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The effect of saline concentration and storage temperature in the quality of Sharri cheese

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Abstract

Most consumed cheeses in Kosovo are white brined cheeses produced mostly in traditional form. One of the most popular cheeses in this country is Sharri cheese produced in mountains called Sharri between Kosovo, Macedonia and Albania. The aim of this work was to study the effect of brine salinity (3, 6, 9 and 12%) and temperature (8 and 22°C) on microbiological parameters (total viable count, psychrophile and total lactic acid bacteria-LAB) and sensory quality of Sharri cheese. Traditional methods by using plate counts for total viable count and selective media for counting LAB are used. Molecular methods such as 16S rRNA DNA gene sequencing was used to identify LAB. The results show significant decrease in all microbiological parameters starting from total viable count, psychrophile and total LAB by increasing the brine salinity during a processing until a final product. In raw milk diversity of LAB was shown while on cheese the most dominant strain of LAB identified by 16S rRNA gene sequencing was different. In 3 and 6% of salt most dominant strain was *Leuconostoc pseudomesenteroides* (around 60%) followed by *Lactococcus lactis*, and *Enterococcus faecium, w*hile in higher concentration *Enterococcus faecalis* and *L. garvieae* became more dominant. Cheese stored on 6% and 22°C had higher scores from the panelists. The results show that, controlling the raw milk quality in microbiological aspects before processing is necessary. In same time for making Sharri cheese the recommended concentration of brine solution is 6-9% and 22°C of storage condition. By using this condition we will have under a control total viable counts, no significant changes between raw milk and final product of LAB diversity and no negative effects in human health.

Key words: Cheese, lactic acid bacteria, sensory analysis, texture profile, brine.

Introduction

White brined cheeses are the most consumed cheeses in Kosovo and very popular in many neighboring countries in Western Balkans [7, 10, 33, 35, 38]. In Kosovo, one of most popular cheeses is Sharri cheese, which was named after a mountain range called Sharri Mountains, situated in the border of Kosovo with Macedonia and partly with Albania, from where the cheese is originated. Sharri cheese is traditionally produced from ovine, bovine and mixed milk during the spring and summer seasons, and is classified as a hard and/or semi-hard cheese with high salt content and produced without addition of start culture [35, 36]. Briefly described, Sharri cheese is produced from unpasteurized milk tempered at approximately 35°C, using rennet. After pre-maturation process (acidification, curding, curd processing and pressing) cheese is left in wooden shelf's for ripening until day 15 (adding approximately 1/3 of the total salt over it). After that day, cheese should be replaced into the metal, glass or plastic jars filled with brine solution and left for further ripening, for another 45 days in brine [35, 36]. Hence, cheese is considered as matured after 60 days of all the cheese making process. During this time, brine salt penetrates into the cheese giving it a characteristic hard consistence, crumbly texture and strong safety flavor [35]. The influence of sodium chloride and period of ripening on sensory properties of cheese were also described in other studies [20]. Both, brine saline concentration and storage temperature may affect the cheese-making process from the beginning of the process to the final product, as well as its ripening or storage duration [18]. There are advantages and disadvantages of the high brine saline concentration used in the cheese production [19, 21]. Traditionally, high saline concentration is used as a preservative and is added into cheese to control bacterial growth, enzyme activity and to improve cheese flavor [2, 6, 19]. High brine saline concentration is reported to block enormously the growth of pathogenic bacteria, such as *Staphylococcus* spp, *Listeria monocytogenes, Salmonella* spp. and *Escherichia coli,* in different dairy products[16, 39]. On the other hand, use of high brine saline concentration reduces simultaneously the bacteria involved in fermentation, and hence prolongs cheese maturation process. In addition, consumption of high amounts of salt is reported to

cause different healthy problems and negative effects to the consumers such as hypertension and other cardiovascular problems [12], kidney stones and osteoporosis [22, 26, 27]. To avoid health risks, the World Health Organization has recommended decreasing of sodium chloride content in all types of food [44]. Temperature also affects the microflora of cheese and other dairy products and hence their characteristics [34], although no such information is available for Sharri cheese. The purpose of this research was to study the effect of brine salinity (at 3, 6, 9 and 12% of sodium chloride) and temperature (8 and 22°C) on microbiological parameters and sensory quality of Sharri cheese.

