Comparative evaluation of composition and properties of milk from cows of different breeds in cheese production

A S Gorelik¹, E I Yarmukhamedova², A F Sharipova², I R Gazeev² and S G Kanareikina²

¹Ural Institute of the state fire service of the EMERCOM of Russia, 22 Mira street, Yekaterinburg, 620075, Russian Federation
²Bashkir State Agrarian University, 34 50-letiya Oktyabrya Str., Ufa, 450001, Russian Federation

E-mail: temae077ex@mail.ru

Abstract. Modern industrial milk processing based on high-tech processes has high demands to the quality of milk used as raw material for the production of a wide range of dairy products. Seasonality of milk production remains a significant problem for dairy cattle breeding. In some seasons, the supply of milk of optimal quality is rather unstable. The purpose of the work was to study the influence of season on the technological properties of milk during its processing into dairy products. As a result of research, it was found that the organoleptic properties of milk met the requirements of regulatory documents. The milk color changed with the seasons. A more intense yellowish tint in the milk color was noted in summer and autumn, which is associated with the carotene content in feed. The highest content of dry matter, SNF, fat and protein in milk was observed in winter, while in summer these values were the lowest. In the spring period, there is an increase in the mechanical contamination of milk up to group 2. In general, the bulk of milk has primary quality. The coagulation phase in cows’ milk was shorter in spring than in other seasons of the year (P <0.001) by 0'05" - 2'35", and it was longer in milk obtained in winter. The best speed to clot under the influence of rennet was the milk of cows in summer. Evaluation of milk for thermal stability, depending on the season of the year, showed that it has high thermal stability and can be used for processing into products with a high temperature of pasteurization and sterilization.

1. Introduction

Uninterrupted and sustainable supply of the population with quality food of animal origin is the main necessity in ensuring the health of the nation and food security of any country [1-6]. An increase in the production of high-quality dairy products is one of the most important tasks for the development of animal husbandry all over the world, which is becoming increasingly important both with the growth of the world's population, and in particular our country, and for the full satisfaction of humanity's needs for food. Milk is a complete nutritiously balanced product and raw material for the processing industry. In this regard, the development of this industry is given great national economic importance [7-14]. An increase in the productivity of cows is connected with an improvement in the quality of milk, which has a significant impact on the quality of finished dairy products [15-25]. The complexity of solving the problem of milk quality is due to the fact that the technologies and sanitary-industrial culture used in most dairy farms in Russia are not compatible with the conditions for obtaining high-quality and safe milk.
milk, and this requires a revision of the technologies for the production of raw milk and preventive measures aimed at improving its quality [25, 26]. In addition, many factors, including genetic ones, affect the composition and properties of milk. At present, dairy cattle of both domestic and foreign selection is widely used for milk production, and the gene pool of the best world Holstein breed is used to improve domestic cattle [27-31]. Therefore, the study of the influence of the breed on the composition and properties of milk is relevant and of practical importance.

The purpose of the work was to study the influence of the breed of dairy cattle on the composition and properties of milk during its processing into cheese.

2. Materials and method

The research was carried out in the conditions of one of the agricultural enterprises of the Sverdlovsk region. Milk was obtained from black-and-white cattle of the Ural type and Holstein breed. The studies were carried out in triplicate. The following properties were determined in milk: dry matter, protein, SNF, density, fat (using the device "Klever-1M"); acidity (titrometric method according to Turner). The technological properties of milk were assessed by rennet clotting, rennet-fermentation test, milk quality indicators in accordance with GOST R 52054 as amended in 2015. Technological experience for the production of cheese "Mozzarella" and semi-hard cheese type "Gollandskiy" was carried out in three replications in the conditions of the dairy laboratory of the Ural State Agrarian University and the Bashkir State Agrarian University.

3. Results

Evaluation of milk as a raw material for the dairy industry begins with a study of organoleptic characteristics, namely, taste, smell, color and consistency (table 1).

| Indicator                  | Breed                                |
|----------------------------|--------------------------------------|
|                            | Black-and-white cattle of the Ural type | Holstein  |
| Color                      | white, with a light cream tint        | white     |
| Consistency                | uniform, without sediment and flakes | uniform, without sediment and flakes |
| Taste and smell            | Pure milk, without foreign odors and tastes | Milk, with a weak feed taste |

In our case, the organoleptic characteristics of milk met the requirements of GOST R 52054-2003. The milk was white or slightly yellowish in color, with a specific smell and taste, corresponding to cow's milk, and a liquid consistency.

It has been established that there is a change in the composition of milk by seasons of the year (figure 1).

