating pairs based on the genetic similarity index of parents[4, 5] [8]. It has been shown that in the formation of the allele pool of offspring, from 50% to 80% of the dominant alleles of the maternal herd of cattle are involved [9].

Considering that blood groups were the predominant genetic markers, during their active use in the selection of farm animals, a substantial amount of factual material has been accumulated on the genetic structure of different breeds, changes in allele and genotype frequencies under the influence of selection and the environment, and more detailed studies on blood group characteristics and the laws of their inheritance. As a result of the analysis of immunogenetic structures of eight species of ruminants, the similarity of some antigen loci of different species (sheep, goats, cattle) has been established [10].

Studies [3] provide data on the concentration, dynamics, and stability of erythrocyte alleles in cattle. It is shown that only 10% of alleles are stable, while about 30-35% are subject to elimination and genetic drift.

The purpose of the research is to analyze and summarize the allele pool of sheep of different breeds, taking into account the direction of productivity, their similarities and differences, and the relationships between them in the conditions of the Siberian-Far Eastern region.

MATERIAL AND METHODS

The research material consisted of blood samples collected from eight different breeds of sheep with various productivity directions, bred in the Siberian-Far Eastern region (Altai and Trans-Baikal Territory, Republic of Buryatia). The studied breeds included: coarse-wooled sheep breeds - Buubei (BUB) and Edilbayevskaya (EDL), semi-coarse-wooled sheep breeds - Buryat (BUR) and Aginskaya sheep of the Zugalai type (AGZ), semifine-wool sheep breeds – Gorno Altai breed of the Prikatunsky type (GAP) and West Siberian meat breed (WSM), and fine-wool sheep breeds – Zabaykalskaya of the Khangil type (ZBH) and Kulunda breed (KUL). A total of 2134 individuals were studied.

Immunogenetic testing was conducted using monospecific reagents from the bank of the Immunogenetics and DNA Technology Laboratory of the All-Russian Scientific Research Institute of Sheep and Goat Breeding. Testing covered six blood group systems (*A, B, C, D, M*, and *R-O*), including 14 erythrocyte factors (*Aa, Ab, Bb, Bd,*

[2]*Nguyen T.C., Morera L., Llanes D., Leger P.* Sheep blood polymorphism and genetic divergence between French Rambouillet and Spanish Merino: roleofgeneticdrift // Anim.Genet, 1992, N 23 (4), pp. 325–332. DOI: 10.1111/j.1365-2052.1992.tb00154.x.

[3]*Marzanov N.S., Komkova E.A., Malyuchenko O.P., Alekseev Ya.I., Ozerov M.Y., Kantanen Y., Lobkov V.Y., Marzanova L.K., Astafieva E.E., Petrov S.N., Kolpakov I.N., Andryukhin A.P., Adamyan K.K., Marzanova S.N.* Characterization of the allelofond of Romanov sheep breed by different types of genetic markers // Problems of Productive Animal Biology, 2015, N 2, pp. 23-40.

[4]*Vitanova O.I., Chizhova L.N.* Physiological and biochemical status of young sheep obtained from parents with different values of the index of antigenic similarity // Collection of Scientific Works of the Stavropol Research Institute of Animal Husbandry and Fodder Production, 2007, vol 3, N 3-3, pp. 10-12.

[5]*Skokova A.V., Barnash E.N., Sharko G.N., Yakubova E.V., Shumaenko S.N.* Productivity of young sheep depending on the index of genetic similarity of parents // Collection of Scientific Works of the Stavropol Research Institute of Animal Husbandry and Fodder Production, 2014, N 7, pp. 145-149

Be, Bi, Bg, Ca, Cb, Ma, Mb, R, O, and *Da*). The study was carried out through hemolysis and agglutination reactions at the Aginsk Veterinary Laboratory and the Laboratory of Biotechnology of the Siberian Research and Technological Design Institute of Animal Husbandry, SFSCA RAS.

The frequencies of antigens were calculated using the method of L.A. Zhivotovsky and A.M. Mashurov (1974). Genetic distance and genetic similarity were calculated using Nei's formulas (1972). Based on these calculations, genetic distance dendrograms were constructed between sheep breeds using the application program PAST version 3.25[6].

RESULTS AND DISCUSSION

To study the genetic characteristics of sheep of different breeds, groups were formed according to the following productivity directions: coarse-wooled, semi-coarse-wooled, semifine-wool, and fine-wool. The least numerous breeds in our study were Buubei, West Siberian meat, and Kulunda breeds, which account for only 1% of the total sheep population bred in the Siberian-Far Eastern region.

