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Sheep Breeding For Dairy Herd, Composition And Technological Properties Of Raw Milk.

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ABSTRACT

The article is written on the basis of long-term research data on milk productivity of sheep of different breeds and crossbreeds, sheep breeding by body weight, shape and measurements of udder, milking operation, evaluation of composition, properties, quality of milk and its processing into fermented dairy products. The article presents the methods of sheep breeding according to milk yield by interbreeding, particularly purebred ewes of the Altai breed with rams of the Romanov breed, and received cross breeds with rams of the Askanian breed and methods of breeding of local hair sheep by prolificacy and milk producing ability of ewes. Special attention is paid to proper feeding providing the diets of both parent groups and lambs with all necessary substances for the *activities* of *daily living* during the period of artificial rearing, weaning and fattening – as an important factor in obtaining high productivity of animals. The evaluation of milk producing ability of ewes in the suckling period was performed on the basis of the results of control milking operation. The optimal period for weaning lambs is determined at which it is possible to maintain high dynamics of growth and development of ewe lambs while using ewes intensively. The amount of milk yield by month of the year, composition and properties of sheep milk are studied. It is established that crossbred ewes produced more milk than purebred ewes by 13-18% which is the result of heterosis after crossing animals of different breeds. The use of pituitrin injection at a dose of 2.5 U (500 IU of oxytocin) five minutes before milking operation for enhancing the benefits of milk and increasing milk yield of ewes by 25%is justified. The study of physical and chemical composition of sheep milk: mass fraction of fat, protein, carbohydrates, acidity, density, abomasal and fermentation test confirmed its suitability for the production of fermented dairy products: cheese “MarcantelFouettes” and *fermented milk drink* made from sheep milk “Bio Yoghurt”. The processing sheep milk by single-shot pressure of gaseous nitrogen at a pressure of 1.4 MPa for 5 minutes to increase the bactericidal phase of milk is proposed.

Keywords: sheep, breed, milk producing ability, milking operation, milk composition.

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INTRODUCTION

In many countries, the share of sheep milk in the total milk production is 20-70 %. The sheep milk is widely used in many countries. Many studies have shown that chemical composition and taste qualities of sheep milk significantly differ from the milk of cows and goats. Sheep milk contains 13-24% of dry substances including total protein 3.0-6.8%, fat 3.9-9.8%, milk sugar 4.0-5.6%, mineral substances up to 1%. Valuable varieties of cheese are produced from sheep milk [1]. Bryndza is most-produced cheese. Therefore, improving the efficiency of sheep breeding, along with meat and wool productivity, is mainly determined by the level of milk producing ability of ewes, milking operation and milk processing [2,3]. The use of sheep milk for the production of food not only replenishes the food market, but also contributes to enhancing the competitiveness of sheep breeding among other branches of animal husbandry. 8-10 kg of bryndza or 6-7 kg of hard cheese can be produced from 40-50 kg of lactation marketable milk yielded from an ewe of any breed, market price of which will exceed the price of wool, especially hard and half-hard, by 3-4 times or more [4]. Therefore, in our opinion, the sheep breeding should not be considered only asa source of wool and meat, butalso as a source of milk and sheepskin. It is known that milk producing ability of ewes of different breeds is not the same. M. F. Ivanov paid much attention to milk producing ability of ewes in his work considering high milk producing ability as one of the requirements in the breeding of ewes. This feature characterizes their biological peculiarities [5]. So Italian Langhe sheep breed produces on average 180 to 259 kg of milk per lactation. In Germany, the ewes of the East Friesian breed produce on average 500 kg of 6.6% milk per6-8 month lactation. Such countries as Turkey, France, Italy, Greece that rank high in the world for the production of sheep milk breed ewes with high-milk yield. Milk yield of ewes per lactation in these countries is: 130; 80-118; 104-222; 98-284 kg, respectively [6,7,8].Among domestic breeds, the Romanov, Lezghin, Andian breeds and other hair sheep, as well as almost all sheep with pure wool have good lactation milk yield. For 100-140 days of lactation the Merino sheep produce 60-100 kg of milk, meat sheep produce60-80 kg. Milk yield of sheep is determined by their fertility. The average milk yield of the single ewes of the Volgograd fine-wool sheep breed was 113 kg and twin ewes – 132-162 kg of milk.

