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COMPARATIVE STUDY OF SHEEP MILK, WHEY AND TRADITIONAL KASHKAVAL FROM GALICHNIK AND LAZAROPOLE

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Abstract

Traditional cheeses are a reflection of the local rural environment, culture and nature expressed by experience of masters through many decades. In recent years, it is noticed increased consumption of traditional sheep dairy products, especially cheese produced by traditional technology. The purpose of this study was to examine the quality of raw sheep's milk and whey during the production of traditional sheep cheese from two locations, Galichnik and Lazaropole. Samples were taken in four iterations. The physico-chemical composition on the 100th day of ripening of cheese is presented also. The mean fat content was $8.45 \pm 1.157\%$ in milk from Galichnik and $8.69 \pm 0.846\%$ in milk from Lazaropole, while the protein was $6.34 \pm 0.837\%$ and $6.15 \pm 0.242\%$ respectively. Titratable acidity in Galichnik milk was 10.33 °SH and the milk from Lazaropole has 10.50 °SH. The Total bacteria count (TBC) and the Somatic cell count (SCC) in both locations showed wide range due to nonstandard sanitary procedures applied in primary production. The results of the chemical composition of whey showed that it has a variable composition, particular in the content of fat (Cv= 9.02% Galichnik and 21.98% Lazaropole) due to the traditional procedure for making cheese. The moisture content of the cheese on 100th day of ripening was 36.64% in cheese from Galichnik and 32.63% in Lazaropole cheese. The mean value for fat content was 27.88% and 30.00% for cheese from Galichnik and Lazaropole respectively. According to the classification of cheese in terms of moisture content on a fat-free basis, after 100 days of ripening, the kashkaval cheese from Galichnik had fallen in the group of hard cheeses, while the kashkaval cheese from Lazaropole belong to the group of extra-hard cheeses. Regarding the fat in dry matter, both cheese variants were on the border between medium fat and full fat cheeses.

Keywords: quality of milk, physico-chemical composition, traditional cheese.

Introduction

In recent years, it is noticed increased consumption of traditional sheep dairy products, especially cheese produced by traditional technology. One of the famous cheese produced in Macedonia is traditional sheep kashkaval from the Bistra mountain. The Bistra Mountain is located in western Macedonia, and it belongs to the group of mountains from the Sharplanina area. The specific climatic conditions, hilly mountain as well as the sheep breeding tradition, are excellent preconditions for the production of the cheese in this region. Milk for the production of cheese on mountain Bistra originates from local breeds, which are adapted to the specific geographical and climatic conditions. They are characterized with high resistance to climatic conditions, but also low milk yield (60-80 l during lactation). Ripening of hard cheese varieties is a long and costly process because of capital immobilization, storage facilities, weight losses, and spoilage caused by undesirable fermentations (Garde et al., 2002). Beside many factors, the final quality of the artisan cheese depends the local human factor - the cheese-maker also. The use of raw unpasteurized milk to produce a cheese that takes months to ripen puts considerable pressure on the capacity of the cheese-makers. It is the cheese-maker's professional skills that ensure that the various phases in the cheese making process are carried out correctly. He relies on his years of experience and training when making these decisions (De Roest, 2000). Although the traditional cheeses are recognized as

important for cheese producers, they are losing battle from the industry and they might extinct (Miajcevic et al., 2005). In Macedonia, the number of traditional cheese producers is continuously decreasing (Santa and Sbrinowska, 2014). Furthermore, information about Macedonian kashkaval is relatively scares. Thus, there is a need for more on research and compilation of data for traditional cheese. Based, on this research the traditional cheeses can be protected and receive PDO or PGI indication. The purpose of this study is to identify data for traditional cheese by examining the quality of raw sheep's milk and whey during the production of traditional sheep cheese from two locations, Galichnik and Lazaropole.

Material and methods

The samples of bulk milk intended for cheese production and whey were taken in four iterations collected from two farms on Mountain Bistra (Galichnik – Variant A and Lazaropole Variant B), transferred under refrigerated conditions (4-6°C) and analyzed immediately. Milk samples were analysed for the content of dry matter, fat, protein, lactose and solids nonfat by infrared analyser Milkoscan. Active acidity was measured with pH meter (Mettler Toledo, Spain) and titratable acidity according to the Soxhlet Henkel method (Carić et al., 2000). The total number of bacteria for the raw milk was measured with Bacto Scan FC, while the number of somatic cells was measured with SomaScope. Cheese samples from four batches were taken on the 100th day of ripening. The cheese composition was analyzed by standard methods : dry matter (EN ISO , 2004), fat (EN ISO , 2008), protein (FIL-IDF, 1993), water soluble nitrogen (Pejić and Đorđević , 1963); salt (Mohr's method, Pejić and Đorđević , 1963), ash (Carić et al ., 2000), pH (Mettler Toledo, Spain). Moisture content on a fat-free basis and Fat in dry matter were calculated.

