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SOFT CHEESE TECHNOLOGY WITH HONEY

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ABSTRACT

The article is about the technology of making a milk product, soft cheese using field honeyas an additive, produced in one of Georgia's regions (Samegrelo). The technology behind this cheese, rooted in the Imereti region, reflects the rich tradition and cultural heritage of Imeruli cheese, a significant part of Georgia's intangible cultural heritage. An important aspect of cheesemaking is studying the chemistry of milk constituents, chemical characterization of cheese constituents, and cheese-making technology with additive. The developed technology has resulted in a new variety of soft cheese that combines traditional techniques with modern enhancements, showcasing both the rich cultural history and technological advancements in Georgian cheesemaking.

KEYWORDS: Soft cheese, Imeruli cheese technology, Honey, Chemical characteristics.

INTRODUCTION

In Georgia, cheese has been produced since time immemorial. Due to the varied terrain of our country, various regions have shown us many traditional methods of cheese making, which are distinguished by their taste characteristics, and appearance.[1,2]

Imeruli cheese is made from cow's milk, which can be mixed with up to 20 % buffalo or goat's milk. It has a pure lactic acid smell and taste, and a slightly soft, elastic consistency with rounded edges. The milk required for the production of Imeruli cheese is collected, processed, and produced in the Imereti region.[3]

Imeruli cheese, a treasured part of Georgia's rich culinary tradition, is classified as a soft cheese. In the regions of Georgia, Imeruli cheese is made from unfermented, fresh milk using the traditional method. The process begins with strained, fresh milk. A curd, made from the stomach lining of ruminant mammals, is added to the milk. This curd acts as a natural coagulant. The mixture is placed on low heat and continuously stirred until the curd dissolves completely in the milk. As the temperature rises, the cheese particles enlarge, forming cheese curds. This mass is then carefully squeezed to remove as much whey as possible. The drained cheese mass is placed in a salted bowl and sprinkled with more salt. It's then covered with a lid and left in a warm place for 2-3 days to mature, allowing for fermentation and the creation of characteristic holes.[4,5,6]

Georgia's unique climate and diverse vegetation make it an ideal location for producing high-quality honey. The variety of honey plants, both wild and cultivated, allows for the creation of honey with exceptional organoleptic (sensory), physical, and chemical properties. Some of the main types of honey produced in Georgia include Acacia, Linden, Chestnut, and field flower honey.[7]

In the production of the soft cheese you've developed, incorporating wildflower honey adds a distinct flavor and potentially beneficial properties from the diverse flora. This combination of traditional cheese-making techniques with the inclusion of local honey showcases the innovation and richness of Georgian culinary heritage.[8,9]

Accurate and efficient methods for quantifying the microbial load of incoming milk are of great importance to the milk industry and dairy product producers. Total viable counts are used as indicators of on-farm hygiene practices, and milk quality.[10,11]

The genera Escherichia, Enterobacter, Klebsiella, Proteus, Serratia, Hafnia and Citrobacter are grouped as coliforms. They originate from the digestive tract of milking animals and their presence in raw milk is usually associated with the unhygienic conditions of the production line. These microorganisms utilize proteins and lactose, and are able to produce CO_2, causing defects in cheese like poor structure of soft cheeses.[12,13,14]

In order to determine the microbial safety of soft Imeruli cheese studies were conducted for total viable count and pathogenic organisms that were recognized as potential contaminants of milk *Listeria monocytogenes*, *Escherichia coli*, coliform bacteria, *Salmonella spp*,

coagulase-positive staphylococcus (Staphylococcus aureus), yeast and mold, *Enterobacteriaceae*.

MATERIALS AND METHODS

The aim of the study was to develop a technology and to study the characteristics of soft cheeses made with the addition of honey. We conducted analyses on cow's milk and honey, studied their chemical composition. We studied the characteristics of filtered raw milk with lACTOSCAN MCCWS (Milk analyzer).

