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СОВЕРШЕНСТВОВАНИЕ КРАСНОГО СТЕПНОГО СКОТА ГЕНОФОНДОМ ГОЛШТИНСКОЙ ПОРОДЫ

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Представлены результаты сравнительной оценки продуктивности, воспроизводительной способности и рентабельности производства молока при использовании коров красной степной породы и помесей разной кровности по голштинской породе красно-пестрой масти. Исследования хозяйственно полезных признаков и рентабельности проводились в 2019–2022 гг. Объектом исследований являлись представительницы красной степной породы (контроль), помеси с 50% (1-я опытная группа) и 75% крови голштинов красно-пестрой масти (2-я опытная группа). По величине удоя установлено превосходство помесных первотелок над сверстницами красной степной породы, которое за 1-ю лактацию составило 605–673 кг ($p > 0,999$), за 2-ю – 714–788 кг ($p > 0,999$), за 3-ю – 817–868 кг ($p > 0,999$). Наибольшим коэффициентом молочности характеризовались голштинские помеси F_1 и F_2 (9,4–9,7 кг), преимущество которых в среднем за все лактации варьировало в пределах 0,9–1,2 кг ($p > 0,95–0,99$). Во все анализируемые сервис-периоды наибольшую оплодотворяемость после первого осеменения демонстрировали животные красной степной породы, в результате чего затраты семени в их случае оказались в среднем на 0,2–0,5 доз ниже, чем у помесей разной кровности по голштинам. Самый высокий коэффициент воспроизводительной способности имели коровы красной степной породы – 0,98–1,01 ед. против 0,85–0,95 ед. у помесей. Анализ оплаты корма молоком свидетельствует о меньших затратах на производство единицы продукции коровами первого и второго поколений, у которых они составили 0,95–0,98 ЭКЕ, что ниже, чем у сверстниц красной степной породы, на 1,11–1,12 ЭКЕ. Более рентабельным оказалось производство молока полукровными помесями – 30,8–32,9% при несущественных различиях между красными степными и высококровными по голштинам особями.

Ключевые слова: коровы, красная степная, голштинская порода, помеси, молочная продуктивность, воспроизводительная способность, рентабельность

IMPROVEMENT OF THE RED STEPPE CATTLE BY THE HOLSTEIN BREED GENE POOL

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The results of the comparative assessment of productivity, reproductive ability and profitability of milk production when using cows of the Red Steppe breed and the crossbreeds of different blood

relationship by the Holstein breed of the Red-and-White color type are presented. The studies of economically useful traits and profitability were conducted in 2019-2022. The objects of the research were representatives of the Red Steppe breed (control), mixtures with 50% (1st experimental group) and 75% of the blood of the Holstein Red-and-White color type (2nd experimental group). The superiority of the crossbred heifers over their herd mates of the Red Steppe breed in terms of milk yield was established: for the 1st lactation it was 605-673 kg ($p > 0.999$), for the 2nd lactation it was 714-788 kg ($p > 0.999$), for the 3rd lactation it was 817-868 kg ($p > 0.999$). The highest coefficient of the milk yield was observed in Holstein F_1 and F_2 crossbreeds (9.4-9.7 kg), whose average advantage during all lactations ranged from 0.9-1.2 kg ($p > 0.95$-0.99). In all analyzed service-periods, the highest fertilization rate after the first insemination was demonstrated by the Red Steppe breed animals; as a result, their semen consumption was on average 0.2-0.5 doses lower than that of the Holstein crossbreeds of different blood relationship. Cows of the Red Steppe breed had the highest reproductive ability coefficient - 0.98-1.01 units vs. 0.85-0.95 units for crossbred cows. The analysis of the feed efficiency shows lower costs per unit production by cows of the first and second generations, in which they were 0.95-0.98 EFU, which is lower than in the Red Steppe breed peers, by 1.11-1.12 EFU. Milk production by half-blooded crossbreeds was more profitable - 30.8-32.9% with no significant differences between the Red Steppe and high-blooded Holstein individuals.

Keywords: cows, Red Steppe, Holstein, crossbreeds, milk productivity, reproductive capacity, profitability

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INTRODUCTION

The Red Steppe breed was one of the most widespread and adapted to natural-climatic, fodder and technological conditions in the southern regions of our country before the beginning of mass Holsteinization of the Russian breeds of dairy cattle. Despite a significant reduction in the specific weight of animals of this breed, at present the work on improvement of its breeding and productive qualities with the use of gene pool of improving breeds - Holstein Red-and-White, Angler and Danish Red continues. The change in the breed composition towards the increase of highly productive herds of dairy cattle in most cases has led to a decrease in productive longevity and reproduction at the expense of local genetic resources, which ultimately reduced the profitability of the dairy cattle breeding industry.