MATERIALS AND METHODS

In the Republic of Mari El, milk producing ability of the Altai ewes, F1 crossbreeds from interbreeding the Altai ewes with rams of the Romanov breed (AL×RO) and F2 cross breeds from inter breeding F1 ewes with rams of the Askanian breed (ASK×(AL×RO) was studied on Shojbulak sky sheep farm. Groups of ewes were formed by the method of pair-analogues, 50 ewes were of the same age and had the same number of lactation. The control milking operation was performed every seven days for two days in a row. Before control milking operation in the evening lambs were weaned from the ewes, and 12 hours later– in the morning milking operation was performed, the obtained milk yield was multiplied by two. Then, to increase milk yield, ten ewes were taken from each group which were given 2.5 U of pituitrin (500 IU of oxytocin)five minutes before milking operation. The chemical composition of sheep milk without injection and with injection of pituitrin was studied (mass fraction of fat in milk –according to GOST 5867-90 “Milk and dairy products. Methods for determination of fat”, mass fraction of protein in milk –according to GOST 25179-90 “Milk. Methods for determination of protein”, mass fraction of lactose was determined by iodometric method, mass fraction of dry substances –according to GOST 3626-73 “Milk and dairy products. Methods for determination of moisture and dry substance”, dry non-fat milk residue (DNFMR) was determined by the calculation method, mass fraction of ash – by incineration, such physical and chemical properties of milk as density – according to GOST R 54758-2011 “Milk and dairy products. Methods for determination of density”, acidity – according to GOST 3624-92 “Milk and dairy products. Titrimetric methods for acidity determination”). Body weight of lambs at birth, their growth during the period of suckling until weaning were studied by individual weighing and taking measures of the body. The fattening quality of ram lambs was determined by the absolute gain, average daily gain and cost of feed per 1 kg of body weight gain.

Milk productivity of ewes of the local hair sheep, the technology of their use (stabling and grazing, feeding, mating, lambing, machine milking) and quality of sheep milk were studied on the sheep farm“Lukoz”. The group of 30 ewes was made. Milk producing ability of ewes was determined by control milking yieldevery month. Every month,100 samples of milk were studied on the physical and chemical composition of milk and its suitability for the production of fermented products (mass fraction of fat, protein, acidity and density) by standard methods mentioned above in the laboratory of the cheese factory in the settlement of Sernur. The dynamics of growth and development of ewe lambs with intensive use of their mothers were studied by

weighing them at birth and then monthly until sexual maturity by calculating the average daily, absolute, relative gain and coefficient of the increase of the biomass.

RESULTS AND DISCUSSION

The **s**elected Altai ewes had mostly a cup-shaped udder consisted of two longitudinal halves much smaller than in goats, small teats directed forward and to the side. The average length of teats was 3.3 cm, their diameter was 1.7 cm, girth of udder at the base before milking was 39.31±1.2 cm, udder depth was 10.70±0.56 cm, udder length was 12.70±1.07 cm, the distance between teats was 12.09±0.08 cm.F2 cross bred ewes in comparison with F1 crossbreeds had better developed udder, the girth of the udder at the base was 41.53±1.60 cm, that was 5.93 cm more (P≤0.05) than in F1 crossbreeds. However, the length of the udder in the animals of this group was 3.13 cm (P≤0.01) less before milking and 3.23 cm less after it than in the Altai ewes. After milking operation the length of the udder in F1 ewes was 4.10 cm more than in purebred ewes (P≤0.001) and 7.33 cm more than in the crossbred ewes of the second generation (P≤0.01). Crossbred animals have well-developed glandular tissue of the udder, a percentage of length shortening was 14.6% and 27.0%, width shortening was20.2% and 11.3%, respectively. The filling udder with milk can be judged by this indicator. There was a positive correlation between milk yield of ewes of the Altai breed and the length of the udder (+0.568), between milk yield and distance between teats (+0.411), in F2 crossbreeds (+0.559). We consider that the breeding of ewes by their morphological characteristics of the structure of the udder: shape, measurements of udder and teats will increase milk producing ability of sheep.

Lambs and ewes were in the same flock all the time during the suckling period (70 days), and only on control days lambs were separated from the ewes. From the age of 15 days lambs were given supplementary feeding– a mixture of concentrates (barley – 43%, wheat – 18%, peas – 5%, wheat bran – 6%), granules (vetch and oat mixture, glasses-and-legumes hay). Analysis of milk producing ability of the ewes of the Altai breed and their crossbreeds obtained by inter breeding them with rams of the Romanov breed F1(AL×RO) and F2 ewes with the Askanianrams – F2 (ASK×(AL×RO) has shown that the ewes had high milk yield during lactation period of 70 days (Table1).