Buubei and Edilbayevskaya breeds belong to the coarse-wooled category, and their breeding histories have no common origin. The Buubei breed was created through long-term selective and breeding work by reintroducing indigenous Buryat sheep from Inner Mongolia, China[7]. The breed is becoming increasingly popular due to its good meat productivity and high meat quality [11, 12].

The Edilbayevskaya breed originates from Kazakhstan and is adapted to various meat sheep farming zones. The breed has three types of animals that differ in body structure and productivity[8]. Despite the same productivity direction, the breeds have significant differences, presumably due to previous selection (see Table 1).

For most antigens, differences were found. In the coarse-wooled meat breed Buubei, antigens *Bd, Bi, Ma*, and *R* were more frequent (by 0.235, 0.106, 0.100, and 0.052, respectively) compared to the coarse-wooled meat breed Edilbayevskaya. Conversely, the frequency of antigens *Ab, Bb, Be, Ca, Cb, Mb*, and *O* was higher in the Edilbayevskaya breed by 0.325, 0.089, 0.223, 0.252, 0.588, 0.354, and 0.098, respectively, compared to Buubei breed ($p \leq 0.05$, $p \leq 0.001$). The genetic similarity index between these breeds is $r = 0.910 \pm 0.014$.

Buryat and Aginskaya (Zugalai type) breeds belong to the semi-coarse-wooled sheep category. The Aginskaya breed was created by crossing the Zabaykalskaya fine-wool ewes with Kuchugursky fine-wool and Kazakh semi-coarse-wooled rams [13]. The Zugalai type of the Aginskaya breed was obtained through initial crossbreeding of the Aginskaya sheep with Kazakh semi-coarse-wooled rams of the Bayys type [14].

The Buryat breed was created with the participation of four breeds, with fine-wool Zabaykalskaya sheep of the Buryat type as the maternal foundation, which were crossed with Kazakh semi-coarse-wooled and Kuchugursky coarse-wooled rams. Subsequently, three-breed crossbred ewes were used, mating them with Baydaragsky rams of the fine-wool breed[9].

Table 2 presents data on the frequency of blood antigens in semi-coarse-wooled sheep of the Buryat and Aginskaya breeds (Zugalai type).

Immunogenetic analysis revealed that the Buryat breed of sheep has a higher frequency of antigens *Bd, Bi, Bg, Ma*, and *O* compared to the Aginskaya breed of the Zugalai type. In contrast, the Aginskaya breed of the Zugalai type surpasses in the frequency of the antigens *Ab, Be, Ca*, and *Cb* ($p \leq 0.05$, $p \leq 0.001$). The genetic similarity index of semi-coarse-wooled sheep is 0.739 ± 0.131.

[6] *Hammer O., Harper D.A.T., Ryan P.D.* PAST: Palaeontological Statistics software for education and data analysis // Palaeontologia Electronica, 2001, N 4 (1), p. 9.

[7] *Merzlyakov A.A., Danilov M.B.* Study of the composition and technological properties of meat of sheep indigenous breed "Buubei" // Education and Science: Materials of the national scientific-practical conf. Ulan-Ude, 2023, pp. 40-45.

[8] *Davletova A.M., Kosilov V.I.* Constitutional-productive types of Edilbaev sheep // Izvestiya Orenburg State University, 2013, N 1 (39), pp.102-104.

[9] *Biltuev S.I.* Creation of type and breed of sheep in specific environmental conditions of Western Siberia and the Republic of Buryatia: Ulan-Ude: Publishing house of BSSA named after V.R. Filippov, Ulan-Ude, 2010, 240 p.

Табл. 1. Частота антигенов крови грубошерстных овец буубэй и эдильбаевской пород

Table 1. Frequency of blood antigens in coarse-wooled sheep of the Buubei and Edilbaevskaya breeds

Antigen	BUB (*n* = 298)	EDL (*n* = 199)
Aa	0,691 ± 0,019	0,683 ± 0,023
Ab	0,107 ± 0,013	0,432 ± 0,025***
Bb	0,765 ± 0,017	0,854 ± 0,018***
Bd	0,742 ± 0,018***	0,507 ± 0,025
Bi	0,362 ± 0,020***	0,256 ± 0,022
Bg	0,399 ± 0,020	0,362 ± 0,024
Be	0,440 ± 0,023	0,663 ± 0,024***
Ca	0,386 ± 0,020	0,638 ± 0,024***
Cb	0,191 ± 0,016	0,779 ± 0,021***
Ma	0,738 ± 0,018***	0,638 ± 0,024
Mb	0,520 ± 0,020	0,874 ± 0,017***
R	0,198 ± 0,016*	0,146 ± 0,018
O	0,721 ± 0,018	0,819 ± 0,019***
Da	–	0,387 ± 0,024

Here and in Tables 2–4.
* $p \leq 0,05$.
** $p \leq 0,01$.
*** $p \leq 0,001$.