Improvement of the Red Steppe breed, aimed at the combination of high milk yields with fat and protein-milk yield, allowed to create the Kulunda type in Western Siberia, the representatives of which surpass the animals of the parent breed by 0.37-0.43% by the main distinguishing feature - fat-milk yield [1]. Along with high milk yields, this type is characterized by excellent reproductive functions: 86 calves can be obtained from 100 cows, which is 11 calves more than from the representatives of the Kuban type, but lower than the level of the Siberian type - 95 calves from 100 cows[1].

In the Rostov region the use of the Holstein Red-and-White and the Ayrshire bulls' semen provided the first-generation littermates with 449.7-518.1 kg increase in milk productivity in comparison with their counterparts of Red Steppe breed in the 1st lactation, with insignificant differences in the 2nd lactation. Milk quali-

[1]*Knyazeva T., Tyurikov V.* Exterior features of the types of the Red Steppe breed of cattle // Dairy and Beef Cattle Farming, 2012, No. 2, pp. 14-16.

ty parameters also had no significant intergroup differences [2].

Application of the semen of the Russian and German stud bulls in the herd consisting of the animals of the Siberian type of the Red Steppe breed provided production of the daughters with duration of economic use of 36,25-38,2 months, which is by 3,0-6,4 months more than the peers obtained from the bulls of Canadian and Danish origin. In the Red Steppe herds of the Omsk region, the best indicators were demonstrated by the daughters of the Angler breed bulls - their period of economic use was 0.29-0.50 lactations longer in comparison with the descendants of the Danish Red and Swedish Red breeds. Although the profitability of the Swedish Red and Danish Red bull daughters was higher by 8.5-10.1% [3].

In the Kabardino-Balkar Republic, F_1 crossbred cows, obtained as a result of crossing the breeding stock of the Red Steppe breed with the Holstein Red-and-White cows, were superior to purebred Red Steppe cows in terms of milk productivity, udder morphofunctional properties and milk feed conversion. The advantage in the milk yield was 465 kg, milk flow rate - 3.6%, feed costs for the production of 1 kg of milk - 0.15 EFU (energy feed units) [4].

Evaluation of stud bulls on the quality of the progeny (comparing the productivity of daughters with their mothers and with their peers) has shown the inexpediency of using purebred Red-and-White Holstein bulls to improve the domestic Red Steppe breed in the farms with average herd milk yield up to 5000 kg per cow per year. The use of the Angler breed bulls gene pool, except for Dax 21699, is also of no breeding interest neither on productive qualities, nor on the type of the progeny physique. The use of crossbred stud bulls of the Red-and-White Holstein breed proved to be a more effective technique [5].

The most suitable for breeding in the conditions of the plains zone of the Kabardino-Balkar Republic are three-breed crosses obtained by crossing half-breed Holstein-Red Steppe cows with the Angler breed bulls. The superiority of such cows in milk yield over purebred Red Steppe cows and half-bloods of the genotypes "Red Steppe × Angler", "Red Steppe × Red Estonian" and "Red Steppe × Holstein" averaged 6.6-20.4% [6].

A single use of the Holsteins on the breeding stock of the Red Steppe breed contributed to the production of the daughters exceeding purebred peers of the Red Steppe breed in milk yield for the 1st lactation by 568 kg, for the 2nd lactation - by 710 kg with lower fat content in milk by 0.05 and 0.04 abs.%, respectively [7].

The effectiveness of Holsteinization of the Red Steppe cattle under creation of proper environmental conditions is evidenced by the studies conducted in different regions of our country[2] [8-10].

The use of bulls of the Swedish Red breed in the herds of the Red Steppe cattle allowed to increase the milk yield of their daughters in comparison with their peers from producers of the Danish Red and Angler breeds by 219 and 569 kg, respectively, to increase the fat content in milk by 0.03 and 0.25 abs.%, protein - by 0.07 and 0.25 abs.%, to improve reproductive functions and udder health, which had a positive effect on the profitability of dairy cattle breeding [11].

The need for selection and appropriate matching of production types of cows to increase the economically useful traits of the Red Steppe cattle is noted by many domestic scientists, but on the Red Steppe breed such studies are extremely limited[3, 4] [12].

