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Looking for added value of milk products of autochthonous sheep breeds

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Abstract

In order to determine the added value of the product, characterization of sheep milk and cheese samples from Sjenica sheep were assessed and compared to British milk sheep. The analyses were carried out according to standard chemical procedures. A comparative study showed that the milk from the Sjenica sheep was higher in fat and protein and had a lower casein/fat ratio. It also had higher total and somatic cell counts than British milk sheep. Sjenica cheese had significantly higher dry matter and fat content. However, both cheeses were classified as soft full-fat cheese with brine. The study showed that sheep's milk contains many essential components for cheesemaking and distinguishes sheep's cheese from other types of cheese, but standardisation of cheese production is still needed. To preserve the autochthonous sheep breeds of Serbia, promoting cheese production with added value is crucial and together with increased production could contribute to the sustainable development of rural areas.

Keywords: sheep, autochthonous breed, added value product, sheep cheese

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Introduction

There is a growing awareness of the need for high levels of biodiversity and its important role in improving the sustainability of low-input dairy production systems (POPOVIĆ-VRANJEŠ et al., 2018). Protecting local products means not only preserving the different local ecosystems at different levels: animals and plants (breeds and local varieties), but also microbial ecosystems, landscapes and dairy products (BERARD and MARCHENAY, 2006). Although many laws and measures have been adopted in Serbia for the protection of autochthonous breeds and genetic resources, many of them are still at risk of complete disappearance (POPOVIĆ-VRANJEŠ, 2018). Due to its compositional characteristics, sheep's milk is well suited for cheese production (POPOVIĆ-VRANJEŠ et al., 2017), and in Serbia sheep's milk is mainly used for cheese production. Autochthonous breeds do not produce large volumes of milk, but they have good quality milk with a desirable protein-fat ratio and small, naturally homogenised fat globules (POPOVIĆ-VRANJEŠ, 2018). The average size of fat globules is therefore the smallest (< 3.5 μm) in sheep milk (PARK et al., 2007). Milk quality depends on many factors, and each component of milk influences cheese yield and quality (POPOVIĆ-VRANJEŠ et al., 2018). SOBRINO et al. (2018) found that, except for the casein/fat ratio, the season was the greatest source of variation in bulk tank milk characteristics of Manchega sheep. The relative stability of the C/F ratio made the sheep's milk more standardised, which is necessary for cheese production. Conversely, the farming system (semi-intensive and intensive) did not affect the chemical composition and physicochemical properties of sheep's milk in the study by KASAPIDOU et al. (2021).

Production of sheep's cheese in Serbia is usually at the farm level or in small local dairy units, with only about 370 tonnes of sheep's cheese produced in 2016 (FILIPOVIĆ, 2019). Traditionally associated with high-quality products such as lamb and Sjenica cheese, the Sjenica Pester plateau is characterised by a specific floristic composition of pastures (SAVIĆ et al., 2017). Sjenica sheep cheese is the best-known cheese from this area and is a protected designation of origin (PDO) product (FILIPOVIĆ, 2019). Sjenica cheese is made from either cow's or sheep's milk and belongs to the group of white cheeses. Producers of this cheese face a number of problems. The main challenges for the export of Sjenica cheese are the insufficient certification of this food product for the European Union market and the lack of a standardised production process, which results in variations in the quality of the product. Although white brine cheese is the most consumed type of cheese in Serbia (PASKAŠ et al., 2020), there is a lack of awareness of Sjenica sheep's cheese among regional consumers due to insufficient communication efforts (FILIPOVIĆ, 2019).

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This study aimed to investigate the influence of different sheep breeds on the chemical composition and hygienic quality of milk, as well as its suitability for cheese production. A study of the chemical composition of white brine cheese was also carried out.

Material and methods

Milk sampling and analysis

From March to October 2022, samples of raw sheep's milk (n=16; n1=8; n2=8;) were collected from local farms. The farms differed in the breed of sheep reared. On the first farm Sjenica sheep was reared and on the second farm British milk sheep. On each farm, bulk milk samples were collected once a month (at regular intervals) and analysed on the same day. Both flocks were milked by hand twice a day and samples were taken after the morning milking. The standard analysis of the chemical composition of the milk was carried out with the MilkoScan FT+ analyser using the FTIR technique. The MilkoScanTM FT+ techniques comply with the ISO 9622: ISO 9622/IDF 141:2020 standard and the official AOAC method 972.16. FossomaticFT FC (ISO 13366-2:2008) and BactoScanTM FC+ (ISO 16297:2020) were used to determine the somatic cell count and total bacterial count of raw milk.

