



Науковий вісник Львівського національного університету  
ветеринарної медицини та біотехнологій імені С.З. Гжицького.  
Серія: Харчові технології

Scientific Messenger of Lviv National University  
of Veterinary Medicine and Biotechnologies.  
Series: Food Technologies

ISSN 2519–268X print  
ISSN 2707-5885 online

doi: 10.32718/nvlvet-f9918  
<https://nvlvet.com.ua/index.php/food>

UDC 637.352:636.146.33

## Sensory indicators of suluguni cheese when using enzyme preparations of different origins in the technology of soft cheeses

I. V. Kholodenko , V. V. Bila, V. Yu. Bilyi, Y. O. Mashkin

*Bila Tserkva National Agrarian University, Bila Tserkva, Ukraine*

### Article info

Received 07.03.2023  
Received in revised form  
10.04.2023  
Accepted 11.04.2023

*Bila Tserkva National Agrarian  
University, pl. Soborna 8/1,  
Bila Tserkva, 09117, Ukraine.  
Tel: +38-097-699-59-61  
E-mail:  
ivan.kholodenko@btsau.edu.ua*

*Kholodenko, I. V., Bila, V. V., Bilyi, V. Yu., & Mashkin, Y. O. (2023). Sensory indicators of suluguni cheese when using enzyme preparations of different origins in the technology of soft cheeses. Scientific Messenger of Lviv National University of Veterinary Medicine and Biotechnologies. Series: Food Technologies, 25(99), 104–107. doi: 10.32718/nvlvet-f9918*

*Cheeses are food products obtained by concentration and biotransformation of the main components of milk under the influence of physicochemical factors of rennet enzyme preparations and microorganisms. Suluguni occupies an important place among cheeses in Ukraine. Suluguni cheese has been known for a long time, it was first mentioned in the book of the Pope's personal chef Bartolomeo Scipri. Industrial production of the product was established at the end of the 18th century. The main operation in the production of rennet cheese is the enzymatic coagulation of milk under the action of chymosin, resulting in the formation of a milk clot with a large part of casein and whey. In the body of animals, chymosin, similar to cheese-making technology, coagulates milk at the beginning of its digestion. Thus, the processing of milk in the process of cheese production corresponds to natural physiological processes. III groups of milk samples ( $n = 5$ ) were formed to conduct the experiment. In the control group of samples, rennet enzyme of microbial origin was used for curdling milk. In the 1st experimental group of samples, an enzyme preparation from the rennet of dairy calves, extracted according to the method of Yu. Ya. Svyridenko, was used. In the II experimental group, an enzyme preparation was used, which was extracted from the rennet of dairy calves according to the method of S. V. Merzlova. The duration of protein coagulation during the production of "Suluguni" cheese using a microbial enzyme preparation is 23 min., when using enzymes of the first research group – 27 min. and when using rennet enzymes of the II research group – 33 min. In view of the output of ready-made Suluguni cheese with a commercial purpose to obtain more profit, it is advisable to use an enzyme of microbial origin. According to sensory analysis, samples using calf rennet enzyme extracted according to the method of S. V. Merzlova (I research group of samples) were characterized by pronounced cheesy, sour-milk, without extraneous tastes and smells, taste and smell characteristic of soft fresh cheese; the surface is clean without mechanical damage, elastic; the consistency of the smear is gentle, moderately dense; the color is white, uniform throughout the mass. Samples of the II experimental group were characterized by the worst organoleptic indicators.*

**Key words:** milk processing, soft cheeses, sensory analysis.

### Introduction

Currently, an important place in people's diets is occupied by cheeses, which are the product of complex technological processing of milk, which results in the concentration of its main components with their subsequent fermentation (Ardo et al., 2002; Tsisaryk, 2013; Johnson, 2017; Merzlov et al., 2019). Cheeses are food products obtained by concentration and biotransformation of the main components of milk under the influence of enzymes, microorganisms and physicochemical factors (Ozturk et al., 2018; Merzlov et al., 2019).