Табл. 2. Частота антигенов крови полугрубошерстных овец бурятской и агинской пород

Table 2. Frequency of blood antigens in medium-wool sheep of the Buryat and Aginskaya breeds

Antigen	BUR (*n* = 70)	AGZ (*n* = 356)
Aa	0,400 ± 0,041	0,449 ± 0,028
Ab	0,043 ± 0,017	0,489 ± 0,027***
Bb	0,714 ± 0,038	0,820 ± 0,016*
Bd	0,457 ± 0,042***	0,014 ± 0,037
Bi	0,400 ± 0,041***	0,191 ± 0,034
Bg	0,543 ± 0,042*	0,407 ± 0,036
Be	0,314 ± 0,039	0,688 ± 0,021***
Ca	0,329 ± 0,040	0,772 ± 0,018***
Cb	0,114 ± 0,027	0,458 ± 0,028***
Ma	0,529 ± 0,042***	0,034 ± 0,037
Mb	0,586 ± 0,042	0,652 ± 0,022
R	0,200 ± 0,034	0,166 ± 0,034
O	0,729 ± 0,038***	0,140 ± 0,035
Da	0,029 ± 0,014	0,008 ± 0,036

Gorno-Altai (Prikatunsky type) and West Siberian meat sheep breeds belong to the semi-fine-wool category. The Prikatunsky type of the Gorno-Altai breed of sheep was created in two stages. In the first stage, fine-wool and coarse-wooled ewes with different types of wool were crossed with rams of the Romni-Marsh breed until the second and third generations were obtained. Then, crossbred sheep of the desired type were bred within the breed[10].

The West Siberian meat breed was created based on the Kulunda short-tailed breed and its crossbreds with rams of the improved meat type of the Southern meat breed[11]. The compared breeds are bred in different eco-geographical conditions.

Semifine-wool sheep of the Gorno-Altai breed of the Prikatunsky type are characterized by a high frequency of occurrence of nine antigens - *Ab, Bb, Bd, Bi, Bg, Be, Ca, R*, and *O* compared to the West Siberian meat breed. Differences in frequencies range from 0.254 to 0.680 ($p \leq 0.05$, $p \leq 0.001$) (see Table 3). The genetic similarity index of semifine-wool sheep is 0.845 ± 0.0014.

The Kulunda fine-wool breed has been improved for a long time through "folk" selection methods, but starting from 1981, it was crossed

[10]*Podkorytov A.T.* Prikatunsky meat-wool type // Achievements of science and technology of AIC, 2006, N 2, pp. 30-31.

[11]*Katamanov S.G., Ulyanov A.N., Kulikova A.Y., Aboneev V.V., Selkin A.I., Afanasyeva A.I., Katamanov Yu. G., Loboda N.L., Moroz V.A., Trukhachev V.I., Katamanov A.S., Chebotaev A.N., Chmyryov M.A.* West Siberian meat breed // Sheep, goats, wool business, 2012, N 3, pp. 6-12.

with the Grozny breed to improve its wool quality, and later with the Stavropol Manych merinos[12].

In the creation of the Khangil type of the Zabaykalskaya breed, three breeds were involved at different times: Zabaykalskaya (maternal foundation), Australian, and Manych merinos[13].

The immunogenetic profile of the fine-wool sheep of the Kulunda and Zabaykalskaya breeds (Khangil type) also shows significant differences in the frequency of antigens (see Table 4).

For Kulunda fine-wool sheep, antigens *Aa, Ab, Bb, Bi, Bg, Ca, Cb, Ma, Mb, R* (50% or more) are characteristic, while antigens *Bd, O, Da* (less than 40%) are rarely present. The frequency of antigen factors *Ab, Bi, Be, Cb, Ma, Mb*, and *R* in this breed exceeds these indicators in the Zabaykalskaya of the Khangil type breed by 0.410, 0.161, 0.353, 0.253, 0.149, 0.150, 0.403, and 0.273, respectively. The Zabaykalskaya of the Khangil type breed, on the other hand, is characterized by a higher frequency of the antigens *Bb, Ca, O* - by 0.209, 0.293, 0.523 ($p \leq 0.01$, $p \leq 0.001$). The genetic similarity index of fine-wool sheep is 0.902 ± 0.022.