Total sugar in cheese and honey was determined by the Bertrand method: we dissolved 5 g of the sample brought to a uniform consistency (cheese was pre-grated) in 25 cm^3 of distilled water, mixed, stirred, added 5 cm^3 of Felling 1 and 2 cm^3 of 1 N solutions of sodium alkaline. The obtained mixture was filled up to 250 cm^3 with distilled water. We let it stand for 30 minutes, then filtered it, transferred 50 cm^3 of the filtrate to an Erlenmeyer flask and added 25-25 cm^3 of Felling1 and Felling 2 solutions. Boil the solution for 6 minutes. At this time, a red layer of copper (I) oxide was precipitated. The liquid was filtered through a Beubchen funnel, washed with distilled water and rapidly titrated with potassium permanganate solution until a light pink color was obtained. Based on the spent permanganate, we calculated the total sugar content in the sample.

To determine the titration acidity, we dissolved 5 g of the sample in 50 cm^3 of distilled water, added 20 cm^3 of a mixture of diethyl and ethyl alcohol (1:1), indicator phenolphthalein and titrated with a 0.1 normality solution of NaOH until a pink color was obtained. Based on the amount of spent NaOH, we determined the titration of the sample.

We determined vitamin C in the samples by the titration method: we dissolved 5 g of the sample in 30 cm^3 of distilled water, heated it to 50 °C, centrifuged, added 150 cm^3 of distilled water, 5-5 cm^3 of hydrochloric acid, and KI to 20 cm^3 of the analytical solution. 0.6 M solutions, 2 cm^3 of 2 % starch solution, and titrated with 0.002 M NaIO3 solution. Based on the spent NaIO3, we estimated the vitamin C content in the samples.

The protein content was determined by the Kjeldahl method: 4 g of Kjeldahl catalyst (Kjeldahl tablets, TP1523569 149, Supelco, Germany) was added to a 200 g sample in a Kjeldahl flask, 10 cm^3 concentrated sulfuric acid. We mineralized at 420 °C (SpeedDigester K-439), after obtaining a green color, we cooled the contents of the flask to 25 °C, washed

the walls of the flask with distilled water (50 °C) and cooled again to 25 °C. Then we placed the flask in the analyzer (KjelFlex k-360) and recorded the analysis results.

We determined the fat content of the cheese with a butyrometer (Gerber, SuperVario-N, 3680-3264). We placed samples of 1.5 g in two fat measuring cups, and added 10-10 cm^3 of sulfuric acid (density 1500 kg/m3) and 1 cm^3 of isoamyl alcohol. We placed the closed burettes in a water bath (65 °C) for 70 minutes (with frequent shaking) until the protein was completely dissolved. Finally, we placed the butyrometers in a centrifuge with the cap down opposite each other and centrifuged for 5 min at a speed of 1100 rpm. In the end, count the amount of fat on the butyrometer scale.

We used the drying method to determine moisture content and dry matter. For this purpose, we placed 5 g of the crushed sample in a pre-dried, weighed sandy porcelain jar and dried it at 105 °C in a drying cabinet for 2 hours. Then we cooled it in a desiccator and recorded the weight. We put it in the drying cabinet again for 20 minutes and repeated the remaining procedures. We recorded the result when the difference between the last two weighings did not exceed 0.01g.[15,16,17,18]

The microbial flora in raw milk is estimated by the standard plate count (SPC) method. The sampling, storage, transport, and mixing of the milk sample(s) to be used for SPC analyses as well as the conduct of the SPC method are very critical in obtaining meaningful counts, and internationally accepted protocols are strictly followed. Raw milk 10-fold serial dilutions with the use of appropriate sterile diluent 0.1% peptone water were carried out. The ten-fold serial dilutions of milk are then pour-plated into standard methods agar (SMA) and incubated aerobically at 30°C for 72 hr. Plates containing 10–300 (IDF) or 25–250 (APHA) colonies are used to calculate the SPC.[19,20]

Determination of coliform bacteria.Prepare two cups of a suitable medium. 1-1 ml of the diluted sample of the test product is added to the center of the cup. Inoculate approximately 15 mL of VRBL agar into each petri dish. The inoculation material and the medium are mixed carefully and left until they solidify. Petri dishes should be placed on a cold, horizontal surface at this time. A control cup with 15 ml of medium is also prepared to check its sterility. After complete solidification, incubation is carried out at 37 ºC for 24 h. Choose cups where 10 to 150 colonies have grown. Purple-red colonies grown on VRBL agar are indicative of the presence of coliforms in the test sample. If atypical colonies grow on the plates, inoculate

