Comparative studies of milk quality of cows of red-mottled breed due to genotype

A V Vostroilov, E S Artemov, A A Sutolkin, M G Sysoeva and A A Bondarenko

Voronezh State Agricultural University after Emperor Peter the Great, Voronezh, Russia, No 1, Michurina Street, Voronezh, 394086, Russia

E-mail: evgeartemov@yandex.ru

Abstract. The results of studies on the influence of the genotype of red-mottled cows of Holstein breed on the chemical composition and technological properties of milk are presented. In a herd of cows of the red-mottled breed of the cattle of "Roschinskoye", for the assessment of the chemical composition and technological properties of milk depending on the genotype of the animals by the method of pairs-analogs, 3 groups of full-aged cows were formed: 1/2, 5/8 and 3/4-blood on KPG. The selected milk on the farm was analyzed in the laboratory of Voronezh State Agricultural University named after the Emperor Peter the Great. For a more complete picture of the qualitative indicators of the milk obtained from the full-aged cows with blood 1/2, 5/8 and 3/4 KPG, butter was also produced. As a result of the production of a trial batch of dairy products, the technological properties of the milk during processing, as well as oil and physical, chemical and organoleptic characteristics of the finished product, were determined. On the basis of the conducted research, the recommendations on improvement of the red-mottled dairy breed of the cattle were given.

1. Introduction

Increasing the productivity of both quantitative and qualitative indicators in the livestock industry, profitability of the industry as a whole is achieved not only by improving the conditions of keeping and feeding animals, but also by improving the inherited qualities of the animal that is breeding.

The task of breeding as a science is to develop methods of breeding and reproduction of highly productive animals, and also to maintain the already obtained results at the same level and improve them further.

In the last years of the XX century, a significant amount of scientific information was accumulated to improve the system of breeding of farm animals, research in the field of genetics of populations, the development of the most modern methods of reproduction, regular evaluation of bulls by the quality of offspring. Many elements of the large-scale selection were introduced. It created preconditions for acceleration of processes of genetic improvement of populations [1, 2].

The most accurate assessment of cows in terms of milk yield, fat and protein content in milk, the total amount of fat and protein can be obtained for the first three lactation or for life. Average milk productivity of cows for all lactation correlates well with milk yield for the highest lactation. The highest lactation can be evaluated only in full-aged cows (6-8 years old) [2, 3, 4].

The red-and-white breed of the cattle is bred in various regions of the Russian Federation, including in the breeding plant of JSC "Roschinskoye" of Chaplyginsky district of Lipetsk region. The animals
of the red-mottled breed of the cattle are characterized by high productivity and live weight. Cows are well adapted to machine milking, having a significant potential for milk production and improved morphological and functional properties of the udder.

Until 1986, the farm bred Simmental breed. Since 1987-1988 at Ranenburg enterprise, and today at Roschinsky enterprise, the red-mottled Holstein bulls-producers of the American and Canadian selection started to be used for the improvement of Simmental cows. As a result of the conducted crossing in economy, the livestock of the following blood is received: 1/4, 3/8, 9/16, 1/2, 5/8 and 3/4-blood of cows of Holstein breed (KPG).

The level of milk production and the composition of the milk are determined by many factors, which in their influence can be reduced to two main groups: external and internal. The external factors are determined by the influence of the environment, internal-genetic data and physical condition [5, 6, 7].

2. Problem statement
The purpose of the research is to analyze the quality and technological properties of milk-raw materials obtained from full-aged cows of the red-mottled dairy breed of cattle with a blood density of 1/2, 5/8 and 3/4 KPG. Under the conditions of the dairy laboratory, the Department of private animal husbandry at Voronezh State Agricultural University named after the Emperor Peter the Great started to produce three test samples of butter from cows, taking into account the blood on the Holstein breed of cattle. The quality of prototypes of butter was evaluated on the basis of the received data to recommend further ways of improvement and formation of the red-mottled breed of the cattle in the conditions of the enterprise and the region.

3. Materials and methods
For the experience of assessing the chemical composition and technological properties of milk, depending on the genotype of animals by pair-analogues, 3 groups of full-aged cows were formed: 1/2, 5/8 and 3/4-blood by KPG. Each of these groups included animals of the desired type, but the quantitative advantage of such individuals was in the group of cows with a blood density of 5/8 by KPG. The animals during the experimental period were in the same conditions of feeding and maintenance. Qualitative research and technological properties of milk, the development of a prototype of butter and evaluation of its quality were carried out in the laboratory of Voronezh State Agricultural University named after the Emperor Peter the Great.

