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JUSTIFICATION OF THE RIPENING PARAMETERS OF CAMAMBER CHEESE PRODUCED USING MODERN DAIRY INGREDIENTS

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Abstract. The article provides an analysis of the volume and structure of cheese imports into Ukraine, as well as the results of a survey of respondents in Ukraine who consume cheese. On the basis of the conducted analysis, the feasibility and relevance of developing the technology of soft Camembert cheese from the milk of cows kept in Ukrainian farms with the use of modern dairy ingredients, as well as the introduction of the developed technology into production in Ukraine for sale on the domestic consumer market, are shown. Based on the analysis of the state of raw materials at the Prykarpattia Dairy Farm of MUKKO LLC – one of the representatives of craft cheese production in Ukraine – the expediency of processing cow's milk, which the company will have in the short term, into soft Camembert cheese, is shown. Analysis of the chemical composition and quality indicators of the milk of Holstein and Ukrainian black and white dairy cows kept at the Prykarpattia dairy farm of MUKKO LLC indicates the feasibility of processing the milk of Holstein cows into soft Camembert cheese, and the milk of Ukrainian black and white cows dairy breed - for hard cheeses. The ripening process of soft Camembert cheese, produced from the milk of Holstein cows at the Prykarpattia Dairy Farm of MUKKO LLC, with the use of modern dairy ingredients – leavening compositions of mesophilic lactic acid bacteria and Penicillium candidum molds directly applied, and liquid milk-producing enzyme (100 percent chymosin) – carried out according to two step modes. The first batch of soft Camembert cheese was ripened according to mode 1: the first ripening chamber – temperature 11–12°C; relative air humidity 85–90%; duration 10 days; the second ripening chamber (in laminated foil) – temperature 6–7°C; relative air humidity 70–75%; duration of 2–3 days. The second batch of soft Camembert cheese was ripened according to mode 2: the first ripening chamber – temperature 11–12°C; relative air humidity 85–90%; duration 17 days; the second ripening chamber (in laminated foil) – temperature 6–7°C; relative air humidity 70–75%; duration of 3–4 days. In samples of soft Camembert cheeses, quality indicators were determined after ripening. According to the results of the conducted research, the ripening parameters of soft Camembert cheese are recommended.

Keywords: soft Camembert cheese, dairy ingredient, maturation, temperature, relative air humidity, organoleptic, physicochemical, microbiological indicators of quality.

Introduction. Formulation of the problem

Effective formation of the product range of the cheese market is of practical interest in the structure of the functioning of the Ukrainian food market. The formation of the domestic food market of Ukraine is significantly influenced by one of the main factors of the globalization of world economic relations - foreign trade. According to the Ukrainian Club of Agrarian Business, in 2020 the volume of cheese imports to

Ukraine increased by 97% – from 23.7 to 46.8 thousand tons [1].

The structure of cheese imports was made up of the following categories: fresh cheeses – 26%; processed cheeses – 13%; blue cheeses – 4.5%; grated or powdered cheese – 0.5%; other cheeses – 56%. The increase in the volume of imports occurred in almost every category. Such rapid growth of import volumes was primarily influenced by the domestic price of raw materials. Over the past year, the demand for rare

varieties of cheeses has grown significantly, in particular, the import of Gouda cheese has increased 3.4 times, up to 3,000 tons; Feta – 2.6 times, up to 0.75 thousand tons; Cheddar – 2.5 times, up to 0.45 thousand tons; Gorgonzola – 2.2 times, up to 0.17 thousand tons; Edam – 2 times, up to 0.61 thousand tons; Parmesan (ParmigianoReggiano) – import increased by 1.7 times, up to 0.23 thousand tons; Brie – 1.5 times, up to 3.2 thousand tons; Camembert – 1.5 times, up to 1.1 thousand tons.

The largest exporters of cheese to Ukraine are Poland – 22.4 thousand tons (48%); Germany – 9.2 thousand tons (20%); France – 3.8 thousand tons (8%); The Netherlands – 3.5 thousand tons (7%); Italy – 1.9 thousand tons (4%) – (Fig. 1.) [1].

