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THE INFLUENCE OF SOME FACTORS ON TEXTURE OF FRESH CHEESE

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ABSTRACT

The aim of the study was to follow up the properties of cheese mass obtained from ewes' milk depending on the pasteurisation temperature, the kind of starter added and level of calcium chloride addition. The chemical composition, pH and texture of cheese mass produced from raw, pasteurised in 72°C for 15 s, and pasteurised in 95°C for 5 s milks were established. Similarly the cheese mass obtained from pasteurised milk without starter addition, with starter of mesophilic bacteria (*Lc. lactis* ssp. *lactis, Lc. lactis* ssp. *cremoris, Lc. lacits* ssp. *diacetilactis*) and with thermophilic starter (*Str. thermophilus, Lb. delbrueckii* ssp. *bulgaricus*). The same routine was applied to cheese mass obtained from pasteurised milk without $CaCl_2$ addition or with 0.1 g/l, or 0.2 g/l of dehydrated $CaCl_2$ addition.

It was concluded that some cheese mass properties were determined by above listed factors - additives and starter types and type of heat treatment. Cheese mass pasteurised in 93°C had less fat and nitrogen compounds more water and was characterised by lower values for all texture parameters in comparison to mass obtained from not pasteurised milk or from milk pasteurised in lower temperature. Cheese mass obtained with mesophilic

starter had the lower pH, higher hardness and chewiness than mass with thermophilic starter and without starter addition. The addition of $CaCl_2$ caused increase in hardness, adhesiveness and chewiness of cheese mass in comparison to cheese mass produced without $CaCl_2$ addition.

Key words: ewes' milk, cheese mass, composition, pasteurisation temperature, mesophilic starter, thermophilic starter, calcium chloride, and texture

INTRODUCTION

The changes in cheeses' texture depend on the kind (species of origin) and chemical composition of milk, the technological routine and ripening conditions [8]. The research done by Surówka [13] has showed the differentiation in texture of Polish ripening cheeses depending of their kind. Paciorek [10] has stated that properties of oszczypki cheeses produced from raw, not pasteurised milk differed from cheeses in oszczypki type, produced from ewes' pasteurised milk. Balcones et al. [1], Calvo and Espinoza [5] found that the level of pasteurisation temperature influences the curd structure. In the opinion of Green & Grandison [7] the higher pasteurisation temperature of milk the more water is left in the curd. Some other researchers [10,2] have pointed that also the kind of starter added influences significantly some ewes' cheeses properties. Cogan and Daly [6] concern that thermophilic rods show higher fermentative activity than mesophilic and thermophilic cocci that determines the time of ripening and cheese properties. Walstra et al. [14] cited the research results of many authors that had pointed the influence of milk initial pH and $CaCl_2$ addition on whey syneresis process, which, in queue, was an influencing factor for cheese properties especially for their texture. Bencini and Johnston concern that $CaCl_2$ addition to pasteurised milk does not influence the curdling parameters, what, in their opinion, is connected to high amount of calcium naturally present in ewes' milk.

The aim of the study was to assess the properties of cheese mass obtained from raw and pasteurised in different temperature ewes' milk, with or without different starters and different levels of calcium chloride addition.

METHODS

The research material was ewes' milk from farm belonging to Kraków Agricultural University, Poland. The heads of game were 80 ewes of Polish long-fleece breed. An amount of at about 20 l of milk was sampled from cooling tank at morning milking five times during spring season.

The raw milk analyses were done: the dry mass content by drying method, the fat content by the Gerber method, the total nitrogen compounds and casein content by the Kjeldahl method with Büchi apparatus (casein was precipitated with sodium acetate and acetic acid solutions), the lactose content by the Bertrand method [4]. Also assessed were the calcium content by titration method, pH by pH-meter, the density by lactodensimeter, the titration acidity by the Soxhlet-Henkel method, the rennet coagulation time by the Schern method [4].

Three experiments were conducted on ewes' milk.

1. Milk was divided into three parts: the first was not pasteurised, the second was pasteurised in 72°C for 15 s, and the third was pasteurised in 93°C for 5 min. The starter and rennet were added to milk after cooling it to 30°C. The medium hard coagulum obtained after at about 30 min. of incubation was cut into grains 4 to 6 mm

dimensions. Then the curd was stirred and heated to 37°C, stirred still for 5 minutes and filled into the moulds. Then fresh cheese was left still to the next day to "mats".

2. Milk was pasteurised in 72°C for 15 s, cooled to 30°C and divided into three parts: the first was not starter added, the second was started with 1% of mesophilic bacteria starter of direct application (DVS) (*Lc. lactis* ssp. *lactis, Lc. lactis ssp. cremoris, Lc. lactis* ssp. *diacetilactis*), and the third was started with 1% of thermophilic bacteria starter (DVS) (*Str. thermophilus, Lb. delbrueckii* ssp. *bulgaricus*). The rennet was added to each part of milk and the coagulem obtained after 30 min. of incubation, was cut into grains of 4 to 6 mm dimensions. Then the curd was stirred and heated to 37°C, stirred still for 5 min. and filled into the moulds. Then fresh cheese was left still to the next day to "mats".
3. Milk was pasteurised in 72°C for 15 s, cooled to 30°C and divided into three parts: the $CaCl_2$ was not added to the first part, the 0.1 g/l of dehydrated $CaCl_2$ was added to the second part and 0.2 g/l of dehydrated $CaCl_2$ to the third part. Then 1% of mesophilic bacteria starter (DVS) and rennet were added to each part of milk. The coagulem obtained after 30 minutes of incubation, was cut into grains of 4 to 6 mm dimensions. Then the curd was stirred and heated to 37°C, stirred still for 5 minutes and filled into the moulds. Then fresh cheese was left still to the next day to "mats".