Suluguni occupies an important place among cheeses in Ukraine. Suluguni cheese has been known for a long time, it was first mentioned in the book of the Pope's personal chef Bartolomeo Scipri. Industrial production of the product was established at the end of the 18th century (Ardo et al., 2002).

The main operation in the production of rennet cheese is the enzymatic coagulation of milk under the action of chymosin, resulting in the formation of a milk clot with a large part of casein and whey (Bos et al., 2003; Wenger & Mishchenko, 2011). In the body of animals, chymosin, similar to cheese-making technology, coagulates milk at

the beginning of its digestion (Bilyi & Merzlov, 2022). Thus, the processing of milk in the process of cheese production corresponds to natural physiological processes.

Another function of enzymes in cheese production is participation in the biotransformation of milk components into compounds that form organoleptic indicators of the product (Chuang et al., 2005).

Today, in connection with the shortage of rennet enzyme and its high cost, other enzymes are widely used, similar in action to rennet: pepsin and microbial enzymes. However, the use of enzymes of microbial origin can negatively affect the sensory parameters of cheeses. In addition, the demand for cheeses made with the use of natural rennet enzymes has been growing recently (Borshch et al., 2019).

Coagulation of milk by rennet enzymes involves two irreversible processes. There are several theories of rennet coagulation. From the standpoint of the hydrolytic theory, the mechanism of rennet coagulation is explained as follows: under the action of introduced rennet enzyme, the polypeptide chains of k-casein of the casein-calcium phosphate complex between phenylalanine and methionine are hydrolyzed (Park, 2001; Tsisaryk et al., 2017; Bilyi & Merzlov, 2022). As a result, k-casein molecules disintegrate into hydrophobic para-do-casein and hydrophilic glycomacropptide. As a result, the micelles lose their negative charge, and the hydration shell is partially destroyed – the system loses its stability, resulting in the appearance of protein flakes (I stage – induction). The loss of protective colloid functions by k-casein creates conditions for intensive coagulation with the participation of calcium ions in the structuring of paracasein (II stage). At this stage, a spatial network of the clot is formed, which later, after appropriate processing, is divided into two phases: solid (casein + fat) and liquid (milk sugar, proteins dissolved in water) (Semko et al., 2018; Bilyi et al., 2021; Bila & Merzlova, 2023).

The advantages of soft cheese production are: efficient use of raw materials; the possibility of selling cheese without ripening or with a short ripening period (no more than 14 days); good organoleptic indicators; high nutritional and biological value; quick turnover of capital investments. On the market of Ukraine, the segment of soft cheeses is mainly represented by products exported from the countries of the European Union (Melina et al., 2016; Bila & Merzlova, 2022).

Physicochemical, biochemical and microbiological processes in cheese and their intensity depend on the concentration and quality of rennet enzymes. Renal enzymes during cheese ripening inhibit the vital activity of putrefactive bacteria in cheese, while in certain concentrations they contribute to the development of lactic acid microflora of leavening preparations and their production of amino acids. Studies show that cheese contains a wide range of microflora such as *Lactococcus* spp., *Lactobacillus* spp., *Leuconostoc* spp., *Enterococcus* spp. and contaminating bacterial cells. Pasteurization of raw milk not only has a positive effect on the yield of cheese, but also protects the consumer from pathogenic microflora (Bilyi & Merzlov, 2022).

In terms of hygiene, the milk used to make mozzarella must be clean (free from mud particles). It should curdle when alcohol is added to it, not contain soda or any preservatives. Regarding microflora, milk has particularly high requirements – it must not contain extraneous microorganisms that can change the normal course of cheese ripening and cause defects. The process of obtaining high-quality cheeses largely depends on the biological integrity of milk, the development of lactic acid bacteria can be inhibited by the insufficient content or absence of digestible substances, necessary amino acids, vitamins, and trace elements in milk (Park, 2001; Semko et al., 2018; Bilyi et al., 2021).

For the production of cheese, lactic enzymes are suitable, which are able to quickly break the connection between the hydrophilic and hydrophobic parts of  $\kappa$ -casein and do not have a negative effect on the yield and organoleptic properties of cheeses. Lactobacillus enzymes differ among themselves in the ratio of chymosin and pepsin and lactobacillus activity.