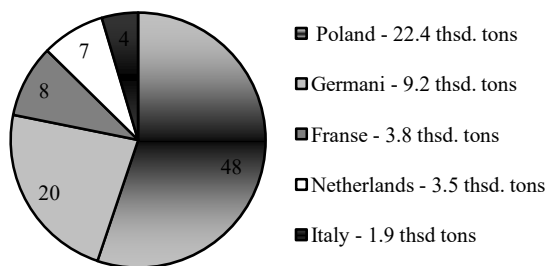


Fig. 1. Dairy product export in natural terms, thousands of tons [1]

The situation that has developed on the cheese market in Ukraine is not to the benefit of domestic producers, as it is difficult for them to compete with imported products from the European Union. The export-import balance (in terms of value) in 2021 worsened for the cheese group and reached \$234 million (in 2020 – \$186 million, in 2019 – \$82 million). However, there was a slight increase in export volumes by 8% (from 6.4 to 6.9 thousand tons). Difficulties faced by producers of hard cheese in Ukraine [1]:

- high prices for quality raw materials;
- outdated equipment;
- increase in energy prices;
- high competition;
- limited opportunities to enter new foreign markets;
- customs barriers;
- inefficient system of sales and realization of products.

Analysis of recent research and publications

The analysis of the cheese market shows that there is a sufficient supply of them in Ukraine. The demand for cheeses and their consumption is growing every year. According to experts, Ukraine has all the capacity to expand export opportunities. For this, first of all, it is necessary to control the quality of products, establish logistics, supply farms with equipment that will ensure the preservation of all useful substances in milk during transportation [1,2].

A consumer survey was conducted within the cheese market using Google Forms. Respondents were asked general questions, namely gender, age, preferred types of cheese, frequency of buying cheese, amount of one-time purchases, questions about their understanding of cheese quality, as well as factors they pay attention to when buying a particular product. In order to get a general idea of the market and consumers of cheese products, an analysis of individual questions proposed to the respondents was carried out.

The survey was completed by 187 people, of which 31.2% were men and 68.8% were women. The majority of respondents were young people aged 18–25 – 135 respondents, 36 aged 26–35, 11 aged 36–50, and only 5 aged over 50 (Fig. 2) [1]. The vast majority of respondents are representatives of the – youth group, but they are quite mature people who independently make purchases and are active consumers of cheese and cheese products. This age group is the most loyal to the appearance of new products, is inclined to want to try something new, is better informed about the possibilities of the market, its assortment, current promotions and offers.

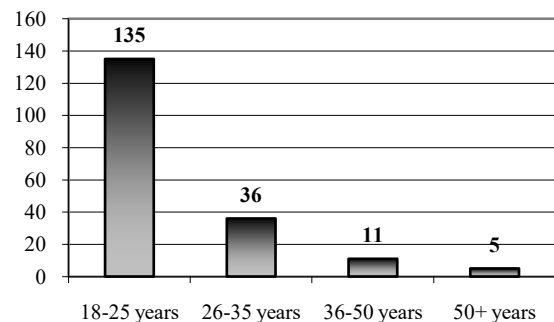


Fig. 2. Age group of surveyed people [1]

In addition, the study of consumer preferences of young people aged 18-25 is a positive moment, as it makes it possible to identify long-term trends in consumer behavior in the cheese market, and based on the results of the survey, it is possible to form an idea about the future of the market. The most important factor influencing the formation and development of the consumer market and cheese products, in particular, is the monetary income of the population (Fig. 3) [1].

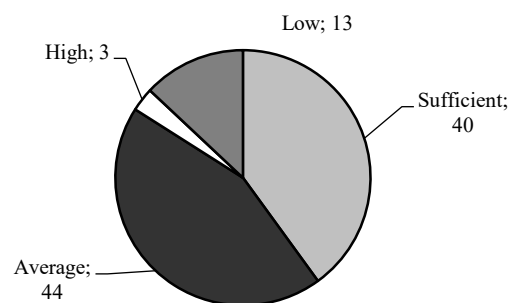


Fig. 3. Respondent income evaluation [1]

Also, as part of the questionnaire, a question was asked about which cheeses consumers choose, several answer options could be chosen (Fig. 4). From Fig. 4 shows that the respondents prefer fresh cheese, it was chosen by 135 consumers. The second most popular soft cheese among respondents is 83 people, in particular, soft Camembert cheese. Fewer respondents preferred the rest of the cheeses.

Camembert (fr. Camembert) is a French soft cheese with white mold. Its name comes from the name of the village of the same name, located in the department of Orne in Normandy [3].

During the last decades, in many countries of the world, research has been conducted on the development and improvement of the technology of soft Camembert cheese from the milk of various mammals [4–7], in particular, considerable attention in the development of technological parameters for the production of this cheese is paid to the study of the ripening process of cheese, which is determined by microbiological factors, biochemical and physicochemical processes occurring in the curd mass under the action of fermenting microflora [8–14].