Comparative assessment of breed similarity expressed through genetic similarity indices and genetic distances is presented in Table 5.

The highest genetic similarity index was found between the Buubei and Buryat breeds (0.9681), which, in our view, can be explained

Табл. 3. Частота антигенов крови полутонкорунных овец горноалтайской и западно-сибирской мясной пород

Table 3. Frequency of blood antigens in semifine-wool sheep of the Gorno-Altai and West Siberian meat breeds

Antigen	WSM (*n* = 116)	GAP (*n* = 573)
Aa	0,543 ± 0,046***	0,150 ± 0,015
Ab	0,595 ± 0,046	0,894 ± 0,013***
Bb	0,500 ± 0,046	0,993 ± 0,003***
Bd	0,345 ± 0,044	0,998 ± 0,002***
Bi	0,603 ± 0,045	0,956 ± 0,009***
Bg	0,172 ± 0,035	0,609 ± 0,020***
Be	0,138 ± 0,032	0,747 ± 0,018***
Ca	0,465 ± 0,046	0,894 ± 0,017***
Cb	0,836 ± 0,034	0,769 ± 0,017
Ma	0,474 ± 0,046***	0,251 ± 0,018
Mb	0,595 ± 0,045	0,607 ± 0,020
R	0,405 ± 0,046	0,659 ± 0,019***
O	0,147 ± 0,033	0,827 ± 0,016***
Da	0,612 ± 0,045***	0,353 ± 0,020

Табл. 4. Частота антигенов крови тонкорунных овец кулундинской и забайкальской пород

Table 4. Frequency of blood antigens in fine-wool sheep of the Kulunda and Trans-Baikal breeds

Antigen	KUL (*n* = 122)	ZBH (*n* = 400)
Aa	0,541 ± 0,045	0,495 ± 0,025
Ab	0,893 ± 0,028***	0,483 ± 0,025
Bb	0,771 ± 0,038	0,980 ± 0,005***
Bd	0,311 ± 0,042**	0,150 ± 0,033
Bi	0,631 ± 0,044***	0,278 ± 0,030
Bg	0,853 ± 0,032	0,873 ± 0,013
Be	0,443 ± 0,045***	0,190 ± 0,032
Ca	0,639 ± 0,043	0,932 ± 0,009***
Cb	0,632 ± 0,044***	0,483 ± 0,025
Ma	0,705 ± 0,041**	0,555 ± 0,024
Mb	0,631 ± 0,044***	0,228 ± 0,031
R	0,811 ± 0,035***	0,538 ± 0,024
O	0,385 ± 0,044	0,910 ± 0,011***
Da	0,336 ± 0,043	0,318 ± 0,029

[12]*Selkin I.I., Katamanov A.S.* Fecundity of mothers and safety of young stock of Kulunda fine-fleece breed // Collection of Scientific Works of the Stavropol Research Institute of Animal Husbandry and Fodder Production, 2009, vol. 2, N 2-2, pp. 81-84.

[13]*Khamiruev T.N., Volkov I.V.* New wool and meat type in the Transbaikalian thin-cross breed of sheep - Khangilskiy // Zootechnia, 2015, N 4, pp. 6-7.

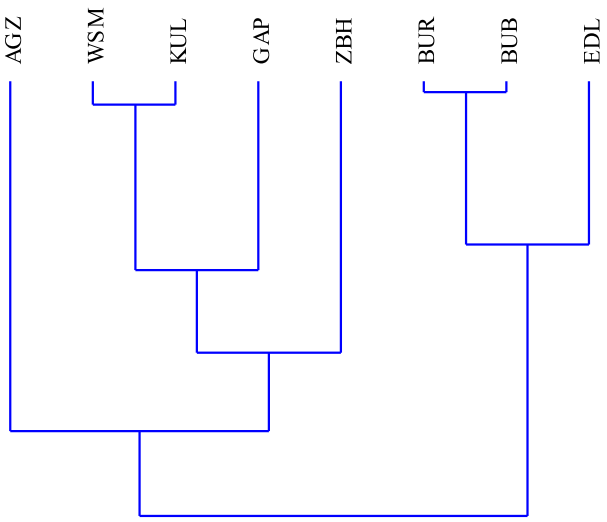
by the fact that the maternal foundation of the Buryat breed of sheep was the Buryat type of the Zabaykalskaya fine-wool sheep. The latter were bred based on indigenous Buryat sheep, on the basis of which the Buubei breed was created through reintroduction from Inner Mongolia, China.