Results and discussion

Quality of raw sheep milk used for the production of kashkaval cheese

Results of the physico-chemical composition of raw sheep milk used for the production of variants of cheese A and B are presented in Table 1.

Table 1. Quality of raw sheep's milk, for the production of cheese from variant A and variant B (n=4)

Parameter	Variant	\bar{x}	Min	Max	Sd	Cv
Milk fat (%)	A	8.45	7.08	9.89	1.157	13.68
	B	8.69	7.54	9.54	0.846	9.75
Protein (%)	A	6.34	5.78	7.57	0.837	13.20
	B	6.15	5.97	6.50	0.242	3.93
Lacotose (%)	A	4.12	3.67	4.46	0.372	9.03
	B	4.30	4.15	4.51	0.164	3.91
Solids non fat (%)	A	11.49	10.83	12.49	0.779	6.78
	B	11.04	10.44	11.54	0.454	4.11
Dry matter (%)	A	19.42	17.78	22.09	1.871	9.60
	B	19.53	18.22	20.79	1.051	5.38
pH	A	6.50	6.41	6.70	0.135	2.07
	B	6.68	6.56	6.80	0.098	1.48
Titratable acidity (°SH)	A	10.33	10.00	11.00	0.472	4.56
	B	10.50	10.00	11.00	0.577	5.50

Quality of sheep milk is mainly evaluated in terms of its technological and coagulation properties, which are highly affected by its concentration of fat and protein and somatic cell count (SCC). High protein, fat and total solids concentrations in the milk are associated with high yields in the resulting dairy products. The content of milk fat is the most variable component of milk (Antunac and Havranek, 1999), which was confirmed by the results presented in Table 1. The results of milk fat content are in accordance with the studies of Pavić et al. (2002), which also emphasizes that milk fat is the most variable component in milk. Talevski et al. (2009) presented lower values in relation of

milk fat, but the difference is due to different quality of bulk sheep milk from different regions collected in his research. The overall results for the milk sheep composition used for the production of two varieties of cheese are similar to the results by Dozet et al. (2006) for the milk from the Bosnian / Herzegovinian region. Sheep health is important and affects the quality milk. Sheep's milk, comparing with cow's contains a significantly higher number of bacteria and mechanical impurities, which is related to the breeding, nutrition and the way of milking (Antunac, 1999). Dozet and et al. (1996) noted that the main problem in the production of autohtonous products is the assurance of milk with good microbiological quality, where should be paid more attention. It is particularly important because the total bacteria count in the bulk milk which is a major indicator of hygiene in milk production. The mean total bacteria count in the milk of variant A was 676 714 CFU mL⁻¹, and variant B showed a significantly higher number of total bacteria (1 125 750 CFU mL⁻¹). The total somatic cells count in Variant A was 345 333 / ml, and in Variant B 412 500 / ml (Table 2). According to the data, we can conclude that the milk from both variants A and B meets the legal requirements (Rulebook, 2012), where the number of colonies (per ml) should not exceed 1 500 000 CFU ml⁻¹.

Table 2. TBC and SCC in sheep milk for the production on Variant A and B cheese (n=4)

Variant	Parameter	\bar{x}	min	max
Milk – Variant A	Total bacteria count/ml	676 714	498 000	855 000
	Somatic cell count /ml	345 333	297 000	423 000
Milk – Variant B	Total bacteria count/ml	1 125 750	980 000	1 325 000
	Somatic cell count /ml	412 500	240000	620 000

From the results of the TCC and SCC in both variants, we can see that there is a large variation of the values. This is probably due to the non-standard sanitation procedures applied in primary production. These results in terms of the TBC, especially for the milk of Variant B, indicate that it is necessary to pay more attention to improving the quality of sheep's milk by implementing hygiene measures and procedures.

Whey composition

Whey is a by product in the process of cheese production. Composition and characteristics of whey are depending on the production technology of the end product and on the quality of the used milk. (Jeličić, 2008). In general, sheep whey contains more protein and therefore is more produced than the whey from cow's milk (Antunac et al., 2011). The results from the physico-chemical composition of the whey from two variants of cheese are shown in Table 3.