Material and Methods

Cheese making: Full–fat homogenized and unpasteurized bovine milk was purchased from a local dairy farmer (Dragash, Kosovo). Sharri cheese was manufactured according to a protocol described previously [36], with some modifications (Fig. 1). Briefly described, sixty litres of milk were filtered before entering into the processing, tempered into the clean tank, and heated up to 35°C. Using a microbiological starter of traditional whey, milk was coagulated for 30 min. After that, the coagulated curd was cut into 1 dm^3 (about 1 kg) and left for approximately 5 min, before transferring each part of it into the separate cheesecloths and left for other 15 min to drain at 40°C, and then pressed by 10 kg of weight for 10 h. The total ripening process lasted 60 days. The first 15 days, cheese was stored in the room temperature, and then it was transported to the laboratory, and randomly assigned to four different brine solutions (3, 6, 9, and 12%, wt/wt solution) and stored at two different temperatures (8°C and 22°C) up to the day 60.

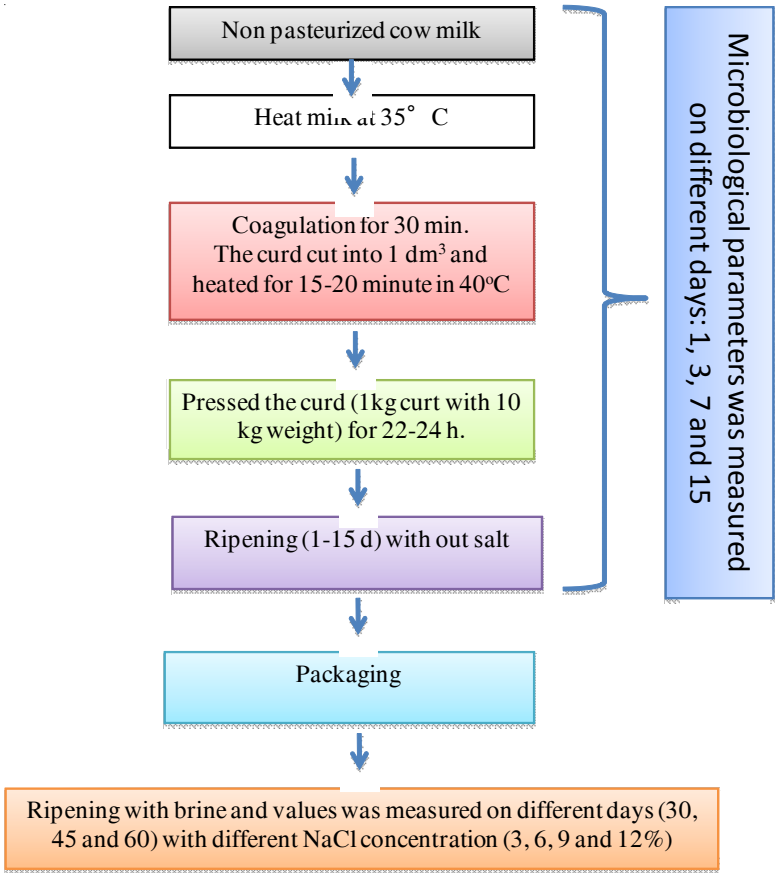

Figure 1. Technological diagram for the Sharri cheese.

Samples of raw milk before entering the cheese making process and cheese samples at day 16 and day 60 were taken for determination of total viable count, psychrofile bacteria, and enumeration and identification of lactic acid bacteria. All analyses were carried out in triplicate.

Microbiological analyses

Standard plate counting (SPC) of microorganisms and psychrophile bacteria: Total viable counts of microorganisms and psychrophile bacteria were conducted according to standard procedures, determined by International Standards Organization, by using pure plating technique as described previously [25]. Briefly, 20 g of cheese were placed into sterile Stomacher bag mixed with 180 ml of sterile 2% (w/v) tri-sodium citrate solution and blended for 5 min in a Stomacher (IUL instruments, Danimark) at room temperature. Serial dilution (10 to 10^{-8}) was made using tri-sodium citrate solutions and 100 µl from each dilution were plated. Mesophilic aerobic bacteria were incubated at 30°C for 72 h in Plate Count Agar (PCA) (Oxoid, Basingstoke, United Kingdom). Psychrofile bacteria counts were determined at 10°C for 96 to 120 h on PCA. LAB were incubated at 30°C for 24-48 h in de Man, Rogosa and Sharpe Agar (MRS) (Oxoid, Basingstoke, United Kingdom). All microbiological analyses were performed in triplicate.