5 colonies onto green lactose bile broth (confirmation medium). Incubate at 37 ºC for 24 h. The test tube where the gas is produced is considered a positive sample. The number of coliforms per 1 ml or 1 g of the sample is calculated from the number of characteristic colonies obtained on the selected cups.[21]

Determination of Salmonella spp. The detection of bacteria of the Salmonella group is carried out in four stages: the initial enrichment is done by inoculating the sample in a non-selective liquid medium (buffered-peptone water). Incubation takes place at 37 ºC for 18+/- 2 hours.

Enrichment – inoculating of culture on two liquid selective media. on Müller-Kaufmann broth - incubation at 37 ºC+/- 1ºC-24 ±3 hours. on magnesium broth (Rappaport-Vassiliadis broth) - incubation at 41.5 ºC +/- 1 ºC for 24 +/- 3 hours.

Inoculation on cups – the culture is transplanted from the enrichment medium onto two solid agarized mediums.

1. On xylose-lysine-deoxycholate agar (XLD) - incubation at 37 ºC +/- 1 ºC 24 +/- 3 hours.
2. On bismuth-sulfide agar - incubation at 37 ºC +/- 1ºC for 24-48 hours.

In order to confirm, suspicious colonies are examined by biochemical and serological methods.[22]

Determination of coagulase-positive staphylococcus (*Staphylococcus aureus*). Serial dilutions are made. Using a sterile pipette, transfer 0.1 ml of the test sample to two Petri dishes with Baird-Parker agar. Repeat the process for the 1/100 dilution and other tenfold dilutions if needed. Allow the cups to dry for 15 min at room temperature. Invert the plates and incubate for 24±2 hours in an incubator at 37 ºC.

After incubation, note the typical colonies present on the bottom of the dish. Typical colonies are black or gray, clear and convex (1 mm-1.5 mm in diameter after 24 hours of incubation and 1.5-2-5 mm in diameter after 48 hours of incubation) and surrounded by a clear zone that may be partially opaque. After at least 24 hours of incubation, an opaque arc immediately surrounding the colony may appear in the bright area.

An atypical colony has the same dimensions as a typical one and may have the following morphology: bright black colonies with or without a narrow white border; The bright area is not present or is difficult to see. Gray colonies without a bright zone.

Atypical colonies are mainly formed by coagulase-positive staphylococcal strains that contaminate, e.g. dairy products. Confirmation is done by coagulase test.[23]

Yeast and mold determination. Using a sterile pipette, transfer 0.1 ml of the initial suspension to various dilutions of the test sample on Sabouraud agar medium to obtain low concentrations of yeast and mold. The diluted sample is applied to the medium area and distributed over the entire surface with a sterile spatula. Incubation is carried out under aerobic conditions at 25 °C ± 1 °C for 5 to 7 days.[24]

Determination of *Enterobacteriaceae.*For sample preparation, a series of dilutions are prepared from the product in a buffer-peptone solution. 1.0-1.0 ml of different dilutions of the product are added to 10-10 ml of bare nutrient medium (McConkey broth/Kessler with lactose); Petri dishes are incubated at 37±10 °C for 24-48±3 hours.

After 24 hours of incubation, the signs of growth (turbidity, acidity, gas) are registered in the test tubes. The final count is made after a further 48±3 hours of incubation.

From all the test tubes, where growth is observed, sowing is done on endo soil. Petri dishes are incubated at 37±10 °C for 24 hours.

Colonies typical for enterobacteria are noted on endo soil; Smears are made from the studied colonies, they are stained by Gram's method, they are examined under a microscope, and an oxidase test is performed. In the presence of gram-negative, oxidase-negative rods, a part of the colonies to be studied is transferred to semi-starch glucose soil. Crops are incubated at 37±10 °C for 24±3 hours.[25,26]

RESULTS AND DISCUSSION

According to the rules, raw cow's milk and honey are first of all roasted (the results of the analyses are given in tables 1 and 2) and in case of receiving positive results, we start making soft cheese with the addition of honey (tables 1, 2).

