

Original scientific paper

10.7251/AGRENG1702116D

UDC: 637.35+637.131(497.7)

QUALITY AND TECHNOLOGY OF INDIGENOUS TRADITIONAL “BIENO” CHEESE IN THE REGION OF MARIOVO, MACEDONIA

Gordana DIMITROVSKA^{1*}, Sonja SRBINOVSKA², Elena
JOSHEVSKA¹, Vangelica JOVANOVSKA¹

¹Faculty of Biotechnical Sciences, University St. "Kliment Ohridski" - Bitola, The Republic of Macedonia,

²Faculty of Agricultural Science and Food, University Ss. "Cyril and Methodius" - Skopje, The Republic of Macedonia

*Corresponding author: gordana.dimitrovska@uklo.edu.mk

ABSTRACT

“Bieno” cheese is an indigenous dairy product in Macedonia with autochthonous traditional production technology which dates back from the Ottoman Empire. The research includes and presents the results of the chemical composition and safety of raw milk used for traditional production of “Bieno” cheese, technology and physico-chemical and microbiological quality of “Bieno” cheese. The quality of the milk samples was determined within the permissible maximum according to data legislation. It is necessary to respect the hygienic-sanitary norms related to cultivation, preservation and care of the milking herds, and with the right technology of milking. After 45 days of ripening the researchers recorded the average results for the following parameters of the “Bieno” cheese: moisture (38.63%), dry matter (61.37%), milk fat (26.89%), milk fat in dry matter (43.83%), proteins (26.53%), ash (9.25%), salt (5.21%) and the average of yield (9.36%). The research specified the microbiological quality of “bieno” cheese after 45 days of ripening in accordance with the special requirements of food safety regarding the microbiological criteria. Nowadays, there is a growing interest of consumers for cheeses produced with traditional technologies, usually based on handmade production, characterized by piquant, unique and specific aromas, atypical for industrial cheeses. The technology, physico-chemical and microbiological quality could be used in the protection of the origin and geographical labelling based on its unique technology. The data obtained serve as the basis for creating standardized production procedures, leading to the uniform quality of these products.

Key words: *Traditional production, raw milk, chemical composition, cheese, microbiological quality.*

INTRODUCTION

Bieno cheese is a typical indigenous dairy product in Macedonia from the central area of Mariovo region whose production dates back from the Ottoman Empire. Bieno cheese is manufactured in industrial conditions, but in some places it is still homemade, formerly produced from sheep milk, but today mostly from cow milk.(Talevski, 2012)

In rural and environmentally unpolluted regions, such as Mariovo, the production of traditional cheese is preserved today. The region of Mariovo is situated in southern part of Macedonia, close to the border with Greece. It is surrounded by high mountains and represents a specific natural area. The region has a diverse flora, due to the specific climate, as well as geologic, geomorphologic and pedologic features (Matevski and Kostadinovski, 1998).

The future of small farmers is to preserve the traditional technologies, production of authentic and traditional products, protection and marketing of domestic and foreign markets. Given its solid consistency and extremely salty taste it is often consumed by the poor and therefore called 'poor cheese'.

Beaten cheese has yellowish color, hard consistence, pleasant aroma and particularly salty taste (5-10%). Different size holes with random arrangement are visible on the cross-section.(Levkov and Kakurinov, 2011)From this perspective, the study finds a particular practical application and economic viability in the new conditions, plans and policies for the development of agriculture and rural development of certain regions in the country. The aim of this study was to present the technology of "bieno cheese" production, and also its physical, chemical and microbiological characteristics.

MATERIALS AND METHODS

Analysis and sampling

This paper presents the results of the milk quality, technology and physico-chemical quality of Bieno cheese. Sampling of milk and cheese, as well as production technology, were done in the Mariovo region, Macedonia.

The technology of Bieno cheese includes the following steps:

Raw milk



Squeezing through cloth lurch



Heating to 35-36⁰C and coagulation with chymosin CHY-MAX (2080 imcv/g)



Processing of curd and heating of curd (by adding boiling water t = 70-75⁰ C)



Kneading and collecting of curd in ball



Self pressing with hanging in the cloth 16-18 h



Ripening at 26-28⁰ C, 5 days

↓

Cutting strips (4-5cm)

↓

Dry salting (1-2 days)

↓

Salting in brine (20-22%)

↓

Ripening and storage (45 days) 16-18⁰ C

Physico-chemical analysis

Milk samples were analysed for the content of dry matter, fat, protein, lactose and solids non fat by infrared analyser LactoScop . Active acidity was measured with pH meter (Testo 206) and titratable acidity according to the Soxhlet Henkel method (Cari et al., 2000). Total count of somatic cell was analysed with a Somascope, and total count of bacteria with Bactoscan.

