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CHARACTERISTICS OF MONTENEGRIAN AUTOCHTONOUS "LISNATI CHEESE"

Slavko Mirecki[1*], Ivan Ivanović[1], Nikoleta Nikolić[1]

[1]Biotechnical Faculty, Mihaila Lalića 1, 81000 Podgorica, Montenegro

[*]e-mail: slami@ac.me

Abstract

There are several types and varieties of cheeses that can be classified as Montenegroan autochtonous dairy product. One of them is "lisnati cheese" characterized by distinctive soft, elastic and smooth structure, mild-sour odor and porcelan white color. Also it is recognizable by very unusual form of slices that are very thin, like a sheet of paper or leaf, which determinate its name: "lisnati" = "foliate, leafy".

Considering the high level of depopulation of rural areas in Montenegro, there are less producers of the original autochthonous "lisnati cheese". Therefore, the aim of this study was to present autochtonous technology of "lisnati cheese", chemical composition of milk for cheese production, as well as the chemical composition of cheese and whey.

Autochthonous technology of "lisnati cheese" is obtained by surveys done at 10 households from the area of north Montenegro. Surveyed households are traditional producers of "lisnati cheese". After skimming, acidification and adding certain amount of water, raw milk contained relatively low content of fat (2.39%), proteins (2.98%), lactose (3.65 %) and solid-non-fat (7.41%), and freezing point depression was (-0.461 ^{0}C). It was determinated that „lisnati cheese" contained 20.38 % of fat, 22.39 % proteins, 48.42 % total solids and 2.59 % salt, in average. The average quality of whey was: 0.196 % of fat, 0.705 % proteins and 5.822 % total solids.

Key words: "*Lisnati cheese*", *autochtonous technology, chemical quality, milk, whey*.

1. Introduction

Since prehistoric age, milk and milk products have been one of the most essential segments in human nutrition. Those products are not important only in terms of their nutritional value, but also as representatives of the cultural and historical identity of people and countries. Montenegro has wide range of autochthonous milk products that take primary place in traditional Montenegrin meal. They are characterized by high nutritional value but their technology is not standardized. The most important dairy products of Montenegro are white brine Pljevlja's cheese, Njeguši's hard fullfat cheese, low-fat hard cheese Prljo, creamy product Skorup, but one of the most specific Montenegrin milk product is "Lisnati cheese".

"Lisnati cheese" was rarely subject of scientific researches, so there are just a few scientific papers about its technology or quality. The earliest scientific paper where technology of Lisnati cheese was described is from 1947 (Zdanovski [1]). In scientific reviews such cheese is known as "meki" (Dozet *et al*. [2]), but for the people of Montenegro it is better known as Kolašin's cheese, by the name of the town where such cheese is mainly being produced, or Lisnati cheese due to its unique foliate, leafy shape of slices (Rakočević [3]).

Lisnati cheese is characterized by distinctive soft, elastic and smooth structure, mild-sour odor and porcelain-white color. Also it is recognized by very unusual form of slices that are extremely thin, like a sheet of paper or leaf and this characteristic determine its name: "lisnati" = "foliate, leafy".

Technology of this cheese is specific and unique and does not match the technology of any other cheese in Montenegro. The unique technology is result of a special way of preparing raw milk for cheese production and specific way of coagulation and curd processing. Cow's milk is used for production of Lisnati cheese. First, raw milk must be acidified. Acidification of milk is caused by activity of natural microorganisms that are in raw milk, leaving the raw milk 12-24 hours at the room temperature. Than, acidified milk should be skimmed, mixed with fresh raw milk and certain amount of water and at the end, the rennet has to be added. After 30-45 minutes, milk starts to coagulate

forming concentric circles of coagulum. When coagulation is finished, it should be provided with a special way of curd processing. As long as syneresis is presented, curd should be pressed and very often folded. Thanks to hard pressure and special way of curd folding, the slices of Lisnati cheese are very thin.

Considering the high level of depopulation of rural areas in Montenegro, there are less and less producers of the original autochthonous "Lisnati cheese". Therefore, the aim of this study is to save unique autochthonous technology of "lisnati cheese" from oblivion and to present chemical composition of milk for cheese production, as well as the chemical composition of Lisnati cheese and whey.

2. Materials and Methods

The experiment consists of activities on field, laboratory analysis and statistical calculations.

