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RESEARCH ARTICLE

Genetic Methods for Increasing Animal Productivity

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ABSTRACT

The intensification of livestock production can be achieved through several approaches, including the efficient and rational use of technological and material resources, as well as scientifically grounded breeding practices within local populations. Modern biotechnological and genetic methods make it possible to obtain unique genotypes that ensure high productivity, disease resistance, and a reduced genetic load. In this regard, the dissemination of positive results from the application of genetic methods in breeding is highly relevant. The aim of the study was to apply genetic and breeding evaluation methods in animals, to identify their relationships with productivity traits, and to implement the most effective approaches in practical farm operations. DNA diagnostics were performed on 150 daughters of Holstein sires at the agricultural production cooperative "Kolos" in the Matveyevo-Kurgan district of the Rostov region. Polymorphism of the prolactin gene and milk productivity were studied in Ayrshire cows at JSC named after Lenin in the Tsimlyansk district of the Rostov region. Genetic methods represent a powerful tool for improving traditional breeding practices; in particular, genetic mapping is essential for monitoring and managing risks associated with the spread of genetic defects. At the breeding farm APC "Kolos" of the Matveyevo-Kurgan district in the Rostov region, DNA diagnostics of daughters of breeding sires revealed the presence of certain genetic anomalies, enabling adjustments in mating selection. A comparative analysis of sire evaluation methods was conducted, including Interbull MACE based on indices and evaluation based on the performance of daughters and contemporaries. For the first time, data on prolactin gene polymorphism were obtained in the Ayrshire population bred at JSC named after Lenin in the Tsimlyansk district of the Rostov region. A high frequency of allele A was observed, with the majority of the population carrying the PRL_AA genotype associated with high milk productivity. The highest milk yield was recorded in cows with the GHCG PRLAA genotype (8254.80 kg), which is 1.66% and 0.4% higher than that of carriers of the GHCC PRLAA and GHCC PRLBB genotypes, respectively.

INTRODUCTION

Animal husbandry is one of the most important sectors of the agro-industrial complex of Russia, providing the population with food products and processing enterprises with raw materials. The production of livestock products can be increased through the competent and efficient use of technological and material resources of enterprises, as well as through properly organized, scientifically grounded breeding and selection work in local populations. [3, pp. 3–5; 9, pp. 2–6; 11, pp. 224–226]

Modern methods of animal improvement make it possible to obtain unique genotypes that ensure high productivity, viability, disease resistance, adaptability to environmental conditions, and a low "genetic load." However, to achieve positive breeding results, it is necessary to understand the appropriate tools that enable effective selection, prediction, and evaluation of animals. In this regard, the dissemination of experience in applying advances in genetics is relevant, as it allows

control over animal heredity, modification of productivity through the justified selection of superior individuals with desirable genes, and the pairing of animals for reproduction. [1, pp. 5–7; 3, pp. 10–15; 5, pp. 20–25]

The aim of the study was to apply genetic and breeding methods for animal evaluation, identify relationships with productivity indicators, and implement effective approaches in practical enterprise operations.

The objectives of the study included identifying the carriage of fertility haplotypes in daughters of Holstein bulls based on genetic analysis data; conducting a comparative analysis of Holstein bulls based on indices and actual productivity of their daughters; and demonstrating the use of genetic markers in dairy cattle breeding by identifying desirable allelic variants and genotypes of the prolactin gene in a herd of Ayrshire cows.

MATERIALS AND METHODS

The research was carried out within the framework of the research plan of FSBEI HE "Don State Agrarian University" for 2021–2025 on the topic "Development of methods for increasing the genetic potential of dairy and beef cattle in farms of various ownership forms," in accordance with the "Strategy for the socio-economic development of the Rostov region up to 2025." Experimental studies were conducted on Holstein cattle in the agricultural production cooperative "Kolos" of the Matveyevo-Kurgan district and on Ayrshire cows at JSC named after Lenin in the Tsimlyansk district of the Rostov region. Artificial insemination was performed using semen from breeding bulls with genomic evaluation, obtained from FSUE CSIO "Moskovskoye," LLC "Genetika Yug," and LLC "Alta Genetics."