The purpose of the research is to investigate the influence of different rennet enzymes on the main indicators of suluguni for soft cheese technology, to compare the effectiveness of different rennet enzymes on sensory and technological indicators of suluguni cheese.

## Materials and methods

III groups of milk samples ( $n = 5$ ) were formed to conduct the experiment. In the control group of samples, rennet enzyme of microbial origin was used for curdling milk. In the 1st experimental group, an enzyme preparation was used, which was extracted from the rennet of dairy calves according to the method of S. V. Merzlova (Merzlov et al., 2019; Bilyi & Merzlov, 2022). In the II experimental group of samples, an enzyme preparation from the rennet of dairy calves, extracted according to the method of Yu. Ya. Svyridenko, was used.

In both control and experimental groups, each sample was 10.0 dm<sup>3</sup>. The filtered milk was cooled to a temperature of 4 °C and kept for 12 hours. Pasteurization was carried out at a temperature of 60–63 °C with a holding time of 30 minutes. Pasteurized milk was normalized by mass fraction of fat. The rennet enzyme was added to the normalized milk heated to a temperature of 33 °C while gently stirring it. The clot was cut into cubes of 15–20 mm in size and left alone for 10–15 minutes, then it was carefully mixed for 20–30 minutes to compact and dehydrate. Mixing was carried out using stops for 2–3 minutes.

The curd curd together with the serum was heated to a temperature of  $43 \pm 1$  °C for its better separation. Later, the curd curd is separated from the whey. The prepared water was heated to a temperature of  $85 \pm 1$  °C, and after tearing off a piece from the cheese curd, it was immersed in hot water for 5...10 seconds. Repeating this several times, formed.

The duration of rennet coagulation of milk in minutes was determined from the moment of introduction of enzymes into the milk base until the formation of a dense clot. Syneretic properties were determined in the resulting clots by measuring the volume of separated serum every

10 minutes. within 1 hour Sensory parameters were analyzed in the finished product and cheese yield was determined.

Sensory analysis of cheese was carried out according to DSTU 4395-2005.

### Results and discussion

The use of enzymes of various origins affects the duration of milk coagulation.

The duration of setting of the normalized mixture during the production of “Suluguni” cheese using a microbial enzyme was 23 minutes. For the use of an enzyme preparation extracted by the method of S. V. Freezing time increased by 12 % compared to the control group of samples, using the enzyme preparation extracted according to the method. In the well, it increased by 21 % compared to the control.

In view of the decrease in the duration of coagulation of the mixture in the samples of the control group of samples, it would be advisable to recommend the use of a microbial lactic acid enzyme in the production of soft cheese “Suluguni”, which leads to a reduction in the technological process of product production. One of the indicators of the quality of finished cheese is the mass fraction of moisture, which depends on the syneretic properties of the curds. Syneresis is the process of separating the serum from the clot, which includes spontaneous compaction of the structure due to the rearrangement of particles and an increase in the number of contacts between them, that is, compaction of the gel and pressing out of the dispersion medium. The data of the conducted studies show that the samples of the control group, in the digestion of which enzymes of microbial origin were used, have the lowest syneretic properties compared to the samples of the I and II research groups. The volume of serum released in 1 hour. in samples of the control group it was 44 %, while in samples I and II it was 46 and 58 %, re-

spectively. It should be noted that samples of research group I had the best syneretic properties when using calf rennet enzyme.

Given the syneretic properties of clots, it is promising to use calf rennet enzyme extracted according to S. V. Merzlov's method for the production of “Suluguni” soft cheese. Milk-digesting enzymes and modes of heat treatment of milk significantly affect the output of the finished product. Samples of the II research group using calf rennet enzyme extracted according to the method of Yu. Ya. Svyrydenka had a lower yield of cheese than the samples of the control and I experimental groups, which is explained by the formation of a larger amount of casein dust, which passes into the whey. The highest yield of cheese is noted when using rennet enzyme of microbial origin.