Field activities were implemented from March to June 2010 at 10 households from the area of Kolašin municipality, which is situated in northern, mountainous part of Montenegro. All households are known as excellent producers of Lisnati cheese. Technology of Lisnati cheese production was observed and recorded at each of households and than summarized. Two groups of milk samples were collected at households: raw cow's milk right after milking; and mixture of skimmed, acidified milk and fresh raw milk mixed with water. Per 10 samples were collected in each group. Sampling of Lisnati cheese was done after 24 hours from the end of processing and one sample from each household was collected. The same method was used also for whey sampling.

Laboratory analyses of all samples were performed at the Dairy Laboratory of the Biotechnical Faculty-Podgorica. The parameters that were analyzed for two groups of milk samples were: fat, solids non-fat (SNF), proteins, lactose, freezing point depression (FPD) and such parameters were analyzed by the instrument MilkoScan 4000 with the method of IR spectrophotometry (IDF [4]). Somatic cell count was determined by the instrument Fossomatic 5000 basic which uses the method of flow citometry (IDF [5]). Parameters for the analysis of chemical quality of Lisnati cheese were: fat, proteins, total solids and salt. Analyses were done by the instrument MilkoScan 120 FT with the method of FTIR spectrophotometry. The same instrument and the same method were used for analyzing the whey quality and parameters that were determined were fat, proteins and total solids. The obtained data were statistically calculated by Excel 2007.

3. Results and Discussion

3.1 Autochthonous technology of Lisnati cheese

Technology of this cheese is specific and unique and does not match with technology of any other cheese in Montenegro. Exclusively cow's milk is used for production of Lisnati cheese. But specificity and uniqueness of its technology are reflected, first of all, in the way of preparing the raw milk, and then in the way of coagulation and curd formation.

After milking, raw cow's milk is heated up to 40-45°C, than it has to be left to cool down and is to be kept at the room temperature for 12 h. During that period, thanks to the activities of microorganisms that are naturally found in milk, the acidification of raw milk occurs. In order to achieve faster and more efficient acidification of milk, some households keep milk next to the stove (Figure 1), so the temperature is slightly higher than the room temperature (20-25°C).

Figure 1. Acidification of milk

Temperatures higher than mentioned can lead to early coagulation of the milk which has negative effects on the formation of smooth, shiny and elastic structure of curd. The primary indicator that show that acidification of milk is completed is milk fat separation from inner rim of the vessel in which milk is acidified. When the optimum acidity of milk is achieved, milk fat separates from milk. Separated milk fat is mostly used for sour cream production. Skimmed and acidified milk is mixed with fresh raw milk in proportion 50:50. Adding larger quantities of raw milk affects the structure of the curd since it annuls the acidity of acidified milk. Last step in preparation of raw milk for cheese production is adding 10-15% of water to the mixture. Mixture has to be well mixed for few minutes and warmed up on 38-42°C. When mixture reaches the mentioned temperature rennet is added.

Coagulation of milk takes 30-45 minutes and during that period milk starts to coagulate, forming concentric circles of coagulum (Figure 2).

Figure 2. Forming concentric circles of coagulum

The beginning of syneresis is the first sign for curd cutting. Curd is being cut crosswise into 4 sections and left to ripen for 15-30 minutes at constant temperature of 40°C. Curd ripening intensifies syneresis, whey starts to separate on surface, curd falls to the bottom of the vessel and it is a sign that it is necessary to gradually remove whey (Figure 3).

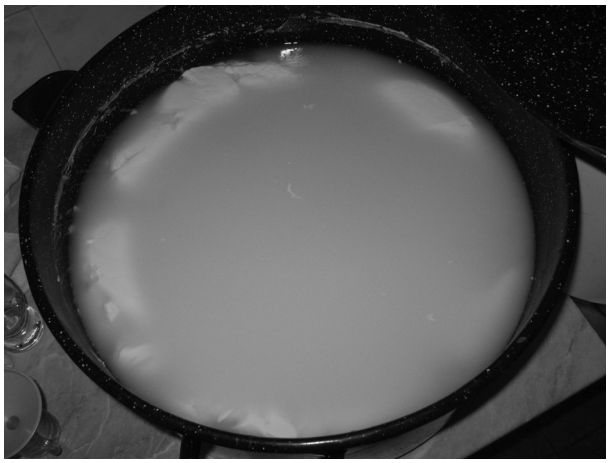

Figure 3. Syneresis

While curd ripens in whey, its structure becomes smooth, soft and elastic. Such curd is subject to combination of intense pressure and very often folding. Curd pressure is done by curling over the curd by a wooden plank and putting the heavy stone on the plank (Figure 4).

