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Immunogenetic Markers in Selection of Sheep.

Larisa Skorykh[1]*, Ivan Kopylov[1], Nina Efimova[1], Galina Starodubtseva[2], and Vladimir Khainovskii[2]

[1]All-Russian Research Institute of Sheep and Goat Breeding, Address: Stavropol, 15 Zootechnicheskiy Ln, Russia
[2]Stavropol State Agrarian University, Address: Stavropol, 12 Zootechnicheskiy Ln, Russia

ABSTRACT

Improvement of existing, creation of new selection forms of agricultural animals provides for extensive use in the selection process of animals with high genetic potential. Identification of such animals cannot be limited only to phenotypic traits. Stable genetic improvement of herds can provide methods of immunogenetic analysis. Of special interest among both scientists and practitioners is the use of blood groups (erythrocyte antigen factors, polymorphic systems of proteins and enzymes) as genetic markers in solving a number of practical selection issues. Therefore, the purpose of this study was a comparative study of blood groups (erythrocyte antigenic factors) in offspring obtained by crossing different variants of parental selection: ½-thorough-bredness Australian merino x Soviet merino, Australian meat merino x Soviet merino, ½-zhiznosti Australian meat merino x Soviet merino, Soviet Merino x Soviet Merino. The allelefund was studied for erythrocyte antigenic factors of blood groups and its specificity was determined in sheep of different genotypes. It was revealed that the descendants of the cross were more bearers of the marker alleles of meat production, which ensured their superiority in terms of the live weight and average daily increments.
Keywords: genetic markers, genotype, interbreeding, sheep.

Corresponding author

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INTRODUCTION

Sheep breeding is an important branch of the world's productive livestock. Currently, in sheep breeding, the focus is on improving meat production. The effectiveness of sheep breeding largely depends on the identification of the best genotypes and their wide use in practical breeding. Identification of the best animal genotypes will be facilitated by the use in the breeding work of immunogenetic analysis methods that allow monitoring of the genetic situation in populations, herds in the breeding process, to identify genetic markers of sheep productivity at an early age [1, 2].

International experience testifies to the need to use immunogenetic methods in breeding and breeding work, which makes it possible to carry out a sufficiently clear control over the course of the selection process at those stages when existing traditional breeding methods are ineffective (establish originality, mark lines, determine the degree of genetic similarity and differences between breeds). The most widely used as genetic markers were blood groups (erythrocyte antigenic factors) [3, 4, 5, 6]

In the works of scientists [7, 8] the possibility and perspectivity of using immunogenetic analysis methods in livestock breeding is substantiated, since this approach is guaranteed to provide significant cost savings associated with selection, with an effective and guaranteed quality improvement.

Selection and selection, taking into account markers of high productivity, will promote the accumulation of a certain set of genes in the population, and in each herd it is specific and depends on the hereditary characteristics of individual producers having their antigenic spectrum. That is why the association of blood group alleles with the selectable traits is often characteristic only of one or another group of animals. These temporarily established connections should be used in the selection process, giving preference to the descendants of those producers who carry in their genotype the alleles desirable for selection.

Genetic marking on hematopoietic factors allows determining the authenticity of origin, to identify animals with high genetic potential. The information on the genetic spectrum of young animals of different genotypes will make it possible to draw an opinion not only about the specificity of the allelfond of offspring, but also to reveal the degree of influence of each parent on its formation. Therefore, the question of studying the possibility of using immunogenetic methods in practical breeding does not lose its relevance.

MATERIAL AND METHODS

The investigations were carried out in the conditions of the arid zone of the Stavropol Territory in the central part of the region. The object of the study was the young sheep obtained by crossing different variants of parental selection: ½-bloodiness Australian Merino x Soviet merino (1 group), Australian meat merino x Soviet merino (2 group), ½-bloodiness Australian meat merino x Soviet merino (3rd group), Soviet Merino x Soviet Merino (4th group). Immuno genetic testing of young offspring of different genotypes was carried out using monospecific reagents of the Bank of the Immuno genetics Laboratory and DNA Technologies of the All-Russian Research Institute of Sheep and Goat Breeding for six blood group systems (A, B, C, M, R, D), including 14 erythrocyte antigenes (Aa, Ab, Bd, Bb, Be, Ca, R, Cb, Bi, Bg, Da, Ma, Mb, O), the formulation of hemolysis and agglutination reactions, genetic and statistical analysis of the data was carried out according to the developed methods.

