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INFLUENCE OF A CATTLE BREED ON THE QUALITY OF RAW MILK AND DAIRY PRODUCTS

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Abstract. Increase in yield and quality improvement of the finished product is a relevant matter for milk conversion into dairy products.Milk composition and properties play a primary role in obtaining qualitative and quantitative indicators during milk production.Their role is particularly important for cheese manufacture.Milk quality depends on the cows' diet, lactation stages, keeping conditions, breed and many other factors.The main task of dairy breeding is an increase in milch cow productivity with elevated milk content of the mass fraction of protein, fat and other components, whereas the dairy industry is targeted at improved quality and quantity of output products, which is closely related to characteristics of processed raw materials.The purpose of the article is to study the influence of Jersey and Montbeliardebreeds of the cattle kept at Novomarkovskoye CFU LLC in Voronezh region, Kantemirovka district, Novomarkovka settlement, on milk composition and properties, cream, butter, curd production, cheese ripening and organoleptic characteristics of the product.The Russian semi-hard cheese was produced from the same amount of milk, following which yield, quality and organoleptic characteristics of the finished product were evaluated to assess the influence of a cattle breed on the quality of rennet cheeses.
Keywords:rennet, butter, curd, cheese, Jersey, Montbeliarde

Introduction

With the industrial technology of milk production at Novomarkovskoye CFU LLC in Voronezh region, Jersey and Montbeliardefresh cows featured high milk productivity.In the farm, milk productivity of Jersey cows over 305 of the first lactation was 5,765 kg with a daily average milk yield of 18.9 kg of milk with a fat mass fraction of 5.63% and protein mass fraction of 3.66%.Correspondingly, Montbeliardefresh cows yielded 7,200 kg of milk in 305 days of the first lactation with a daily average milk yield of 23.6 kg with a fat mass fraction of 4.22% and protein mass fraction of 3.49%.There is a difference in milk yield, the mass fraction of fat and protein in the first lactation, in which Jersey fresh cows yielded 1,435 kg milk less than Montbeliardecows.The mass fraction of fat and protein in Jersey cows exceeds the mass fraction of fat and protein in Montbeliardecows by 1.41% and 0.17%, correspondingly. [10]

The second lactation of Jersey breed is characterized by the fact that milk yield over 305 days was 5,665 kg with a daily average milk yield of 18.57 kg with a fat mass fraction of 5.61% and protein mass fraction of 3.95%.At the same time, milk productivity of the second lactation of Montbeliardebreed over 305 days was 8,190 kg with a daily average milk yield of 27 kg with a fat mass fraction of 4.17% and protein mass fraction of 3.53%.There is a difference in milk yield, the mass fraction of fat and protein in the second lactation, in which Jersey fresh cows yielded 2,525 kg milk less than Montbeliardecows.The mass fraction of fat and protein in Jersey cows exceeds the mass fraction of fat and protein in Montbeliardecows by 1.44% and 0.42%, correspondingly.

Methods and techniques

Milk samples obtained from Jersey and Montbeliardebreeds and manufactured dairy products:sweet butter, curd, semi-hard rennet cheeses were used as test subjects.

The size and quantity of milk's fat globules of the breeds under study were determined by diluting the milk with water at 1:100. One drop of diluted milk or cream was applied on a slide, covered with coverglass and the coverglass was gently forced against the slide.Vaseline was applied on coverglass edges to seal the preparation.The preparations were left to rest at a room temperature from 15 min to 1 h for the fat globules to rise to the surface.After setting, the preparation was placed on a microscope stage and an eyepiece micrometer was used to determine the size of fat globules with a magnification of 1,350 power (lens 90, eyepiece 15 with immersion).The fat globules were divided into fractions (groups) by diameters subject to microscopic augmentation and established division value of the eyepiece micrometer.

The size of the fat globules was expressed as a mean diameter.

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1 cm^3 of milk contains from 1.5 bln to 3 bln fat globules on the average.The diameter of the fat globules ranges from 0.1 to 10 mcm with 3 to 6 mcm prevailing.

The cream was produced by milk separation, butter was produced by churning, Russian semi-hard cheese was produced by acid-rennet method and curd was produced by the acid method at a laboratory of the veterinary medicine and cattle breeding technology chair of Voronezh State Agricultural University named after Emperor Peter the Great.

Russian semi-hard cheese production by acid-rennet method included milk's preliminary pasteurization and standardization, heating of the standardized mixture to 35ºC, preparation of the starter based on Lactococcuslactis subspecies lactis, LactococcusLactis subspecies cremoris, Lactococcuslactis subspecies lactisbioorderdiacetylactis, addition of the starter in the amount of 6.25 DCU per 100 l of heated milk to 35-37ºC with continuous stirring, setting at this temperature for 20-40 minutes, addition of calcium chloride brine in the amount of 20 g per 100 liters.Setting for 10 minutes, addition of liquid rennet with setting for 30-60 minutes to obtain a dense curd, cutting of the ready curd discharging transparent serum with a size of 2-4 cm, mixing of the cut curd, discharge of 30% of the serum, addition of water heated to 40ºC in the amount of 20% of the milk's mass, cheese grain mixing while maintaining a temperature of 40ºC, cheese grain dispensing into pressing molds or bags, mold pressing with a load of 2-3 kg per mold. 30 minutes after pressing, the serum discharged was removed with cheese head tumbling in the mold, pressing with a load of 4-5 kg per mold for 12 hours and further drying of cheese heads in a dry place at a temperature of no more than 8ºC for 2 days [1-5].