Isolation, enumeration and phenotypic characterization of LAB: Traditional methods were applied for isolation and identification of LAB species as previously described [29]. Briefly, Sharri cheese samples were mixed in milk broths and 10-fold serial dilutions were applied. Samples were diluted at different serial dilutions (from 10 up to 10^{-8}), and 100 µl from each dilution was spread onto M17 agar supplemented with 0.5% w/v glucose (GM17) and MRS agar plates, and incubated at 30°C for 24 to 48 h. Based on the morphological differences single colonies from each experiment were picked up (15-20 colonies from each sample), re-streaked and stored in GM17 containing 15% glycerol at -80°C. The pure cultures were grown at 10, 15 and 45°C in MRS or GM17 and broth was evaluated visually after 24, 48 and 72 h of incubation. Tests for presence of catalase, production of ammonia from arginine, type of fermentation, different salt tolerance and pH were carried out as described previously [1]. The isolates were grouped based on biochemical tests and from each % of sodium chloride concentration and temperature 15 strains were used for future phenotypic and genotypic identification.

DNA isolation, PCR, and DNA sequencing: The DNA was extracted by using the bacterial genomic DNA Kit (Sigma-Aldrich, Missouri USA) [29]. PCR was done on genomic DNA to amplify 16S rRNA encoding genes, using the universal primers 11F (50-TAACACATGCAAGTCGAACG-30) and 5R (50-GGTACCTTGTTACGACTT-30) [8, 40]. The thermal profile used for PCR was done at 90°C for 1 min, and 35 cycles at 95°C for 15 s, 54°C for 30 s, and 70°C for 90s. PCR products were purified with NucleoSpin Extract II (Macherey-Nagel, Düren, Germany), and

sequenced by ABI prism 377 DNA sequencing system (Applied Bio System, Darmstadt, Germany).

Sensory analysis and evaluation: Twelve trained panelists from the Faculty of Agriculture and Veterinary in Kosovo carried out sensory evaluation of control and treated Sharri cheese (in different sodium chloride concentration and temperature). Profiles of 6 sensory attributes of cheese evaluated by panelists were: appearance (color – from whitish to yellow – and presence of "eyes"), odour (odour intensity), texture (hardness, springiness and friability), flavor (intensity) and taste (salty, sharp and strange tastes). In brief, the sensory evaluation sessions were held at mid-morning; about three hours after breakfast and panelists were supplied with mineral water before each session. In each group, cheeses were presented to each panelist individually, cut in triangular and thickness.

Statistical analyses: The data were analyzed by using R statistical program version 3.0.1. ANOVA model was used to test effect of different treatments, and Tukey's HSD at level of significance 0.01(1%) was applied to test for significant difference among different treatments (salt and temperature).

Results and Discussion

Enumeration of microorganisms: The characteristics of microbial populations in cheese at the time of processing and storage conditions have a significant influence on shelf life, sensoric quality, bacterial level and cheese making as well as on the other dairy products. Therefore, the total viable counts (TVC), number of psychrophile and lactic acid bacteria (LAB) in Sharri cheese have been enumerated, and results are summarized in Table 1.