RESULTS AND DISCUSSION

Since the allele fund of rocks, populations, herds, because of regularly conducted selection actions, inevitably changes, and the reflection of the processes occurring in the herd is the dynamics of frequency of occurrence of alleles of blood groups, causing their changes, drift, elimination, we studied blood groups of sheep of different breeds and the breeding stock of sheep of the Soviet merino breed.

Immunogenetic testing, the use of hematological tests (hemolysis and agglutination reactions) of the sheep breeds Soviet merino, Australian meat merino, half-breed producers of Australian merino and Australian meat merino, and sheep, whose mother base was made by animals of the Soviet merino, was performed on six blood group systems – A, B, C, M, R, D, with the inclusion of 14 erythrocyte antigens (Aa, Ab, Bd, Bb, Be, Ca, R, Cb, Bi, Bg, Da, Ma, Mb, O).

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Common to the sheep-producers of the rocks studied is the manifestation of polymorphism of antigens in the A, B and C systems.

For the sheep population, the parent base, which was made up of the animals of the Soviet merino, the erythrocyte antigens Aa, Bb, Bd, Be, Bg, Cb, O (0.409-0.585), Ab, Ca (0.240-0.320), antigens Bi, Ma, Mb, R, Da (0.085-0.176) (Figure 1).

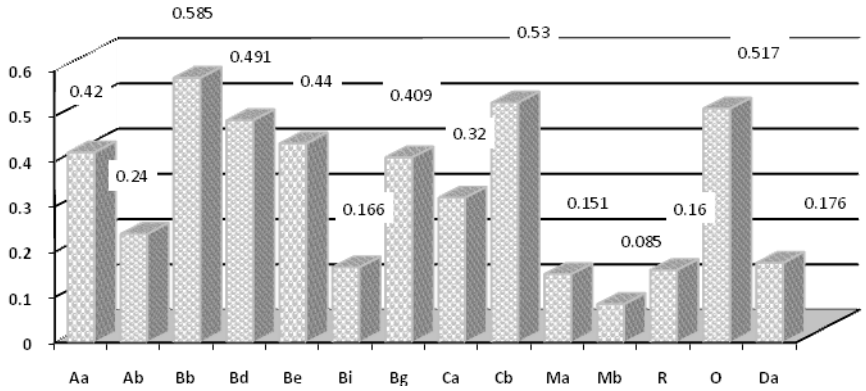

Figure 1: Frequency of occurrence of erythrocyte antigenic factors of blood in the mothers of the breed Soviet merino

However, the amplitude of frequency of occurrence of factors was ambiguous and depended on different genotypes (Table 1).

Table 1: Frequency of occurrence of antigenic factors of blood in sheep of different genotypes

System	Antigens	Group of animals			
		1 group	2 group	3 group	4 group
A	Aa	0.364	0.385	0.378	0.327
	Ab	0.230	0.267	0.247	0.185
B	Bb	0.336	0.417	0.333	0.490
	Bd	0.564	0.667	0.625	0.445
	Bg	0.427	0.583	0.524	0.385
	Be	0.200	0.383	0.243	0.100
	Bi	0.181	0.150	0.186	0.300
C	Ca	0.282	0.308	0.386	0.256
	Cb	0.520	0.567	0.543	0.491
M	Ma	0.120	0.190	0.167	0.100
	Mb	0.091	0.143	0.100	0.060
R	R	0.164	0.175	0.124	0.100
	O	0.464	0.762	0.500	0.480
D	Da	0.091	0.100	0.167	0.100

A – system is represented by antigens Aa and Ab with the superiority of antigen concentration Aa almost twice (0.420);

B – system – five antigens Bb, Bd, Be, Bi, Bg with growing concentration of Bb (0.585), Bd (0.491), Be (0.440), Bg (0.409) antigens;

C – system – two antigens of Ca and Cb, with a high concentration of Cb (0.530) factor;

R – system – by two erythrocyte factors – R and O with the superiority of the concentration of antigen O (0.517) by almost three times;

D – system – one antigen Da, having a low concentration (0.176);

M – system – two erythrocyte factors Ma and Mb, the concentration of which was lower (0.151, 0.085) than other erythrocyte antigens.

Immunogenetic testing revealed the presence of 14 erythrocyte factors (Aa, Ab, Bd, Bb, Be, Ca, R, Cb, Bi, Bg, Da, Ma, Mb, O) in six genetic systems – A, B, C, M, R, D – in the sheep of the genotypes under consideration.

