Seasonal changes in milk quality indicators jersey cows

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Abstract. The article presents the results of studies of milk quality indicators: the mass fraction of fat, the mass fraction of protein and the number of somatic cells in the Jersey breed in the Stavropol Territory in 2022-2023. In the autumn period, the indicators of the mass fraction of fat and protein were higher compared to other seasons and equal to 6.08% and 4.66%, respectively. The number of somatic cells was also increased in the autumn and spring periods of 140 and 146 thousand units/ml, respectively. A significant negative correlation of the mass fraction of protein and average daily productivity to the number of somatic cells r = -0.21 and -0.12 was established. And a significant positive correlation between the mass fraction of fat and the level of somatic cells r = 0.52.

1 Introduction

One of the priorities in the dairy farming development in the Russian Federation is to obtain high-quality milk and increase the productivity of animals. Therefore, the choice of breed and control over the products produced play important roles in the subsequent profitability of the farm [1].

The Jersey breed of cows stands out among other breeds in terms of fat and protein in milk. In Europe, according to ICAR (International Committee for Animal Registration), the average milk productivity for 305 days of lactation was 5993 kg with a fat mass fraction of 5.45% and a protein mass fraction of 3.95% [7]. At the same time, in the USA, according to research data, the productivity of Jersey breed cows averages 8376 kg with a milk fat and protein content of 5.17% and 3.73%, respectively, which indicates the targeted breeding of this breed to increase productivity, while losing high fat and protein indicators (Lynn A. et al., 2023).

In Russia, according to All-Russian Research Institute of Breeding, in 2022, the average fat mass fraction in the country for this breed was 5.53%, and the protein mass fraction was 4.26% with milk productivity for 305 days of lactation of 6537 kg of milk. In the Stavropol Territory, the milk productivity of the Jersey breed breeding stock for 2022 amounted to 6609 kg with a fat mass fraction of 5.66% and a protein mass fraction of 4.23%, which is higher than the average data for the Russian Federation [2].

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Separately, it should be noted that the Jersey breed animals tolerate acclimatization well, have a high feed conversion, and the udder is suitable for machine milking, all these factors make this breed promising for breeding in adverse climatic conditions [3].

The high productivity of cows is also directly affected by the health of animals. One of the main diseases of dairy cows is mastitis, therefore, when studying the quality indicators of milk, attention should be paid to the number of somatic cells, which are an indicator of this disease control [4].

According to Camila J. et al. (2023), the decrease and increase in milk productivity is associated with seasonal stress, which is also noted in the works of O.E. Samsonova (2021). Therefore, when breeding cattle, it is necessary to consider this aspect for timely decision-making to maintain the productivity of animals at a high level.

2 Materials and Methods of Research

The object of the study is raw milk samples taken by monthly control milking from Jersey cows (n=1290) bred by a breeding reproducer of the Stavropol Territory.

Studies of milk quality indicators were carried out in the Laboratory of Milk Quality Control of the Stavropol State Agrarian University (state registration number in the breeding Register of the Russian Federation No. 262704801000, Certificate of registration in the state breeding register, PJ 77 series No. 011667), using the CombiFoss 7ds milk analyzer (Foss, Denmark), which work is based on infrared spectrophotometry with Fourier transform.

Sample preparation and milk sampling were carried out in accordance with GOST R ISO 707-2010 and GOST 26809.1-2014.

The correlation coefficients between the main indicators of milk composition and statistical calculations were calculated using the MS Excel computer program.

3 Research results

Throughout the entire period of research, 15480 milk samples from dairy cattle of the Jersey breed were selected and studied according to the qualitative composition.

As a result of the analysis, it was found that the mass fraction of fat and protein in raw milk has a seasonal severity (Fig. 1).