That is why the development of the technology of soft Camembert cheese from the milk of cows kept on Ukrainian farms with the use of modern dairy ingredients, and the introduction of the developed technology into production in Ukraine for sale on the domestic consumer market, is an urgent task for Ukraine.

The purpose and tasks of the research.

The purpose of this study was to develop recommendations for substantiating the ripening parameters of soft Camembert cheese produced from the milk of Holstein cows at the Prykarpattia Dairy Farm of MUKKO LLC.

To achieve the goal, the following tasks were formulated:

1. To analyze the state of raw materials at the Prykarpattia Dairy Farm of MUKKO LLC and to characterize the prospects for the production of soft Camembert cheese at the enterprise.

2. To determine the chemical composition and quality indicators of the milk of Holstein cows and

Ukrainian black and white dairy breeds and provide recommendations for their processing into hard and soft cheeses.

3. To investigate the ripening process of soft Camembert cheese produced from the milk of Holstein cows at the Prykarpattia Dairy Farm of MUKKO LLC using modern dairy ingredients.

4. To provide recommendations on the ripening parameters of soft Camembert cheese produced with the use of modern dairy ingredients.

Research materials and methods

For research, whole milk from Holstein and Ukrainian dairy cows of the black-spotted breed, obtained at the Prykarpattia Dairy Farm of MUKKO LLC, was purified. Directly introduced starters – mesophilic lactic acid bacteria, (*FD DVS CH-N 19* and *FD DVS CH-N 11*) and *Penicillium candidum* (*FD DVS PC*) from Chr. Hansen, as well as natural chymosin of the same company *CHY-MAX Extra* were used as lactic acid-forming ingredients.

When performing experimental studies, a complex of physicochemical, organoleptic, and microbiological research methods, which are used in the dairy industry to determine the quality indicators of milk and cheese, were used. The mass fraction of dry substances/moisture, fat, protein, and salt (%) was determined by the arbitration method according to National Standard of Ukraine (DSTU) 8552 :2015, by Gerber's acid method according to DSTU ISO1211, refractometric method according to DSTU ISO 8968-1:2005 and titrimetric method according to DSTU 4395:2005. Titrated and active acidity ($^{\circ}\text{T}$ and units of pH) were determined by the titrimetric method according to DSTU ISO 6091:2007 and the potentiometric method according to DSTU 8550:2015, respectively. Density (kg/m^3), temperature ($^{\circ}\text{C}$) and degree of purity (group) of milk were determined according to DSTU 6082:2009, according to DSTU 6066:2008 and according to DSTU 6083:2009, respectively. Test for butyric acid bacteria, fermentation and rennet-fermentation tests in milk were carried out according to the methods given in [15].

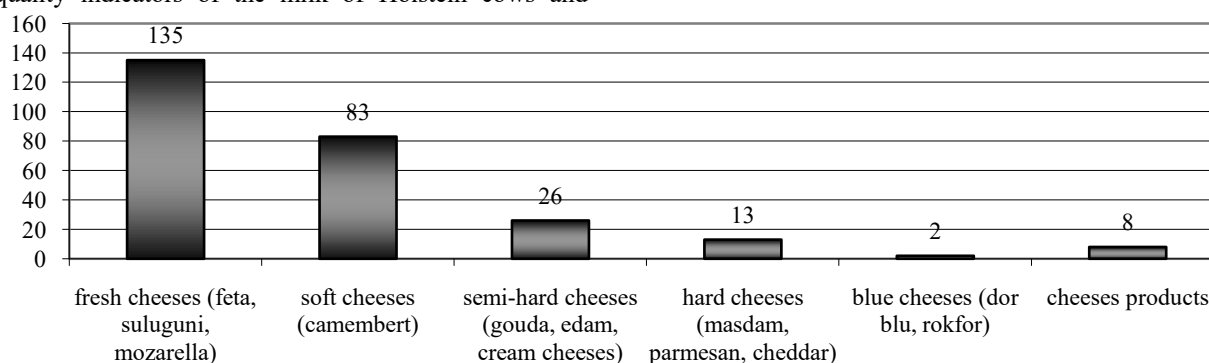


Fig. 4. Frequency analysis of the choice of cheese when buying, persons

The number of mesophilic aerobic and facultatively anaerobic microorganisms and the number of somatic cells in milk were determined according to DSTU 7357:2013 and according to DSTU ISO 13366-1/IDF 148-1:2014. The number of lactic acid bacteria and Escherichia coli bacteria in Camembert cheese was determined according to DSTU 7357:2013, the number of molds in Camembert cheese – according to DSTU ISO 6611/IDF 94:2007.