The butter production method by churning included milk acceptance in accordance with GOST R 52054-2003, separation at a temperature of 35-40°C to obtain cream with the desired mass fraction of fat, cream pasteurization at a temperature of 85°C without setting, low-temperature treatment (cream physical ripening) at a temperature of 2-4°C. In line with this process, following thermal treatment, cream was chilled to a temperature below the butter fat solid point and was set for a certain time.Cream physical ripening results in enhanced emulsion stability and fat dispersion and change in cream viscosity [16].

Butter fat consolidation plays an important role in butter formation.Butter fat in the form of butter grains may be isolated when creaming only subject to consolidated butter fat.Low-temperature treatment contributes to proper butter consistency and normal fat withdrawal to buttermilk. [9]

With cream holding, fat globule membranes undergo changes.Fat globules membranes get thinner, destruction occurs easier, some membrane substances, in particular, phospholipids pass into plasma.Membrane's electric charge decreases, which results in the approximation and aggregation of fat globules [12]

The ripened cream was beaten at a temperature of 12-14°C for 30-35 minutes to obtain butter grain and buttermilk, following which the butter grain was washed with water with a temperature equal to the temperature of the buttermilk produced and, during the second washing, 1-2°C lower [15].

The conventional acid-based curd production method included milk acceptance in accordance with GOST R 52054-2003, milk treatment with a milk cleansing separator at a temperature of 35-40°C, milk pasteurization at a temperature of 70-80°C with a setting for 20-30 s, milk cooling to the inoculation temperature – 28-30°C in the warm season, and 30-32°C in the cold season, inoculation with Lactococcuslactis, Lactococcuscremoris, Lactococcusdiacetylactis, Str.Thermophilus (freeze-dried direct starter material, heterofermentative starter with prevailing mesophilic bacterial population) in the amount of 4 DCU per 100 l of milk, calcium chloride at the rate of 40 g per 100 l of milk, milk ripening for 6-8 hours until a curd is formed, curd cutting with further serum separation, curd cooling, filling and packing and finished product storage at a temperature of not higher than 8°C and a humidity of 80-85% [14].

Organoleptic evaluation of Russian semi-hard cheese samples was conducted by a taste panel.

The taste panel was set up for the tasting assessment of Russian semi-hard cheese samples produced by an acid-rennet method from Jersey and Montbeliardemilk.

Organoleptic tests were conducted in full conformity to GOST 32260-2013 Semi-hard cheeses.Specifications.

The testing room was in close proximity to the sample preparation point.The area of the tasting assessment room was no less than 36 m^2, 15-20 of which were allocated to the experts (tasters) with the remaining area used for sample preparation and other additional activities.The room is well ventilated, no drafts, vibration- and noise-protected, sufficient uniform illumination. [7]

For the tasting assessment, the tasters were provided with documents for the products to be assessed, tested product score scales, expert sheets, and pens, neutralizers to restore gustation, napkins, metal rulers, dishes for waste collection, neutral-odor soap, etc.

Cheese point samples collected with a knife are cut into strips or segments (strips 75-80 mm long, 40-45 mm wide and 2.5-3.0 mm thick).It should be remembered that the tests are to be conducted once the samples have been prepared.Point samples belonging to the same product group should be combined in a set.A set of samples is provided for the tasting assessment with an increase in the fat mass fraction in the product or with an increase in the ripening period [6].

Cheese organoleptic indicators are monitored on the whole head followed by the cut product.The product appearance is assessed by the portions to be monitored.The flavor is assessed by smelling strips, segments or stacks of the product being assessed.However, the final flavor is only assessed when the product is tasted.Consistency is first assessed on breaking followed by biting and, eventually, on chewing.According to regulations, assessment results of single organoleptic examinations are to be documented in the a report comprising the following data:testing date and place; list

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of members of the expert (taste) panel; assessment purpose; details of tested product samples; production date, batch number, sample code; sampling date and time; full name of the person in charge of sampling, results of statistical processing of panel members' assessments; panel's opinion; signatures of the chairman and secretary of the expert (taste) panel.

Based on the overall organoleptic evaluation of the quality of semi-hard cheeses, they are divided into grades that are determined based on the score as per table 1.

Table 1 – Semi-hard cheese quality differentiation based on the score [16]

Grade	Overall rating	Taste and flavor assessment, score, NLT
Superior	87-100	37
First	75-86	34

Experimental butter production resulted in butter yield data shown in table 2.