The study of the possibility of further increase in the volume of milk produced in the conditions of the south of our country is topical and of great national and economic importance.

For the first time in the Kabardino-Balkar Republic in the framework of industrial production

[2]*Ulimbashev M.B.* Features of Holsteinized Red Steppe cattle of Kabardino-Balkaria // Agrarnaya Rossiya, 2010, No. 3, pp. 23-24.

[3]*Ulimbashev M.B.* Productive and ethological features of cows of different production types // Reports of the Russian Academy of Agricultural Sciences, 2007, No. 5, pp. 35-36.

[4]*Pisarenko A.V.* Economically useful traits of the Red Steppe cows of different constitutional and production types in the conditions of gene pool conservation // Scientific support of livestock breeding in Siberia: Proceedings of the III International Scientific and Practical Conference (Krasnoyarsk, May 16-17, 2019). Krasnoyarsk, 2019, pp. 209-213.

comparative data on economically useful traits and efficiency of milk production using the Red Steppe and Holsteinized cattle of different generations have been obtained.

The purpose of the research is a comparative assessment of productivity, reproductive ability and profitability of milk production when using cows of the Red Steppe breed and the crossbreds of different bloodlines on the Holstein Red-and-White breed.

MATERIAL AND METHODS

The study of economically useful traits and profitability of milk production was conducted in 2019-2022. The object of research were cows of Red Steppe breed (control), crossbreds with 50% (1st experimental group) and 75% (2nd experimental group) blood of the Holstein Red-and-White cows. Formation of the experimental groups of first heifers was carried out taking into account the origin, age, live weight and physiological condition of animals. Each group included 30 heifers.

All groups were in the same conditions of care, housing and feed supply. The structure of the diet of the experimental herd in winter was as follows: roughage - 18%, haylage - 22, silage - 25, concentrated fodder - 35%. The technology of dairy herd maintenance is stall-pasture. In the pasture period green conveyor was used with the use of village pastures.

Cows were milked in the milk pipe using ADM 8 unit, control milking was carried out once a month. Milk quality parameters were determined using analyzer "Lactan 1 4M". Milk yield (milk protein and milk fat) and milking capacity coefficient were calculated according to the formulas generally accepted in zootechnical practice. Live weight of animals was determined according to the Kluver-Strauch table, for which the following body measurements were taken: chest circumference behind the shoulder blades and oblique body length.

Reproductive ability of experimental stock was studied on the basis of zootechnical and veterinary records on such indicators as fertilization rate after insemination, insemination frequency, duration of service and inter-mating periods. The reproductive capacity coefficient was calculated as the ratio of days in a calendar year to the duration of the inter-breeding interval.

The amount of feed eaten was determined as a group by the difference between the amount of feed given and the uneaten residues. Costs for production of 1 kg of milk were calculated as the ratio of milk yield to the volume of feed consumed.

Biometric processing of the obtained data was carried out by methods of variation statistics, the reliability of intergroup differences on the analyzed indicators was determined by the Student's criterion at three levels of reliability of difference.

RESULTS AND DISCUSSION

Productive qualities of cows of different genotypes during the first three lactations are presented in Table 1.

The superiority of crossbred first calvers in terms of milk yield over their peers of the Red Steppe breed was established, which amounted to 605-673 kg ($p > 0.999$) in the 1st lactation, 714-788 kg ($p > 0.999$) in the 2nd lactation, and 817-868 kg ($p > 0.999$) in the 3rd lactation. The greatest growth of milk yield with age (752 kg) was observed in half-blooded littermates, which is probably due to the effect of heterosis. Increasing the bloodlines of Red-and-White Holstein breed up to 75% did not have such a significant effect on milk yield compared to the indicators of half-blooded stock. If milk yields of 3/4 Holstein-blooded crossbreds in the first two lactations tended to be superior to half-blooded animals, then in the 3rd lactation the picture was the opposite.

Regardless of the blood on Holsteins, the litters of both groups were inferior to the cows of the Red Steppe breed on the content of the main components in milk - fat and protein. Despite this, due to significant superiority in milk yield, the highest yield of milk fat and protein was characterized by the groups of Holsteinized cows, whose advantage in the 1st lactation was 35.6-37.7 kg ($p > 0.99$), in the 2nd lactation - 41.6-42.9 kg ($p > 0.99$), in the 3rd lactation - 43.7-51.5 kg ($p > 0.99$-0.999).