The fresh cheeses analyses in each of three experiments were the same: the dry mass content by drying method, the fat content by butyrometric method in van Gulik's butyrometer, the total nitrogen compounds content by Klejdahl method with Buchi apparatus, the calcium content by Mattson and Swartling method and the pH by the pH-meter [4]. The cheese mass texture was measured with TA-Xt2 texture analyser produced by Stable Micro System (GB) with PC registration. The aluminium cylindrical probe of 50 mm diameter was used with 60% compression of sample. The cheese samples were cut into cubes of 20-mm sides. The hardness, adhesiveness, cohesiveness, springiness, chewiness and resilience were measured as firm mass texture parameters.

The results were statistically estimated with Statgraphics v.3.0.

RESULTS

The average content of ewes' milk was: 17.43% ± 0.76 of dry mass, 5.16% ± 0.39 of fat, 5.65% ± 0.67 of total nitrogen compounds, 4.53% ± 0.21 of casein, 4.60% ± 0.12 of lactose and 0.325% ± 0.12 of calcium. The density of milk was 1.036 g/cm^3, the titration acidity 11.3ŞSH ± 0.67, the pH 6.63 ± 0.01 and the milk rennet coagulation time was 228 sec ± 4.9. The above data were in agreement with literature data for ewe milk [3].

There was a significant influence of milk pasteurisation temperature on some fresh cheese properties (tab. 1). The biggest yield of cheese mass was obtained from milk pasteurised in 93°C, what was probably due to whey proteins denaturation [9]. The denatured whey proteins could form complexes with casein giving the irregularly dispersed curd accumulating more water in inside spare spaces [7]. The higher the pasteurisation temperature was the more intensively the process went. The fresh cheese obtained from not pasteurised milk was fatter and included more total nitrogen compounds and more calcium and less water in comparison to cheese obtained from pasteurised milk. The hardness, cohesiveness, chewiness and resilience were higher for the cheese from not pasteurised milk. The fresh cheese obtained from milk pasteurised in 93°C was characterised by lower numbers for all texture parameters

and lower fat, nitrogen compounds and higher water content then cheese obtained from not pasteurised milk and from milk pasteurised in 72°C.

Table 1. The properties of fresh cheese produced from not pasteurised ewe milk, and milk pasteurised in 72°C and 93°C

The properties of fresh cheese	Without pasteurisation		Pasteurisation in 72°C		Pasteurisation in 93°C	
	x	δ	x	δ	x	δ
Yield of cheese [%]	20.23 a	1.35	20.77 a	1.14	24.66 b	1.69
Water [%]	59.50 a	2.39	59.27 a	0.65	64.00 b	2.75
Fat [%]	14.33 a	1.30	13.17b	1.09	12.33 c	1.12
Total nitrogen compounds [%]	22.71 a	2.21	22.20 a	0.68	21.00 a	1.67
Calcium [%]	0.97 a	0.09	0.95 a	0.09	0.82 a	0.08
pH	5.01 a	0.12	5.11 a	0.05	5.11 a	0.05
Hardness TPA [KG]	2.03 a	0.2 2	1.97 ab	0.33	1.13 b	0.25
Adhesivness TPA [KGs]	-0.01 a	0.002	-0.02 a	0.010	-0.02 a	0.008
Springiness TPA	0.88 a	0.02	0.88 a	0.01	0.87 a	0.02
Cohesiveness TPA	0.43 a	0.04	0.36 ab	0.04	0.29 b	0.02
Chewiness TPA [KG]	0.78 a	0.14	0.65 a	0.17	0.30 a	0.11
Gumminess TPA [KG]	0.88 a	0.15	0.74 a	0.19	0.34 a	0.13

a, b, c - statistically significant differences between the averages with differ letters in rows ($p \leq 0.05$)
x - mean δ - standard error

Paciorek [10] was examining the texture of “oszczypki” cheeses made of not pasteurised ewes’ milk and cheeses, in “oszczypki” type, made of milk pasteurised in 72°C, and concluded that the differences between texture parameters for these cheeses were small with except of adhesives. The adhesives for “oszczypki” was twice lower then for cheeses produced from pasteurised milk what was confirmed in this study.