Table 1: Chemical composition of cow's milk.

№	Name of analysis	Results
1	Fat content, %	3,61
2	Dry matter (including fat), %	12,44
3	Acidity, pH	7,12
4	Lactose content, %	4,85
5	Mineral substances, %	0,71
6	Protein, %	3,22
7	Density, °A	30,37

The milk was taken from a farm in the village of Mukhrani in Georgia. The milk meets international standards in chemical and physical parameters, so it was used to make honey cheese.

Table 2: Chemical composition of field honey.

№	Name of analysis	Results
1	Total sugar, %	81,68
2	Protein, %	0,33
3	Humidity, %	18,10
4	Dry matter, %	81,90
5	Mineral substances, %	0,38
6	Vitamin C (mg per 100 g)	0,50

Honey is extracted in the Samegrelo region of Georgia. According to chemical and physical indicators, honey meets international standards, it is field May honey.

We added honey to milk before milking - in pasteurized and normalized milk and used it as a starter. The method of making soft cheese is presented in Figure 1. The characteristics of soft cheeses made by the new method are discussed in Table 3.

Table 3: Characteristics of soft cheese with honey addition after 7 days of ripening.

№	Characteristics	Results
1	Acidity, 0 Th	60
2	Humidity, %	44,5
3	Dry matter, %	55,5
4	Protein in dry matter, % In the cheese, %	46,01 25,54
4	Vitamin C (mg per 100 g)	0,09
5	Total sugar, %	3,96
6	Salt, %	2,5
7	Fat content in dry matter, % In the cheese, %	40 23,5
8	Texture	Soft, fluffy
9	Visual characteristics	Light yellowish, marble-like

		with yellow inclusions
10	Organoleptic characteristic	The characteristic taste of cheese with a light aroma of honey without the sweetness

Honey cheese is a type of soft cheese and, according to international standards, is classified as a moist, medium-fat, unripened cheese.

The microbiological indicators of soft cheese ripened with honeywas studied. The quality and safety of cheese depend on the microbial composition. In particular, some microbiological parameters should be tested for safety, such as coliform microorganisms and *e.coli*. Their concentration is an indicator of the hygienic condition of products. In cheeses made from milk or whey that have undergone heat treatment, the *E. coli* content is unsatisfactory >1000 cfu/g.[27,28]

The results of our research showed that at the end of the fermentation process, the Total colony count was 7.4 ± 0.2 Log/cfu/g.

Table 4: Number of microorganisms in cheese made with honey.

Microbial Group Log/cfu/g	**Fermented soft cheese with honey**
Total colony count	7.4 ± 0.2
Total Coliforms	<1
Enterococci	<1
S. aureus	<1
Yeast and molds	<1
Salmonella	-

Total Coliform microorganisms, *Enterococci, staphylococcus, salmonella*, yeasts, and molds were not found in the studied samples.

The technological block diagram was elaborated (fig. 1).

