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TECHNOLOGY AND QUALITY OF KUČKI CHEESE - TRADITIONAL MONTENEGRIN BRINED CHEESE

Olga Jokanović¹, Božidarka Marković¹, Jelena Miočinović², Slavko Mirecki^{1*}

¹Biotechnical Faculty, University of Montenegro, Mihaila Lalića 15,
81000 Podgorica, Montenegro

²Faculty of Agriculture, University of Belgrade, Nemanjina 6, 11080 Belgrade-Zemun, Serbia

*e-mail: slami@ucg.ac.me

Abstract

Kučki cheese is an inseparable part of the heritage of the Kuči region, because of the depopulation of this area, there is a danger of losing its original technology. The aim of the present study is Kučki cheese, traditional Montenegrin brined cheese.

The quality of the three types of raw milk used for Kučki cheese production (cow's, sheep's and mixed), as well as Kučki cheese technology, the chemical, the microbiological quality and cheese yield, were investigated. The chemical quality of raw milk was analyzed by the method of infrared spectrophotometry (IR), and the somatic cells and total bacteria count by flow cytometry method. For the chemical analysis of cheese, method of Fourier transform infrared spectrophotometry (FTIR) spectrophotometry was used. The presence of following microbes was established: *Listeria monocytogenes*, (MEST EN ISO 11290-1:2009), *Salmonella* spp. (MEST EN ISO 6579:2008), and coagulase-positive *Staphylococci* (MEST EN ISO 4833-1:2015). The data were analysed by one way analysis of variance (ANOVA) performed using the statistical software (Software-a Statistica version 12:2012).

All the milk samples had high values of the chemical quality parameters, but high numbers of somatic cells and total bacteria count indicates a lack of milking hygiene. All samples of Kučki cheese were of excellent chemical quality, but the best was Kučki cheese made from sheep's milk (30.04% fat, 20.41% proteins, 54.71% dry matter, 54.93% fat in dry matter and 2.13% salt). The type of milk significantly influenced on differences between the fat content of the cow's and sheep's cheese. The same is for the fat content in the dry matter ($p < 0.05$). The variation of all quality parameters in

cheese was highlighted. That indicated an absence of standardized technology. Microbial analysis indicated that all samples of cheeses have met the requirements of national microbiological standards.

The results obtained in this study could be base for adequate data to launch initiatives for the protection of origin of Kučki cheese (PDO).

Key words: Chemical and microbial quality, Kučki cheese, Raw milk, Traditional technology.

1. Introduction

White-brine cheeses are one of the most commonly produced cheeses whose production is widespread in the world. Also, they are one of the oldest types of cheeses, and cited from Dozet, [1], Abd El-Salam in 1993 stated that the production of these cheeses was recorded in the region of Egypt more than 3,200 years BC. The white-brined cheeses are the most popular varieties of cheeses manufactured in the North-eastern Mediterranean area and the Balkans where, the most popular cheeses as Feta in Greece, Domiati in Egypt, Bayaz peynir in Turkey and Halloumi in Cyprus, are produced [2]. Other geographical regions where the white-brine cheese's production is popular are the Eastern Europe and the Middle East, also, a lot of varieties are present in the area between the Black Sea and the Caspian Lake and beyond [1]. Climatic conditions, soil type, botanical composition, species and breeds of animals for milk production affects the organoleptic properties of the produced cheese, particularly on