As a result of calculating the ratio of the milk yield to the live weight, it was found that Hol-

Табл. 1. Изменение продуктивных особенностей красного степного скота разного генотипа с возрастом (по данным трех лактаций)

Table 1. Changes in productive characteristics of the Red Steppe cattle of different genotypes with age (based on three lactations)

Lactation	Group		
	control	1st experimental	2nd experimental
Number of cows, heads			
1st	30	30	30
2nd	29	27	26
3rd	27	25	23
Milk yield for 305 days, kg			
1st	3856 ± 96	4461 ± 124***	4529 ± 131***
2nd	4079 ± 119	4793 ± 144***	4867 ± 156***
3rd	4345 ± 128	5213 ± 163***	5162 ± 174***
Fat mass fraction, %			
1st	3,83 ± 0,02	3,74 ± 0,03*	3,71 ± 0,03**
2nd	3,88 ± 0,02	3,77 ± 0,03**	3,73 ± 0,04***
3rd	3,90 ± 0,02	3,78 ± 0,04**	3,75 ± 0,04***
Protein mass fraction, %			
1st	3,31 ± 0,02	3,23 ± 0,03	3,20 ± 0,03
2nd	3,35 ± 0,02	3,25 ± 0,03	3,21 ± 0,03
3rd	3,35 ± 0,02	3,25 ± 0,03	3,20 ± 0,03
Total yield of milk fat and milk protein, kg			
1st	275,3 ± 6,6	310,9 ± 8,3**	313,0 ± 8,9**
2nd	294,9 ± 8,2	336,5 ± 9,7**	337,8 ± 10,4**
3rd	315,0 ± 8,7	366,5 ± 10,8***	358,7 ± 11,5**
Live weight at 2-3 months, kg			
1st	456,0 ± 3,7	476,0 ± 3,5***	481,0 ± 3,2***
2nd	482,0 ± 4,0	510,0 ± 3,7***	518,0 ± 3,5***
3rd	509,0 ± 4,4	537,0 ± 4,1***	549,0 ± 4,0
Milk yield ratio			
1st	8,4 ± 0,20	9,4 ± 0,25**	9,4 ± 0,27**
2nd	8,4 ± 0,24	9,4 ± 0,27**	9,4 ± 0,29**
3rd	8,5 ± 0,23	9,7 ± 0,28**	9,4 ± 0,30*

Note. Here and in Table 2:
*$p > 0,95$; **$p > 0,99$; ***$p > 0,999$.

stein F_1 and F_2 littermates had the highest milk yield ratio (9.4-9.7 kg), the advantage of which varied between 0.9-1.2 kg on average over all lactations ($p > 0.95$-0.99).

The results of evaluation of the reproductive qualities of experimental stock are presented in Table 2.

In all the analyzed service-periods, the greatest fertilization after the first insemination was demonstrated by the cows of the Red Steppe breed, as a result of which their semen expenditure was on average 0.2-0.5 doses lower than that of the Holstein littermates of different bloodlines.

Longer period from calving to fruitful insemination was characterized by crossbred animals, in which it exceeded 100 days and after the third calving reached 127-144 days, which is more than the values obtained for the cows of the Red Steppe breed on average by 35-52 days ($p > 0.999$).

In all the periods compared, the longer inter-breeding interval was characterized by the cows of 3/4 blooded Holstein Red-and-White cows - 392-426 days, which is higher than the values of the Red Steppe cows on average by 31, 50 ($p > 0.95$) and 53 days ($p > 0.95$), respectively.

During the study, the maximum values of the reproductive ability coefficient were recorded in the Red Steppe cows - 0.98-1.01 units against 0.85-0.95 units in the crossbreds.

The efficiency of milk production by the Red Steppe cows of different origins can be judged by the materials presented in Table 3.

Analysis of the milk feed conversion indicates lower costs per unit of production by cows of the first and second generations, in which they amounted to 0.95-0.98 EFU, which is lower than the values obtained for peers of the Red Steppe breed - 1.11-1.12 EFU.

Taking into account the actual costs of milk production and the revenue received from its realization, the most profitable was the exploitation of crossbreds of the genotype “1/2 Red Steppe + 1/2 Red-and-White Holstein”. In this connection, milk production by half-blooded littermates can be considered more profitable - 30.8-32.9% with insignificant differences between the Red Steppe and high-blooded Holstein animals. Also, the age-related decrease of milk production profitability values in all groups of cows should be noted.

