

Production technology and some quality parameters of Njeguši cheese

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Abstract

Industrialization of agricultural production and depopulation of areas that are recognized by traditional products, reached its peak during the last few decades. This represents a significant risk that the technology of traditional agricultural products, especially cheeses, can go into oblivion. *Njeguši* cheese is one of the famous Montenegrin traditional dairy products which originates from the mountain *Lovćen* and its peripheral areas. Produced by traditional technology, it belongs to a group of full fat, hard cheeses. Owing to its characteristic, spicy taste and pleasant odour, *Njeguši* cheese can be compared with some of the most famous hard cheeses. Originally it is made from ewe's milk, but also, cow's, goat's and their mixture in different proportions, are increasingly used, which may be the treat to the originality of *Njeguši* cheese. The present study offers a description of original *Njeguši* cheese technology, followed by analysis of the chemical quality of ewe's milk, cheese and whey. Thereat milk, cheese and whey samples were taken from 5 households located at the place of cheese origin - the *Njeguši* village. Chemical quality of ewe's milk, cheese and whey was determined by method of FTIR spectrophotometry. Milk fat in the dry matter and moisture in cheese non-fat basis were mathematically calculated. The average content of milk fat in ewe's milk was 4.92 %, proteins 4.59 %, lactose 4.14 % and total solids non-fat 9.46 %. Accordingly, the analysed cheeses belonged to full fat, semi-hard cheese due to 51.73 % fat in total solids and 60.07 % moisture in non-fat basis. The only deviation from original technology was shortening of the ripening period. Apart from the main objective - the preservation of the original technology, this study could significantly contribute to the process of protection of origin of *Njeguši* cheese, because the technology of cheese fulfilled the requirements listed in the National Law on the protection of designations of origin.

Key words: *Njeguši* cheese, ewe's milk, technology, protection of designations of origin

Introduction

Traditional cheeses are recognizable by their authentic flavour and texture. The authenticity is result of large number of factors that are present on the area at which they are produced: geographic features, climate, soil and water quality, botanical composition of natural meadows, races and breeds of dairy animals, but also of traditional habits and customs of the local population (Lukač 1989 cited Prpić et al., 2003). Since traditional cheeses are mainly produced from raw milk, aroma and texture

of these cheeses originate from the activity of wide spectrum of natural microflora that is present in raw milk, primarily lactic acid bacteria (Mijačević and Bulajić, 2007). Natural microflora influences the physicochemical and microbiological quality of the raw milk, and also directs and accelerates ripening of traditional cheeses (Monnet et al., 2000). Lukač-Havranek et al., (2000) affirmed that the texture and taste of authentic cheeses arose from an extremely complex system of biochemical reactions caused by the joint action of known and unknown bacterial populations and enzymes in milk and curd,

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as well as from secondary microbial populations during ripening of the cheese. Autochthonous microbial population influences the taste and texture of cheese and are the most important parameters to identify origin of traditional cheeses produced from raw milk (Gaiaschi et al., 2000). Owing to the development of dairy industry, there are hundreds of different types of dairy products in the world today. All of these products were created directly or through modification of traditional products (Lukač, 1991), among which the most common ones are raw milk pasteurization and adding a starter culture. Heat treatment of raw milk and addition of commercial cultures causes the loss of the original taste, aroma, and texture of cheese, resulting in partially or complete loss of the cheeses authenticity (Estaper et al., 1999, cited Moračanin et al., 2012). The technology of traditional agricultural products, especially cheeses is under the great risk to go into oblivion because of high level of industrialization of agricultural production, which is particularly evident in the dairy industry. Industrial cheese, characterized by very similar and uniform sensory qualities, over the time, become “boring” to a certain group of consumers. Lately, more and more consumers increasingly look for traditional cheeses with a specific taste and odour (Mirecki, 2012). The importance of traditional cheeses is not only that they are carriers of a wide variety of different shapes, textures, flavours and odour, or that in recent years they have increased market value. It is also very important that their production is based on family tradition passed from generation to generation, so they are an indispensable part of the history and material and cultural treasure of each nation.