Genetic analysis of Holstein bulls was carried out on 396 daughters; the daughters were evaluated based on the fertility index, calving ease, lifetime profit index, and productive longevity. For molecular genetic studies, blood samples were collected from 300 Ayrshire cows and analyzed in the molecular genetics laboratory of FSBEI HE "Don State Agrarian University." DNA was extracted from blood samples according to standard manufacturer protocols. Genotyping of 300 first-calf Ayrshire cows for the PRL gene was performed using the PCR-RFLP method (restriction fragment length polymorphism) in a total reaction volume of 20 μL, using specific nucleotide sequences (primers) synthesized by the research and production laboratory "Syntol" (Moscow). Visualization of electropherograms for the PRL gene and restriction analysis were carried out using the restriction endonuclease RsaI.

Milk yield was determined based on the results of monthly test milkings. The fat content in milk was measured using a "LAKTAN 1-4" milk analyzer. Zootechnical and breeding records at the farm were maintained using the information-analytical system "SELEX" (developer LLC "RC PLINOR"). Data processing was performed using statistical and mathematical methods implemented in Microsoft Excel.

RESULTS AND DISCUSSION

According to the Board of the Eurasian Economic Commission, 14 haplotypes in Holstein and Holsteinized cattle are recommended for study. Of particular interest are lethal mutations such as complex vertebral malformation (CVM), bovine leukocyte adhesion deficiency (BLAD), and brachyspina syndrome (BY), which cause significant economic losses (Zinovieva N.A.; Schutz E.; Segelke D.H.; Utami M.) [4, 9, 10, 16].

Based on the above, the aim of our study was to analyze information on the haplotypes of daughters of Holstein breeding bulls whose semen is used in the breeding farm SPK "Kolos" of the Matveyevo-Kurgan district of the Rostov region. Genomic passports of the breeding bulls provided by semen suppliers (FSUE CSIO "Moskovskoye," LLC "Genetika Yug," LLC "Alta Genetics") confirmed the absence of carrier status for recessive mutations. A total of 396 daughters were obtained from breeding bulls, of which 150 were subjected to genetic analysis in the molecular genetics laboratory of JSC "Agroplem" (Moscow, license No. 012345). The study revealed BLAD carrier status in six daughters obtained from five bulls: Alta-Olaf HO840003150701313 – 2, Break-Even HO840003209641335 – 1, Fortnite HO840003200824963 – 1, Alta-Tarnkey HO840003129128746 – 1, and Lightap HO840003200824460 – 1, belonging to the Wis Back Ideal

line. One daughter of the bull Alta-Olaf HO840003150701313 was identified as a carrier of BY. HCD carrier status was detected in the daughter of the bull Davaine-Pi HO840003206094039 and in the daughter of the bull Alta-Olaf HO840003150701313 of the Wis Back Ideal line. Two carriers of CVM were identified among the daughters of the bull SED 3141657461 of the Wis Back Ideal line. Carrier status of haplotype HH3 was detected in four daughters of the bulls VH Seo 770893000 (line Reflection Sovereign), Alta-Olaf HO840003150701313, Fortnite HO840003200824963, and Alta-Tarnkey HO840003129128746 (line Wis Back Ideal). Three carriers of HH5 were identified among the daughters of the bull Alta-Tarnkey HO840003129128746. The obtained results made it possible to adjust mating programs in the herd.

It should be noted that the Holstein breed is an international breed, and some researchers (Wu X.; Mesbah-Uddin M.; Guldbrandtsen B.; Lund M.S.; Sahana G.) indicate that national subpopulations of this breed differ in genetic load due to specific features of breeding practices [19, pp. 413–419].

The importance of analyzing the genetic structure of herds under specific farm conditions and identifying the selection pressure of sires on shifts in average productivity values remains relevant. Russian researchers such as Zhekamukhov M.Kh., Petrukhina L.L., Belozertseva S.L., Kuznetsov A.I., Denisenko L.V., Kuznetsov N.A., Rusanov A.N., Aisanov Z.M., Lepekhina T.V., Kosyachenko N.M., and others emphasize that foreign genetic resources have been widely used in the Russian Federation over the past 25–30 years. However, no significant progress in the genetic improvement of specific herds has been observed [3, pp. 16–25; 6, pp. 12–19; 9, pp. 2–6].