Table 1: Dynamics of the milk yield of ewes by month of lactation

Month of lactation	Unit	Breed (crossbreed)		
		Altai (n =50 ewes)	F_1 (AL×RO) (n =50 ewes)	F_2(ASK×(AL×RO) (n =50 ewes)
First	kg	24.80±2.68	29.35±1.75	27.71±0.39
	%	47.0	47.2	46.6
Second	Kg	19.44±2.00	22.75±1.81	22.07±1.99
	%	36.8	36.6	37.2
Third	kg	8.53±0.91	10.03±0.88	9.62±0.75
	%	16.2	16.2	16.2
Total	Kg	52.78±5.36	62.15±4.35	59.41±3.93
	%	100	100	100
Average daily milk yield				
First	kg	0.671±0.01	0.864±0.06	0.854±0.02
Second	kg	0.524±0.01	0.635±0.03	0.579±0.04
Third	kg	0.441±0.02	0.544±0.01	0.545±0.03
Average	kg	0.566±0.03	0.708±0.05	0.682±0.05

Cross breeds produced more milk than the purebred ewes – F1by17.7%, F2 by 12.5%, which is due to heterosisas a result of interbreeding animals of different breeds. However, when the control milking operation is performed it is not always possible to milk all the milk from the udder, the administration of 2.5 U of pituitrin before the beginning of milking contributed to the increase in milk yield. As a result, the milk yield of the ewes of all groups increased: milk yield of the purebred Altai breed by 24.9%, F1 crossbreeds by 20.2% and F2 by19.6%. The pituitrin injection caused a change in metabolic processes –increase in the level of fat and dry substance in milk and decrease in the level of protein and DNFMR (Table 2).The pituitrin injection had some effect on the increase in the level of fat in milk. So, mass fraction of fat in milk of ewes that were injected with

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the drug was higher than that of ewes that were not injected – in the Altai ewes by 1.06% (P≤0.01), in F1crossbreedsby 1.58% (P≤0.001) and in F2 crossbreeds by 1.20% (P≤0.01). Mass fraction of protein in the milk of the Altai ewes that were not injected with the drug was higher by 0.37% (P≤0.01), F1 cross breeds by 1.11% and F2 crossbreeds by 0.22%. DNFMR of the milk of the Altai ewes reduced by 0.48% (P≤0.001), of F2 crossbreeds by 0.50% and the decrease in DNFMR of the milk of F1 cross breeds was equivocal. Mass fraction of dry substances in the milk increased in ewes of all groups after the administration of pituitrin and was more in the milk of F1 ewes by 1.48% (P≤0.001).

Table 2: Chemical composition of sheep milk

Indicator	Experimental groups		
	Altai	F_1 (AL×RO)	F_2ACK×(AL×RO)
Mass fraction of fat, %			
without pituitrin injection	5.35±0.27	4.45±0.25	4.98±0.16
withpituitrin injection	6.41±0.28	6.03±0.26	6.18±0.32
Mass fraction of protein, %			
without pituitrin injection	5.60±0.07	5.54±0.08	5.34±0.09
with pituitrin injection	5.23±0.12	5.43±0.07	5.12±0.01
Mass fraction of lactose, %			
without pituitrin injection	4.22±0.13	4.26±0.07	4.37±0.13
with pituitrin injection	4.10±0.13	4.26±0.10	4.09±0.18
Mass fraction of DNFMR, %			
without pituitrin injection	10.67±0.11	10.65±0.09	10.57±0.14
with pituitrin injection	10.19±0.08	10.55±0.16	10.07±0.83
Mass fraction of dry substance, %			
without pituitrin injection	16.02±0.29	15.10±0.27	15.55±0.24
with pituitrin injection	16.60±0.34	16.58±0.28	16.25±0.35
Density, °A			
without pituitrin injection	38.47±0.50	38.37±0.53	38.00±0.46
with pituitrin injection	35.89±0.36	38.09±0.56	36.34±0.62
Acidity, °T			
without pituitrin injection	25.77±0.85	26.02±0.85	23.99±0.79
with pituitrin injection	24.81±1.49	26.00±0.77	23.63±0.58
Mass fraction of ash, %			
without pituitrin injection	0.85±0.012	0.85±0.011	0.86±0.014
with pituitrin injection	0.86±0.013	0.86±0.013	0.86±0.013

There was no certain regularity in the change in the density of milk after administration of the drug. The administration of pituitrin had virtually no effect on the change in the acidity of milk, only in the group of F2 ewes it decreased significantly by 2.3 °T (P≤0.05) in comparison with F1 crossbreeds. Mass fraction of lactose and ash in milk was about the same in the groups.