their taste when they are produced from raw milk. Thanks to the improvement of technologies, equipment, and conditions of production, white-brine cheeses are producing all over the world. But those cheeses are still the typical and most consumed group of cheeses in the eastern Mediterranean and neighboring countries [3]. Milk and dairy products have always been the most important foodstuffs in the diet of the Montenegrin population. The most represented, both in production and consumption, are different types of cheeses, Skorup, and fermented milk. Fermented dairy products are produced mainly in the mountainous areas of northern Montenegro, and the most notable are Jardum, Gruševina, and Kisjelo mlijeko. Skorup is a full-fat dairy product which cannot be classified as either cheese or butter but has the features of cheese and butter [4]. The cheeses are produced throughout the territory of Montenegro. In the southern region, hard and semi-hard cheeses are produced, and the best known is Njeguški cheese. The central part is recognized by Lisnati (leafy) or Kolašinski cheese, having the characteristics of pasta filata cheeses. But, according to the consumption and quantity of production, the most dominant are white-brined cheeses [5]. White-brined cheeses often bear the name of the geographical area, town or village where they are mostly produced [6]. Climate, geographic location, land, water, the botanical composition of natural meadows and pastures, race and breeding of dairy cattle, as well as traditional habits and customs of the local population affects at a specificity of cheese [7]. Also, specific taste, aroma, and consistency of the cheese depend on the species and strains of lactic acid bacteria that are naturally found in milk and environment. All the above factors contribute to the authenticity and recognition of Kučki cheese, one of the most popular Montenegrin white-brined cheese. It belongs to full-fat, white-brine cheese type, mostly produced from raw cow's and mixed milk (cow's + sheep's), and very rarely only from sheep's milk, and it is characterized by a strong taste and smell [4]. Producers and consumers of Kučki cheese considered that the best cheese is produced during the summer season on katuns - temporary settlements in mountainous regions where the farmers stay with livestock during the summer. This is explained by the specific climatic conditions affecting the production and maturation of Kučki cheese, mountain pasture quality, applying centuries-old technology that is transmitted from generation to generation and skills of "planinka" - women who produce cheese. Kučki cheese has a distinctive aroma, taste, and consistency, specific traditional technology, the production area is defined and, as such, meets the requirements for the protection of origin. Production of Kučki cheese is an inseparable part of the heritage of the Kuči region, based on a family tradition, which is passed down from generation to generation and represents an unavoidable part of history and the material treasure of mentioned area.

Therefore, the aim of this scientific paper is to collect adequate data about traditional technology, raw milk quality and Kučki cheese quality for the purpose of launching initiatives for the protection of origin (PDO) of Kučki cheese.

2. Materials and Methods

2.1 Characteristics of the production area

Kučí is the hilly area on the eastern part of Montenegro, more precisely northeast from Podgorica, the capital of Montenegro. Geographically, it covers around 220 square kilometers. In the mentioned area, there are some 20 peaks of 2,000 m and higher. The southern part is more rugged, rocky terrain, with pine in higher and some beech forests in lower parts, while the middle and northern range are characterized with larger pastures. Although bounded by the rivers Morača and Mala Rijeka from the west, Ribnica from the south-west, Cijevna from south and south-east, Opasanica from the north, Kuči area is mostly deficient in water [8] (Figure 1, a and b).

There are several katuns, temporary settlements where the farmers who gravitate to suburban areas around



(a)



(b)

Figure 1. (a) Montenegro, and (b) the area of Kučki cheese production

Podgorica stay with livestock during the summer. Pastures located in the middle and northern part of Kuči Mountains are suitable for sheep, goats and cattle breeding. Like in the rest of the katuns in Montenegro, livestock production is mostly extensive or semi-extensive. Sheep production is based on the rearing mostly autochthonous breeds Bardoka and Ljaba, and other crossbreeds. Cattle production is based on the rearing of local breed Buša and its crosses with Tyrolean Grey and Brown Swiss breed. The main livestock products are meat and milk. Kuči area is well known for the production of Kučki cheese, very tasteful full-fat, brined cheese, whose technology is transferred from generation to generation. Among other dairy products, the most common is production of dairy beverages "kisjelo mlijeko" and "gruševina"/"jardum" [8].

2.2 Raw milk and Kučki cheese sampling

Samples of milk and cheese are sampled from 12 households. Households were selected among more than 50 households surveyed. All selected households are longtime producers of Kučki cheese and they are recognizable by the quality of the cheese. At the households, 60 samples of cow's milk, 24 sheep's, and 40 mixed milk samples were collected. Sampling was done after milking, immediately after filtering the milk. Samples of fresh and ripened Kučki cheese were taken directly from the manufacturers. The total number of analyzed fresh cheeses was 36. Three types of fresh cheeses were tested for chemical and microbial quality, 12 of them were from cow's milk, 12 samples of sheep's milk and 12 samples of mixed milk. Samples of ripened cheese were taken after ripening period of minimum 30 days. The total number of ripened cheeses samples was 60. Twenty-four of them were made from cow's milk, 12 sheep's and 24 samples of mixed milk (cow's milk + sheep's milk). Sampling was done by the requirements of the method ISO 707:2008 [9].