Comparative analysis of the antigen spectrum for blood groups of lambs of different genotypes established its generality for all groups of animals, expressed in a high concentration of factors Bd (0.445-0.667), Cb (0.491-0.567), O (0.400-0.762), average incidence Aa (0.327-0,385), Ca (0,256-0,386) antigens, lesser Ab (0.185-0.267), Ma (0.100-0.190), R (0.100-0.175), Mb (0.060-0.143) and Da (0.091-0.167) – factors.

It was established that for the hybrid lambs of the ½-genotype genotype, the Australian merino-Soviet merino (group 1) is characterized by high incidence of antigenic factors Bd and Cb (0.564, 0.520), the average concentration of factors Aa, Bb, Bg, O (0.385, 0.336, 0.427, 0.464), low Ab, Be, Bi, Ma and R (0.230, 0.200, 0.181, 0.120, 0.164) antigens. The Mb and Da antigens (0.091, 0.091) were the least widely distributed among the youngsters of the genotype under study.

Antigenic spectrum of erythrocytes of the lambs of the genotype Australian australian merino x Soviet merino (group 2), expressed in a sufficiently high incidence of O antigen (0.762).

In the system – A for factor Aa, the average frequency of occurrence (0.385), antigen Ab – low frequency of occurrence (0.267) is characteristic.

In the system – B antigens (0.667) and Bg (0.583), were more common than Bb (0.417), Be (0.383) antigens among the animals of the genotype under consideration.

In system C, Cb antigen had a high frequency of occurrence (0.567), Ca antigen – the average frequency of occurrence (0.308).

The system – M is characterized by the presence of two antigens – Ma and Mb, whose concentration in the blood of the sheep of group 2 was low and amounted to (0.190, 0.143).

In the R system, the R antigen concentration was 0.175, and Da was 0.100 in the blood of the offspring of the genotype under consideration.

In descendants of the ½-thorough-bredness genotype, the Australian meat merino and Soviet merino (group 3) in the A-system, both antigens Aa and Ab had a similar distribution (0.378, 0.247).

In the most polymorphic B-system, the factors Bd and Bg (0.625, 0.524), and rarely, but with a uniform distribution, were the factors Bb, Be (0.333, 0.243).

In the C system, a high incidence rate (0.543) is characteristic of the Cb antigen.

In the system – M, the presence of two blood groups – Ma and Mb – was determined. The concentration of Mb factor was 0.167, and the factor Ma was 0.100.

In the system – R, two antigenic factors were found. The concentration of antigen O was high and amounted to 0.500, and R low – 0.124.

In the system – D, the positivity of the Da antigen in the blood of the descendants of group 3 was expressed in a concentration of 0.167.

In the blood of purebred sheep of the Soviet merino breed (group 4), a high incidence of antigens of blood groups Bb, Bd, Cb, O (0.490, 0.445, 0.491, 0.480) was found. The concentration of antigens Aa, Bg, Bi, in the blood of the lambs studied was medium (0.327, 0.385, 0.300). In contrast, carriers of Ab, Be, Ca, Ma, R, Da (0.185, 0.100, 0.256, 0.100, 0.100, 0.100) antigens were much less likely to be detected among the animals of the genotype under study. The concentration of Mb factor was lower (0.060) than the rest of the erythrocyte antigens.

A comparative analysis of the genetic spectrum of the maternal basis of the Soviet merino breed and the offspring of different genotypes revealed an uneven distribution of antigens. It was established that purebred animals of the Soviet merino breed (group 4) differed in the frequency of occurrence of two factors – Be and Bi. However, the descendants of the genotype ½-bloodiness of the Australian merino-Soviet merino (group 1) differed in the distribution of the three factors – Bb, Be, Da. The crossed animals of the genotype ½-bloodiness of the Australian meat merino-Soviet merino (group 3) also differed in the concentration of three factors – Bb, Bd, Bg. While for the lambs of the genotype, the Australian meat merino-Soviet merino (group 2) was characterized by the frequency of occurrence of four factors – Bb, Bd, Bg, O.

It was found that the factors Aa, Ab, Bg, Ca, Cb, Ma, Mb, R had a similar distribution both among the ewes and among the offspring obtained from different variants of crossing.