In our opinion, this is largely due to the complexity of evaluating bulls within the reproductive systems of specific herds across different regions of the country. For a long time, bulls and semen products were supplied to the domestic market from the USA and Canada [2; 4, pp. 35–39]. In this context, a comparative analysis of genomic evaluation and the realized performance of daughters of Holstein bulls was carried out in the breeding farm SPK “Kolos” of the Matveyevo-Kurgan district of the Rostov region. The farm uses semen from Holstein bulls of two lines: the Wis Back Ideal line and the Reflection Sovereign line. All bulls have a genetic evaluation (a prediction developed by Holstein Association USA) under the Interbull MACE system [10]. The daughters of these bulls were evaluated in the molecular genetics laboratory of JSC “Agroplem” to obtain genomic passports. A comparative analysis of daughter productivity was carried out based on the most significant indices. The results are presented in Table 1.

Table 1: Genetic evaluation of breeding bulls according to the Interbull MACE system

Sire ID	**Genetic evaluation**					
	NMS	PTAM	**Sire ID**	**Genetic evaluation**	SCS	PL
Wis Back Ideal line						
Alta Tarkey 3129128746	335,55 ±11,04	118,44 ±40,11	0,10 ±0,007	0,03 ±0,002	2,91 ±0,01	1,29 ±0,09
Alta Olaf 3150701313	487,25 ±16,00	910,18 ±60,42	-0,02 ±0,010	-0,002 ±0,004	2,9 ±0,01	3,96 ±0,13
Fortnite 3200824963	355,26 ±23,27	191,10 ±64,36	0,09 ±0,008	0,03 ±0,004	2,84 ±0,01	2,20 ±0,17
Break-Even 3209641335	518,33 ±21,20	862,12 ±76,33	-0,006 ±0,001	0,03 ±0,004	2,93 ±0,02	3,43 ±0,19
Alta Admiral 3014562353	203,90 ±54,61	305,50 ±201,70	0 ±0,02	0,014 ±0,012	2,98 ±0,03	2,02 ±0,45
Reflection Sovereign line						
Dandy 314282288	368,51 ±17,20	-6,37 ±19,2	0,10 ±0,009	0,05 ±0,004	2,89 ±0,01	2,77 ±0,15
Rodeo 3138919647	271,70 ±26,37	690,40 ±121,73	0,011 ±0,016	0,007 ±0,010	2,91 ±0,03	0,79 ±0,36
VH Finish 260952	253,60 ±27,68	586,35 ±83,01	0,002 ±0,017	0,002 ±0,010	2,93 ±0,06	1,65 ±0,39
Beyond	129,60 ±28,99	199,30 ±80,78	-0,02 ±0,022	-0,005 ±0,0093	2,87 ±0,027	1,55 ±0,42
Alta Cary 3129128894	282,40 ±19,29	569,47 ±66,14	0,004 ±0,011	0,003 ±0,004	2,91 ±0,01	2,24 ±0,13

Note: NM$ – net merit index; PTAM – predicted transmitting ability for milk yield (lb); PTAF – predicted transmitting ability for fat; PTAP – predicted transmitting ability for protein; SCS – somatic cell score; PL – productive life (months*).*

At present, the 2024 US base is used: milk yield 11,583 kg, fat 444 kg (≈3.83%), protein 366 kg (≈3.16%), PL = 0, and SCS = 3 points (62 thousand cells/mL). [6, pp. 35–39; 18, pp. 32–34]

According to the predicted values, daughters of the bull Alta Olaf 3150701313 show an increase of 910 lb, or 413.14 kg, of milk relative to the base, with a decrease in fat content of 0.02% and protein content of 0.002%. A similar prediction is observed for the bull Break-Even 3209641335: a positive effect on milk yield of daughters (+862.12 pounds or +391.40 kg) and protein content (+0.03%), but a negative effect on milk fat content (−0.006%). The productive life of daughters is expected to be longer by 3.43 months. [16, pp. 46–53] The prediction for the bull Fortnite 3200824963 is generally positive: milk yield increases by 191.10 lb, or 86.75 kg, fat content by 0.09%, protein content by 0.03%, and productive life by 2.2 months compared to the base.