4. Results and discussion
After the estimation of the organoleptic indicators of the milk in the experimental groups the significant differences were not revealed and milk met the requirements according to GOST 31449-2013 “Cow's Milk raw. Technical conditions” Qualitative indicators and technological properties of the cow milk, depending on the blood of the red-mottled Holstein breed is presented in table 1 and figures 1 and 2.

| Indicators   | Groups of cows |
|--------------|----------------|
|              | 1/2 KPG | 5/8 KPG | 3/4 KPG |
| Density, kg/m³ |         |         |         |
| Acidity, °T   | 17.70   | 17.40   | 17.10   |

The analysis of the results showed that the animals with 5/8-blood KPG (4.00%) had the largest mass fraction of fat in the milk; they were also protein-milkier (3.30%) than the cows of 1/2 and 3/4-blood KPG. In comparison with the red-mottled breed as a whole, and with the "Voronezh" type, animals with a blood density of 5/8 in KPG have superiority and are inferior only to animals of the "Yenisei" type of the red-mottled breed [9, 10].
The number and size of fat globules are of practical importance in the transition of fat in the production of cream, butter, cheese, cottage cheese. The largest diameter of fat globules is in the milk of the cows with 5/8-blood KPG. Dairy products can be made from such milk with the least loss.

![Figure 1](image.png)

**Figure 1.** Quality indicators and technological properties of milk

The content of the mass fraction of protein in the milk of the cows was at a low level. After all, this figure in the 5/8-blooded cows exceeded by KPG (3.30%) the average percentage of protein in the milk of the red-mottled breed (3.12%), but was lower than that in the animals of "Yenisei" types of the red-mottled dairy breed [9, 10].

The highest mass fraction of lactose in the cows with 5/8-blood KPG (4.55%) is more than that in the milk of the cows with 1/2 and 3/4-blood KPG. And in the studies of [11], in breeding plants of the Krasnoyarsk territory, in the cows of the red-mottled breed blood 1/2 KPG, the lactose content exceeded, including the 5/8-blood cows.

The ash content in the milk of the cows with 1/2, 5/8 and 3/4-blood KPG was approximately at the same level: 0.73; 0.73 and 0.72, respectively; in the studies of [11] ash components were at the same level.

Dry skim milk residue in the milk of the cows with 5/8-blood KPG was 8.83%, which according to [10] was in animals "Voronezh" type, and this is more than in the milk of the experimental cows with 1/2 and 3/4-blood KPG, but less than in the cows of "Yenisei" type of the red-mottled dairy breed.

The dry matter content in the milk of the cows with 5/8-blood KPG was 12.83%, which is more than in the milk of the experimental cows with 1/2 and 3/4-blood KPG. And according to [10], it was higher than that in the whole red-mottled breed, the trend of superiority of milk cows with blood 5/8 KPG in Krasnoyarsk region is also confirmed in the studies of [11].
The milk density of the cows with 5/8-blood KPG was 1029.71 kg/m³, which is more than that in the milk of the cows with 1/2 and 3/4-blood KPG. But in the experiments of [11], this figure was slightly higher in the cows with blood 1/2 KPG. Based on the data of [10], the milk density of experimental animals has no obvious differences with that of the cows of the "Voronezh" type of the red-mottled breed.

The energy value of the milk of the cows with 5/8-blood KPG was 66.5 kcal / 100g, which is more than in the milk of the cows with 1/2 and 5/8-blood KPG.

Summarizing the above, we can conclude that the best quality indicators of the milk in the conditions of OAO PZ "Roschinsky" belong to the cows with a blood density of 5/8 KPG.

In order to study the suitability of the milk for the preparation of butter, we conducted studies on the technological properties of the milk.