The West Siberian meat breed was created based on the Kulunda breed, which is reflected in the level of genetic similarity between the breeds (0.963).

The genetic similarity index is higher in breeds with the same productivity direction and lower in different ones. For example, Buubei and Edilbayevskaya breeds of sheep have a genetic similarity index of 0.912, while with the semi-coarse-wooled Aginskaya breed, it is 0.719.

Cluster analysis of genetic distances showed the relationships between the studied breeds (see the figure).

West Siberian and Kulunda formed one cluster, Buubei and Buryat also entered one cluster. More distant were the Zugalai type of the Aginsky breed (semi-coarsed wool direction) and Edilbaevskaya breed (coarse-wooled).



Дендрограмма генетических дистанций
Dendrogram of genetic distances

CONCLUSION

Sheep breeds of the Siberian and Far Eastern region have distinctive features on blood group alleles, conditioned by breed peculiarities, previous genesis and, possibly, natural and climatic conditions. Breeds of the same direction of productivity from different breeding zones have the

Табл. 5. Матрица генетических расстояний между породами
Table 5. Matrix of genetic distances between the breeds

Breed	BUB	EDL	BUR	AGZ	WSM	GAP	KUL	ZBH
BUB		0,912	0,968	0,719	0,730	0,815	0,809	0,823
EDL	0,092		0,897	0,867	0,867	0,872	0,871	0,862
BUR	0,033	0,109		0,739	0,707	0,831	0,826	0,862
AGZ	0,330	0,143	0,302		0,754	0,813	0,834	0,800
WSM	0,315	0,143	0,347	0,282		0,845	0,963	0,823
GAP	0,205	0,137	0,185	0,207	0,168		0,903	0,847
KUL	0,212	0,138	0,191	0,182	0,038	0,102		0,902
ZBH	0,195	0,149	0,149	0,223	0,195	0,166	0,103	

Note. Genetic similarity indices are above the diagonal (r), under the diagonal are the genetic distances (DN); BUB – Buubei, EDL – Edilbayevskaya, BUR – Buryat, AGZ – Aginskaya – Zugalai type, WSM – West Siberian meat, GAP – Gorno Altai – Prikatunsky type, KUL – Kulunda, ZBH – Zabaikalskaya – Khangil type

same level of similarity and difference as interbreed (0.845-0.910). The interbreed difference ranges from 0.707 to 0.968.

The dendrogram of genetic distances of the studied breeds showed that breeds close in origin - West Siberian and Kulunda - formed one cluster, Buubei and Buryat breeds were also included in one cluster. Breeds of the same direction of productivity - Kulunda, Gorno-Altai, Aginskaya (Zugalai type) - form close subclusters, the index of genetic similarity of which is in the range of 0.845-0.903.

Thus, blood group antigens can serve as reliable genetic markers in studying the genetic profile of breeds, monitoring its change under selection pressure.

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ИНФОРМАЦИЯ ОБ АВТОРАХ

(✉)**Гончаренко Г.М.** доктор биологических наук, главный научный сотрудник; **адрес для переписки:** Россия, 630501, Новосибирская область, р.п. Краснообск, а/я 463; e-mail: gal.goncharenko@maiI.ru

Хамируев Т.Н., доцент, кандидат сельскохозяйственных наук, ведущий научный сотрудник

Дашинимаев С.М., кандидат сельскохозяйственных наук, старший научный сотрудник

Хорошилова Т.С., кандидат биологических наук, старший научный сотрудник

Халина О.Л., научный сотрудник

Гришина Н.Б., кандидат биологических наук, старший научный сотрудник

AUTHOR INFORMATION

(✉)**Galina M. Goncharenko,** Doctor of Science in Biology, Head Researcher; **address:** PO Box 463, Krasnoobsk, Novosibirsk region, 630501, Russia; e-mail: gal.goncharenko@maiI.ru

Timur N. Khamiruev, Associate Professor, Candidate of Science in Agriculture, Lead Researcher

Solbon M. Dashinimaev, Candidate of Science in Agriculture, Senior Researcher

Tatyana S. Khoroshilova, Candidate of Science in Biology, Senior Researcher

Olga L. Khalina, Researcher

Natalia B. Grishina, Candidate of Science in Biology, Senior Researcher

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