2.3 Analyses of milk and cheese

Analyses of samples were made in Dairy Laboratory at Biotechnical Faculty - Podgorica and Specialistic Veterinary Laboratory - Podgorica. From the farm to the laboratory reception, samples were placed in hand refrigerators and held on + 8 °C to prevent any change in quality of milk and cheese samples.

Chemical quality of raw milk, or more precisely: milk fat, proteins, lactose, solids non-fat content and freezing point depression were analyzed on instrument MilkoScan4200 by the method of infrared spectroscopy (IR) spectrophotometry [10].

Somatic cells count in raw milk was analyzed on instrument Fossomatic 5200 basic by the method of flow cytometry [11].

Total bacteria count in raw milk was analyzed on instrument BactoScan 100H by the method of flow cytometry [12].

Chemical quality of cheese or: milk fat, proteins, total solids and salt content were analyzed on instrument MilkoScan™ FT 120 by the method of FTIR spectrophotometry [10].

The content of fat in the dry matter (DM) was mathematically calculated [13].

Microbiological quality of cheese: detection of *Staphylococcus aureus* by the horizontal method for coagulase positive staphylococci enumeration [14]; *Salmonella* spp. by MEST EN ISO 6579, [15], and *Listeria monocytogenes* by MEST EN ISO 11290-1 [16].

2.4 Statistical analysis

Statistical data processing included standard statistical parameters of mean, minimum and maximum values, as well as standard deviation and coefficient of variation. Also, the statistical significance of the difference between mean values of chemical quality parameters (fat, protein, dry matter, fat in dry matter and salt content) was determined between three varieties of matured Kučki cheese (cheese from cow's, sheep's and mixed milk). The comparison of means was done with LSD test at $p < 0.05$. For this purpose, the program of Statistics 12 was used [17].

3. Results and Discussion

3.1 Technology of Kučki cheese

For the production of Kučki cheese cow's, sheep's and mixed milk are used. In households where the technology of cheese was recorded, cow's milk was dominantly used for cheese production, mixed milk (cow's + sheep's) less, and the least amount of produced cheese is cheese from sheep's milk. Immediately after milking (Figure 2), the rennet is added to the fresh milk. In the past, the rennet was made on households from



Figure 2. Milking on farm



Figure 3. Coagulated milk (curd)



Figure 4. Curd pressing



Figure 5. Kučki cheese ripening in a wooden vat

the stomachs of young ruminants, but today they are using industrial rennet.

In the moment of rennet adding, the milk temperature is from 31 to 32 °C. After 20 to 30 minutes from the rennet addition, the milk starts to coagulate, and after 60 minutes a curd is formed. In the moment of rennet adding, the milk temperature is from 31 to 32 °C. After 20 - 30 minutes from the rennet addition, the milk starts to coagulate, and after 60 minutes a curd is formed. The curd (Figure 3) is cutting into cubes of the size of 3 - 5 cm, gently stirred and left to rest for 5 - 6 minutes with additional heating up to 35 °C.

Then, the separation of whey from the curd (syneresis) started. Separation of whey is accelerated by additional cutting and stirring. Part of whey is separated, and the curd is left for another 10 - 15 minutes covered by cheesecloth, pressed and heated as long as most of the whey is separated. Further, the curd is squeezed in cheesecloth by hands. Such drained and shaped curd is placed under the wooden plank that is further burdened by a stone (Figure 4).

After, approximately 6 hours of pressing, the curd is removed from the cheesecloth, cut out to slices that are stacked, layer by layer, in wooden vats. At each layer of cheese, salt is placed in an amount which depends on the experience of the person who produces cheese. The cheese can be consumed as fresh or as ripened cheese. The ripening takes place in wooden vats (Figure 5).