**Table 2.** Technological properties of milk in processing of butter

| Indicators                        | 1/2 KPG | 5/8 KPG | 3/4 KPG |
|----------------------------------|---------|---------|---------|
| Duration of churning, min.       | 60.0    | 55.0    | 65.0    |
| Quantity of milk per 1 kg of cream, kg | 20.15   | 19.05   | 21.35   |
| Consumption of milk per 1 kg of butter | 27.39   | 26.83   | 27.65   |
| Mass fraction of fat in butter, % | 82.05   | 82.50   | 81.97   |
| Mass fraction of fat in buttermilk, % | 0.67    | 0.57    | 0.79    |
| The degree of use of fat milk, %  | 92.50   | 95.00   | 91.18   |
| The degree of use of fat cream, % | 98.72   | 99.05   | 98.65   |
| The amount of production losses, % | 6.14    | 4.91    | 7.89    |

All experiments on the development of cream and butter were carried out in compliance with the same regime and technology, so that the duration of churning, the nature of the oiled grain, the degree of use of fat, product moisture and other indicators could be judged by the characteristics of the milk of the cows of the studied genotypes.

The milk intended for processing into butter was subjected to organoleptic evaluation and chemical analysis. Organoleptic evaluation did not show significant differences between genotypes in taste, smell and consistency of milk.
The consumption of milk of the basic fat content (3.4%) for the production of 1 kg of oil for the cows with 5/8 blood by CNG was 26.83 kg, 1/2 blood by CNG – 27.39 kg, and the consumption of the milk of the cows with 3/4 blood by CNG was 27.65 kg. The amount of production loss for the production of butter from the milk of cows 5/8 blood on KPG is 1.23% lower than that of the cows with 1/2 blood by KPG and by 2.98% lower than that of the cows with 3/4 blood by KPG (table 2).

After the production of butter from the milk of the cows of different genotypes, we studied its physical and chemical composition (table 3).

### Table 3. Physico-chemical and organoleptic characteristics of butter

| Indicators                     | 1/2 KPG | 5/8 KPG | 3/4 KPG |
|-------------------------------|---------|---------|---------|
| Mass fraction of fat, %       | 82.05   | 82.50   | 81.97   |
| Mass fraction of moisture, %  | 16.35   | 16.02   | 16.43   |
| The taste and smell           | of pure, milk, without foreign tastes and odors | uniform, the cut surface is slightly shiny, dry in appearance, there are tiny droplets of moisture |
| Consistency and appearance    | light yellow, homogeneous throughout the mass |
| Color                         |         |         |         |

5. Conclusion

Thus, the conducted research has shown that the milk of the cows of the red-mottled breed has good technological properties and is suitable for production of butter of high quality, and using the milk of the cows of 5/8 blood by KPG, it is possible to make dairy products with the least losses.

The best representatives of 1/2, 5/8 and 3/4-blood by KPG breed from cultivation "in itself" created the structure of the bull-breeding group of the red-mottled breed.

Further selection and breeding work with the red-mottled breed will be carried out in the direction of conservation of dairy-type animals. Selection of pairs should be carried out taking into account the growth of the protein-milk herd and preservation of the constitutional strength of the animals.

References

[1] Krasota V F and Japaridze TG 1999 Breeding of farm animals (Moscow: VNIIplem)
[2] Moskalenko L P, Muravyeva N A and Furaeva N S 2012 Features and effectiveness of breeding highly productive cows with a number of features (Yaroslavl: FSBEI HPE "Yaroslavl state agricultural Academy")
[3] Krasota V F, Japaridze T G and Kostomakhin N M 2005 Breeding of farm animals (Moscow: Colossus)
[4] Chomaev A M, Semenyutin V B and Kostromin V N 2009 Ways and methods of formation of the dairy herd at the present stage Achievements of science and technology of agriculture 8 47-49
[5] Parshin P A, Vostoilov A V, Kuznetsov N, Nikulin I A and Parshin V I 2007 Productive qualities of cows and calves when included in the diet of biologically active substances Veterinary Pathology 44 (2) 200
[6] Korotkikh E A, Vostoilov A V, Artemov E S and Shumsky N I 2010 Technological properties of milk of cows of Simmental breed and quality of the dairy products developed from it Bulletin of Voronezh state agrarian University 4 (27) 79-82
[7] Barabanchikov N V 1989 Dairy business (Moscow: Kolos)
[8] GOST 31449-2013 2018 "Raw cow's Milk. Technical conditions" (Moscow: STANDARTINFORM)
[9] Breeding work with red-mottled breed of cattle 2009 9 (Forest glades: FGNU VNIIplem)
[10] Results of tests of animals of "Voronezh" type of cattle of red-mottled breed on distinctiveness, homogeneity and stability 2007 (Forest glades: FGNU VNIIplem)
[11] Golubkov A I 2003 Creation and cultivation of red-mottled breed of dairy cattle in Krasnoyarsk Krai (Krasnoyarsk)