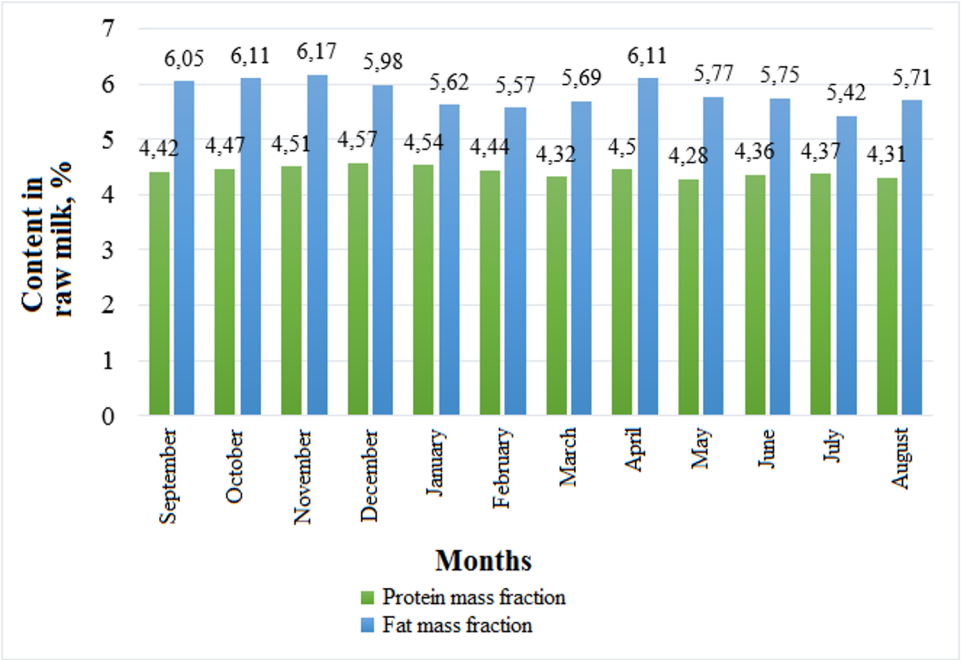

Fig. 1. Dynamics of the fat mass fraction and the protein mass fraction in raw milk for the period 09.2022 – 08.2023.

Thus, in the autumn period, the average is 6.08%, in winter there is a decrease to an average of 5.66%. In the spring and summer periods, the trend of the autumn and winter periods is repeated, respectively 5.86% and 5.60%. The average value of the fat mass fraction for the entire period was 5.80%.

The minimum and maximum fat index in the studied milk for all seasons of the year was 5.4% and 6.1%, which significantly exceeds the established in GOST 31449-2013 "Raw cow milk. Technical conditions" threshold of 2.8% for receiving raw milk for dairy processing enterprises.

According to the content of the protein mass fraction in raw milk, the highest indicator in the autumn period is 4.66%, and the lowest value in the summer period is 4.34%. For the entire period, the average protein mass fraction is 4.42%. The minimum value is 4.28% in May and the maximum is 4.57% in December. The protein shows the most stable data for the studied period.

Since 2017, according to GOST R 52054-2003 "Raw cow milk. Technical conditions" the content of somatic cells in cow milk should not exceed 250 thousand units/ml for the highest grade.

When determining the number of somatic cells in raw milk, we obtained results that this indicator for the entire period is in the range of 96-162 thousand units/ml, which is significantly lower than the requirements of the standard and the milk of Jersey cows participating in the study belongs to the highest grade (Fig. 2).

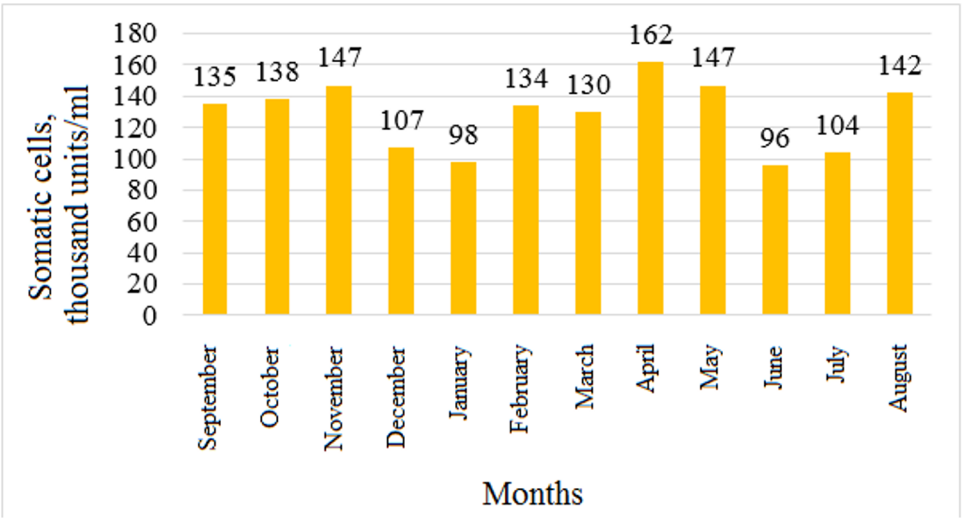

Fig. 2. Dynamics of the content of the number of somatic cells in raw milk for the period 09.2022 – 08.2023.