While the wooden vat is filled in, a wooden plank is placed on the cheese, and when the vat is full, the heavy stone is placed on the plank. Ripening lasts, on average 4 weeks or more, depending on the desired intensity of flavour, aroma and texture. Local market consumers prefer even stronger aroma, so the producers let the cheese to ripen for two, even more months. During this period, strong proteolytic changes occur in the cheese, which is reflected in the flavour. This very pronounced aroma is the specificity of this cheese. Ripened cheese has slices of an elongated rectangle shape, white to white yellowish colour and solid consistency with minor porosity. The cheese could have a pleasant sour milky taste to the very strong, moderately salty aroma, and its aroma depends on the stage of ripening.

3.2 Raw milk quality

As said before, Kučki cheese is produced from raw milk, usually made from cow's, less often of mixed (cow's + sheep's), while the lowest amount of Kučki cheese is made from sheep milk. The chemical quality of raw milk that is used for Kučki cheese production, is presented in (Table 1).

Table 1. The chemical quality of raw milk

Milk		Fat (%)	Proteins (%)	Lactose (%)	SNF (%)	FPD* (- °C)	Cells** x 10 ³ /mL	CFU*** x 10 ³ /mL
	n	60	60	60	60	60	60	60
	X	4.16	3.28	4.41	8.42	0.523	630	647
Cow's	X min	3.13	2.74	3.80	8.01	0.499	13.000	23
	X max	4.93	4.11	4.91	8.96	0.551	3541	3222
	SD	0.419	0.279	0.305	0.271	0.014	786.43	826.89
	n	40	40	40	40	40	40	40
	X	5.95	4.29	4.49	9.43	0.548	1.165	710
Mixed	X min	4.14	3.05	4.3	7.51	0.528	53	33
	X max	7.51	5.78	4.82	10.84	0.577	2948	5232
	SD	0.816	0.796	0.131	0.934	0.012	835.79	1270.69
	n	24	24	24	24	24	24	24
	X	7.98	5.28	4.27	9.96	0.566	1.981	917
Sheep's	X min	5.74	4.30	3.67	8.97	0.553	187	40
	Xmax	10.22	6.84	4.67	11.93	0.590	6966	3999
	SD	1.330	0.729	0.300	1.007	0.012	2140.98	1139.84

Legend: * - Freezing point depression; ** - Number of somatic cells; *** - Total bacteria count (colony-forming units).

Table 2. The chemical quality of fresh Kučki cheese

Type of cheese		Fat (%)	Proteins (%)	Dry Matter (%)	Fat in DM (%)	Salt (%)
	n	12	12	12	12	12
	X	22.77	15.54	43.86	51.84	2.49
Cow's milk	X min	17.60	13.35	36.97	41.27	1.77
	X max	27.07	18.40	48.65	56.31	3.82
	SD	3.079	1.639	3.620	4.691	0.672
	n	12	12	12	12	12
	X	24.61	15.67	44.69	54.97	1.72
Mixed milk	X min	19.59	12.34	36.97	51.29	0.83
	X max	30.18	18.32	50.71	59.51	3.34
	SD	3.373	2.128	4.485	3.079	0.958
	n	12	12	12	12	12
	X	25.78	17.45	48.15	53.57	2.08
Sheep's milk	X min	22.96	16.15	45.20	47.01	1.25
	X max	28.21	19.73	52.15	58.66	3.13
	SD	1.728	1.291	2.243	3.675	0.598

The content of milk fat and protein in all three types of milk was high. It was expected because the sampling and analyzing were done at the end of August and during September, ie. at the final stages of lactation. Cow's, mixed and sheep's milk contained 4.16, 5.95 and 7.98 % of milk fat, while proteins were 3.28, 4.29 and 5.28, respectively.

The somatic cells count in cow's milk was relatively good, and it has averaged of 630,000/mL. Increased number of somatic cells in sheep's milk was ranged up to 6,966,000/mL (average 1,981,000/mL), indicating that animals in herds were with udder health problems. Somatic cell count of sheep's milk contributed to the increase of the cells number of mixed milk (1,165,000), as expected.