Significant individual variation in productivity indicators was observed among daughters of different bulls. For example, the daughter No. 1901 of the bull Alta Olaf 3150701313 ranks first in the net merit index, but ranks 30th in milk yield index, 4th in fat yield index (kg), 14th in protein yield index (kg), and 3rd in productive life index. Daughter No. 1856 ranks first in the milk yield index, but ranks 11th in the net merit index, 28th in fat yield index (kg), 27th in protein yield index (kg), and 29th in productive life index. A positive prediction for milk fat content was observed only in the daughters of the bull Break-Even 3209641335. A positive prediction for milk protein content was also observed in the daughters of the bull Break-Even.

A similar evaluation was carried out for daughters of bulls of the Reflection Sovereign line, which made it possible to identify the top 20 daughters based on indices. Daughters of the bull Dandy 2288 showed high rankings in net merit index, milk yield index, and productive life index. Daughters of the bull Beyond 0987 showed high rankings in net merit index and milk yield index. Based on these approaches, trends in key economically important traits at this dairy enterprise were identified, allowing informed decisions regarding further breeding activities. [8, pp. 4–8]

However, the obtained data on the productivity level of daughters of bulls are difficult to interpret at the level of a specific farm or region. Therefore, the evaluation was carried out based on the actual data obtained for each daughter. The analysis of milk productivity indicators of daughters by lactation is presented in Table 2.

Table 2: Distribution of daughters by lactation number and milk productivity

Name, sire ID	Number of lactations	Milk yield, kg	Fat content in milk		Protein content in milk	
			%	kg	%	kg
Wis Back Ideal line						
Alta Tarnkey 3129128746	1	9755,58	3,91	381,44	3,31	322,90
	2	10515,30	3,94	414,30	3,34	351,21
	3	11003,04	3,96	435,72	3,34	367,50
	4	11192,13	3,96	443,20	3,33	372,69
	5	11767,05	3,95	464,79	3,32	390,66
Alta Admiral 3014562353	1	10062,06	3,95	397,45	3,35	337,07
	2	11094,31	3,95	438,22	3,35	371,65
	3	12204,00	4,10	500,36	3,34	407,61
	4	13004,00	4,00	520,16	3,34	434,33
Break-Even 3209641335	1	9575,58	3,98	381,11	3,44	329,39
	2	10644,08	3,97	422,57	3,65	388,51
	3	10967,00	4,30	471,58	3,40	372,88
	4	11195,00	4,30	481,38	3,30	369,43
Fortnite 3200824963	1	9468,57	3,91	370,22	3,35	317,19
	2	10068,86	3,87	389,66	3,35	337,31
	3	12012,00	3,89	467,26	3,28	393,99
	4	13770,00	3,83	527,39	3,28	451,65
Alta Olaf 1313	1	9640,97	3,92	377,92	3,30	318,10
	2	10103,09	3,97	401,09	3,33	336,43
	3	10210,00	4,20	428,82	3,34	341,01
	4	10416,00	4,20	437,47	3,33	346,85
Average for the line	1	9761,77 ±74,90	3,92 ±0,007	382,63 ±0,17	3,33 ±0,008	325,06 ±0,15
	2	10558,33 ±111,49	3,94 ±0,01	415,99 ±0,24	3,38 ±0,016	356,87 ±0,32
	3	11131,60 ±208,21	3,99 ±0,02	444,12 ±0,26	3,33 ±0,006	370,66 ±0,25
	4	11417,80	3,98	454,39	3,32	379,04