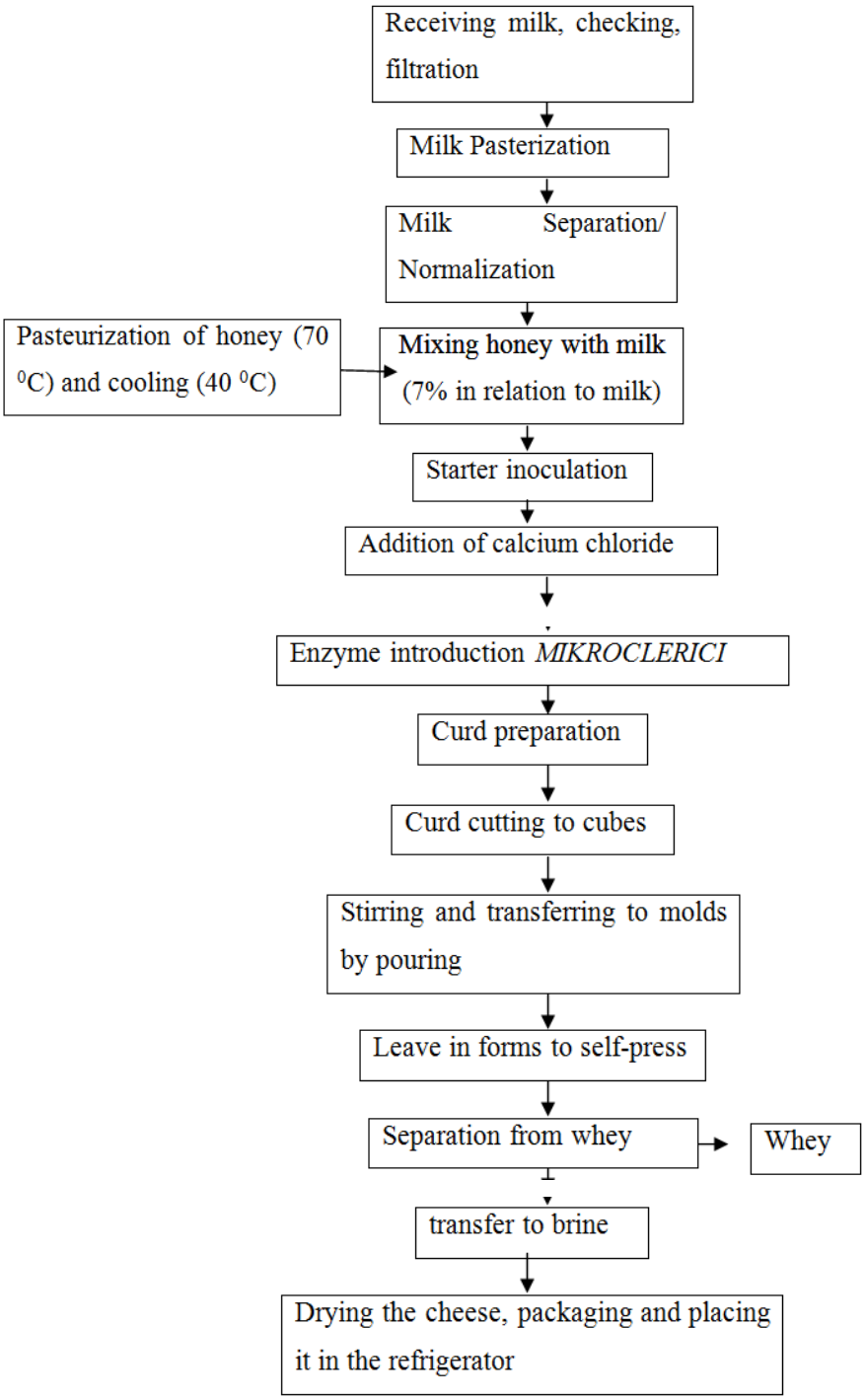

Fig. 1: Technological block diagram of making soft cheese with honey additive.

CONCLUSION

This innovative product differs from existing soft cheese production technologies by incorporating biologically active additives of natural origin—specifically, field honey. This addition enhances both the nutritional and sensory qualities of the cheese.

The honey adds essential amino acids to the cheese, improving its protein quality.Organic Acids contribute to the cheese's tanginess and play a role in its preservation. Honey is a source of various vitamins, which boost the nutritional value of the cheese.

The natural sweetness and floral notes of the honey enhanced the overall taste, offering a unique blend of sweet and savory. The incorporation of honey affected the texture, making the cheese creamier and smoother. The honey contributes to a pleasant, aromatic profile, making the cheese more appealing to the senses.This combination not only honors the rich culinary traditions of Georgian cheesemaking but also introduces a novel product that offers enhanced nutritional benefits.

The obtained data points to the absence of potentially hazardous microorganisms. Therefore, it is necessary to know the relations between microbiological quality and safety data and the artisanal manufacturing conditions, including the efficacy of critical process steps to ensure the product's safety and quality.

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