Statistical data processing was carried out using the Microsoft Excel software package.

Results of the research and their discussion

The first stage of experimental and statistical research involved analyzing the state of raw materials at the Prykarpattia Dairy Farm of MUKKO LLC and providing recommendations for their future processing into hard and soft cheeses.

As of October 1, 2022, the number of cows at the Prykarpattia Dairy Farm of MUKKO LLC was 1.500, including dairy herd – 900 heads. After 18 months, the dairy herd will include 1.500 heads, that is, an increase of 600 heads. The amount of milk that MUKKO LLC will receive additionally will be:

$$M_{w.m.} = C_{count} \times Y_{single} = 600 \times 25 = 15000 \text{ kg/day}, \quad (1)$$

where $M_{w.m.}$ – mass of whole milk obtained additionally at MUKKO LLC, kg/day;

$C_{count.}$ – the number of cows that will be added to the dairy herd in 18 months, head;

$Y_{single.}$ – milk yield from a single cow, kg/day.

The mass of hard Gouda cheese with a mass fraction of fat in dry matter of at least 50%, obtained from 15,000 kg of milk, will be:

$$M_{g.c.} = M_{w.m.} / C_{w.m.} \times 1000 = 15000 / 11400 \times 1000 = 1315.8 \text{ kg}, \quad (2)$$

where $M_{g.c.}$ – mass of hard Gouda cheese with a mass fraction of fat in dry matter of at least 50%, obtained from 15,000 kg of milk, kg/day;

$C_{w.m.}$ – consumption of whole milk per 1000 kg of hard Gouda cheese, kg/1 ton.

The mass of soft Camembert cheese with a mass fraction of fat in dry matter of 60%, obtained from 15,000 kg of milk, will be:

$$M_{s.c.} = M_{w.m.} / C_{w.m.} \times 1000 = 15000 / 8900 \times 1000 = 1685.4 \text{ kg}, \quad (3)$$

where $M_{s.c.}$ – mass of soft Camembert cheese with a mass fraction of fat in dry matter of 60%, obtained from 15,000 kg of milk, kg/day;

$C_{w.m.}$ – consumption of whole milk per 1000 kg of soft Camembert cheese, kg/1 ton.

The cash received from the sale of hard Gouda cheese produced in one day will be:

$$MV_{g.c.} = M_{g.c.} \times P_{g.c.} = 1315.8 \times 480 = \text{UAH } 631584, \quad (4)$$

where $M_{g.c.}$ – mass of hard Gouda cheese with a mass fraction of fat in dry matter of at least 50%, obtained per day, kg/day;

$P_{g.c.}$ – sale price of 1 kg of hard Gouda cheese, hryvnias

The funds received from the sale of soft Camembert cheese produced in one day will be:

$$MV_{s.c.} = M_{s.c.} \times P_{g.c.} = 1685.4 \times 640 = 1078656 \text{ UAH}, \quad (5)$$

where $M_{s.c.}$ – mass of soft Camembert cheese with a mass fraction of fat in dry matter of 60% obtained per day, kg/day;

$T_{s.k.}$ – sale price of 1 kg of soft Camembert cheese, UAH.

The additional profit that the Prykarpattia Dairy Farm of MUKKO LLC will receive on a daily basis, when processing the obtained surplus cow's milk into soft Camembert cheese, instead of into hard Gouda cheese, will be:

$$DPR = MV_{s.c.} - MV_{g.c.} = 1078656 - 631584 = 447072 \text{ UAH}, \quad (6)$$

where DPR is additional profit of the enterprise, hryvnias/day.

In view of the obtained results, we make a management decision regarding the processing of cow's milk, which the enterprise will have in the short term, into soft Camembert cheese.

According to the marketing department of MUKKO LLC, soft Camembert cheese is in demand in the Carpathian region and will be in demand on the consumer market, in particular, by health resorts.

The second stage of research involved determining the chemical composition, quality indicators and sirupatability of whole milk of Holstein and Ukrainian black and white dairy cows kept at the Prykarpattia Dairy Farm of MUKKO LLC; it was carried out in the laboratory of an enterprise that processes milk into cheese.