Name, sire ID	**Number of lactations**	**Milk yield, kg**	**Fat content in milk**		**Protein content in milk**	
			%	kg	%	kg
		±120,31	±0,02	±0,20	±0,007	±0,27
	5	11767,10 ±234,40	3,95 ±0,03	464,79 ±0,37	3,32 ±0,006	390,66 ±0,25
Reflection Sovereign line						
Dandy 2288	1	10421,36	3,97	413,73	3,30	343,90
	2	11747,25	3,93	461,67	3,29	386,48
	3	12012,20	3,97	476,88	3,29	395,20
	4	12076,33	3,95	477,01	3,28	396,10
Rodeo 6947	1	10161,22	3,89	395,27	3,27	332,27
	2	10980,64	3,88	426,05	3,27	359,06
	3	11482,20	3,89	446,65	3,26	374,32
VH Finish 260952	1	9984,47	4,11	410,36	3,30	329,48
	2	10641,17	4,08	434,16	3,30	351,15
	3	11230,80	4,05	454,85	3,31	371,73
Beyond 0987	1	10286,47	4,0	411,45	3,23	332,25
	2	10792,50	3,96	427,38	3,28	353,99
	3	10892,55	3,95	430,25	3,18	346,38
Alta Cary 8894	1	10177,47	3,92	398,95	3,27	332,80
	2	11230,50	3,90	437,98	3,27	367,23
	3	11097,50	3,90	432,80	3,27	362,88
	4	11654,63	3,92	456,86	3,27	381,10
Average for the line	*1*	10201,04 ±53,74	3,97 ±0,02	404,87 ±2,39	3,27 ±0,006	333,75 ±1,94
	2	11035,63 ±92,52	3,95 ±0,022	435,09 ±3,50	3,28 ±0,006	361,97 ±3,17
	3	11416,39 ±100,52	3,95 ±0,02	450,32 ±4,36	3,28 ±0,005	374,85 ±3,27
	4	11769,64 ±158,77	3,93 ±0,04	462,49 ±7,84	3,28 ±0,005	385,52 ±5,27
Herd average	*1*	8891,40	3,92	348,50	3,30	293,40
	2	9224,00	3,84	354,2	3,33	307,20
	3	9605,20	3,84	368,80	3,33	319,80
	4	9419,50	3,87	357,50	3,32	307,10
	5	10541,10	3,90	411,10	3,28	345,75

Note: The herd average values are based on the 2024 bonitation results.

Daughters of bulls of the Reflection Sovereign line outperformed daughters of the Wis Back Ideal line, as well as herd average values, both at the line level and for individual sires. Thus, in the first lactation, daughters of bulls of the Reflection Sovereign line exceeded herd averages by 1309.64 kg and their contemporaries of the Wis Back Ideal line by 439.27 kg in milk yield, by 56.37 kg and 22.24 kg in milk fat, and by 40.35 kg and 8.69 kg in milk protein, respectively. In the Wis Back Ideal line, daughters of the bull Alta Tarnkey 3129128746 were characterized by a long productive lifespan of 5 lactations, with high productivity indicators: 11,767.05 kg of milk yield over 305 days of lactation, 464.79 kg of milk fat, and 390.66 kg of milk protein.

The realized genetic influence of bulls on herd productivity was expressed through absolute and relative differences between daughters of bulls, their contemporaries, and herd averages; the results are presented in Table 3 below.

Table 3: Breeding value of breeding bulls

Name, sire ID	**Breeding value**	**Milk yield, kg**	**Fat content in milk**		**Protein content in milk**	
			%	kg	%	kg
Wis Back Ideal line						
Alta Tarnkey 3129128746	A	26,85	-0,043	-2,27	-0,05	-21,01
	O	864,18	-0,01	32,94	0,01	29,50
	P	100,71	99,24	99,94	98,51	99,22
Alta Admiral 3014562353	A	431,01	0,018	123,32	0,001	14,56
	O	1170,7	0,03	48,92	0,05	43,67
	P	104,70	100,51	105,24	100,00	104,71
Break-Even 3209641335	A	-187,34	0,05	-2,32	0,11	4,15
	O	684,18	0,06	32,61	0,14	35,99
	P	98,39	101,47	99,83	103,38	101,72
Fortnite 3200824963	A	-278,53	-0,03	-13,64	0,01	-8,60
	O	577,17	-0,01	21,72	0,05	23,79
	P	97,03	99,24	96,29	100,00	97,04
Alta Olaf 1313	A	-108,47	-0,02	-6,13	-0,06	-9,42
	O	749,57	0	29,42	0	24,7
	P	99,23	99,56	98,79	98,14	97,39