CONCLUSION

The greatest increase in milk productivity and profitability of milk production at the lowest feed costs are characterized by the first-generation littermates, obtained as a result of using the gene pool of the Holstein breed of the Red-and-White breed on the mother stock of the Red Steppe cattle, while the coefficients of reproductive ability in this case are practically at the same level with the representatives of the

Табл. 2. Воспроизводительные качества подопытных групп животных
Table 2. Reproductive qualities of the experimental groups of animals

Period	Group		
	control	1st experimental	2nd experimental
Fertilization rate after the first insemination, %			
After the 1st calving	66,7	60,0	56,7
After the 2nd calving	62,1	55,6	53,8
After the 3rd calving	59,3	52,0	47,8
Insemination index, doses			
After the 1st calving	1,6 ± 0,03	1,8 ± 0,05**	1,9 ± 0,07***
After the 2nd calving	1,9 ± 0,04	2,2 ± 0,07***	2,3 ± 0,10***
After the 3rd calving	2,2 ± 0,05	2,5 ± 0,09**	2,7 ± 0,12***
Service period duration, days			
After the 1st calving	82,0 ± 2,7	103,0 ± 4,0***	112,0 ± 4,9***
After the 2nd calving	85,0 ± 3,0	118,0 ± 5,2***	133,0 ± 6,8***
After the 3rd calving	92,0 ± 3,4	127,0 ± 5,5***	144,0 ± 7,4***
Duration of the calving interval, days			
Between the 1st and the 2nd calvings	361,0 ± 12,1	383,0 ± 15,0	392,0 ± 16,4
Between the 2nd and the 3rd calvings	365,0 ± 12,8	400,0 ± 16,3	415,0 ± 18,7*
Between the 3rd and the 4th calvings	373,0 ± 14,2	410,0 ± 19,4	426,0 ± 22,0*
Reproductive capacity ratio			
Between the 1st and the 2nd calvings	1,01 ± 0,032	0,95 ± 0,036	0,93 ± 0,038
Between the 2nd and the 3rd calvings	1,00 ± 0,034	0,91 ± 0,037	0,88 ± 0,039*
Between the 3rd and the 4th calvings	0,98 ± 0,037	0,89 ± 0,040	0,85 ± 0,042*

Red Steppe breed and littermates of the second generation. Increase of blood on Holsteins up to the second generation is inexpedient, as in these animals productive qualities and efficiency of milk production in comparison with half-blood stock increase insignificantly, and the indicators of fertility and qualitative composition of milk are much lower than in the purebred Red Steppe and F1 litters. Based on the results obtained, the use of the seed of Holstein bulls of the Red-and-White breed for obtaining the first generation of litters can be considered as an effective method of improving herds of the Red Steppe breed.

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Табл. 3. Эффективность производства молока коровами разного происхождения (по данным трех лактаций)

Table 3. Efficiency of milk production by cows of different origin (based on three lactations)

Lactation	Group		
	control	1st experimental	2nd experimental
Milk yield for 305 days, kg			
1st	3856	4461	4529
2nd	4079	4793	4867
3rd	4345	5213	5162
Volume of energy feed unit consumption			
1st	4289	4361	4450
2nd	4568	4684	4745
3rd	4872	4950	4936
Energy feed unit inputs for production of 1 kg of milk			
1st	1,11	0,98	0,98
2nd	1,12	0,98	0,97
3rd	1,12	0,95	0,95
Cost of 1 kg of milk, rubles			
1st	20,34	19,20	19,56
2nd	22,53	20,89	21,44
3rd	23,79	22,31	22,58
Production costs, rubles			
1st	78 431,04	85 651,20	88 587,24
2nd	91 899,87	100 125,77	104 348,48
3rd	103 367,55	116 302,03	116 557,96
Cost of sales of 1 kg of milk, rubles			
1st	26	26	26
2nd	28	28	28
3rd	29	29	29
Revenue from milk sales, rubles			
1st	112 944	127 582	128 492
2nd	130 340	148 792	149 492
3rd	144 536	168 055	165 097
Profit (+) / loss (-), rubles			
1st	34 512,96	41 930,80	39 904,76
2nd	38 440,13	48 666,23	45 143,52
3rd	41 168,45	51 752,97	48 539,04
Profitability, %			
1st	30,5	32,9	31,1
2nd	29,5	32,7	30,2
3rd	28,5	30,8	29,4

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