Breeding lambs under ewes of high milk producing ability contributes to the breeding well-developed strong lambs and getting extra milk. Body weight of lambs (Table 3) produced by the Altai ewes was 4.46±0.3 kg, it was higher than by the crossbreeds, moreover they are often born as twins. At the age of 15 days, the lambs of all groups had an average body weight of 7.43; 6.20,6.8 kg, and the milk yield produced by ewes during this period was 13,60; 15,80; 14,86 kg, respectively, so to gain1 kg of body weight, crossbred lambs drank 4.58; 5.50; 5.70 kg of milk.

When the lambs in the 1st group were weaned, their body weight was 19.95±0.74 kg, which was higher than that of the lambs in the 2nd group by 3.07 kg (P≤0.01), but it did not significantly differ from the body weight of the lambs in 3rd group. As the lambs in the 1st group were mainly singles, they grew more quickly than their twin-peers produced by crossbred ewes F1and F2, that naturally received less milk, and consequently were somewhat behind in growth. Lambs in the 1st group, that received more milk during the suckling period, had broader chest behind shoulders than their peers from the 3rd group by 3.1 cm (P≤0.05).

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Their depth of the chest was 2.3 cm more (P≤0.05), the width in hipswas2.4 cm more (P≤0.001), metacarpus girth was 0.99 cm more (P≤0.05) than in the lambs of the 3rd group.

Table 3: Influence of milk producing ability of ewes on body weight gain of lambs, kg

Indicators, kg	Group of ewes		
	The Altai	F_1crossbreed	F_2crossbreed
Milk yield for 15 days during the suckling period	13.60±1.52	15.80±0.84	14.86±0.84
Average daily milk yield for 15 days	0.90±0.01	1.05±0.38	0.99±0.01
Birth weight of lambs	4.46±0.03	3.33±0.17	4.18±0.12
Body weight of lambs at the age of 15 days	7.43±0.20	6.20±0.20	6.80±0.30
Body weight gain of lambs for 15 days	2.97±0.35	2.87±0.21	2.62±0.29
Amount of milk per 1kg of gain for 15 days	4.58	5.50	5.70

The fattening quality of ram lambs are also determined by milk producing ability of ewes, as the correlation coefficient between milk producing ability of ewes and body weight of ram lambs in the 1st group was +0.442 at the moment of weaning; between milk producing ability of ewes and absolute gain–+ 0.463, between milk producing ability of ewes and average daily gain –+0.465, they needed less feed per 1 kg of gain – 4.94 fodder units against 5.60 in the other two groups. We recommend developing mutton boiled in the skin using milk-protein complex [9].

On the sheep farm “Lukoz” animals are kept in the shedon deep litter in separate sections by age and sex. Manure is removed in spring when sheep are on the pasture. During the stall-feeding period the sheep get legume-grass hay, silage, concentrates and mineral fertilizers. From May to October, they graze on the pasture sowed with perennial grasses. Mating of ewes is in August, lambing starts in January. One ewe had 1.45 lambing per year. 191 lambs were born for every 100 ewes per year (Table 4).

Table 4: Distribution of lambings and born lambs by month of the year

Month	ewes		Born lambs, head			
	heads	%	total	including		Per ewe
				ewe lambs	ram lambs	
January	13	31.70	16	10	6	1.15
February	6	14.63	6	3	3	1.00
March	4	9.76	5	3	2	1.25
April	1	2.44	1	1	-	1.00
July	2	4.88	2	1	1	1.00
August	11	26.83	12	4	8	1.09
September	4	9.76	4	2	2	1.00
Total	41	100	46	24	22	1.91

Lambs after their birth suck mother for 5 days while they are in the shed. Then they are weaned from the ewes and given artificial feed forming drop bands. Ewe lambs are kept together with doe kids on deep litter and get goat milk up to the age of 3 months according to the scheme (Table 5).