The average number of bacteria was 647,000 CFU/mL in cow's milk, 710,000 CFU/mL in mixed and 917,000 CFU/mL in sheep's milk, indicating the lack of hygiene at individual households, particularly milking hygiene, hygiene of dishes and equipment used, milker and post contamination after milking. One of the main causes of insufficient hygiene is the aridity of Kuči area.

Unfortunately, there are no other literature data about the quality of raw milk for the production of Kučki

cheese. However, it is necessary to introduce some measures in order to improve the microbiological quality of raw milk. According to literature data, quality of raw milk used for Kučki cheese production is similar as raw milk quality used for production of traditional cheeses of the same type in the other Montenegro regions [4, 18 and 19]. Radonjic *et al.*, [31], while studying the effect of phenological phase of dry grazing pasture on fatty acid composition of cows' milk, reported the content in cow's milk: fat (3.54 - 3.86%), protein (3.10 - 3.18%). content of lactose was very constant during this period (4.38 - 4.35%) and solids-non-fat content (8.16 - 8.27%). The average content of milk fat and proteins were higher than average for sheep's milk analyzed for Pljevaljski cheese [4, 20], and much higher than sheep's milk for Njeguški cheese production [21].

3.3 Chemical quality of Kučki cheese

Considering the market requirement and the fact that fresh Kučki cheese is increasingly popular, the chemical quality of fresh cheese was analyzed. The results of the chemical quality of fresh Kučki cheeses are presented in Table 2.

Table 3. The chemical quality of ripened Kučki cheese

Cheese		Quality parameters				
		Fat (%)	Proteins (%)	Dry matter (%)	Fat in DM (%)	Salt (%)
Cow's milk	n	24	24	24	24	24
	X	22.39*	17.93^{ns}	48.06^{ns}	46.62*	2.52^{ns}
	Xmin	20	15.44	42.6	42.26	1.16
	Xmax	25.64	21.43	54.11	52.51	3.91
	SD	1.785	1.731	3.116	3.116	0.833
	CV	7.97	9.65	6.48	6.68	33.02
Sheep's milk	n	12	12	12	12	12
	X	30.04*	20.41^{ns}	54.71^{ns}	54.93*	2.13^{ns}
	Xmin	26.86	19.19	50.38	51.46	1.11
	Xmax	33.48	23.26	58.63	59.82	3.91
	SD	2.080	1.300	3.191	2.477	0.818
	CV	6.92	6.35	5.83	4.51	38.48
Mixed milk	n	24	24	24	24	24
	X	25.85^{ns}	18.52^{ns}	50.36^{ns}	51.37^{ns}	2.45^{ns}
	Xmin	21.68	16.33	40.26	43.75	1.14
	Xmax	30.94	20.17	54.92	57.26	5.01
	SD	2.189	1.179	3.713	3.161	1.045
	CV	8.47	6.36	7.37	6.15	42.71

Legend: ns - The difference is not statistically significant ($p > 0.05$); * - The difference is statistically significant at the level ($p < 0.05$).

The differences in the quality of fresh Kučki cheese made from cow's milk and mixed milk are relatively small. Reason may be a small proportion of sheep's milk added in mixed milk. According to Codex Stan 208-1999, [22], analyzed cheese belong to full-fat cheeses, but cow's cheeses have belonged to soft and mixed cheeses to semi-hard cheeses. There are no literature data about the quality of fresh Kučki cheese, up to now. The results of the chemical quality of ripened Kučki cheese are presented in Table 3.

The relation between the quality of a ripened cow's and mixed cheeses is the same as for fresh cheeses. The quality of ripened cheese made from mixed milk is slightly better than the quality of cow's ripened cheese. The cheese obtained from sheep's milk had the following average quality: 54.93% fat in dry matter, 54.71% dry matter, 30.04% fat, and 20.41% protein. If the cheese classification according to the standard for brine cheese [22] is applied, all three varieties of Kučki cheese due to the fat content in dry matter belong to full-fat cheeses, while the dry matter content is classified as soft to semi-hard. Cow's cheese belongs to soft, full-fat, and cheese made of mixed milk to semi-hard, full-fat cheese. It can be seen that the fat content in the dry matter of fresh cheeses is higher than the content in ripened cheeses. The reason for this is, probably, that a certain amount of fat has transferred in the whey during ripening. If the results for chemical quality of Kučki cheese [4] are compared with results of this study, it can be seen that experimental cheeses had lower values of compositional parameters of chemical quality. The fat content in the dry matter is slight-