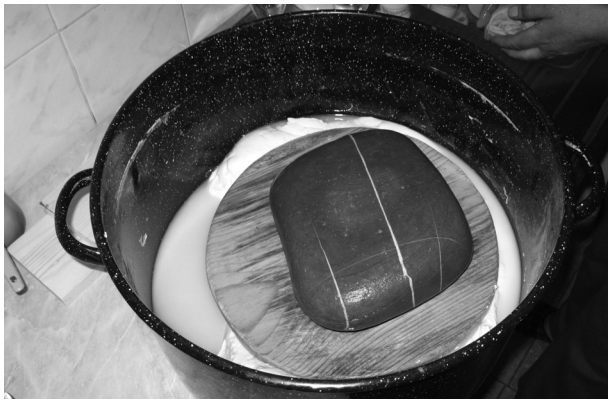

Figure 4. Curd pressure

As long as synerezis exists, curd should be pressed and very often folded. At the beginning, curd is to be folded at ½ of total curd amount and latter on ¼. When the separation of whey from curd stops it is a sign that production of Lisnati cheese is finished. Salting of the cheese is optional and it is done with dry salt. Lisnati cheese can be consumed immediately or left for ripening (Figure 5).

Figure 5. Lisnati cheese

But, Lisnati cheese has one more specific characteristic; it can be conserved at temperatures below -20°C for years. After defrosting of conserved Lisnati cheese, there are no changes in its characteristic sensory, nutritional, qualitative and quantitative traits. Table 1 presents summary of autochthonous technology of Lisnati cheese.

Table 1. Autochthonous technology of Lisnati cheese

Technological step	Parameter
Heating of raw milk	45°C
Acidification of raw milk	12 h
Cooling of acidified raw milk	Room temperature or 20-25°C
Separation of milk fat Skorup	
Mixing of fresh raw milk and acidified milk	50:50
Adding water to mixture	10-15 %
Mixing	Up to 5′
Rennet adding	38-42°C
Ripening and forming concentric circles of coagulum Zrenje 15′	15′
Synerezis of whey 30′	30′
Curd forming	15-30′
Curd pressure	Wooden plank and stone
Curd folding	First on ½, than on ¼
Salting (optional)	Dry salt

The above technological scheme is not in full compliance with (Zdanovski [1] and Rakočević [3]), but it is similar to scheme (Dozet *et al*. [2]). If we take in consideration relatively long period between the surveys and that during that period there were intensive population migrations, changes in the population structure, changes in habits and lifestyle of the population, the detected differences are negligible.

3.2. Analysis of raw cow's milk

The quality of raw cow's milk right after milking is given in the Table 2.

Table 2. Quality of raw cow's milk

Statistical parameters	Fat (%)	Proteins (%)	Lactose (%)	SNF (%)	FPD - °C	Somatic cells x 10^3
n	10	10	10	10	10	10
$\overline{x}$	3,59	3,32	4,37	8,46	0,5174	368,4
Min	2,84	2,94	3,70	7,56	0,445	36
Max	4,88	3,82	4,76	9,41	0,535	1750
SD	1,03211	0,4416	0,53648	0,92511	0,0477	908,947
CV	28,7735	13,3212	12,2652	10,9351	9,2191	246,728

The average quality of ten analyzed samples of fresh raw milk was: 3,59% of fat, 3,32 % of proteins, 4,37% lactose and 8,46 % solids non-fat. The average somatic cells count was 368,4 x 103/ml. It can be noticed that variation of values for each parameter, especially for fat, is relatively high. Such variations can be explained by different racial composition of milking cows at households. The cross breeds are dominant, than Holstein-Friesian and Gray Tyrolean breeds.

Also, the different nutrients which milking cows were fed with and milk sampling that was performed during different lactation periods caused relatively high variations in milk content. Even the variations of milk quality parameters were high, the data of individual samples and average for all samples are in compliance with data of raw cow's milk used for production of Lisnati cheese (Dozet *et al*. [2] and Dozet [6]), some Croatian autochthonous cheeses (Havranek-Lukač [7]), Travnik's cheese (Dozet [8]) and Pljevlja's cheese (Mirecki and Adžić [9]). Eight out of ten analyzed milk samples had less than 400 x 103 somatic cells per ml of mil, which indicates that the health of animals that were used in experiment was at the satisfactory level.