Table 5: Scheme of goat milk feeding lambs after weaning from the ewes, kg

Day of the week	Age, week				
	1	2	3	4	5 and more
1	0.5	0.7	0.8	0.9	1.2
2	0.6	0.8	0.9	1.0	1.2
3	0.6	0.8	0.9	1.0	1.2
4	0.6	0.8	0.9	1.0	1.2

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5	0.6	0.8	0.9	1.0	1.2
6	0.6	0.8	0.9	1.0	1.2
7	0.7	0.8	0.9	1.0	1.2

After weaning from ewes, lambs get cereals in the form of milk jelly. From the tenth day they are accustomed to eating dry hay and oats. From the age of 2 months they are fed with extrudable grain feed (oats 60% + rye 40%), if it is available peas or wheat (2%). As mineral feeding, lambs receive lime phosphate and salt brick. In the summer, ewe lambs get green grass from feeders. An important indicator of the value of animals is their body weight (Table 6).

Table 6: Dynamics of the growth and development of ewe lambs with intensive use of ewes

Indicator	Age, month				
	at birth	1	2	3	4
Body weight, kg	3.92±0.16	8.39±0.30	15.90±0.84	22.07±0.82	28.90±1.39
Absolute gain, kg	-	4.47	7.51	6.17	6.83
Repetition factor of gain in the biomassover each period	-	2.14	1.89	1.32	1.31
Relative gain, %	-	114	89	39	31
Average daily gain, g	-	149	250	205	228

It is known that body weight of the ewe is directly correlated with the biomass of the newborn lamb and later determines the value of economically useful traits of the offspring. It is generally accepted that ewes with large body weight for the most part result in larger offspring. Besides, there's influence of the father's characteristics, the level and completeness of the feeding and housing conditions for ewes. Therefore, the selection of animals according to their body weight since birth is an important task when a dairy herd of sheep is formed. The indicator of growth rate is absolute gain in body weight. Under the same conditions, a fast growing animal consumes less nutrients per 1 kg of body weight and more quickly reaches its economic maturity than animals with slow growth. The highest repetition factor of gain in body weight of the ewe lambs in the experiment was in the first month (2.14), further there was a decrease. Average daily gain was different over each period of growth. It was on average 208 g for 120 days of observation. In general, the analysis of the data in Table 7 has shown that early weaning of ewe lambs from ewes and raising them on milk and supplementary feeding have not had a negative effect on body weight of ewe lambs. At the age of 8 months body weight of ewe lambs was 38 kg, which corresponds to 60-65% of the bodyweight of ewes. At 9-10 months age, ewe lambs are mated.

5 days after lambinge wes are milked with machines. Milking operation is performed in a milking-room, in which there are two parallel milking platforms (each for 40 ewes), input and output ladders, troughs for feeding sheep with extrudable concentrates. Milk yield was accounted after each machine milking (Table 7).

Table 7: Milk yield by month of the year

Indicator	The number of milk ewes	Milk yield, kg		
		total	per 1 ewe	
			per month	per day
January	8	70	8.75	0.282
February	12	363	30.25	1.043
March	22	438	19.91	0.642
April	23	469	20.39	0.679
May	23	436	18.96	0.612
June	22	254	11.55	0.384
July	-	24	Milked beforelambing	
August	12	131.3	10.94	0.353
September	17	376	22.12	0.737
October	17	310	18.24	0.588

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November	16	210.2	13.14	0.438
December	-	-	-	-
Total	24	3081.5	128.39	0.422

The amount of milk yield by month of the year was different. 24 ewes produced 3081.5 kg of marketable milk for 10 months, one eweproduced 128.39 kg per month, the average daily milk yield – 0.422 kg. Maximum gross yield on the farm was 17.4% in February, the maximum mass fraction of protein in milk was in March – 5.92±0.04%, the maximum mass fraction of fat was in April – 8.14±0.07% (Figure 1).