Cheese sampling and analysis

Cheese samples (n=10; n1=5; n2=5) were collected from the same producers and analysed for chemical composition. Dry matter was determined using a standard method for measuring weight loss after drying (AOAC 926.08-1927). Protein was determined by the Kjeldahl-Van Slyke method for total N (AOAC 2001.14) using a Kjeltec Auto Analyzer and multiplying by 6.38. Fat content was determined according to IDF (2008) and ash was determined by dry ashing at 550°C (AOAC 935.42). Phosphorus was determined using a spectrophotometer (PG Instruments, type T80+) (AOAC 995.11), while flame photometry (Sherwood, type M410) was used for Ca and Na. The NaCl content was determined by the Volhard method (FIL-IDF, 1988).

Statistical analysis

Results were statistically analysed and presented as mean, standard deviation, range and coefficient of variation. A t-test at $p<0.05$ was used to determine a significant difference between the means. Statistical analysis was performed using Statistica 10 (StatSoft STATISTICA 10.0).

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Results and discussion

Table 1 shows the chemical characteristics and hygiene parameters of the sheep milk samples. There was a statistically significant difference in the average fat content between milk samples from two different sheep breeds. The total protein content of Sjenica sheep milk was 5.58 and the fat content was 7.23g/100g. These results are in line with the range previously reported for Sjenica sheep milk (SAVIĆ et al., 2017). Compared to the results of SAVIĆ et al. (2014), the fat content was higher, but the protein and dry matter content were lower. There were no significant differences ($p<0.05$) in the casein/fat ratio between milk samples from the two different breeds. Both breeds showed a higher variation in the ash content and in the C/F ratio, which can negatively affect cheese production. The results related to the hygienic parameters of milk SCC and TBC showed that the milk from both breeds was of good quality. No difference was found in the hygienic parameters (SCC and TBC), but the results of the milk samples varied greatly in milk from both breeds. Monitoring SCC is a good tool for assessing the hygienic and sanitary quality of milk, but in sheep's milk, it is necessary to consider non-pathological factors that cause large variations in SCC and are different from those in cow's milk (RAYNAL-LJUTOVAC et al., 2007). This study shows the opposite results to those of TONAMO et al. (2020) for the SCC count of British milk sheep. They also differed from the SCC and TBC results in Lacaune sheep milk (MERILIN JUNIOR et al. 2015). SCC in milk affects cheese yield and cheesemaking performance. Milk with a low SCC can yield more than 4% more protein in cheese production than milk with a high SCC (RAYNAL-LJUTOVAC et al., 2007).

Table 1. Physicochemical composition of milk from two different breeds of sheep

Parameters (g/100g)	**SJENICA SHEEP MILK**			**BRITISH MILK SHEEP MILK**		
	$\bar{X}$ **± SD**	**range**	**CV (%)**	$\bar{X}$ **± SD**	**range**	**CV (%)**
Dry matter	17.89±1.06	16.54-19.77	5.93	17.26±0.73	16.09-18.66	4.26
SNF	10.64±0.58	9.79-11.5	5.42	10.99±0.61	10.21-12.20	5.58
Fat	7.23^{a}±0.69	6.57-8.5	9.49	6.34^{b}±0.34	5.88-7.0	5.31
Protein	5.58±0.49	5.13-6.7	8.80	5.50±0.61	4.33-6.38	11.09
Lactose	4.05±0.37	3.48-4.52	9.03	4.28±0.43	3.6-4.88	10.11
Casein	4.44±0.41	4.06-5.37	9.22	4.47±0.57	3.40-5.16	12.78

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Ash	1.03±0.22	0.82-1.46	21.56	1.10±0.19	0.83-1.38	17.56
C/F	0.62±0.07	0.49-0.72	11.71	0.70±0.10	0.46-0.82	14.73
SCC (*1000/ml)	1499.62±457.82	872-2031	30.53	1384.62±484.59	465-2065	34.78
TBC (CFU*1000/ml)	224.87±101.15	124-392	44.98	129.12±76.09	35-240	58.93

