Evaluation of milk quality indicators depending on seasonality in the conditions of JSC Kirov Volgograd region

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Abstract. The paper presents the results of studying the influence of the season on the change in the physico-chemical and amino acid composition of milk obtained from black-and-white cows. During the analysis, it was revealed that the composition of milk throughout the year was not constant. The highest fat content in milk was produced in autumn and winter, while the highest protein content was found in spring and summer milk. The amino acid composition of milk in the autumn-winter period is higher compared to the spring-summer period, which is due to a change in the diet, namely the predominance of concentrated feeds in winter. Based on the data obtained, it can be assumed that the milk produced by JSC named after Kirov, meets all requirements and can be recommended for the production of high-quality food.

1 Introduction

Milk is an indispensable food product that contains in its composition all the necessary elements to ensure the normal functioning of the human body, it contains in its composition at least 100 important substances that are necessary for the construction of bones, blood and nerve tissues. The components of milk are easily absorbed by the body. The completeness of the chemical composition of milk is incomparable with the composition of other natural foods [3,4,5].

Currently, milk production is one of the most profitable areas of animal husbandry, but it remains one of the most difficult both technologically and economically. Knowledge, a scientific and technical approach and the introduction of best practices are necessary to increase the number of livestock, obtain large milk yields of cows and high-quality products. The qualitative properties of raw milk and its suitability for further processing directly depend on factors such as the breed of the animal, health status, lactation stage, age, as well as external factors. [1,8,9,10].

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The purpose of this work is to assess the influence of the time of year on the qualitative and amino acid composition of the obtained raw milk in the conditions of the JSC "im. Kirov".

2 Materials and methods

The research was carried out on the basis of the dairy complex of JSC Kirov Staropoltavsky district of the Volgograd region. The object of research was a dairy herd of a black-and-white breed. Keeping animals is tethered: in winter – in cowsheds by compartments, in summer – in open bases that do not have canopies.

Studies of milk samples were carried out in the laboratory of the Volga Research Institute for the Production and Processing of Meat and Dairy Products. Fat was determined by acid method, protein by formol titration, acidity by indicator meth in the presence of phenolphthalein and density by hydrometric. The analysis of the amino acid composition of milk was carried out by capillary electrophoresis of Kapel-105M.

The obtained data were processed using software and statistical methods.

3 Results and discussion

Feeding and keeping of the studied animals were carried out under the same conditions. Cows were fed a standard diet approved on the farm, which was compiled taking into account the age, sex of the animal, as well as the physiological state. The feeding ration of dairy cows in different periods of the year is presented in Table 1.

Table 1. The feeding ration of dairy cows in winter and summer with an average milk yield of 20 kg/head.

Feeds	Units of measurement	Season of the year	
		Winter	Summer
Corn silo	kg	25.00	–
Grain-legume hay	kg	4.00	–
Haylage	kg	10.00	–
Concentrates	kg	5.00	5.00
Molasses	kg	8.00	10.00
Table salt	g	80.00	80.00
Green mass	kg	–	60.00

According to the data indicated in the table, it can be argued that dry and concentrated feeds predominate in winter, and green mass prevails in the summer season. The nutritional content of the diet is given in Table 2.

Table 2. The content of nutrients in feed in winter and summer with an average milk yield of 20 kg / head.

Indicator	Units of measurement	Season of the year	
		Winter	Summer
Feed units	mj	16.00	14.90
Exchange energy	kg	197.10	179.00
Dry matter	g	23.40	18.80
Raw protein	g	2352.00	2315.00
Digestible protein	g	1610.00	1519.00
Raw fiber	g	4130.00	4560.00

Starch	g	2140.00	2015.00
Sugar	g	1370.00	1340.00
Raw fat	g	485.00	480.00
Calcium	g	115.00	240.00
Phosphorus	g	80.00	72.00
Magnesium	g	30.00	28.00
Potassium	g	108.00	112.00
Carotene	mg	680.00	2500.00

Based on their indicators given in Table 2, it can be concluded that the feed has a sufficiently high nutritional and energy value.

The quality of dairy products and the volume of its output depends on the composition of milk, which is due to its nutritional and biological value. Based on this, an important point in the production and processing of milk is to study the influence of various factors on the change in the chemical composition of milk [7].

Table 3 shows the results of analyses of milk from cows of the black-and-white breed of JSC Kirov in different seasons.

Table 3. Qualitative indicators of cow's milk for 2022.

Indicator	**Season of the year**			
	Winter	**Spring**	**Summer**	**Autumn**
Fat, %, not less	4.44±0.06*	4.18±0.05	4.08±0.04***	4.21±0.05
Protein, %, not less	3.45±0.02***	3.35±0,01*	3.32±0.01***	3.38±0.02
Acidity, °T	16.00±0.45	16.00±0,51	17.00±0.41	16.00±0.44
Density, kg/m3, not less	1029.88±21.34	1029.77±22.34	1029.27±22.01	1029.95±21.56

Note: differences with P <0.05 were considered significant: ** * P <0.001; ** P <0.01; * P <0.05

Based on the results shown in Table 3, it can be concluded that the qualitative indicators fluctuate slightly. When comparing the average for the studied herd, a decrease in the fat and protein content in milk was observed in the spring and summer periods. Changes in the quality of milk in different periods of the year are associated with external factors, namely the composition of the diet, humidity and temperature. Thus, the maximum fat and protein content in milk was observed in autumn and winter. This is caused by an increase in the content of feed units, carbohydrates, digested protein, as well as vitamins and minerals in the diet. The average mass fraction of fat in spring and summer was 4.1%, and in autumn and winter - 4.3%. The protein content in spring and summer was -3.3%, in autumn and winter it increased to 3.4%, respectively. The indicators of fat and protein in milk were in a ratio to each other in different seasons of the year from 1.24:1 to 1.28:1, which may indicate balanced feeding. The changes in density were insignificant and corresponded to the norm. The acidity remained virtually unchanged throughout the entire time and was within the normal range.