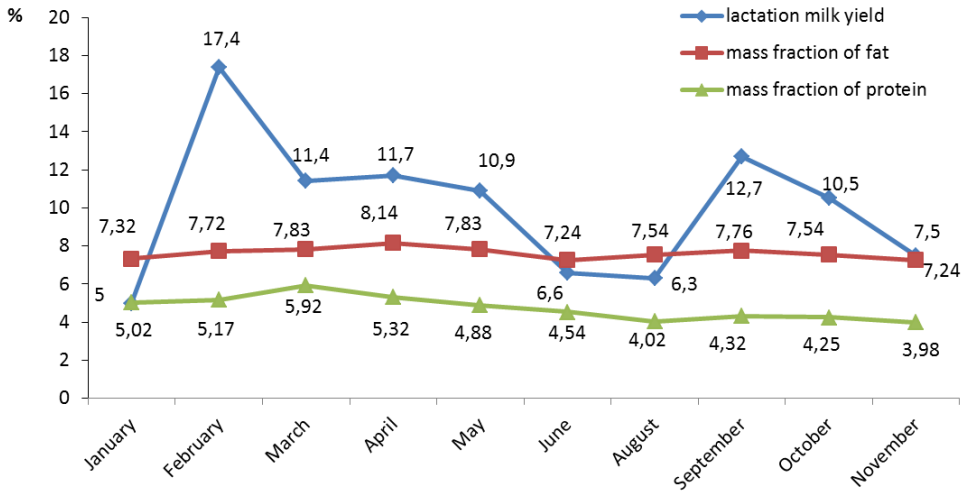

Figure 1: The amount of milk yield, mass fraction of fat and protein by month of the year

Technological properties of raw milk determine the quality of products produced from it. Our studies of physical and chemical composition of sheep milk confirmed its suitability for the production of fermented dairy products. Titratable acidity depends on the level of protein in milk, it was 25°T in autumn and spring, which corresponds to high-quality milk. The increase in titratable acidity up to 26,01±0,11°T in June has shown the presence of products of lactic acid bacteria in bulk milk and the loss of lactose in the process of lactic acid fermentation, but this only contributed to the time shortening of milk souring after the introduction of bifidus bacteria by the technology of fermenting.

To improve the technological properties and microbiological parameters of sheep milk, we recommend single processing bulk milk after receiving before allocation by single pressure of gaseous nitrogen (1.4 MPa) for 5 min followed by a sharp pressure-relief (less than 1 second). Impact on the raw milk of at least Grade A with bacterial content of more than 5×105 CFU/cm^3 does not impair the organoleptic characteristics of milk and causes thedecrease in the number of microflora in comparison with raw milk increasing the bactericidal phase of the milk[10].

It is known that the density of milk is affected by the level of fats, proteins, carbohydrates and mineral salts in it. When the average mass fraction of fat was 7.70% and the average mass fraction of protein was 5.04% for 10 months, this indicator was 1033 kg/m^3.

After cooling, sheep milk is delivered to Sernursky cheesefactory, which is 12 km away from the farm to determine its suitability for the production of fermented dairy products (Table8).

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Table 8: Chemical composition and properties of sheep milk by month of the year

Month	mass fraction, %		Acidity, °T	Density, °A
	Fat	protein		
January	7.32±0.06	5.02±0.09	24.08±0.15	1032.00±0.21
February	7.72±0.08	5.17±0.08	23.01±0.28	1032.50±0.32
March	7.83±0.02	5.92±0.04	25.06±0.14	1033.00±0.19
April	8.14±0.07	5.32±0.05	25.05±0.21	1032.00±0.14
May	7.83±0.03	4.88±0.03	25.00±0.34	1032.20±0.31
June	7.24±0.04	4.54±0.04	26.01±0.11	1034.32±0.20
August	7.54±0.06	4.02±0.03	24.08±0.14	1034.30±0.15
September	7.76±0.09	4.32±0.05	25.01±0.21	1033.48±0.13
October	7.54±0.06	4.25±0.08	25.08±0.35	1033.31±0.21
November	7.24±0.06	3.98±0.09	25.06±0.25	1033.42±0.14

Mass fraction of fat in milk was on average 7.70%; protein – 5.04%for 10 months of milking sheep. Acidity, density, abomasal-fermentation test allowed using sheep milk in the production of cheese "MarcantelFouettes" according to the following scheme: pasteurization at a temperature of 72-76°C → cooling up to 32°C→introduction of starter culture of mesophilic and aroma former bacteria → introduction of enzyme rennet → coagulation → cutting cheese curd → production of grain → heating it up to 39-40°C→ drying out grain → formation of the cheese-head → pressing into molds → packing → cheese ripening from 6 to 12 months.

The enterprise also producesfermented milk drink "Bio Yoghurt" made from sheep milk according to the following scheme: milk receiving → sorting → pasteurization at 92-94°C with exposure for 5 minutes→ cooling it up to 35°C → introduction of starter culture of bifidusbacteria → mixing → packing→ ripening at 35°for 9 hours→ acidity test (75-80°T) → maturing at 8°for 12 hours → storage at 2-6°C for 14 days.

CONCLUSION

The studieshave shown that early weaning of lambs contributes to more intensive use of ewes and receiving milk for processing it into fermented dairy products which have a high biological value and increasinglamb crop for the production of lamb.

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