ly lower than the fat content in the dry matter in the Sjenica cheese [23], while the salt content is approximated. Compared with Svrlijski and Zlatarski cheese [24], which have a similar chemical composition, Kučki cheese contains slightly less fat in dry matter, except for sheep milk cheese which had higher fat content in dry matter and higher protein content, especially for sheep's milk cheese. By testing the significance of the difference (LSD test), it can be seen that the effect of the milk type did not have a statistically significant effect on the protein content, dry matter content and salt content ($p > 0.05$). The mixed milk did not have a statistically significant influence on all chemical parameters. On the contrary, the type of milk significantly influenced on differences between the fat content of the cow's and sheep's cheese. The same is for the fat content in the dry matter ($p < 0.05$).

3.4 Microbial quality of Kučki cheese

The microbial quality of cheese can be affected by spoilage and pathogens microorganisms originated from raw milk, that may be present due to lack of hygiene conditions during production, ripening, and storage of cheeses. On the other hand, the ripening process can have positive effects on microbial quality of cheeses and after some time unwanted microorganisms could be inhibited. Proof of this statement could be the results of the microbiological analysis conducted on 7 randomly selected samples of cheeses produced at chosen households. Results are presented in Table 4.

Table 4. The microbial quality of Kučki cheese

Sample code	<i>Listeria monocytogenes</i> /25 g	Coagulase-positive staphylococci CFU/g	<i>Salmonella</i> spp. /25 g
1	not found	< 10 ³	not found
2	not found	< 10 ³	not found
7	not found	< 10 ³	not found
8	not found	< 10 ³	not found
12	not found	< 10 ³	not found
18	not found	< 10 ³	not found
101	not found	< 10 ³	not found

According to the Regulations on the microbiological safety of food on the market, [25], all of seven analyzed samples showed satisfied microbiological quality. Coagulase-positive *Staphylococci* were isolated in a number that is allowed by the Regulation (26/2016), [25], while the presence of *Listeria monocytogenes* and *Salmonella* spp. have not been found. It is interesting to notice that cheese produced from relatively poor hygiene milk quality had very good microbial quality after the ripening period. The assumption is that the lactic acid bacteria naturally present in raw milk, during the ripening, thanks to their metabolic activity, created unfavourable conditions for the growth and development of undesirable bacteria [26]. Also, ripened white-brined cheeses were not involved in microbial contamination, probably because of the high salt content and low pH of these cheeses [2]. White-brined cheeses are traditionally manufactured as artisanal cheeses from raw milk. Raw milk is still used by small dairies, while some larger factories use thermized milk. Although thermization destroys some pathogenic bacteria, certain pathogens (i.e. *L. monocytogenes* and *E. coli* O157:H7) might survive and contaminate the final product [2]. Investigation of the microbial quality of Kuflu cheese showed that in 17 of 30 samples *E. coli* was detected, in seven samples *Salmonella* spp. was found, only three of 30 samples didn't contain coliform bacteria and in 11 samples *S. aureus* was detected [27]. A survey of the microbiological quality of three types of Turkish cheeses shows that 1/3 of samples of brined cheeses, nine of 20 Savak cheese and two of 20 Van Herby cheeses contained coliforms [28]. The same study showed that in 60% of Savak, 35% brined and 30% Van Herby cheese samples, *Staphylococcus aureus* was detected. Also, investigation of the microbiological quality of 30 samples of soft white cheese produced traditionally in Jordan found out that eight samples of cheeses were contaminated by coagulase-positive *Staphylococci*, two by *S. aureus* and three by *Salmonella* spp. [29]. There are no scientific data about the microbiological quality of Kučki cheese and these results are the first effort to establish its microbiological quality.