The average indicator of the number of somatic cells during the entire study period was at the level of 128 thousand units/ml. The seasonal nature of the level of somatic cells was distributed as follows: in the autumn and spring periods, there was an increase to 140 and 146 thousand units/ml, respectively, in winter and summer, the number of somatic cells decreased to 113 and 114 thousand units /ml, which indicates that the content of the number of somatic cells depends on the season of the year.

A comparative analysis between the indicators of average daily milk yield and the number of somatic cells in milk showed the relationship between them (Fig. 3).

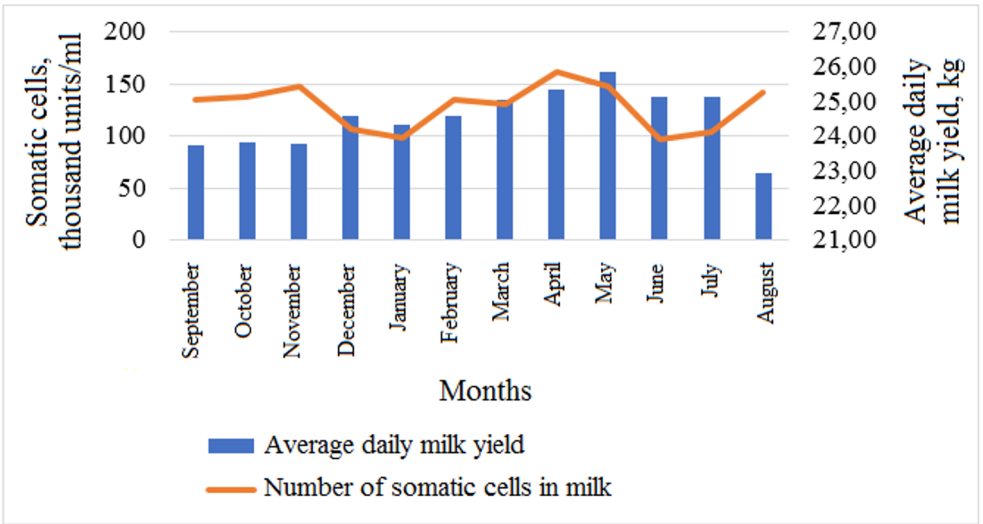

Fig. 3. The relationship of the average daily milk yield with the number of somatic cells in raw milk for the period 09.2022 – 08.2023.

The result is reliable ($p < 0.05$), but a correlation coefficient is weak $r = -0.12$. This means that an increase in the number of somatic cells in milk leads to a decrease in milk yield, but

given that there are no cows with mastitis in the herd, this relationship shows a low correlation. At the same time, this relationship is clearly visible in Figure 4, especially in the autumn and summer periods.

The correlation of the number of somatic cells with the qualitative indicators of milk fat and protein also showed a significant relationship (Table 1).

Table 1. The correlation coefficient between the number of somatic cells in milk and the fat and protein mass fraction.

Raw milk quality indicators	Correlation coefficient, r*		
	Fat mass fraction, %	Protein mass fraction, %	Average daily milk yield, kg
Number of somatic cells, thousand units/ml	0.52	-0,21	-0,12

Note: * when p <0.05

There was a high reliable correlation between the indicator of the fat mass fraction and the number of somatic cells. This may mean that with an increase in the number of somatic cells in raw milk, the fat mass fraction also increases. But the protein mass fraction has a negative correlation with the number of somatic cells, which indicates a decrease in the protein index in milk with an increase in the level of somatic cells. In conclusion of the conducted studies, an intermediate conclusion can be made that with an increase in the number of somatic cells in raw milk, there is a decrease in the average daily milk yield and the protein mass fraction, with an increase in the fat mass fraction.

4 Conclusions

1. The level of the fat mass fraction and the protein mass fraction in raw milk for the studied period was on average at the level of 5.80% and 4.42%, respectively.

2. The number of somatic cells was in the range of 96 -162 thousand units/ml, with an average number of 128 thousand units/ml for the entire study period.

3. There was a significant negative correlation between the average daily milk yield and the protein mass fraction to the number of somatic cells in milk r = -0.11 and r = -0.21, respectively. As well as the high positive correlation of the fat mass fraction and the level of somatic cells r = 0.52.

4. According to the results of all studies, it was found that the milk under study meets Russian standards in terms of quality and belongs to the category of the highest grade.

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