For the whey there were conducted the following analysis: Active acidity of the milk with a digital pH meter (testo 206) ;Titrable acidity (⁰SH) - by the method of Soxhlet Henkel (Cari et al., 2000);Chemical analisys of whey (milk fat, protein, lactose and dry matter) with an infrared analyzer LactoScop .

The cheese composition was analysed by standard methods: dry matter (AOAC,1995), fat Soxhlet Henkel method (Cari et al., 2000), protein (AOAC, 1995), salt and ash (Inihov method, 1971). The contents of moisture and fat in the dry matter (FDM) were calculated (Codex, 1978), and also the yield of “bieno” cheese (Balthadzieva,1993).

Microbiological analysis

The cheese was subject to the following microbiological analysis:ISO 6579, Microbiology of food and feed-Horizontal method for the enumeration of *Salmonella spp* (ISO6579: 2002 / Cor: 2004); ISO 16649, Microbiology of food and feed-Horizontal method for the enumeration of - glucuronidase - positive *Escherichia coli* ISO 16649 1, 1: Material of counting colonies of 44 0C using membranes and 5 bromo-4-chloro- 3-indolyl - D- glucuronide (ISO 21528-1: 2001); ISO 21528-2, Microbiology of food and animal feed - Horizontal method for the detection and enumeration of *Enterobacteriaceae*, Part 2: Method of counting colonies (ISO 21528 1: 2004); ISO 11290-1, Microbiology of food and animal feed - Horizontal method for the enumeration of *Listeria monocitogenes*, Part 1: Detection method (ISO 11290-1: 1996/ Amd.1: 2004); ISO 6888-1, Microbiology of food and feed-Horizontal method for the detection of *Staphylococcal koagulasa* positive (*Staphylococcus aureus* and other species), Part 1: Technique using Baird-Parker agar medium (ISO 6888-1: Amd 1: 2003)

RESULTS AND DISCUSSION

The quality parameters of raw milk used for the production of "bieno" cheese are shown in Table 1.

Table 1. Physico-chemical parameters and hygienic quality of milk for "bieno" cheese

Parameters %	Raw cow milk				
	\bar{x}	Min	Max	Sd	Cv
Milk fat	3,50±0.12	3,29	3,67	0,15	4,25
Proteins	3,11±0.04	3,02	3,18	0,06	1,96
Lactose	4,28±0.06	4,20	4,41	0,08	1,93
Dry matter	12,29±0.16	106	12,,50	0,19	1,57
	6,69±0.08	660	6,81	0,09	1,41
°	6,32±0.10	614	6,51	0,14	2,24
*TCSC/ml	343600	276000	368000	38474,67	11,20
*TCB/ml	342000	326000	363000	15313,39	4,48

*TCSC/ml (Total count of somatic cells)

*TCB/ml (Total count of bacteria)

The milk used for the production of indigenous hard cheese has good chemical composition, hygiene is right with allowable number of somatic cells and the total number of bacteria in accordance with the special requirements for raw milk. Our results regarding the chemical composition of cow's milk were in accordance with the results from other authors (Srbinovska,2007; Mateva et al., 2008; Talevski,2012) . In the indigenous technology of production of bieno cheese, must pay particular attention to all the factors that affect the microbiological quality of the milk and the hygienic correctness, namely: hygienic milking, milk cans, cooling devices (tankers) were the milk is held at a temperature of 5°C, transport and storage. It is necessary to respect the hygienic-sanitary norms related to cultivation, preservation and care of the milking herds, and with the right technology of milking, (Dozet and Macej, 2006; Samaržija et al., 2003).

The total number of bacteria in the milk used for the manufacture of "bieno" cheese varies in the range of 2.7×10^6 to $1,0 \times 10^8$ / ml and 2.0 to 3.5×10^7 / ml by the author (Kakurinov, 2002), (Levkov and Kakurinov, 2007) and that depends on milking hygiene, storage and transportation of milk. Whey is a product obtained in the manufacture of cheese. It is more or less clear, yellowish liquid with a distinctive sweet flavor.

The chemical composition and properties of whey depend primarily on the quality of milk and the technological process of producing cheese. The results of chemical composition and acidity of the whey can be seen in Table 2. Whey is an important by product in the manufacture of "bieno" cheese which can be used to obtain fresh albumin cheese.

Table 2. Chemical composition of whey

Parameters %	Whey				
	Min	max	Sd	Cv	
Milk fat	0,19±0,03	0,15	0,23	0,04	18,86
Proteins	1,04±0,04	0,98	1,14	0,06	5,88
Lactose	4,46±0,06	4,38	4,57	0,08	1,75
Dry matter	6,42±0,05	6,33	6,51	0,07	1,06
	6,49±0,06	6,40	6,58	0,07	1,13
°	4,89±0,32	4,60	5,34	0,37	7,59

From the table 2 can be seen that the content of milk fat (0,19±0,03) in whey likely due to the higher heat treatment. In whey, it exceeds about 50% of the dry matter of the milk. The largest% of the dry matter in the whey is lactose, followed by proteins and minerals, and finally, the fat percentage is the lowest.