Therefore, in view of the production of ready-made Suluguni cheese with a commercial purpose to obtain more profit, it is advisable to use an enzyme preparation of microbial origin. Organoleptic indicators of Suluguni soft cheese are formed depending on the type of lactic acid enzyme.

The results of the sensory analysis are shown in Table 1. According to the organoleptic evaluation, the samples of the I experimental group using calf rennet enzyme were characterized by a pronounced cheesy, sour-milk taste, without extraneous flavors and odors, characteristic of soft fresh cheese taste and smell; the surface is clean without mechanical damage, elastic; the consistency of the smear is gentle, moderately dense; the color is white, uniform over the entire mass; dough with the presence of cells. The samples of the II experimental group were characterized by the worst organoleptic indicators when using the lactic acid enzyme extracted according to the method of Yu. Ya. Svyrydenka. It was characterized by an unexpressed cheesy taste; appearance – white color with a cream shade; smear consistency, slightly fragile; dough with the presence of small voids.

**Table 1**  
Organoleptic indicators of soft cheese “Suluguni” with the use of different rennet enzymes

Indexes	Control group of samples	I experimental group of samples	II experimental group of samples
Appearance	The surface is clean without mechanical damage, hard	The surface is clean without mechanical damage, elastic	The surface is clean without mechanical damage, moderately elastic
Taste and smell	Cheesy, sour milk, without extraneous tastes and smells	Cheesy, sour-milk, without extraneous tastes and smells, characteristic of soft fresh cheese	Inexpressive cheesy taste, without extraneous tastes and smells, with the presence of slight acidity
Consistence	Smear, slightly brittle, moderately dense	Smear, gentle, moderately dense	Smear, slightly fragile, moderately dense
The color of the dough	White with a cream shade, uniform over the entire mass	White is uniform over the entire mass	White with a cream shade, uniform over the entire mass
Drawing	Dough with holes and the presence of small voids	Dough with eyes	Dough with small voids
Form	Rectangular	Rectangular	Rectangular

### Conclusions

The duration of protein coagulation during the production of “Suluguni” cheese using a microbial enzyme preparation is 23 minutes, when using enzymes of the first research group – 27 minutes. and when using rennet enzymes of the II research group – 33 min. In view of the

output of ready-made Suluguni cheese with a commercial purpose to obtain more profit, it is advisable to use an enzyme of microbial origin. According to sensory analysis, samples using calf rennet enzyme extracted according to the method of S. V. Merzlov's 1st experimental group of samples was characterized by pronounced cheesy, sour-milk, without extraneous tastes and smells, taste and

smell characteristic of soft fresh cheese; the surface is clean without mechanical damage, elastic; the consistency of the smear is gentle, moderately dense; the color is white, uniform over the entire mass; dough with the presence of cells. Samples of the II experimental group were characterized by the worst organoleptic indicators.

#### Conflict of interest

The authors declare that there is no conflict of interest.