![Figure 1. Chemical composition of milk, %](image-url)
The highest content of dry matter, SNF, fat in milk was noted in the milk of black-and-white cattle of the Ural type. In the milk of Holstein cows, the mass fraction of milk sugar (lactose) is higher. From the point of view of processing milk into cheese according to the ratio of SNF and fat; fat and protein in milk, it meets the requirements of the technological instructions for the production of cheese, but the reduced fat content in the milk of Holstein cows (3.61%) leads to a decrease in the efficiency of cheese production. Thus, the breed influences the quality of milk in terms of its chemical composition.

When evaluating milk, much attention is paid to its physical properties, since they are indicators of the naturalness of the product. Studies of these indicators allow us to conclude that the breed also influences their changes (figures 2,3).

![Figure 2. Milk density, kg / m³.](image)

The density of milk of both breeds corresponded to the GOST requirements for premium milk. Figure 2 clearly shows that the density of milk is higher in black-and-white cattle of the Ural type, which is explained by the higher dry matter content in milk. The second indicator of the naturalness of milk is the freezing point (figure 3). It also met the requirements of GOST R 52054-2003.

![Figure 3. Freezing point of milk, °C.](image)

According to sanitary and hygienic indicators, namely, bacterial contamination and the presence of somatic cells, acidity, both the quality of milk and its freshness (acidity) are judged. Figure 4 presents data on the health and hygiene indicators of milk from cows of different breeds.
In terms of sanitary and hygienic indicators, the milk of cows of both groups was of the highest quality and in terms of bacterial contamination and the presence of somatic cells in the milk it corresponded to primary quality, and in terms of acidity it was fresh and also belonged to primary quality.

For cheese production, milk, which, along with normal physical and chemical composition and microbiological parameters, is characterized by certain technological properties is required. Evaluation of the cheese suitability of milk according to the rennet-fermentation test and rennet coagulability showed that milk is suitable for cheese and belongs to the second type, the most suitable for the production of cheese. Milk from Holstein cows had a higher clotting rate than milk from black-and-white cows, the curd was too dense, which resulted in a coarse cheese consistency. In our opinion, this milk is more suitable for making semi-hard and other maturing cheeses. When using this milk, it is worth adjusting the cheese cooking technology: lower heating temperatures and increase grain size.

Evaluation of the quality of ready-made cheeses has confirmed the above. According to the organoleptic characteristics of the Mozzarella cheese, the best was the cheese made from the milk of the black-and-white cattle of the Ural type, and from the semi-hard cheese the cheese from the milk of the Holstein breed had a more pronounced taste (figure 5).
The quality and grade of cheese was determined according to a 100-point system, in which each indicator is given a certain number of points: taste, smell - 45, consistency 25, figure 10, dough color - 5, appearance - 10, packaging, marking - 5 points. Depending on the amount of points, cheeses are assigned to a certain grade: the highest - with a total score of 100-87 points, including at least 37 points in taste and smell; I with a total score of 86-75 points, including taste and smell of at least 34 points.

All cheeses, with the exception of Mozzarella cheese from the milk of Holstein cows, are classified as superior. Mozzarella cheese from the milk of Holstein cows is true to the 1st grade. The evaluation showed that milk from black-and-white cows is better suited for the production of Mozzarella cheese than milk from Holstein cows, such a cheese is richer in smell and taste with a softer and firmer consistency. And semi-hard cheeses made from milk from Holstein cows showed good results, in particular in terms of consistency.

4. Discussion
The quality of milk, its physical and chemical indicators depend on many factors, including the season of the year, despite the creation of optimal conditions for feeding and keeping, in our case, the same type of feeding and year-round stablekeeping. There is a change in the milk of cows of Holsteinized black-and-white cattle of the Ural type in its physical and chemical parameters and technological properties, depending on the season of the year. The best in nutritional and biological value was milk obtained in winter; the best in terms of technological properties for cheese making is milk obtained in summer. Similar studies were carried out by A Beloukov, O Beloukova, V Zhuravel, S Gritsenko, & E Ponomarev, O Gorelik, Y Shatskikh, M Rebezov & E Okuskanova, S L Gridina, V F Gridin, O I Leshonok, A S Shuvarikov, D A Baimukanov, M I Dunin, O N Pastukh, E V Zhukova, E A Yurova, Yu A Yuldashbayev, A I Erokhin, E A Karasev.

5. Conclusion
The breed of cattle affects the quality of milk and cheese produced from it, despite the high quality indicators and suitability for processing. The evaluation showed that milk from black and white cows is better for production of Mozzarella cheese than milk from Holstein cows.

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