According to the EU regulation the TVC should be $<10^5$ cfu/ml, while the Ministry of Agriculture, Forestry and Rural Development of Kosovo (MAFRD) regulation is less strict, with a TVC of $5x10^5$cfu/ml set as the upper limit [9, 24]. Level of TVC in raw milk before processing was analyzed, and only milk with number of bacteria according to EU regulation, has been used for further processing in cheese production. On the day 15 all the microbiological parameters were analyzed. The results of maturated Sharri cheese showed level of bacterial counts to be: TVC 8.6 $\log_{10}$CFU g^{-1}, psychrophile bacteria 6.8 $\log_{10}$CFU/ml, and LAB 8.3 $\log_{10}$CFU g^{-1}. Usually, high level of TVC is an indicator of bacterial contamination. In our study the most of bacteria found were LAB, indicating that this group of bacteria was responsible for the fermentation process during cheese maturation. In the similar types of cheese the number of total LAB during the fermentation process was reported to reach more than 6.8 $\log_{10}$ CFU g^{-1} [3, 42]. Sodium chloride is traditionally used as a cheese preservative and is added to improve its flavor, enzymatic activity and for bacterial growth control [6, 19]. However, the use of high amounts of sodium chloride in foods was reported to cause different health problems [11]. Based on that, World Health Organization has recommended decreasing the level of salt in dairy products (including cheese) [43]. Sharri cheese manufacturing is not fully standardized yet and homemade cheese makers or industries still use high concentration of salt to control bacterial growth. Traditional cheese makers use to store cheese for maturation in different conditions and temperatures. Some prefer to store it in the room temperature, while the others prefer to do that on cold rooms or cold-water streams.

To understand possible effects of brine salt concentration and storage temperature, after the day 15-cheese samples were divided equally and placed on different brine solution (3, 6, 9 and 12%) and stored in two different temperatures (8°C and 22°C) up to day 60. All microbiological parameters mentioned previously have been measured again in the end of experiment (at day 60). Results showed significant effect of both factors (NaCl % and temperature) in all microbiological parameters (TVC, psychrofile bacteria and LAB) ($P<0.01$) (Table 1). The total viable counts (TVCs) varied significantly between cheeses stored in two different temperatures, ranging from 6.99 $\log_{10}$ to 4.44 $\log_{10}$ and 6.48 to 4.29 $\log_{10}$, respectively. Similar significant differences were also shown for the other groups of bacteria. However, brine salinity had the main effect in microbiological parameters. Our results are in agreement with results obtained in a previous study [14], showing that sodium chloride controlled the microbiological growth and enzyme activity of cheese. Unfortunately, it is well known that, extended storage of cheese or other dairy products in cold temperatures, as a common practice in dairy sector today, favors the growth of psychrophile bacteria. In general, these groups of bacteria are able to form termo-resistent enzymes (protease, lipases and phospholipases), which can cause spoilage of cheese and other dairy products [4]. In this study, the number of psychrophile bacteria was lower than total viable count. In previous works variable ratios between TVC and psychrophile bacteria have been reported. In some cases number of psychrophile bacteria is even higher than TVC, while in other cases the opposite is true. Higher number of psychrophile bacteria is an indicator that pasteurization of raw milk before processing is required. Nowadays, psychrophile bacteria represent a major problem in dairy industry, by causing cheese spoilage (not a good view for customers) and hence economic losses [37]. Based on that, special attention is required to control raw milk processing and storage conditions.

Table 1. The level of different groups of microorganisms under different temperature and sodium concentration in cheese.

	TVC			*Psycrophilus*			LAB		
NaCl (%)	8 ºC	22 ºC	Mean[1]	8 ºC	22 ºC	Mean[1]	8 ºC	22 ºC	Mean[1]
3	6.99	6.48	6.73	5.61	5.12	5.37	6.46	5.40	6.43
6	6.78	6.37	6.58	5.48	4.92	5.20	6.29	5.99	6.14
9	6.25	5.06	5.65	4.41	4.31	4.36	5.92	5.84	5.88
12	4.44	4.29	4.36	3.76	3.29	3.52	5.84	5.37	5.61
Mean[2]	5.11	4.55		4.82	4.41		6.13	5.90	

TVC – total viable count, LAB – Lactic acid bacteria, TC – total coliforms. Data are present on $\log_{10}$.