Protein is an important component in the chemical composition of whey and average mean values ranging from 1,04±0,04%. Most % of the dry matter constitutes lactose whey, followed by protein and minerals and finally, with the lowest number was fat. The active acidity of the whey has an average mean (6,49±0,06) and the titrable acidity has an average mean (4,89±0,32). Similar results are found in whey obtained in the production of cheese and soft white cheese in research of ,(Mateva et al., 2008, Sulejmani et al.,2014)].

From Table 3, the Bieno cheese contains 38,63±0,32 of moisture, 61,37±0,32 of dry matter, 26,89±0,26 fat, 43,83±0,62 fat in dry matter, proteins 26,53±0,93, ash 9,25±0,06 and salt 5,21±0,05 after 45 days of ripening. Those results coincide with results of scientific papers whose topic was hard cheese and that show that moisture content ranges from 38 to 40%, fat 21 - 26% and fat in dry matter 40 - 43%(Kapac-Parka eva,1974; Kamber and Uelik,2007).

Yield is a complex variable because it depends upon a number of factors, the major effect on the quality of milk, the protein content and milk fat,(Guinee, 2004) . The greater degree of the distribution of the components of milk into cheese, primarily protein and milk fat affect the majority of the cheese dressing percentage. This statement can be seen in our results obtained in our research and average cheese yield of bieno cheese was (9.36 %).

Table 3. Chemical composition of bieno cheese after 45 days of ripening

Parameters %	"Bieno" cheese				
	Min	Max	Sd	Cv	
Moisture	38,63±0,32	38,29	39,40	0,46	1,18
Dry matter	61,37±0,32	60,60	61,71	0,46	0,74
Milk fat	26,89±0,26	26,43	27,50	0,39	1,46
Fat in dry matter	43,83±0,62	42,84	45,38	0,94	2,14
Proteins	26,53±0,93	25,26	28,33	1,23	4,63
Ash	9,25±0,06	9,14	9,33	0,07	0,80
Salt	5,21±0,05	5,08	5,28	0,08	1,46

The research specified the microbiological quality of “Bieno” cheese after 45 days of ripening in accordance with the special requirements of food safety regarding the microbiological criteria.

Table 4. Microbiological analysis of “bieno” cheese after 45 days of ripening

	<i>Enterobacteriaceae</i> cfu/ml	<i>E. coli</i> cfu/ml	<i>Coagulase positive staphylococcus</i> cfu/ml	<i>Listeria monocytogenes</i> cfu/ml	<i>Salmonella</i> spp. cfu/ml
I	680	430	92	/	/
II	2000	1200	102	/	/
III	20	10	124	/	/
IV	1600	720	36	/	/
V	1150	300	180	/	/

From the results of Table 4 can be concluded that it was not determined the presence of *Listeria monocytogenes* and *Salmonella* spp. The presence of *Enterobacteriaceae* set possibly due to the production of bieno cheese from raw milk. For cheeses manufactured from raw milk, according to the Regulation on microbiological quality, allowed the presence of coagulase positive staphylococcus.

In our study, these values are much lower in all variants in all iterations of the experiment; it can be connected with the fact that at the time of mating the cheese dough temperature of 70-75°C comes to the destruction of coagulase positive staphylococci as confirmed in tests of (Lima et al., 2008) and (Gomez-Lucia et al., 1990). *E. coli* whose limits are allowed (10 to 1200 cfu / ml) was determined in all samples in limits given refer to each tested unit - sample. According to Kakurinov (2002), following the dynamics of coliform bacteria during the whole technological process for hard cheese, 45th day of ripening in brine, found the presence of coliform bacteria in height 10^4 - 10^6 /ml. In tests of (Levkov and Kakurinov, 2007), 45th day of ripening of hard cheese in brine, the number of coliforms ranged from $1,0 \times 10^6$ to $2,8 \times 10^6$ / ml. The presence of Enterococci under [14] in their ripening, due to their tolerance to temperature of 10 to 45°C, pH value of 4.0 to 9.0 as a result of tolerance to certain concentrations of salt (6.5%).

CONCLUSION

Bieno cheese from the region Mariovo was indigenous product with specific and recognizable properties. The chemical composition and properties of whey depend primarily on the quality of milk and the technological process of producing cheese. Whey is an important by product in the manufacture of “bieno” cheese which can be used to obtain fresh albumin cheese.