In analyzing the test data of sheep of different genotypes for polymorphic systems, the Australian merino x Soviet merino smear has a high incidence of alleles A and D of the transferrin locus (0.350, 0.417), hemoglobin and serum aryl esterase (0.905, 0.770), C – alkaline phosphatase (0.515), the average frequency of occurrence of the allele of H – serum aryl esterase (0.230), but low – the allele B and C of the transferrin locus (0.162 and 0.071, respectively), A – hemoglobin (0.095), which phenotypically manifested in a high concentration of phenotype AD transferrin locus (63.6%), BB – hemoglobin (72.0%), HB –arilesterazy serum (65.0%), BC – alkaline phosphatase (63.6%). In this group of sheep, an E allele of the transferrin locus and A – alkaline phosphatase was not found.

In the blood of hybrid genotypes, the Australian meat merinos of Soviet merino showed a high incidence of alleles A and D of the transferrin locus (0.375, 0.420), B – hemoglobin (0.917), serum arylesterase (0.833) and alkaline phosphatase (0.542), the average frequency of occurrence of allele B locus of transferrin (0.205) and low – of the A locus of hemoglobin (0.083), of H – serum arylesterase (0.167). Phenotypically, this was manifested in the high incidence of phenotypes of the AD locus of transferrin (58.3%), BB – hemoglobin (80.0%), HB – arylesterase (83.3%), BC – alkaline phosphatase (70.8%). Alleles E and C of the transferrin locus, allele A – alkaline phosphatase were not detected in this group of animals.

For descendants of the ½-genotype genotype, the Australian meat merino-soviet merino has a high incidence of alleles A and D of the transferrin locus (0.384, 0.438), B – loci of hemoglobin, arylesterase and alkaline phosphatase (0.910, 0.790, 0.667), a low B transferrin (0.178), A hemoglobin locus (0.090), H – serum aryl esterase (0.210), which phenotypically manifested itself in a high concentration of phenotypes of the AD transferrin locus (62.0%), BB hemoglobin (85.7%), HB locus serum aryl esterase (76.2%), BC – alkaline phosphatase (57.1%). Alleles E and C of the transferrin locus, allele A – alkaline phosphatase were not detected in this group of animals.

In the blood of purebred animals, Soviet merino, a high incidence of alleles A and D of the transferrin locus (0.345, 0.397), B – hemoglobin (0.883), serum aryl esterase (0.750), B and C, and alkaline phosphatase (0.525 and 0.475, respectively) the incidence of allele B in the transferrin locus (0.258), H serum aryl esterase (0.250) and low in the A locus of hemoglobin (0.117). Phenotypically, this was manifested in a high incidence of phenotypes of the AD locus of transferrin (57.1%), BB – hemoglobin (86.0%), HB – arylesterase (71.4%), BC – alkaline phosphatase (72.0%). Alleles E and C of the transferrin locus, allele A – alkaline phosphatase were not detected in this genotype.

Since earlier genetic markers with high living weight – Bd, Mb antigens were identified, we were interested in the conjugation of marker alleles with meat productivity in descendants of different genotypes.

When examining the meat alleles of meat production among the animals studied, it was established that in the blood of hybrid lambs of the genotypes of ½-bloodiness, the Australian merino x Soviet merino (1st

group), Australian meat merino x Soviet merino (group 2), ½-bloodiness Australian meat merino x Soviet merino (Group 3) the concentration of Bd and Mb factors was higher and amounted to 10.0-66.7%; lower – in purebred animals breeds of Soviet merino (44.5 and 6.0%). The presence of marker alleles ensured the superiority of crossed animals of Groups 1, 2 and 3 over purebred contemporaries in terms of live weight by 4.8, 13.3, and 7.6%, which was reflected in the value of the average daily growth from birth to 4 months, amounting to 159.7; 173.2 and 163.3 g respectively.

Among the genotypes studied, the best results were typical for the sheep's offspring Australian meat merino of varying degrees of bloodiness. The revealed regularity testifies that the descendant descendants, especially from the rams, the Australian meat merino, were to a greater extent carriers of marker alleles of meat productivity.

CONCLUSION

Summarizing the results obtained, it can be concluded that the revealed intra-breed differences in the study of the breeding stock are indicative of the individual orientation and specificity of the genetic processes that ensure the biodiversity of the sheep population of the Soviet merino sheep. Identified antigenic factors can be used as a genetic markers that control the change of genetic structures due to the effect of squeezing and implementing the selection of the optimal variants of parent couples for obtaining offspring with high genetic potential.

To increase the number of Soviet sheep in the population of sheep with the desired genotypes, the most valuable for selection, it is advisable to select parental pairs, taking into account the presence of Bd, Mb genetic markers.

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