Total counts and identification of LAB from cheese samples: LAB species are mostly used on dairy products fermentation as a starter culture during maturation process [41]. Therefore, in our study level of cheese LAB on the day 15 was higher (8.3 $\log_{10}$CFU g^{-1}) but decreased significantly ($P<0.01$) in the end of maturation process after cheese storing on different brine salt concentration for 45 days, ranging from 6.4 to 5.37 $\log_{10}$ CFU g^{-1} (from the lowest to the highest concentration of salt, respectively). Different species are included on the LAB group. To identify the present species inside this group we have used five to ten colonies (623 isolates), during different experimental conditions. The classification has been performed based on the morphological characteristics and different dilutions. The preliminary identification of LAB isolates was done based on biochemical test (cell morphology, catalase activity, Gram staining, and growing on different growth condition: temperature, pH and percentage of sodium chloride). The results showed that all 623 isolates were Gram positive and catalase negative and showed different pattern based on the growth conditions (data not shown). Finally, 15 isolates from each treatment combination group of brine saline concentration and temperature (total 120 isolates) and 20 isolates before brine treatment were identified based on 16S rRNA gene sequencing. The predominant LAB species on the day 15 were *Leuconostoc* (9 out of 20 isolates), while the other species present were: lactococci (7 out of 20 isolates), enterococci (3 out of 20 isolates) and lactobacilli (1 out of 20 isolates) (Table 2). Our results about LAB species present in cheese are consistent with findings from other studies on similar types of cheese from Western Balkan countries[17, 41]. Interestingly, after storing cheese in brine saline for 45 days the presence of LAB species was changed, and varied on different brine solutions. In low concentration of brine saline (3%) the most dominant species was *Leuconostoc pseudomesenteroides* (7 out of 15 isolates) and *Lactococcus lactis* (5 out of 5 isolates), while by increasing brine saline concentration *Enterococcus faecalis* (5 out of 15) and *Lactococcus garvieae* (5 out of 15 isolates) became more dominant. In brine solutions with 6 and 9 % salt mixed lactic acid bacteria species were observed. It is known that, the presence of mixed LAB plays a positive effect on cheese quality. Lactobacilli and lactococci are the main contributors for cheese maturation, as they are able to participate on acidification and proteolytic activity as well as on the other enzymatic processes during cheese ripening. *Leuconostoc* and enterococci produce a typical flavor, texture and aroma component [5, 13, 31]. Interestingly, on 12% brine saline concentration the only LAB species present were *Lactococcus garvieae* and *Enterococcus faecalis* (Table 2), while the other groups of bacteria found in lower brine saline concentration (like *Lactobacillus* and *Leuconostoc*) were not found, indicating that high concentration of brine saline changes the total microflora of Sharri cheese. Diversity of LAB was also reported for other cheese varieties similar to the Sharri cheese in the region, like in Zlatar cheese from Serbia [42], Feta cheese from Greece [28] and Beaten cheese from Macedonia [23]. In previous study in Sicilian cheese called Ragusano temperature was shown not to have a significant effect on cheese fermentation process [15]. In Feta cheese cold storage was shown to prevent further fermentation [28]. This is an indication of differences on the effect of storage temperature on fermentation process among cheese types.

Sensory evaluation: Sensory evaluation based on acceptability scores of Sharri cheese obtained from 11 panelists is displayed in Table 3. The cheese ripened in the highest (12%) brine saline concentration had the best score for overall acceptability. However, cheese stored in 12% brine saline concentration was significantly different in overall acceptability only from cheese stored in 3%, but not from that stored in 6 and 9% (scored 3.08, 2.12, 2.56 and 2.93, respectively). In addition, storage temperature was not shown to affect the overall acceptability significantly. It is well known that people from Balkan countries, Middle East and countries bordering Mediterranean Sea are used to eat dairy products with

Table 2. Distribution of lactic acid bacteria in artisanal Sharri cheese under different brine concentration and temperature.

		8°C				22°C			
Species	Before salting	3%	6%	9%	12%	3%	6%	9%	12%
Enterococcus spp.	3	3	3	6	7	2	3	6	6
Enterococcus faecalis	1	0	0	5	6	0	1	5	6
Enterococcus faecium	2	3	3	1	1	2	2	1	0
Lactococcus spp.	7	5	5	3	6	5	5	4	7
Lactococcus lactis	7	5	4	2	1	5	4	2	2
Lactococcus garvieae	0	0	1	1	5	0	1	2	5
Leuconostoc spp.	9	6	5	3	1	7	4	3	1
Leuconostoc pseudomesenteroides	9	6	5	3	1	7	4	2	1
Leuconostoc mesenteroides	0	0	0	0	0	0	0	1	0
*Lactobacillus*spp.	1	1	2	3	1	1	3	2	1
Lactobacillus sakei	1	1	1	2	1	1	2	1	0
Lactobacillus curvatus	0	0	1	1	0	0	1	1	1

Table 3. Sensory evaluation of Sharri cheese.