Montenegro has wide spectrum of traditional dairy products: cheeses (soft, brined, semi hard, “pasta filata”), fermented milks (“kisjelo mlijeko”, “jardum”, “gruševina”) and very specific extra fatty product “skorup” (Dozet et al., 1996). But, one of the best known and the most appreciated Montenegrin traditional dairy product is the *Njeguši* cheese. History of *Njeguši* cheese reaches far into the past. In the age of the Roman Empire, Rome was supplied with cheese “*Caseus Doclestes*” (Markeš, 1973). Since *Doclea* was an old state which existed at the territory of Montenegro, it is assumed that the cheese is “*Caseus Doclestes*” is an “ancestor” of the *Njeguši* cheese. Heinrich Stieglitz commented

the hospitality of the *Njeguši* village inhabitants in his travelogue “Ein Besuch auf Montenegro” (1841., reprint 2008) and said that he was served with extremely tasty cheese. Rakočević (1950) mentioned that ewe’s milk was the main raw material for *Njeguši* cheese production. Later, several papers that studied the technology and quality *Njeguši* cheese were published (Adžić et al., 1984; Adžić et al., 1997; Mirecki, 1998; Dozet et al., 2004), but the most detailed research was carried out by Dozet et al., (1996). All researches confirmed that it should belong to group full fat, hard cheeses. However the industrialization expanded to the production of *Njeguši* cheese and due to demands of higher profits, the cheese was produced from cheaper and more accessible cow’s milk, the ripening period was intentionally shortened and industrial starter cultures were used. Consequently, the *Njeguši* cheeses produced that way had no original flavour and were characterised by and inadequate milk fat and moisture content. Hence, it became almost impossible to find the original *Njeguši* cheese on the market. The aim of this paper was to record the production technology currently used at the place of cheese origin and to note possible deviations from the original technology. Also, one of the objectives was to analyse the quality of ewe’s milk, the traditionally produced *Njeguši* cheese and it’s whey. The data could be very useful in the process of requesting the protected designation of origin and later for development of its own standard. The technology of cheese fulfilled all the requirements of the Law on protected designation of origin, protected geographical indication and traditional speciality guaranteed (Official Gazette of Montenegro, 2011).

Materials and methods

The presented research was provided through field and laboratory activities. Field research was organized in 5 households in the *Njeguši* village during summer 2013. The households were recognized as producers which use traditional technology of *Njeguši* cheese. All the phases of cheese production were recorded at each household and the presented technology is summary of the collected data. Samples of ewe’s milk and whey were collected in the period from July to August, while samples of cheese

were taken after 40-50 days of ripening. In total, 10 samples of milk, whey and cheese were taken following the IDF methodology (FIL-IDF 50B:1985). Quality of ewe's milk and whey was analysed using the method of FTIR Spectrophotometry (FIL-IDF 141C, 2000) on the instrument MilkoScan 120 FT (Foss Analytic A/S, Denmark). The analysis of ewe's milk and whey included following parameters: milk fat, proteins, lactose and total solid non-fat. The same method and instrument were used for analysis of fat, proteins, dry matter and salt content in cheese. Content of moisture and fat in dry matter (Sabadoš, 1996) and moisture in the non-fat basis (Codex Stan 283-1978) were mathematically calculated.

Sensory analysis of mature cheeses was performed by a panel consisting of six members using the scoring method and according to the sum of the weighted points, whereas the cheeses were classified into different quality categories (Ritz et al., 1991).

The results of chemical analysis were statistically analyzed using SPSS 12.0 (Chicago IL., SPSS Inc: 2003).

Results and discussion

Njeguši cheese production technology

The original *Njeguši* cheese was produced from ewe's milk which was milked manually. The milk was filtered through a "cjedilo", the cheese making cloth, and fed to the temperature of 32 °C to 35 °C. After reaching the optimal temperature, a homemade rennet consisting of lamb stomach parts was added. The amount of rennet should be sufficient to form a sturdy curd during 30-60 minutes. The formed curd was cut up to the size of walnuts, and after 5 minutes of resting, again to the size of corn grains. The cheese curd was formed in the whey gradually heated to the temperature "until the hand can withstand" (40-45 °C). All the time the curd had to be formed by hands in whey until it gets a globose shape. This phase lasted 15-20 minutes, and the goal was to achieve an optimal separation of whey and to form a favourable curd structure. The so formed curd was placed into "cjedilo" and by hand squeezing an additional amount of whey was separated. After that, the curd was placed in "tvorilo" - a wooden or metal cheese mold, and pressed. Curd was pressed