Reflection Sovereign line						
Dandy 2288	A	266,36	0	10,96	0,03	12,07
	O	-176,75	0,05	65,23	0	50,50
	P	102,65	99,75	102,41	100,99	103,68
Rodeo 6947	A	37,50	-0,10	-12,80	-0,01	-2,70
	O	1269,82	-0,03	46,77	-0,03	38,87
	P	99,45	97,25	96,73	99,85	99,30
VH Finish 260952	A	-189,96	0,17	6,08	0,03	-5,70
	O	1093,07	0,19	61,88	0	-3,32
	P	97,30	104,18	101,36	100,99	98,26
Beyond 0987	A	43,43	0,02	6,49	-0,06	-2,29
	O	1395,07	0,08	62,95	-0,07	38,85
	P	100,99	100,69	101,70	98,33	99,29
Alta Cary 8894	A	-40,06	-0,06	-7,62	-0,01	-1,88
	O	1286,1	0	50,45	-0,03	39,40
	P	99,65	98,18	97,85	98,63	99,50

Note: A – absolute breeding value of the bull (difference between daughters (D) and contemporaries (C), expressed per effective daughter of the bull), expressed in units of the trait; O – absolute breeding value of the bull as the difference between daughters (D) and the herd average, expressed in units of the trait; P – relative breeding value of the sire (D/C) × 100, expressed as a percentage.

It was established that daughters of the bull Alta Admiral exceeded herd average values in milk yield by 1170.7 kg, in milk fat content by 48.92 kg, and in protein content by 43.67 kg. The relative breeding value of the sire exceeded 100% for all indicators. Daughters of the bull Break-Even were characterized by high fat and protein content in milk. The relative breeding value of the sire was 101% for milk fat content and 103% for protein content.

It should be emphasized that determining the breeding value of animals based on quantitative traits is a complex task, since these traits are governed by polygenic inheritance, complex segregation, and gene recombination. [11, pp. 9–13; 13, pp. 22–27; 15, pp. 303–307; 12, pp. 94–100; 20, pp. 355–366]

In this regard, the use of genetic markers of the prolactin gene in dairy cattle breeding is of particular importance. Using the PCR-RFLP method, A and B allelic variants of the PRL gene were identified in Ayrshire cows, and the genotypes present in the studied population were determined. The frequency of alleles A and B of the prolactin gene was 0.90 and 0.10, respectively. Our data on the frequency of occurrence of different genotypes and alleles of the PRL gene are consistent with the findings of several authors, indicating that a high frequency of allele A of the PRL gene is observed in many dairy cattle breeds and ranges from 0.524 to 1.00. [21, pp. 1–15] Russian researchers have shown that rare breeds have a lower frequency of allele A, at 0.690 and 0.650, respectively. Studies by M.A. Leonova, L.V. Getmantseva, and A.V. Usatov on the genetic structure of Red Steppe cows for the prolactin gene identified AA, AG, and GG genotypes with frequencies of 6.3%, 31.2%, and 62.5%, respectively. Pozovnikova M.V., Serdyuk G.N., Pogorelsky I.A., and Tulinov O.V. found that cows with different genotypes differ in productivity. [7, pp. 37–39; 13, pp. 22–27; 14, pp. 8–12; 20, pp. 355–366; 21, pp. 1–15]

Based on the obtained results, groups of animals were formed according to the identified PRL gene genotypes, and first-calf Ayrshire cows were evaluated for milk productivity. The results are presented in Figure 1.