Temperature (ºC)	NaCl (%)	External appearance	Internal appearance	Flavor	Taste	Texture	Average	%
8	3	2.55	2.5	2.38	2.29	1.4	2.22	44.48
	6	2.91	2.75	2.54	2.36	2.13	2.54	50.76
	9	3.64	3.08	2.92	2.64	2.47	2.95	59.00
	12	3.64	3.42	3.00	2.71	2.33	3.02	60.40
22	3	2.18	2.17	2.08	2.21	1.40	2.01	40.16
	6	3.09	2.75	2.46	2.57	2.00	2.57	51.48
	9	3.64	3.08	2.92	2.64	2.27	2.91	58.20
	12	3.82	3.17	3.08	3.00	2.67	3.15	62.96

higher percentage of salt (up to 18%) [30]. For example, a Turkish cheese called Beyaz cheese, one of the most preferable cheeses in Turkey, contains 12 g NaCl in 100 g of cheese (12 %). However, less salty brine (6 - 8%) have been reported for Feta cheese from Greece [28], and Feta cheese from Serbia (up to 8%) [42]. If we want to decrease the brine saline concentration, because of possible health risks for consumers by use of high saline concentration, we may need to consider replacing NaCl salt by other chemicals less dangerous for human health, in order to keep unchanged the cheese taste for the consumers.

Increase of the brine saline concentration was reported to change the properties of cheese. It is well known that in Feta cheese, higher percentage of brine saline increases cheese hardness and pH values, while the moisture content is decreased [32]. Comparison of results from the sensory evaluation and LAB diversity showed that 6 and 9% brine saline concentration to be best, in order to keep unchangeable the cheese taste, which is in accordance with results from other studies for similar type of the cheeses in Western Balkan and Mediterranean countries. Texture of the cheese treated with 3% brine saline concentration was significantly different from cheeses with higher concentration of brine saline. This is in accordance with previous findings, that sodium chloride increases cheese hardness.

Conclusions

The level of TVC, psychrophile bacteria and LAB were all decreased significantly by increasing the level of saline concentration. In the cheeses stored on 3, 6 and 9% saline concentration, mixed species of LAB (including: lactococci, lactobacilli, enterococci and leuconostoc) were found, while on 12% the dominant LAB species were *Enterococcus faecalis* and *Lactococcus garvieae*. On sensory evaluation the best scores for flavor were for 6, 9 and 12% brine saline concentration. To avoid the healthy problems and save the traditional cheese making the sensory evaluation results coupled with microbiological results suggest that Sharri cheese could be successfully manufactured using 6% brine instead of higher concentration currently used (12 % or higher) and stored on room temperature. Due to the negative effect of sodium chloride it would be interesting to replace the sodium chloride with other compounds and then to study the possible changes on microbiological flora and sensory quality of Sharri cheese.

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Reference

[1]Abdullah, S. A. and Osman, M. M. 2010. Isolation and identification of lactic acid bacteria from raw cow milk, white cheese and rob in Sudan. Pak. J. Nutri. **9**:1203-1206.

[2]Ayyash, M. M. and Shah, N. P. 2010a. Effect of partial substitution of NaCl with KCl on Halloumi cheese during storage: Chemical composition, lactic bacterial count, and organic acids production. J. Food Sci.**75**:525–529.

[3]Ayyash, M. M. and Shah, N. P. 2010b. The effect of substituting NaCl with KCl on Nabulsi cheese: Chemical composition, total viable count, and texture profile. J. Dairy Sci. **94**:2741–2751.

[4]Chen, L., Daniel, R. M. and Coolbear, T. 2003. Detection and impact of protease and lipase activities in milk and milk powder (review). Int. Dairy J. **13**:255-275.

[5]Crow, V. L., Curry, B. and Hayes, M. 2001. The ecology of non-starter lactic acid bacteria (NSLAB) and their use as adjuncts in New Zealand Cheddar. Int. Dairy J. **11**:275–283.

[6]Doyle, M. E. and Glass, K. A. 2010. Sodium reduction and its effect on food safety, food quality and human health. Comp. Rev. Food Sci. Food Safety **9**:44–56.

[7]Dozet, N., Ad•ić, N., Stanišić, M. and •ivić, N. 1996. Autohtoni mljeèni proizvodi. Podgorica & Silmir, Belgrade, Serbia and Montenegro, pp. 56-57.