Organoleptic, physico-chemical, microbiological indicators and chemical composition of milk of cows of Holstein and Ukrainian black and white dairy breeds, determined in the laboratory of the enterprise, are given in the Table 1.

The analysis of organoleptic, physico-chemical, microbiological indicators of the quality of milk of Holstein cows and Ukrainian black and white dairy breeds shows that all quality indicators correspond to those for the extra grade according to DSTU 3662-2018 "Cow raw milk. Specifications". The milk of cows of both breeds has high organoleptic indicators without extraneous tastes and smells that are not characteristic of milk (Table 1), which is due to the correct organization of the process of milking cows on the farm - the enterprise uses a machine milking method (that is, milking in a "closed" flow), which excludes the ingress of foreign substances into the milk, including aromatic.

Analysis of the chemical composition of the milk of Holstein and Ukrainian black and white dairy breeds indicates that the milk of both breeds of cows can be used for processing into cheese. It should be noted that the milk of cows of the Ukrainian black and white

dairy breed has a higher protein content – 3.3–3.5%, and fat – 3.9–4.1%, compared to the milk of Holstein cows – 3.2–3.4% of proteins and 3.7–3.9% of fat, in particular casein (the main milk protein used in cheese making) – 2.70–2.80% and 2.65–2.75%, respectively. This is due to the selection and genetic features of both breeds. Holstein cows have higher milk yields (30–35 dm³/day) compared to Ukrainian dairy black-spotted cows (26–30 dm³/day), so the protein and fat content in the milk of Holstein cows is lower.

The value of the "titrated acidity" indicator (16–17°C) indicates the freshness of raw milk obtained from cows of both breeds. Microbiological indicators indicate that the milk of both breeds of cows on the farm is obtained in compliance with all sanitary and hygienic requirements and immediately after receipt is filtered and cooled – the temperature of the milk is (4 ± 1)°C. According to fermentation and rennet-fermentation samples, the milk of both breeds of cows belongs to the I class (this indicates the insignificant content or absence of bacteria of the *Esherichia coli* group). The absence of bacteria was determined by the butyric acid test, which is due to the use of machine milking, which prevents the ingress of microorganisms from feed and air into milk (this is especially important in the autumn and winter period, when the cows' diet contains such feed as silage). The number of mesophilic aerobic and facultatively anaerobic

microorganisms in the milk of Holstein cows is (25.0 ± 0.5) thousand/cm³, in the milk of Ukrainian black and spotted dairy cows – (30.0 ± 0.5) thousand/cm³, which indicates high microbiological "purity" of raw milk obtained from cows of both breeds. The number of somatic cells in the milk of cows of the Holstein breed is (23.0 ± 0.5) thousand/cm³, in the milk of cows of the Ukrainian black-spotted dairy breed – (23.0 ± 0.5) thousand/cm³, which indicates that all animals are healthy.

The milk of cows of the Holstein and Ukrainian black and white dairy breeds belongs to the II type in terms of sirupatability.

In view of the obtained results, it is advisable to use the milk of cows of the Ukrainian black-speckled dairy breed as a raw material for the production of hard cheeses, since the basis of these cheeses is only casein (the pasteurization temperature of milk for the production of hard cheeses is (70–72)°C [17], due to which all whey proteins pass to whey [19–20]) and for the production of soft Camembert cheese, it is recommended to use milk from Holstein cows (the pasteurization temperature of milk for the production of soft cheeses is (78–80)°C [17], due to which some of the whey proteins are involved in the curd and pass into cheese mass, and then – into soft cheese, which determines the higher degree of use of proteins [19-20]).

Table 1 – Organoleptic, physico-chemical, microbiological parameters, chemical composition and sirupatability of milk of Holstein and Ukrainian black and white dairy cows, determined at the Prykarpattia Dairy Farm of MUKKO LLC