#### References

- Ardo, Y., Thage, B. V., & Madsen, J. S. (2002). Dynamics of free amino acid composition in cheese ripening. *Australian Journal of Dairy Technology*, 57(2), 109–115.
- Bila, V. V., & Merzlova, G. V. (2022). Research on the amino acid composition of milk obtained in Kyiv, Vinnytsia and Cherkasy regions as a raw material for soft cheeses. *Bulletin of the Poltava State Agrarian Academy*, 3, 97–101. DOI: 10.31210/visnyk2022.03.12.
- Bila, V., & Merzlova, H. (2023). The influence of antibiotics in milk on the action of sourdough using cheese technology. *Scientific Messenger of LNU of Veterinary Medicine and Biotechnologies. Series: Agricultural Sciences*, 25(98), 66–69. DOI: 10.32718/nvlvet-a9811.
- Bilyi, V. Yu., & Merzlov, S. V. (2022). The effect of some modern enzymes on the parameters of milk coagulation. *Scientific Bulletin of the Lviv National University of Veterinary Medicine and Biotechnology. Series: Agricultural Sciences*, 24(96), 144–147. DOI: 10.32718/nvlvet-a9620.
- Bilyi, V. Yu., & Merzlov, S. V. (2022). The effect of various rennet enzymes on the technological and sensory parameters of cheese. *Bulletin of the Poltava State Agrarian Academy*, 1, 103–109. DOI: 10.31210/visnyk2022.01.13.
- Bilyi, V., Merzlov, S., Narizhnyi, S., Mashkin, Yu., & Merzlova, G. (2021). Amino acid composition of whey and cheese under different rennet enzymes. *Scientific horizons*, 24(9), 19–25. DOI: 10.48077/scihor.24(9).2021.19-25.
- Borshch, O. O., Borshch, O. V., Kosior, L. T., Lastovska, I. A., & Pirova, L. V. (2019). The influence of crossbreeding on the protein composition, nutritional and energy value of cow milk. *Bulgarian Journal of Agricultural Science*, 25(1), 117–123. URL: <https://www.agrojournal.org/25/01-16.pdf>.
- Bos, C., Metges, C. C., Gaudichon, C., Petzke, K. J., Pueyo, M. E., Morens, C., Everwand, J., Benamouzig, R., & Tomé, D. (2003). Postprandial kinetics of dietary amino acids are the main determinant of their metabolism after soy or milk protein ingestion in humans. *The Journal of Nutrition*, 133(5), 1308–1315. DOI: 10.1093/jn/133.5.1308.
- Chuang, C. K., Lin, S. P., Lee, H. C., Wang, T. J., Shih, Y. S., Huang, F. Y., & Yeung, C. Y. (2005). Free amino acids in full-term and pre-term human milk and infant formula. *Journal of Pediatric Gastroenterology and Nutrition*, 40(4), 496–500. DOI: 10.1097/01.mpg.0000150407.30058.47.
- Johnson, M. E. (2017). A 100-Year Review: Cheese production and quality. *Journal of Dairy Science*, 100(12), 9952–9965. DOI: 10.3168/jds.2017-12979.
- Melina, V., Craig, W., & Levin, S. (2016). Position of the Academy of Nutrition and Dietetics: Vegetarian Diets. *Journal of the Academy of Nutrition and Dietetics*, 116(12), 1970–1980. DOI: 10.1016/j.jand.2016.09.025.
- Merzlov, S., Bilyi, V., & Ryndin, A. (2019). Effect of extractors on the elimination rates of exposed enzymes. *Scientific horizons*, 8, 77–81. DOI: 10.33249/2663-2144-2019-81-8-77-81
- Ozturk, M., Govindasamy-Lucey, S., Jaeggi, J. J., Johnson, M. E., & Lucey, J. A. (2018). Investigating the properties of high-pressure-treated, reduced-sodium, low-moisture, part-skim Mozzarella cheese during refrigerated storage. *Journal of Dairy Science*, 101(8), 6853–6865. DOI: 10.3168/jds.2018-14415.
- Park, Y. W. (2001). Proteolysis and Lipolysis of Goat Milk Cheese. *Journal of Dairy Science*, 84, E84–E92. DOI: 10.3168/jds.s0022-0302(01)70202-0.
- Semko, T. V., Vlasenko, I. G., & Hyrych, S. V. (2018). Innovations in the production of hard cheeses. Vinnytsia: VITE KNTEU.
- Tsisaryk, O. (2013). Analysis of the microbiological composition of sheep cheese. In *Actual problems of the food industry: Materials of the scientific conference* (p. 146–147). Ternopil: Ternopil National Technical University named after Ivan Pulyu.
- Tsisaryk, O. I., Musii, L. Ya., Slyvka, I. M., & Molokus, T. F. (2017). Development of “Mozzarella” cheese technology using different cheese sourdough. *Scientific Messenger LNUVMB*, 19(75), 23–28. DOI: 10.15421/nvlvet8019.
- Wenger, O. O., & Mishchenko, G. V. (2011). The use of proteolytic enzymes to provide wool-containing tissues with a durable soft vulture. *East European Journal of Advanced Technologies*, 3/6 (51), 42–44.