[8]Edwards, U., Rogall, T., Blocker, H., Emde, M. and Bottger, E. C. 1989. Isolation and direct complete nucleotide determination of entire genes. Characterization of a gene coding for 16S ribosomal RNA. Nucleic Acids Res. **17**:7843-7853.

[9]European Union 2004. Commission Regulation (EC) No 853/2004 of the European Parliament and of the Council of 29 April 2004 laying down specific hygiene rules for food of animal origin. Official J. European Union **226**:22–82.

[10]Ferati, I., Bijo, B., Idrizi, Xh., Durmish, N. and Xhabiri, G. 2013. Microbiological assessment of Sharri cheese produced under traditional and industrial conditions. Eur. Sci. J. **9**:1857-7881.

[11]Fitzgerald, E. and Buckley, J. 1985. Effect of total and partial substitution of sodium chloride on the quality of Cheddar cheese. J. Dairy Sci. **68**:3127–3134.

[12]Forshee, R. A. 2008. Innovative regulatory approaches to reduce sodium consumption: Could a cap-and-trade system work? Nut. Rev. **66**:280-285.

[13]Foulquié-Moreno, M. R., Sarantinopoulos, P., Tsakalidou, E. and De Vuyst, L. 2006. The role and application of enterococci in food and health. Int. J. Food Microbiol. **106**:1-24.

[14]Fox, P. F., Guinee, T. P., Cogan, T. M. and McSweeney, P. L. H. 2000. Salting of cheese curd. Fundamentals of Cheese Science. Aspen Publishers Inc., Gaithersburg, MD, pp.153–168.

[15]Fucá, N., McMahon, D. J., Caccamo, M., Tuminello, L., La Terra, S., Manenti, M. and Licitra, G. 2012. Effect of brine composition and brining temperature on cheese physical properties in Ragusano cheese. J. Dairy Sci. **95**:460–470.

[16]Genigeorgis, C. A. 1981. Factors affecting the probability of growth of pathogenic micro-organisms in foods. J. Am. Vet. Med. Assoc. **179**:1410-1417.

[17]Golicì, N., Cade•, N., Terzicì-Vidojevicì, A., Šuranská, H., Beganovicì, J., Lozo, J., Kos, B., Šuškovicì, J., Raspor, P. and Topisirovicì, L. 2012. Evaluation of lactic acid bacteria and yeast diversity in traditional white pickled and fresh soft cheeses from the mountain regions of Serbia and lowland regions of Croatia. Int. J. Food Microbiol. **166**: 294-300.

[18]Guinee, T. P. 2004. Salting and the role of salt in cheese. Int. J. Dairy Tech. **57**:99–109.

[19]Guinee, T. P. and Fox, P. F. 2004. Salt in cheese: Physical, chemical and biological aspects. In Fox, P. F., Mcsweeney, P. L. H., Cogan, T. M., and Guinee, T. P. (eds). Cheese: Chemistry, Physics and Microbiology. Vol. 1.General Aspects. 3rd edn. Elsevier Academic Press, San Diego, CA, pp. 207–259.

[20]Guinee, T. P., Feeney, E. P., Auty, M. A. E. and Fox, P. F. 2002. Effect of pH and calcium concentration on some textural and functional properties of mozzarella cheese. J.Dairy Sci. Tech. **19**:151-162.

[21]Hayaloglu, A. A., Guven, M. and Fox, P. F. 2002. Microbiological, biochemical and technological properties of Turkish white cheese "Beyaz Peynir". Int. Dairy J. **12**:635–648.

[22]Heaney, R. P. 2006. Role of dietary sodium in osteoporosis. J. Am. Coll. Nutr. **25**:271S-276S.

[23]Kapac-Parkačeva, N. 1988. Mlekarstvo II del - Tehnologija na prerabotkite od mleko. Agricultural Faculty, Skopje.

[24]MAFRD 2006. Administrative Instruction MA-No. 20/2006 on Quality Standards and Grade of Fresh Milk.Ministry of Agriculture, Forestry and Rural Development in Kosovo.

[25]Marshall, T. R. 1993. Standard Methods for the Examination of Dairy Products. 16th edn. American Public Health Association, Washington, DC.