with a wooden circular plank and then with stone added on a plank. After 12 hours of pressing, the curd was placed in a new, dry cloth, rolled over to the other side and pressed again for next 12 hours. After a total of 24 hours of pressing, the cheese was removed from mold and dry salted. The salted cheese was placed in "kašun" a wooden chest. During the first 2 days, the cheese was salted 2-3 times per day and each time turned on a dry side. Salting was done in "kašun" because that way the cheese was protected from flies and rodents. Also, "kašun" provided a stable temperature, which was essential for the uniform salting. After salting, the cheese was ripened. According to the narratives of experienced manufacturer, the best quality cheese was obtained if the ripening took place in "volat" - a room with stone vault placed on the basement. The average temperature during ripening was 16.1 °C while the relative humidity was 87.6 %. The cheese ripened on dry wooden shelves. In the first 3-4 days of ripening, the cheese was turned 2-3 times per day and always put on the dry part of the shelf. Later, the cheeses were turned once a day. Ripening on the shelves lasted at least 4 weeks. During that period it was necessary to maintain the surface of cheese. Mostly, the occurrence of molds was the main problem, but they could be effectively removed by washing the cheese surface with cold and salty water. After washing, it was necessary to dry the cheese with a clean, dry cloth and then to put it back on the shelf. Ripening on the shelves commonly lasted 40-50 days. After that, cheese is ready for consumption or ripening could be prolonged. Longer ripening gave the cheese more piquant taste. Also, the ripened cheese may be exposed to smoke for a few days, dipped into the olive oil or put into a wheat grain. Cheese could stay in oil or grain from 90 to 150 days. The average randman was 4-5 liters of milk for 1 kg of cheese.



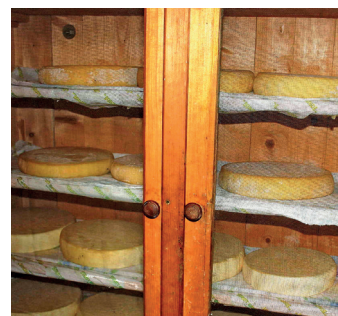
Cheese pressing



Cheese salting



"Kašun"



Cheese ripening

Quality of Njeguši cheese

Results of the chemical analyses of *Njeguši* cheese are shown in table 1. The results showed that the analysed cheeses belonged to the full fat, semi-hard cheese, since they had 51.73 % fat in total solids and 60.07 % moisture in the non-fat basis.

The obtained results confirmed fears that the original *Njeguši* cheese could be lost because even cheeses from the present study did not achieve the quality that could classify them as full-fat hard cheeses. The reasons could be shortening the optimal ripening period and a lower content of milk fat and protein in milk than expected (Table 1). Despite those facts, quality of the investigated cheeses was very good. Compared with the results of other authors (Adžić et al., 1984; Dozet et al., 1996; Adžić et al., 1997; Dozet et al., 2004), the content of moisture (42.07 %) was higher, the dry matter was lower (57.93 %) and the salt content was surprisingly lower (1.94 %), which was a positive feature. The values of other parameters were relatively

uniform when compared to results of some former studies.

Sensory evaluation of Njeguši cheese

Six panel members evaluated ten samples of *Njeguši* cheese according to the scoring method that included six cheese characteristics - appearance, colour, consistency, cut, odour and flavour (Ritz et al., 1991). The results of sensory evaluations are presented in Table 2. According to the sum of the weighted points, cheeses were classified into different quality categories (Ritz et al., 1991). Classification of the *Njeguši* cheese samples are shown in Table 3.

To obtain 20 points, *Njeguši* cheese must have had the following characteristics - thin and smooth crust of golden-yellow colour, closed and hard consistency, yet easy to cut with only few "cheese eyes", pleasant odour, slightly milky-sour and moderately salty taste.