Milk fat ($2.15 \pm 0.194\%$ - A and $1.69 \pm 0.372\%$ - B), was significantly variable in the whey, as it can be seen from the high coefficient of variation, 9.02% in Variant A and 21.98% in Variant B. The variation is due to the traditional procedure for the cheese production, especially during the process cutting and stirring the curd with the wooden tool "krstach". The chemical composition of whey is similar with data on whey from traditional krčki cheese, made from sheep's milk (Prpić et al., 2003). Talevski (2013), determined that the dry matter of the whey in kashkaval cheese ranged from 6.30 to 6.49%, the milk fat from 0.29 to 0.42 and the proteins from 1 to 1.18%. This difference is due to the different used raw material (cow's milk / sheep milk, 9:1) used in the production of the cheese, as well as the industrial way that differs significantly from the traditional way of making of cheese. Our results for the protein, fat and dry matter of whey are higher than the results of Chizbanovski (1981), who analysed the sheep whey for the production of white sheep cheese production. These differences are probably due to the different applied technological process of making the white brine cheese. From the results shown in Table 3 it can be noticed that the dry matter in the whey in Variant A is $9.37 \pm 0.513\%$ and $8.65 \pm 0.379\%$ in Variant B. Baltadjieva (1993) noted that the content of dry matter in whey is half of dry matter in milk, which corresponds to our sheep milk results where the dry matter ranged from 19.42 to 19.53%.

Table 3. Physico-chemical composition of whey from production of cheese from variant A and variant B (n=4)

Parameter	Variant	\bar{x}	Min	Max	Sd	Cv
Fat (%)	A	2.15	1.97	2.60	0.194	9.02
	B	1.69	1.30	2.06	0.372	21.98
Protein (%)	A	1.79	1.58	2.10	0.198	11.06
	B	1.75	1.11	2.10	0.438	25.11
Lactose (%)	A	4.21	4.12	5.11	0.116	2.76
	B	4.42	4.11	5.01	0.457	10.33
Solids non fat (%)	A	7.36	6.81	7.65	0.550	7.47
	B	7.07	6.14	7.65	0.697	9.84
Total solids (%)	A	9.37	8.79	8.90	0.513	5.47
	B	8.65	8.10	8.90	0.379	4.37
pH	A	6.40	6.20	6.60	0.163	2.55
	B	6.10	5.50	6.40	0.424	6.95
Titratable acidity (°SH)	A	5.13	4.90	5.30	0.171	3.33
	B	6.25	6.00	6.50	0.222	3.56

Physico-chemical composition of kashkaval cheese

The quality of the cheese depends on its composition, especially the moisture and dry matter, salt, pH, and the percentage of fat in dry matter (Fox, 2000). The moisture content of the cheese is influenced by several factors, such as acidity, processing of the curd, pressing, moulding, as well as the conditions of storage and ripening. Moisture is one of the basic factors that influence the shelf life of the cheese.

Table 4. Physico-chemical composition of kashkaval cheese on 100 days of ripening (n=4)

Variant	Moisture	Fat	Protein	Moisture content on a fat-free basis	Fat in dry matter	Water soluble nitrogen	Ash	pH	Salt
A	36.64	27.88	23.05	50.803	44.00	0.5536	4.85	5.34	2.02
B	32.63	30.00	26.65	46.577	44.63	0.6904	5.27	5.16	2.17

Some important characteristics like consistency, shelflife and even taste of cheese are in direct relation with the acidity. Each type of cheese has a characteristic pH whose value is an indication for the conversion of lactose into lactic acid in the process of cheese production (Lawrence, 1993). Our results for the pH of kashkaval are similar with the Turkish kashar cheese analyzed by Tarakci and Kucukoner (2006) and with results on Egyptian kashkaval by Abou Donia (2004). According to the classification of cheese in terms of moisture content on a fat-free basis, after 100 days of ripening, the kashkaval cheese from Galichnik had fallen in the group of hard cheeses, while the kashkaval cheese from Lazaropole belong to the group of extra-hard cheeses. Regarding the fat in dry matter, both cheese variants were on the border between medium fat and full fat cheeses. The difference in the fat content of both variants is due to the difference in the composition of the raw material and the processing of the cheese itself. Namely, in Variant B, higher fat content in raw milk is noticed, but its content in the whey is lower as a lower degree of processing the curd.

Conclusions

Traditional cheeses are a reflection of the local rural environment, culture and nature expressed by experience of masters through many decades. In recent years, it is noticed increased consumption of traditional sheep dairy products, especially cheese produced by traditional technology. Kashkaval from mountain Bistra is one of the famous traditional products in the country. In this research quality of raw sheep's milk and whey during the production of traditional sheep cheese from two locations,

Galichnik and Lazaropole was examined. From the results of the TCC and SCC in milk from both variants, we can see that there is a large variation of the values. This is probably due to the non-standard sanitation procedures applied in primary production. The results of this study showed that according to the classification of cheese in terms of moisture content on a fat-free basis, after 100 days of ripening, the kashkaval cheese from Galichnik had fallen in the group of hard cheeses, while the kashkaval cheese from Lazaropole belong to the group of extra-hard cheeses. Regarding the fat in dry matter, both cheese variants were on the border between medium fat and full fat cheeses.

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