Indicator name	Characteristics and value of the indicator for cow's milk	
	Holstein breed	Ukrainian black and white dairy cows
Taste and smell	Clean, milky, sweet taste, without extraneous tastes and smells not typical of fresh milk	
Consistency	A homogeneous liquid without lumps of fat, without flakes of protein, without sediment and clots	
Color	Light cream, homogeneous throughout the mass of milk	
Acidity, °T	16.5 ± 0.5	16.5 ± 0.5
Degree of purity according to the standard, group	I	I
Density, kg/m ³	1028.0 ± 0.5	1028.5 ± 0.5
Temperature, °C	4 ± 1	4 ± 1
The number of mesophilic aerobic and facultatively anaerobic microorganisms, thousand/cm ³	25.0 ± 0.5	30.5 ± 0.5
Number of somatic cells, thousand CFU/cm ³	23.0 ± 0.5	25.0 ± 0.5
Fermentation sample, class	I	I
Rennet fermentation sample, class	I	I
Test for butyric acid bacteria	absent	absent
Cheese production suitability, type	II	II
Mass fraction of dry substances, % including:	15.23 ± 0.29	15.55 ± 0.30
fat	3.8 ± 0.1	4.0 ± 0.1
proteins	3.3 ± 0.1	3.4 ± 0.1
including casein	2.70 ± 0.05	2.75 ± 0.05
lactose	4.70 ± 0.03	4.70 ± 0.05
mineral substances	0.70 ± 0.02	0.72 ± 0.02

Further research on the development of soft Camembert cheese technology at the Prykarpattia Dairy Farm of MUKKO LLC was conducted on the milk of Holstein cows.

To study the ripening process of soft Camembert cheese (third stage of research), experimental samples of the product were produced in the restaurant of the Saint Charbel Hotel, since the production of soft cheeses with mold in the main production building or laboratory of the Prykarpattia Dairy Farm LLC "MUKKO" is impossible (to prevent mold from entering hard cheeses).

The production process of soft Camembert cheese was carried out similarly to that described in the scientific literature [16-18], with the exception of the pasteurization parameters of the milk of Holstein cows. In the production of samples of soft Camembert cheese, pasteurization of milk was used at a temperature of 85°C with holding for 5 minutes, after which it was cooled to 10°C, FD DVS CH-N 11 leaven was added in the recommended amount and subjected to maturation for 12 hours.

The last amount of FD DVS CH-N 11 sourdough was added to mature milk with an acidity of 19°C, kept for 1 hour to increase the acidity to 21–22°C, heated in a water bath with a water temperature of 45–50°C to a setting temperature of 32–33°C, after what was added to the prepared milk by the last lactating ingredients - calcium chloride solution 40% in the amount of 25 g per 100 kg of milk, white mold starter FD DVS PC and liquid lactic enzyme CHY-MAX Extra 600 IMCU in the amount of 2.2 cm³ per 100 kg milk. The mixture of milk with the ingredients of the milk pump was mixed and left alone for 50–55 minutes. to form a clot.

The obtained curd was cut with a sterile knife into cubes with a 15 mm edge, cheese grain formation was carried out, after which the whey was drained and cheese heads were formed (in specially prepared perforated plastic molds). The formed cheese was sent for self-pressing at a temperature of 22°C. Self-pressing was carried out until the moisture content in the cheese mass reached 55%. The duration of self-pressing was 14–16 hours; the number of turns – 4. After self-pressing, the active acidity of the cheese mass was determined – it was within the normalized limits – 4.3–4.4 units, then the cheese heads were

placed in a previously prepared brine (the mass fraction of kitchen salt in the brine was 20%, the temperature 12°C). The duration of salting of soft Camembert cheese, produced from the milk of Holstein cows according to the specified parameters, was 40 minutes.

After salting, the soft Camembert cheese was sent for ripening.

Traditionally, in the technology of soft Camembert cheese, a staged ripening mode is used [16-18]):

- 1 chamber: $t = 11-13^{\circ}\text{C}$; $\tau = 4-5$ days; relative air humidity 88–92%;

- 2 chamber: $t = 10-12^{\circ}\text{C}$; $\tau = 3-5$ days; relative humidity 80–87%

- 3 chamber (in laminated foil): $t = 5-8^{\circ}\text{C}$; $\tau = 2-3$ days; relative air humidity 70–75%.

The produced cheeses were divided into two batches. During the research, step-by-step ripening regimes were used in two chambers:

the first batch of Camembert cheese (the first series of studies) was ripened according to the regime:

- 1 chamber: $t = 11-12^{\circ}\text{C}$; $\tau = 10$ days; relative air humidity 85–90%;

- 2 chamber: (in laminated foil): $t = 6-7^{\circ}\text{C}$; $\tau = 2-3$ days; relative air humidity 70–75%.

the second batch of Camembert cheese (the first series of studies) was ripened according to the regime:

- 1 chamber: $t = 11-12^{\circ}\text{C}$; $\tau = 17$ days; relative air humidity 85–90%;

- 2 chamber: (in laminated foil): $t = 6-7^{\circ}\text{C}$; $\tau = 3-4$ days; relative air humidity 70–75%.