Table 2 – Cream and butter production from test cows' milk

No.	Product	Indicators	Breed	
			Jersey	Montbeliarde
1	Milk	Milk weight, g	20,000.00	20,000.00
2	Cream	Skimmed milk weight, g	18,286.00	18,934.00
3		Cream weight, g	1,714.00	1,066.00
4		Cream yield, %	8.57	5.33
5	Butter	Cream weight, g	1,000.00	1,000.00
6		Butter weight, g	738.00	682.00
7		Butter yield, %	73.80	68.20
8		Butter milk weight, g	262.00	318.00
9		Buttermilk yield, %	26.20	31.80

Table 3 provides data on Russian semi-hard cheese production from the milk of the breeds tested.Organoleptic indicators of the ripened Russian semi-hard cheese were assessed with a grade assigned to each product tested (table 4).

Table 3 – Yield of Russian semi-hard cheese from the milk of various breeds

Indicators	Breed	
	Jersey	Montbeliarde
Milk weight, g	5,000	5,000
Post-production cheese weight, g	1,135.41	875.0
Serum weight, g	3,864.59	4,125.0
Post-brining cheese weight, g	903.71	767.9
Post-drying cheese weight, g	802.67	667.31
Post-ripening cheese weight, g	695.15	580.36
Post-production cheese yield, %	22.71	17.50
Serum yield, %	77.29	82.50
Post-brining cheese yield, %	18.07	15.36
Post-drying cheese yield, %	16.05	13.34
Post-ripening cheese yield, %	13.90	11.61

Table 4 – Organoleptic evaluation of Russian semi-hard cheese

Organoleptic evaluation criteria	Product score by breed	
	Jersey	Montbeliarde
Flavor and taste, score	44	43
Consistency, score	25	25
Color, score	5	5
Pattern, score	10	10
Appearance, score	10	10
Packing and labeling, score	5	5
Total, score	99	97
Grade	Superior	Superior

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Results and discussion

The size of fat globules is of practical importance as it determines the degree of fat conversion into the product in the production of cream, butter, cheese, curd and other dairy products [16].

Particles remain dispersed in the liquid phase in a stable emulsion or suspension, which is ensured by a thin layer (coating) on the surface of dispersed globules.This layer creates an energy barrier on the surface of fat globules and prevents their aggregation [18].

Being fine particles, the fat globules move in a manner similar to Brownian motion and collide due to their large number, which inevitably results in their aggregation to form bigger fat droplets.Nevertheless, this virtually does not occur in the milk not exposed to heavy mechanical and thermal treatment [13].

Table 5 – Size and quantity of fat globules in the milk of the breeds under study

Breed	Size of fat globules, mcm	Quantity of fat globules, 10^9/ml
Jersey	7.9	3.5
Montbeliarde	6.2	3.2

It follows from table 5 that Jersey milk leaves Montbeliardemilk behind in terms of the size and quantity of fat globules per 1.7 mcm and 0.310^9/ml, correspondingly.This implies that the milk from these cows may be recommended for the production of cheese, butter, curd and other dairy products. [11].

When butter and cream are produced, Jersey cows yield 3.24% more cream and 5.6% more butter from the same quantity of milk of the breeds under study.

Cheese yield directly correlates to the milk animal's breed.Jersey cows yield 2.29% more cheese compared to Montbeliardecows (table 3).

Specifications of Russian semi-hard cheese produced from Jersey cows' milk conforms to GOST 32260-2013 Semi-hard cheese.Specifications (table 4).The product under study has a hard even crust, no defects. Head cheese has a latex coating, which ensures the good appearance of the product.This product has a pronounced cheese flavor.The consistency is moderately elastic, homogenous.In section, the cheese has a pattern comprising irregular and angular eyes that are evenly distributed throughout.Thecheeseisofa yellowishcolor, homogenousthroughout.

Specifications of Russian semi-hard cheese produced from Montbeliardecows' milk conforms to GOST 32260-2013 Semi-hard cheese.Specifications.The product under study also has a hard even crust, no defects or thicksubcrustal layer. Head cheese also has a latex coating. This product has a pronounced slightly acid cheese flavor.The consistency is moderately elastic, somewhat dense, homogenous.In section, the cheese has a pattern comprising irregular and angular eyes that are evenly distributed throughout.Thecheeseisofwhitecolor, homogenousthroughout [8].

Besides butter and cheese quality, curd was also assessed; curd yield data is provided in table 6:

Table 6 – Jersey and Montbeliardemilk curd yield

Indicators	Breed	
	Jersey	Montbeliarde
Skim milk weight, g	10,000.00	10,000.00
Curd weight, g	1,401.00	1,247.00
Serum weight, g	8,599.00	8,753.00
Serum yield, %	85.99	87.53
Curd yield, %	14.01	12.47

One may conclude from table 6 that processing of the Jersey milk skimmed into curd yields 1.54% more product.

Conclusion

The studies conducted confirm that the milk from Jersey cows has better production indicators, which enables a major increase in butter, cheese, curd yield, which, in its turn, justifies the use of this milk for the production of dairy products with high protein and butter fat content.

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