“Bieno” cheese has a good chemical composition: moisture (38.63 %), dry matter was (61.37 %), milk fat (26.89 %), the content of fat in dry matter (43.83 %), protein (26.53 %), ash (9.25 %), salt (5.21 %). According to dry matter content

cheese belongs with hard cheeses, and according to their storing belongs to the sour brined cheese. Average yield of “Bieno” cheese was (9.36 %).

“Bieno” cheese is hard, low fat cheese with spongy appearance, which matures in brine, with a great diversity in production and non-standard quality. The data obtained may serve as the basis for creating standardized production procedures, leading to the uniform quality of these products. Therefore, traditional dairy should not be seen as a return to the past, but as an effort to preserve the indigenous technology, to gain their organized form, the ethnographic richness of a given region so distinctive, a time stamp to the development of a nation.

REFERENCES

- Baltadijeva, M..A.(1993): Tehnologija na mlecnite produkti / Technology of dairy products/. Zemizdat, Sofija, 86-90
- Cari ,M., Milanovic, S., Vucelija, D. (2000). Standardne metode analize mleka i mlecnih proizvoda /Standard methods for analysis of milk and dairy products/. Tehnoloski fakultet, Novi Sad, 2000;
- Dozet N., Macej, O. (2006). Autohtoni beli sirevi u salamuri /Indigenous white cheeses in salamuri/. Monografija: Poljoprivredni fakultet, Beograd – Zemun.
- Giraffa G. (2004). Styding the dynamics of microbial populations during food fermentation. FEMS Microbiology Reviews 28, pp. 251-260.
- Gomez- Lucia E.,Goyache J.,Orden A.J. Domenech A., JavieR Hernandez, F.,Riz – Santa Quiteria J.A., Lopez B.,Blanco J.L.,Suarez G. (1990). Growth od Staphiloccocus aureus and Synthesis of Enterotoxin During Ripening of Experimental Manchego–Type Cheese. Journal of Dairy Science, 75, pp. 19-26.
- Guinee, T.P. (2004). Salting and the role of salt in cheese. Int.J.Dairy Tech.,Vol 57, No 2/3, pp. 99-109.
- Kamber U., Úelik H.T. (2007). Some microbiological and chemical characteristics of Gorcola cheese. YYÜ Vet. Fak. Derg., 18, (1), pp. 87-92.
- Kakurinov V. (2002). Composition and dynamics of microflora of beaten cheese, Phd Thesis, Agricultural Faculty, University Ss. “Cyril and Methodius”, Skopje.
- Kapac-Parka eva N., ižbanovski T., Lazarevska D. (1974). hemiski sastav, osobine i reološka svojstva bijelog sira sa podru ja SR Makedonije, Mljekarstvo 24, (4), (1974).
- Lima Carla d., Las Casas., Monica M.O.P.Cerquera.,Elaine G.Ferreira. Cesar L.L.Faria JR., David lee Nelson., Luiz S.Carmo., Carlos A.Rosa. (2008). Microbiological, physical-shemical and sensory evaluation of a tradicional Brazilian cheese during ripening process. World J.Microbiol.Biotechnol. 24: 2389-2395.
- Levkov V., Kkakurinov V. (2007). Microbial characteriristics of beaten cheese made in Tetovo region. Proceedings of III Symposiym of livestock production with International participation, pp. 379-388.
- Levkov, V., Kakurinov, V. (2011). Microbiological properties of artisanal cheese (Bieno sirenje). Journal of Hygienic Engineering and Design 1, pp. 325-329.

- Mateva N., Z., Naletoski., B. Palasevski. (2008). Technology and chemical composition of beaten cheese in R. Macedonia. *Biotechnology in animal husbandy*, 24(1)-2:139-147.
- Matevski, V., Kostadinovski, M. (1998). *Biserrulo-Scleranthetum Dichotomae* Matevski et Kostadinovski ass. nova in highland pastures in Republic of Macedonia. *Annual Biology* 51, pp. 25-35.
- Samaržija D., Antunac N., Pecina M., Havranek J. (2003). Quality of artisanal hard cheeses produced in the Mediterranean area of Croatia, *Milchwissenschaft*, 58,1/2, pp. 43-46.
- Srbinovska S. (2007). Hygiene and quality of milk in the Republic of Macedonia in accordance with the legislation, *Savremena poljoprivreda*, 56, (5): pp. 61 - 68.
- Sulejmani E., Hayaloglu AA, Rafajlovska V. (2014). Study of the chemical composition, proteolysis, volatile compounds, and textural properties of industrial and traditional Beaten (Bieno sirenje) ewe milk cheese, *J. Dairy Sci.* 97(3).
- Talevski, G. (2012). Tradition production of beaten cheese, *Third International Scientific Symposium "Agrosym Jahorina"*, pp. 524-528.