The total duration of the ripening process of soft Camembert cheese of the second batch was 21 days (this ripening option was chosen for comparison, because instead of three ripening chambers, as provided by the classical technology, two chambers were used in the research, as this simplifies the technological process of cheese production and reduces capital costs for the construction of a new production building).

Upon completion of the ripening process according to the specified parameters, organoleptic, physicochemical and microbiological parameters were determined in soft Camembert cheeses obtained from the milk of Holstein cows. The results of the research are given in Table 2 and in Fig. 5.



a) – first series of studies cheese



b) – second series of studies cheese

Fig. 5. Appearance and consistency of soft Camembert cheeses:

Table 2 – Organoleptic, physicochemical, microbiological indicators of the first and second batches of soft Camembert cheeses produced from the milk of Holstein cows at the Prykarpattia Dairy Farm of MUKKO LLC

Indicator name	Characteristics and value of the indicator for soft Camembert cheese	
	first batch	second batch
Physico-chemical parameters		
Mass fraction of moisture, %	52.0 ± 0.1	51.8 ± 0.1
Mass fraction of fat in dry matter, %	59.9 ± 0.1	60.0 ± 0.1
Mass fraction of salt, %	1.8 ± 0.1	1.8 ± 0.1
Active acidity, units	6.1 ± 0.1	6.2 ± 0.1
Microbiological indicators		
The number of lactic acid bacteria in 1 g, CFU	$(4.5 \pm 0.5) \times 10^8$	$(6.5 \pm 0.5) \times 10^8$
Number of molds in 1 g, CFU	$(3.7 \pm 0.3) \times 10^5$	$(6.9 \pm 0.2) \times 10^5$
ECB per 1 gramm	Absent	Absent
Organoleptic indicators		
Taste and smell	Clean, cheesy taste, with the taste and aroma of mushrooms (mushrooms) and a light cheesy taste	Clean, cheesy, delicate taste, with the taste and aroma of mushrooms (mushrooms)
Consistency and appearance	The consistency of the cheese is liquid, slightly cheesy throughout the mass of the head; moldy crust holds its shape well	The consistency of the cheese is runny in the center, like soft caramel, and denser closer to the edges; moldy crust holds its shape well
Pattern	Individual cells of an irregular shape, located unevenly in the cheese mass	Absent
Color	Light yellow cheese dough with white mold on the surface	Light yellow cheese dough with white mold on the surface

Listed in the table 1 data indicate that the physico-chemical indicators of soft Camembert cheeses of both batches meet the requirements of regulatory documents [12-14,16-18]. Microbiological indicators differ according to the number of lactic acid bacteria and molds – the cheeses of the second batch contain 2.4–2.5% more lactic acid bacteria and 5.9–6.0% more molds, which is explained by the longer maturation of the cheeses of the second batch.

The most significant difference is noted in the organoleptic indicators of cheeses of both groups: as shown in the table 2 and in fig. 5 data, soft Camembert cheese of the first batch, which ripened for 13 days, is characterized by a cheesy consistency throughout the mass of the head and a light cheesy taste, which indicates that the maturation process of the product is not complete. Camembert cheeses of the second batch have a taste and aroma, appearance and consistency that meet the requirements of regulatory documents [12-14,16-18] – the consistency of the cheese in the center is liquid, like soft caramel, and denser closer to the edges, the moldy crust is good keeps the shape; the taste of cheeses is clean, cheesy, delicate, with the taste and aroma of mushrooms (champignons); there is no pattern in the cheese (Table 2, Fig. 5).

Based on the results of the research, it is recommended that the ripening of soft Camembert cheese, produced from the milk of Holstein cows at the Prykarpattia Dairy Farm of MUKKO LLC, be carried out in two chambers according to the following parameters: 1 chamber: $t = 11-12^\circ\text{C}$; $\tau = 17$ days;

relative air humidity 85–90%; 2 chamber: (in laminated foil): $t = 6-7^\circ\text{C}$; $\tau = 3-4$ days; relative air humidity 70–75%.

Approbation of research results.

The results of the research were tested in the restaurant of the hotel "Svyatiy Charbel" (Morshyn) and in the laboratory of the Department of Technology of Milk, Oil and Fat Products and the Beauty Industry of the Odessa National University of Technology. Approbation and implementation of soft Camembert cheese technology using modern dairy ingredients is possible at craft cheese-making enterprises of Ukraine, provided there is a separate production workshop for soft cheeses with white mold.