The fresh cheese obtained from pasteurised in 72°C milk, without acidifying starter addition, and with mesophilic or thermophilic bacteria starter addition, did not differ statistically in dependence of starter added but the statistically significant differences were in dependence of pH, hardness and chewiness. The pH of cheese with mesophilic bacteria starter addition was significantly lower and hardness and chewiness higher then cheese with thermophilic bacteria starter and without starter addition (tab. 2). The results presented by Walstra et al. [14], showed that with lowering of milk pH the intensity of syneresis rose, what was confirmed in this study. As shown in table 2 the cheese with mesophilic starter addition was characterised by the lowest pH, contained the smallest amount of water and the biggest hardness. The research of Paciorek [10] showed that ewe’ cheeses, in oszczypek type, produced from

pasteurised milk with mesophilic starter addition included less water and more total nitrogen compounds then cheeses with thermophilic bacteria starter addition. The similar results were obtained in this research.

Table 2. The properties of fresh cheese produced from ewe milk without starter and with thermophilic and mesophilic starters

The properties of fresh cheese	Without starter		Starter of mesophilic bacteria		Starter of thermophilic bacteria	
	x	δ	x	δ	x	δ
Yield of cheese [%]	24.94 a	1.67	24.22 a	1.62	25.45 a	0.94
Water [%]	62.97 a	1.26	60.79 a	1.79	62.99 a	1.76
Fat [%]	11.89 a	0.60	13.66 a	1.88	12.67 a	0.60
Total nitrogen compounds [%]	19.32 a	1.23	20.87 a	1.16	18.94 a	0.58
Calcium [%]	0.91 a	0.04	0.90 a	0.08	0.85 a	0.02
pH	6.55 A	0.26	5.11 B	0.09	6.40 A	0.20
Hardness TPA [KG]	1.64 ab	0.21	1.88 a	0.31	1.33 b	0.25
Adhesivness TPA [KGs]	-0.008 a	0.0003	-0.009 a	0.003	-0.006 a	0.0003
Springiness TPA	0.90 a	0.01	0.91 a	0.01	0.87 a	0.02
Cohesiveness TPA	0.44 a	0.02	0.40 a	0.04	0.40 a	0.06
Chewiness TPA [KG]	0.64 ab	0.07	0.70 a	0.18	0.47 b	0.15
Gumminess TPA [KG]	0.71 a	0.09	0.77 a	0.20	0.55 a	0.19

a, b - statistically significant differences between the averages with differer letters in rows ($p \leq 0.05$)
A, B - statistically highly significant differences between the averages with differ letters in rows ($p \leq 0.01$)
x - mean
δ - standard error

In table 3 the results of physical and chemical analyses of fresh cheese obtained from milk without $CaCl_2$ and with $CaCl_2$, in amount of 0.1 and 0.2 g/l, addition are shown.

The $CaCl_2$ did not influence significantly the cheese properties. There could be observed the lower cheese yield then for cheese without $CaCl_2$ addition. The lower hardness and chewiness of cheese without calcium was measured in comparison to cheese with $CaCl_2$ addition. Bencini and Johnston and Balcones et al. stated that there was not significant influence of calcium addition, to pasteurised milk, on milk coagulation parameters. In the opinion of Alichanidis, cited by Bencini and Johnston [1], the ewe's milk does not need the calcium addition for proper cheese production process, because the milk contains enough calcium itself.

Table 3. The fresh cheese properties produced from ewe milk with different $CaCl_2$ level of addition

The properties of fresh cheese	Without $CaCl_2$		With addition of $CaCl_2$ 0.1 g/l		With addition of $CaCl_2$ 0.2 g/l	
	x	δ	x	δ	x	δ
Yield of cheese [%]	21.92	1.60	25.42	1.99	23.44	2.18
Water [%]	59.86	2.43	60.27	2.36	60.73	2.53
Fat [%]	14.17	0.44	15.50	1.73	12.67	1.45
Total nitrogen compounds [%]	21.00	1.42	20.64	1.24	21.06	1.43
Calcium [%]	0.92	0.07	0.86	0.09	0.97	0.10
pH	5.06	0.05	5.06	0.05	5.09	50.03
Hardness TPA [KG]	1.31	0.33	1.59	0.59	1.82	0.55
Adhesivness TPA [KGs]	-0.006	0.0007	-0.013	0.005	-0.010	0.007
Springiness TPA	0.86	0.02	0.87	0.02	0.85	0.02
Cohesiveness TPA	0.38	0.02	0.42	0.05	0.37	0.03
Chewiness TPA [KG]	0.43	0.12	0.65	0.30	0.62	0.22
Gumminess TPA [KG]	0.51	0.14	0.75	0.34	0.72	0.24

x - mean
δ - standard error

CONCLUSIONS

1. It was stated that the temperature of milk pasteurisation had the influence on some fresh cheese properties.
2. The cheese obtained from milk pasteurised in 93°C contained less fat and nitrogen compounds, more water and was characterised by lower numbers for all texture parameters then cheese obtained from milk pasteurised in lower temperatures and not pasteurised at all.
3. The fresh cheese with mesophilic bacteria starter was characterised by lower pH; higher hardness and chewiness then cheese with thermophilic bacteria starter and without starter addition.
4. The additive of $CaCl_2$ to ewe's milk pasteurised in 72°C did not have the significant influence on fresh cheese properties.

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