The protein contained in milk is one of the main components. Unlike meat or fish proteins, milk proteins have the greatest value and are also digested faster. The composition of milk proteins includes casein, globulin, albumin, which contain essential amino acids necessary for the human body. One of the important indicators of milk quality is its amino acid composition. The importance of amino acids in human life cannot be overestimated. An insufficient amount or their complete absence has a detrimental effect on the normal functioning of the body. For example, a deficiency of arginine, lysine and tryptophan can lead to improper functioning of reproductive functions. With a lack of methionine in the diet, infertility is observed [6].

Amino acid composition of milk obtained from the studied cows of JSC Kirov, is shown in Firure 1.

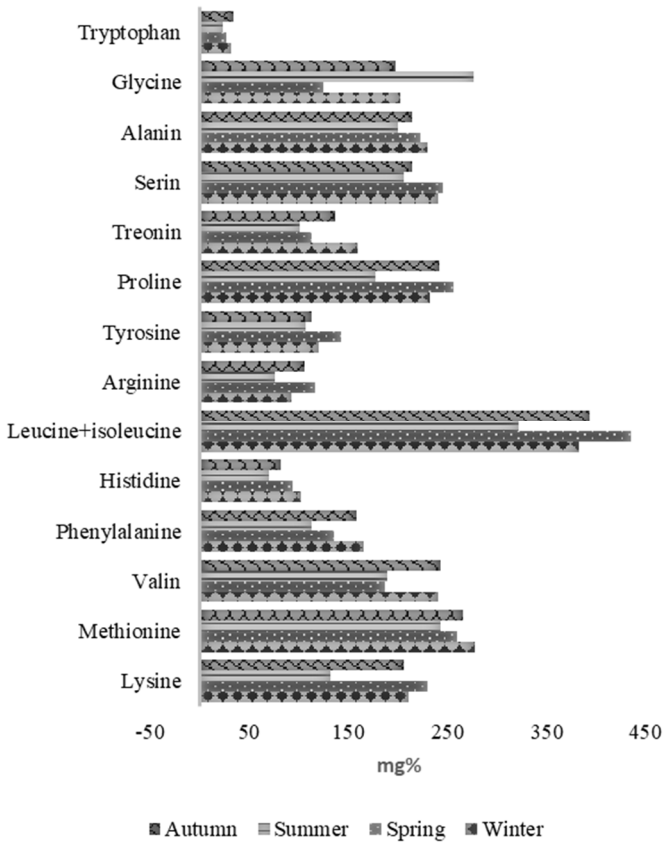

Fig. 1. The content of amino acids in milk depending on the season of the year.

Analyzing the data obtained, it can be concluded that the highest indicators of the number of essential amino acids were in the autumn-winter period. The largest number of essential amino acids in winter are lysine (277 mg%), phenylalanine (165 mg%), the level of methionine (92 mg%) was lower in comparison with the spring and autumn periods by 1.26 and 1.14 times, respectively. The sum of essential amino acids in the winter-spring period was almost the same 1227-1228 mg%, summer – 984mg%, autumn - 1205 mg%. In all lactation seasons, the largest proportion of interchangeable amino acids in cow milk protein belongs to tyrosine, proline and serine. The highest indicator of the total number of interchangeable amino acids was observed during lactation in winter.

The ratio of interchangeable and essential amino acids at different times of lactation was – in winter - 0.84, in spring - 0.90, in summer - 0.78, in autumn - 0.86, respectively. The relative content of amino acids in milk protein fluctuates throughout the year, but their total amount was higher in winter and autumn.

4 Conclusion

Based on the experience, it can be concluded that during the entire lactation period, the qualitative composition of milk in the farm of JSC named after Kirov was not permanent. The indicators of the amount of protein and fat in milk were not constant and depended on the season of the year. In the autumn-winter period, qualitative indicators, namely the mass

fraction of fat and protein, amino acid composition, milk from black-and-white cows was higher compared to spring-summer.

The protein content in raw milk in spring and summer was 3.3%, and in autumn and winter it increased to 3.4%. The average mass fraction of fat in spring and summer was 4.1%, and in autumn and winter - 4.3%. Such indicators as titrated acidity and density were within the norm and almost did not change for all periods.

The amino acid composition in the autumn-winter and spring-summer periods had different indicators. Thus, in the autumn-winter period, the highest content of amino acids such as lysine, tyrosine, phenylalanine and threonine were observed, while in the spring period arginine, leucine +isoleucine, methionine, valine and proline predominate, and in the summer glycine.

Thus, studies of the influence of the season on the quality of milk demonstrate the need to adjust feeding diets in a timely manner, thereby preventing metabolic disorders in animals, and constant monitoring of physico-chemical parameters and amino acid composition will allow you to get high-quality milk regardless of the time of year.

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