3.5 Kučki cheese yield

According to data collected by the survey on 12 households, for production of 1 kg of cheese, it is necessary

to provide 7 - 9 litres of cow's milk. If it is made from mixed milk, the percentage ratio of cow's and sheep's milk influence on the cheese yield. At surveyed households the ratio was approximately 70% of cow's and 30% of sheep's milk. The yield of Kučki cheese made from mixed milk was 5.5 - 6.5 litres for 1 kg of cheese. For a kilogram of Kučki cheese, on average, 4 - 5 litres of sheep's milk is required. Given that there is no data in the scientific literature on the yield of Kučki cheese, the cheese yield can be compared with the yield of traditional Montenegrin cheeses of the same type according to Dozet *et al.*, [4]: the yield of Pljevaljski cheese made from sheep's milk in households was 4 - 4.5 L, cow's 5.5 - 6 L and mixed 4.4 - 5.0 L, which are smaller quantities of milk than the amount used in the experiment. However, the same authors reported that the yield of Pljevaljski cheese produced under the industrial conditions is as high as the yield of Kučki cheese. The results of for the yield of Polimsko-vasojevicki [19] and for Pljevaljski cheese [5], both made from cow's milk, are in agreement with the results for experimental Kučki cheese. For farmers, it is of great economic importance to establish an optimal cheese yield in order to control the efficiency of cheese production and to achieve the greater profits.

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4. Conclusions

- Kučki cheese is a Montenegrin dairy product that is produced in the region of Kuči Mountain by traditional technology. Households in this area produce cheeses made from cow's, sheep's and mixed (cow and sheep) milk. Although it is a nutritionally valuable product, during the past 30 years, there is no scientific research about Kučki cheese. All the conditions for protection of Kučki cheese by designations of origin or geographical indications are provided: technology is transmitted from generation to generation, the cheese production

is an unavoidable segment of Kuči history and culture, the geographical area of production of cheese is accurately defined and Montenegro has adopted an appropriate Law [30], that came into force.

- The milk used for Kučki cheese had good quality:

- Cow milk: 4.16% fat, 3.28% protein, 4.41% lactose 8.42%, solids-not-fat (SNF), - 0.523 0C freezing point depression (FPD), 647,000 total number of bacteria/mL, and 630,000 somatic cells/mL.
- Mixed milk (sheep's and cow's): 5.95% fat, 4.29% protein, 4.49% lactose, 9.43% SNF, - 0.5480C FPD, 710,000 total number of bacteria/mL, 1,165,000 somatic cells/mL.
- Sheep's milk: 7.98% fat, 5.28% protein, 4.27% lactose 9.96% SNF, 0.556 FPD, 917,000 total number of bacteria/mL, 1,981,000 somatic cells/mL.

• - Fresh Kučki cheese has good nutritional value:

- Cow's milk cheese: 22.77% fat, 15.54% protein, 43.86% dry matter (DM), 51.84% fat in dry matter (FDM), and salt 2.49%.
- Mixed cheese: 24.61% fat, 15.67% protein 44.69% DM, 54.97% FDM, and 1.72% salt.
- Sheep milk cheese: 25.78% fat, 17.45% protein 48.15% DM, 53.57% FDM, and salt 2.08%.
- All three varieties of ripened Kučki cheese had very good nutritional value:
- Cow's milk cheese: 22.39% fat, 17.93% protein, 48.06% DM, 46,62% FDM, and 2.52% salt.
- Mixed cheese: 25.85% fat, 18.52% protein, 50.36% DM, 51.37% FDM, and 2.45% salt.
- Sheep milk cheese: 30.04% fat, 20.41% protein, 54.71% DM, 54.93% FDM, and 2.13% salt.

- If the cheese classification according to the General Codex Alimentarius standard for brine cheese (Codex stan 208-1999) is applied, all three varieties of ripened Kučki cheese due to the fat content in dry matter belong to full-fat cheeses, while the dry matter content is classified as semi-hard.

- All cheese samples are of good microbiological quality. The expansion of the market, especially the development of tourism in the area of Kuči Mountains, offers the possibility to households to improve and increase the production of Kučki cheese.

- Protection of the cheese increases the market value of the product which may result in higher income of households. This will stimulate the population to remain on katuns, reducing the level of depopulation from rural areas and encourage this kind of agricultural production which contributes to the preservation of the environment, protection of biodiversity and the protection of rural areas.

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