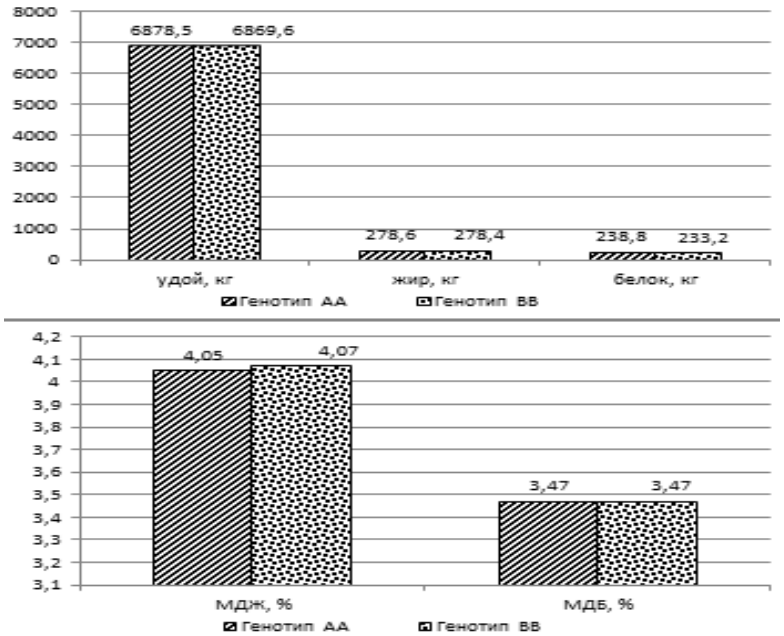

Figure 1: Milk productivity of Ayrshire cows with different PRL gene genotypes.

[milk yield, kg; fat, kg; protein, kg; genotype AA; genotype BB; milk fat, %; genotype AA; genotype BB; milk protein, %]

The average milk yield per lactation in the group of cows with the PRL_AA genotype was 6878.5 kg, and for PRL_BB – 6869.63 kg. Cows with the PRL_BB genotype yielded 8.87 kg less milk than their counterparts with the PRL_AA genotype. The fat content in milk ranged from 4.05% in PRL_AA to 4.07% in PRL_BB. A higher amount of protein in milk per lactation was characteristic of animals with the PRL_AA genotype, exceeding PRL_BB by 5.58 kg. To increase the proportion of animals with A/A and A/B genotypes in the population, it is necessary to select and assign breeding bulls with the A/A genotype for the PRL gene.

Thus, it was established that new genetic approaches and traditional breeding methods make it possible to use valuable genetic material from highly productive sires to improve dairy cattle in specific enterprises and regions of the country. [17, pp. 70–76]

The calculated indicators of economic efficiency of milk production from cows with different genotypes for the GH and PRL genes showed that the highest amount of milk of standard fat content was produced by animals with the genotype combination GHCG PRLAA – 8254.80 kg, while the cost of producing 1 kg of milk was 22.50 RUB. The increase in production in cows with the GHCG PRLAA genotype combination amounted to 136.76 kg and 31.45 kg, respectively, which is 1.66% and 0.4% higher than in carriers of homozygous alleles GHCC PRLAA and GHCC PRLBB genotypes. The cost of milk production was 185,745.8 RUB. Revenue from milk sales per cow with the GHCG PRLAA genotype amounted to 251 thousand RUB, and profit was 65,913.44 RUB per year.

CONCLUSION

The obtained research results demonstrate that genetic methods are a unique tool for improving traditional breeding practices through the rapid dissemination of superior genotypes within a population. In particular, genetic mapping should be considered as a tool for monitoring and managing risks associated with the spread of genetic defects in a specific breeding population. For the first time in the Rostov region, using the example of the breeding farm SPK “Kolos” of the Matveyevo-Kurgan district, DNA diagnostics of daughters of breeding bulls was carried out, along with a comparative analysis of bull evaluation using different methods: the Interbull-MACE system based on indices, progeny testing based on daughters and contemporaries, and herd average productivity.

For the first time, in the Ayrshire population bred at JSC named after Lenin in the Tsimlyansk district of the Rostov region, data were obtained on the presence of prolactin gene polymorphism

and the genetic structure of the population. The PRL_AA genotype associated with high milk productivity was identified. The increase in main production in cows with the genotype combination GHCG PRLAA amounted to 136.76 kg and 31.45 kg, which is 1.66% and 0.4% higher than in carriers of homozygous alleles GH^{CC} PRL^{AA} and GH^{CC} PRL^{BB} genotypes.

Ethics Committee Statement

The study was conducted in accordance with Directive 2010/63/EU on the protection of animals used for scientific purposes. The acquired scientific knowledge and practical activities are aimed at preventing animal diseases and ensuring the production of safe and high-quality animal products in compliance with the requirements set out in the Law of the Russian Federation No. 4979-1 of 14 May 1993 (as amended on 29 December 2025) "On Veterinary Medicine." During the research, officially accepted methods of breeding record-keeping, identification, productivity control, assessment of breeding value, and distribution of breeding products were applied in accordance with the regulations governing pedigree livestock breeding, "Types of organizations engaged in pedigree livestock breeding activities."

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