3.3. Analysis of milk mixture: acidified skimmed milk + fresh raw milk +water

Final step in preparing milk for the Lisnati cheese production is to add water to the mixture of acidified skimmed milk and fresh raw milk. Results of analysis of this mixture are presented in the table 3.

Table 3. Quality of milk mixture: acidified skimmed milk + fresh raw milk + water

Statistical parame-ters	Fat (%)	Proteins (%)	Lactose (%)	SNF (%)	FPD - °C	Somatic cells x 10^3
n	10	10	10	10	10	10
$\overline{x}$	2.39	2.98	3.65	7.41	0.4607	266.4
Min	1.21	2.71	2.93	6.37	0.428	11
Max	3.68	3.53	4.21	8.18	0.5	1005
SD	1.2352	0.4171	0.6418	0.9083	0.03604	516.20331
CV	51.4916	13.9648	17.5652	12.2594	7.8251	193.77001

After mixing fresh and acidified milk and adding water, the average content of this mixture was 2.39% of fat, 2.98% proteins, 3.65% of lactose and 7.41% of solids non-fat. Freezing point of depression shows that approximately 11% of water was added, in average. The results are compatible with results obtained during Lisnati cheese production on field and laboratory (Dozet *et al*. [2]) and (Dozet [6]).

3.4. Chemical quality of Lisnati cheese

The samples of Lisnati cheese were collected 24 hours after the end of cheese production. The results of analysis are presented in the Table 4.

Table 4. Chemical quality of Lisnati cheese

	Fat %	Proteins %	Dry matter %	Salt %
n	10	10	10	10
$\overline{x}$	20.381	22.395	48.426	2.598
min	16.59	17.66	42.96	1.45
max	25.01	26.82	57.16	8.14
SD	2.8650479	3.0835222	4.7144249	2.3865291
CV	14.057445	13.768797	9.7353176	91.860244

Chemical analysis of ten samples of Lisnati cheese show that the average fat content was 20,38%, proteins 22.40, dry matter 48.43 and salt 2.60%. In comparison with the results of chemical composition of cheese that was processed by researches (Rakočević [3] and Dozet *et al*. [6]), our results are in compliance. Results of milk fat content presented research (Dozet *et al*. [2]) are slightly higher than results obtained in this experiment, but content of proteins and salt are in compliance, so in general, the differences are negligible.

Using the results of fat content and dry matter content it is possible to calculate content of fat in dry matter. Calculation shows that experimental Lisnati cheese has 42.08% fat in dry matter. According to Regulations (Službeni list SRJ [10]), Lisnati cheese belongs to semi-fat cheeses.

3.6. Chemical quality of whey

Quality of whey samples that were collected during the syneresis process is presented in the table 6.

Table 6. Chemical quality of whey

	Fat %	Proteins %	Dry Matter %
n	10	10	10
$\overline{x}$	0.196	0.705	5.822
min	0.02	0.56	5.21
max	0.41	0.89	6.48
SD	0.14643	0.1104449	0.4601001
CV	74.709181	15.665944	7.9027843

The average quality of whey obtained by production of Lisnati cheese was: 0, 2% of fat, 0.71% proteins and 5.82% dry matter. Such results are in compliance with the results presented in researches (Dozet *et al.* [2] and [6]). All households use whey for feeding young domestic animals.

4. Conclusions

The growing trend in developing food products that are declared as autochthonous and traditional products encouraged the research on Lisnati cheese production. The research included recording of autochthonous cheese technology, raw milk quality, and quality of whey as well as quality of Lisnati cheese. The research results show:

- Autochthonous technology of Lisnati cheese is still present in the area of Kolašin municipality;
- When compared with the technology previously recorded by other authors, there are some minor changes that are caused by intensive population migrations, changes in the population structure, changes in habits and lifestyle of the population, but those changes are still negligible;
- Milk, as the raw material for cheese production, is of satisfactory quality;
- Based on the results of investigations it can be concluded that Lisnati cheese has good nutrition value;
- Results of whey quality show that whey can be good raw material not only for feeding young domestic animals, but also for human consumption.
- As a final conclusion it can be said that Lisnati cheese is nutritionally valuable food. Also, because of its characteristic taste and aroma and soft and elastic texture this cheese may be of interest for broader commercialization. Market expansion for Lisnati cheese can give opportunity to households to develop and improve its production which can increase economic prosperity of those households. That can be one of steps for decreasing high level of depopulation of rural areas in Montenegro.

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