[26]Massey, L. K. 2005. Effect of dietary salt intake on circadian calcium metabolism, bone turnover, and calcium oxalate kidney stone risk in postmenopausal women. Nutri. Res. **25**:891-903.

[27]Massey, L. K. and Whiting, S. J. 1995. Dietary salt, urinary calcium, and kidney stone risk. Nutri. Rev. **53**:131-139.

[28]McMahon, D. J., Motawee, M. M. and McManus, W. R. 2009. Influence of brine concentration and temperature on composition, microstructure and yield of feta cheese. J.Dairy Sci. **92**:4169–4179.

[29]Mehmeti, M., Muji, S., Diep, D. and Nes, I. 2015. High frequency of the potential pathogen *Lactococcus garvieae* in raw milk from Kosovo. Food Control **53**:189-194.

[30]Melilli, C., Barbano, D. M., Caccamo, M., Tuminello, L., Carpino, S. and Licitra, G. 2006. Interaction of brine concentration, brine temperature, and pre-salting on salt penetration in Ragusano cheese. J. Dairy Sci. **89**:1420-1438.

[31]Palles, T., Beresford, T., Condon, S. and Cogan, T. M. 1998. Citrate metabolism in *Lactobacillus casei* and *Lactobacillus plantarum*. J. Applied Microbiol. **85**:147-154.

[32]Prasad, N. and Alvarez, V. B. 1999. Effect of salt and chymosin on the physicochemical properties of feta cheese during ripening. J. Dairy Sci. **82**:1061-1067.

[33]Radulović, Z., Mioèinović, J., Pudja, P., Barać, M., Miloradović, Z., Paunović, D. and Obradović, D. 2011. The application of autochthonous lactic acid bacteria in white brined cheese production. Mljekarstvo **61**:15-25.

[34]Rehman, S. U., Bank, J. M., Mcsweeney, P. L. H. and Fox, P. F. 2000. Effect of ripening temperature on the growth and significance of non starter lactic acid bacteria in cheddar cheese made from raw and pasteurized milk. Int. Dairy J. **10**:45-53.

[35]Rysha, A. and Dela, F. 2014a. Sensory properties and chemical composition of Sharri cheese from Kosovo. Mljekarstvo **64**:295-303.

[36]Rysha, A., Markov, K., Frece, J., Èvek, D. and Delaš, F. 2014b. A survey of the microbiological quality of Sharri, a hard mountain cheese from Kosovo. Int. J. Dairy Tech. **67**:277-282.

[37]Samar•ija, D., Zamberlin, Š. and Pogacicì, T. 2012. Psychrotrophic bacteria and milk and dairy products quality. Mljekarstvo **62**:77-95.

[38]Sarić, Z., Lüthi-Pengt, Q. Q. and Puhan, Z. 2002. Quality aspect of Travnicki cheese made from raw and pasteurised cow and goat milk. Milchwissenschaft **57**:631-634.

[39]Speer, E. and Mixa, A. 1998. Milk And Dairy Product Technology. Marcel Dekker, New York, 483 p.

[40]Stackebrandt, E. and Charfreitag, O. 1990. Partial 16S rRNA primary structure of five *Actinomyces* species: phylogenetic implications and development of an *Actinomyces israelii*-specific oligonucleotide probe. J. Gen. Microbiol. **136**:37-43.

[41]Terzic-Vidojevic, A., Vukasinovic, M., Veljovic, K., Ostojic, M. and Topisirovic, L. 2007. Characterization of microflora in homemade semi-hard white Zlatar cheese. Int. J. Food Microbiol. **114**:36-42.

[42]Veljovic, K., Terzic-Vidojevic, A., Vukasinovic, M., Strahinic, I., Begovic, J., Lozo, J., Ostojic, M. and Topisirovic, L. 2007. Preliminary characterization of lactic acid bacteria isolated from Zlatar cheese. J. Applied Microbiol. **103**:2142-2152.

[43]WHO 2007. Reducing Salt Intake in Populations: Report of a World Health Organization Forum and Technical Meeting Geneva. Accessed Aug. 2007.

[44]WHO 2010. Creating an Enabling Environment for Population-based Salt Reduction Strategies. Report of Joint Technical Meeting Held By World Health Organization and the Food Standards Agenncy, UK.