SNF-solids non-fat; C/F-casein/fat; SCC-somatic cells count; TBC-total bacteria count; x ± sd-arithmetic mean ± standard deviation; cv-coefficient of variation; Means with different letters are significantly different (p<0.05

Table 2. Chemical composition of white-brined cheese from two different breeds of sheep

Parameters	**SJENICA SHEEP CHEESE**			**BRITISH MILK SHEEP CHEESE**		
	$\bar{X}$ ± SD	**range**	**CV (%)**	**$\bar{X}$ ± SD**	**range**	**CV (%)**
Dry matter (g/100g)	45.77a±1.10	44.80-47.06	2.41	43.77±0.83	42.80b-44.90	1.89
Fat (%)	24.85[a]±0.73	23.89-25.74	2.93	23.71[b]±0.74	22.98-24.68	3.10
Protein (%)	15.45±0.77	14.63-16.25	4.98	14.45±0.86	13.38-15.32	5.95
Total ash (%)	2.35±0.11	2.21-2.51	4.76	2.42±0.12	2.23-2.56	5.18
FDM	54.28±0.72	53.33-55.23	1.33	54.18±1.25	52.62-55.80	2.30
MFFB	72.15[a]±0.90	71.10-73.08	1.25	73.71[b]±0.80	72.75-74.80	1.08
NaCl (%)	3.34[a]±0.40	2.85-3.74	11.88	2.75[b]±0.32	2.22-3.01	11.83
S/M (%)	6.17[a]±0.80	5.18-7.06	12.95	4.88[b]±0.55	4.03-5.34	11.24
Ca (%)	0.38±0.07	0.31-0.48	18.27	0.43±0.06	0.37-0.51	13.34
P (%)	0.24±0.04	0.19-0.28	15.45	0.26±0.03	0.22-0.29	10.24

FDM-fat on a dry matter basis; PDM- a protein on a dry matter basis; MFFB-moisture on a fat-free basis; S/M (%)-salt in moisture; $\bar{X}$ ± SD-arithmetic mean ± standard deviation; cv-coefficient of variation; Means with different letters are significantly different (p<0.05).

Table 2 shows the chemical composition of white-brined cheese from the two different breeds. It was found that dry matter and fat were significantly lower in British sheep's cheese. In a study by JANDRIĆ and SAVIĆ (2019), after 30 days of ripening, Sjenica sheep's milk cheese contained an average of 28.31 g/100 g of milk

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fat, while at the beginning of the process, it contained 23.43 g/100 g. The research results for Sjenica cheese were within the mentioned ranges. A statistically significant difference was also found for NaCl content, MFFB and S/M ratio. The salt content of the cheese depends on the salt content of the brine. As the salt concentration in the brine increased, the salt content in the cheese also increased, as did the total ash, fat and protein content (RAHIMI et al., 2013). No difference was found in protein and FDM content, although the milk was not standardised. The dynamics of fat in dry matter showed a tendency of a balanced increase throughout the ripening period, from 49.44% to 52.72% in Sjenica sheep cheese (JANDRIĆ and SAVIĆ, 2019). The values obtained in this study were higher than those mentioned for both cheeses. According to the FDM content, the cheeses were classified as full-fat cheeses, and according to the MFFB, they belonged to the group of soft cheeses (SERBIAN REGULATIONS, 2014). The Ca and P contents of the two sheep cheeses were the most variable components. Ca and P directly influence cheese texture by participating in the protein network that forms the structural matrix of cheese (RAHIMI et al., 2013). Therefore, it was expected that the effect of different Ca and P levels on cheese texture would also vary, which could have an impact on cheese sensory properties.

Conclusion and recommendation

The results of this study showed the favourable composition and properties of Sjenica sheep's milk, with significantly higher fat and dry matter contents compared to British milk sheep's milk. The results also confirmed the good quality of Sjenica white cheese. By adhering to higher standards and good manufacturing practices, sheep's milk and cheese can be produced safely without compromising quality. In particular, the production of Sjenica cheese could help to preserve the genetic diversity of domestic animals. To conserve local species and breeds, more breed-level data is needed and a knowledge base on livestock biodiversity needs to be developed.

To preserve the autochthonous sheep breeds of Serbia, promoting cheese production with added value is crucial and together with increased production could contribute to the sustainable development of rural areas.

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