Conclusions

1. Based on the analysis of the state of raw materials at the Prykarpattia Dairy Farm of MUKKO LLC, the expediency of processing cow's milk, which the enterprise will have in the short term, into soft Camembert cheese is shown.

2. Analysis of the chemical composition and quality indicators of the milk of Holstein cows and Ukrainian black and white dairy breeds shows the expediency of processing the milk of Holstein cows into soft Camembert cheese, and the milk of Ukrainian black and white dairy cows into hard cheeses.

3. The ripening process of soft Camembert cheese produced from the milk of Holstein cows at the Prykarpattia Dairy Farm of MUKKO LLC with the use of modern dairy ingredients was studied in two stages. The organoleptic, physico-chemical and

microbiological indicators of soft Camembert cheeses ripened according to the studied regimes were determined; it is shown that soft Camembert cheese, matured according to the second regime, meets the requirements of regulatory documents.

4. It is recommended that the ripening of soft Camembert cheese, produced with the use of modern

dairy ingredients, be carried out in two chambers according to the following parameters: 1 chamber: $t = 11-12^{\circ}\text{C}$; $\tau = 17$ days; relative air humidity 85–90%; 2 chamber: (in laminated foil): $t = 6-7^{\circ}\text{C}$; $\tau = 3-4$ days; relative humidity 70–75%.

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ОБҐРУНТУВАННЯ ПАРАМЕТРІВ ВИЗРІВАННЯ СИРУ КАМАМБЕР, ВИРОБЛЕНОГО ІЗ ЗАСТОСУВАННЯМ СУЧАСНИХ МОЛОКОЗСІДАЛЬНИХ ІНГРЕДІЄНТІВ

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Анотація. У статті наведено аналіз обсягу та структури імпорту сирів в Україну, а також результати анкетування респондентів в Україні, які споживають сири. На основі проведеного аналізу показано доцільність та актуальність розроблення технології сиру м'якого Камамбер із молока корів, які утримуються у фермерських господарствах України із застосуванням сучасних молокозсідальних інгредієнтів, а також впровадження розробленої технології у виробництво в Україні для реалізації на внутрішньому споживчому ринку. На основі аналізу стану сировинних ресурсів на Молочній фермі Прикарпаття ТОВ «МУККО» – одного із представників крафтового виробництва сирів в Україні – показано доцільність перероблення молока коров'ячого, яке буде у підприємства у короткостроковій перспективі, на м'який сир Камамбер. Аналіз хімічного складу та показників якості молока корів Гольштинської та української чорно-рябої молочної порід, які утримують на Молочній фермі Прикарпаття ТОВ «МУККО», свідчить про доцільність перероблення молока корів Гольштинської породи на м'який сир Камамбер, а молока корів української чорно-рябої молочної породи – на тверді сири. Процес визрівання сиру м'якого Камамбер, виробленого із молока корів Гольштинської породи на Молочній фермі Прикарпаття ТОВ «МУККО» із застосуванням сучасних молокозсідальних інгредієнтів – заквашувальних композицій мезофільних молочнокислих бактерій та плісеней *Penicillium candidum* прямого внесення, та рідкого молокозсідального ферменту (100-відсоткового хімозину) – здійснювали за двома ступеневими режимами. Перша партія сиру м'якого Камамбер визрівала за режимом 1: перша камера визрівання – температура 11–12°C; відносна вологість повітря 85–90%; тривалість 10 діб; друга камера визрівання (у кашированій фользі) – температура 6–7°C; відносна вологість повітря 70–75%; тривалість 2–3 доби. Друга партія сиру м'якого Камамбер визрівала за режимом 2: перша камера визрівання – температура 11–12°C; відносна вологість повітря 85–90%; тривалість 17 діб; друга камера визрівання (у кашированій фользі) – температура 6–7°C; відносна вологість повітря 70–75%; тривалість 3–4 доби. У зразках м'яких сирів Камамбер після визрівання визначали показники якості. За результатами проведених досліджень рекомендовано параметри визрівання сиру м'якого Камамбер.

Ключові слова: сир м'який Камамбер, молокозсідальний інгредієнт, визрівання, температура, відносна вологість повітря, органолептичні, фізико-хімічні, мікробіологічні показники якості.