Table 1. Chemical quality of *Njeguši* cheese

Parameters	n	\bar{X}	\bar{X}_{\min}	\bar{X}_{\max}	SD
Fat, %	10	29.97	25.98	34.95	3.02
Proteins, %	10	21.89	19.75	23.7	1.35
Dry matter, %	10	57.93	51.55	65.08	4.28
Moisture, %	10	42.07	34.92	49.45	4.28
Fat in DM, %	10	51.73	49.69	54	1.61
Moisture in non-fat basis, %	10	60.07	53.67	65.45	3.62
Salt, %	10	1.94	1.3	3.04	0.56

Table 2. Results of sensory evaluation of *Njeguši* cheese

Samples	1	2	3	4	5	6	7	8	9	10
\bar{X}	16.36	16.20	15.60	15.12	16.64	16.76	17.56	17.80	18.40	18.18

Table 3. Classification of *Njeguši* cheese samples

Quality category	Weighed scores	Samples
Excellent	17.6-20.0	7, 8, 9, 10
Good	15.2-17.5	1, 2, 3, 5, 6
Mediocree	13.2-15.1	4
Acceptable	11.2-13.1	-
Not acceptable	<11.2	-

Table 4. Chemical quality of ewe's milk

Parameters	n	\bar{X}	\bar{X}_{\min}	\bar{X}_{\max}	SD
Fat, %	10	4.92	3.31	6.26	0.91
Proteins, %	10	4.59	4.14	5	0.32
Lactose, %	10	4.14	4.01	4.26	0.1
Total solids non fat, %	10	9.46	8.88	9.94	0.4

Table 5. Chemical quality of whey

Parameters	n	\bar{X}	\bar{X}_{\min}	\bar{X}_{\max}	SD
Total solids, %	10	7.72	6.74	8.20	0.49
Fat, %	10	1.34	0.61	1.98	0.46
Proteins, %	10	1.25	1.17	1.38	0.07
Lactose, %	10	4.4	4.2	4.59	0.12
Total solid non-fat, %	10	6.35	6.06	6.62	0.49

Results presented in Tables 2 and 3 indicated that, due to the seasonal nature of sales and in order to achieve higher profits, manufacturers of *Njeguši* cheese obviously accelerated the production by reducing the ripening, which was consistent with conclusions of Dozet et al., (1996). For that reasons only four cheeses had sensory characteristics of the original cheese, five were of good quality, and one sample had a mediocre sensory quality.

Quality of ewe's milk

The quality of milk largely affects the physico-chemical and sensory properties of cheese (Lukač, 1989). The quality of ewe's milk used in the production of *Njeguši* cheese is presented in Table 4.

The content of milk fat is the most variable component of milk (Antunac and Lukac-Havranek, 1999), which was confirmed by the results presented in Table 4. The content of milk fat was in range 3.31 to 6.26 %. The average content of milk fat (4.92 %) and proteins (4.59 %) were lower

than average for ewe's milk analysed by Adžić et al., (1984). Results for fat content were equal as those obtained on experimental households (Dozet et al., 1996), but protein content was much higher. The lactose content was relatively the same as those obtained by Adžić et al. (1984) and Dozet et al (1996). Generally, ewe's milk didn't show the expected quality, which was most probably related to very extensive way of ewe breeding, especially regarding the quality of the diet.

Quality of whey

More than 90 % of whey was water. Compared with the results Dozet et al., (1996), content of total solids, milk fat and lactose was approximately the same, but the content of protein was higher. Whey is a significant source of lactose, but also, of nutritionally valuable whey proteins and milk fat. Unfortunately, in the *Njeguši* area, whey was mostly used for feeding young farm animals, like calves and pigs (Mirecki, 1998). However, in recent years it is

increasingly being used for human consumption as whey-protein cheese *Urda* or a tasty and refreshing fermented beverage.

Conclusion

Njeguši cheese is one of the famous Montenegrin traditional dairy products. The original cheese is made from ewe's milk. Lately, there was a deviation from the original production methods of *Njeguši* cheese by introduction of modern equipment, using cow's milk and industrial starter cultures, as well as by the modification of certain phases of production, such as shortening of ripening time. So, there is a risk that the original technology of *Njeguši* cheese went into oblivion. Therefore, the main objective of this study was to find households that still produce cheese on the traditional way, record original technology and examine the quality of ewe's milk, *Njeguši* cheese and whey. The research results were as follows:

- fortunately, there are still households that practice the old traditional technology for *Njeguši* cheese production,
- but, screening of technology showed that even at those households there is certain deviations from original technology and it is shortening of the optimal ripening period,
- the content of milk fat in ewe's milk was 4.92 %, proteins 4.59 %, lactose 4.14 % and total solids non-fat 9.46 %, chemical analysis of ewe's milk showed that milk had good quality and that, even though the fat content was lower than expected, milk was appropriate for processing into cheese,
- the experimental cheeses belonged to full fat, semi-hard cheese due to 51.73 % fat in total solids and 60.07 % moisture in non-fat basis, variation of quality components of cheese indicated a lack of uniform technology, not only between but also within households,
- the whey obtained after production of *Njeguši* cheese contained on average 7.72 % of total solids, 1.34 % fat, 1.25 % proteins, 4.40 % lactose and 6.35 % of total solids non-fat, and it was used for human consumption as whey-protein cheese *Urda* and/or as a fermented beverage.

To produce *Njeguši* cheese with a good and uniform quality, it is necessary to introduce uniform standards in the technology of its production on households, but also on SMEs (small and medium enterprises), where deviation in technology were higher than in households. Also, the process of protection of origin of *Njeguši* cheese should be launched, because *Njeguši* cheese fulfills all the requirements listed in the National Law (Official Gazette of Montenegro, 2011). The national food law was harmonized with the EU law which provides a promising perspective and a bright future for the destiny of traditional dairy and other food products from Montenegro during and after the integration of Montenegro into the EU.

Tehnologija i kvaliteta njeguškog sira

Sažetak

Industrijalizacija poljoprivredne proizvodnje i depopulacija područja koja su poznata po tradicionalnim proizvodima, dosegli su vrhunac tijekom posljednjih nekoliko desetljeća. Rezultat je značajan rizik da tehnologije tradicionalnih poljoprivrednih proizvoda, osobito sireva, mogu otići u zaborav. Stoga je glavni cilj ovog istraživanja bio snimiti izvornu, tradicionalnu tehnologiju proizvodnje njeguškog sira, koji je jedan od najpoznatijih crnogorskih tradicionalnih mliječnih proizvoda. Izvorno područje proizvodnje je planina Lovćen i njegova rubna područja. Sir pripada skupini punomasnih, tvrdih sireva. Zahvaljujući svom karakterističnom pikantnom okusu i ugodnom mirisu, njeguški sir može se usporediti s najboljim renomiranim sirevima. Izvorni sir se proizvodi od ovčjeg mlijeka. Međutim, sve se više koristi kravlje, kozje i mješavina navedenih mlijeka, u različitim omjerima, što može biti prijetnja originalnosti njeguškog sira. Studija opisuje originalnu tehnologiju proizvodnje njeguškog sira, praćenu analizom kemijskog sastava ovčjeg mlijeka, sira i sirutke. Uzorci mlijeka, sira i sirutke uzeti su u 5 domaćinstava, u selu Njeguši. Kemijski sastav ovčjeg mlijeka, sira i sirutke određeni su metodom FTIR spektrofotometrije. Sadržaj mliječne masti u suhoj tvari i vode u nemasnoj tvari sira dobiveni su izračunavanjem. Sadržaj mliječne masti u ovčjem mlijeku bio je 4,92 %, bjelančevina

4,59 %, laktoze 4,14 % i suhe tvari bez masti 9,46 %. Sirevi pripadaju punomasnim, polutvrđim sirevima, jer imaju 51,73 % masti u suhoj tvari i 60,07 % vode u nemasnoj tvari. Osim glavnog cilja - očuvanje izvorne tehnologije, ova studija može značajno doprinijeti procesu zaštite podrijetla njeguškog sira, jer tehnologija sira ispunjava uvjete navedene u Nacionalnom Zakonu o oznakama podrijetla.

Ključne riječi: njeguški sir; ovčje mlijeko, tehnologija, zaštita oznaka izvornosti

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