

Ministry of Education and Science of Ukraine

Odessa national university of technology

Department of Technology of milk, oil and fat products and the beauty industry



Biotechnology of soft Camembert cheese utilizing modern dairy ingredients

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TOPIC RELEVANCE

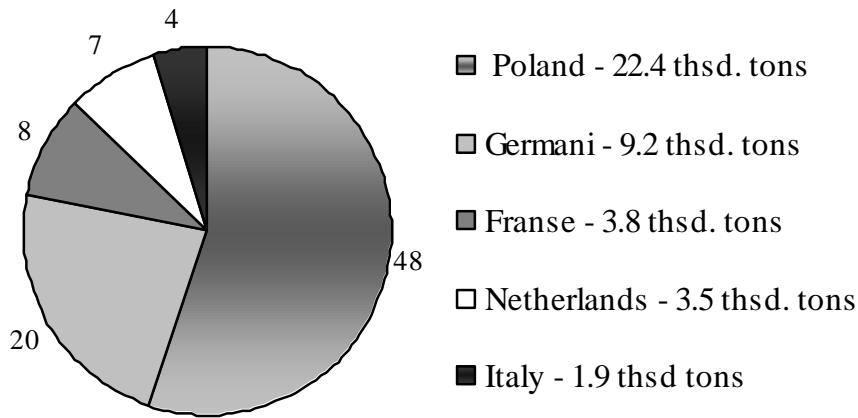


Fig. 1. Dairy product export in natural terms, thousands of tons

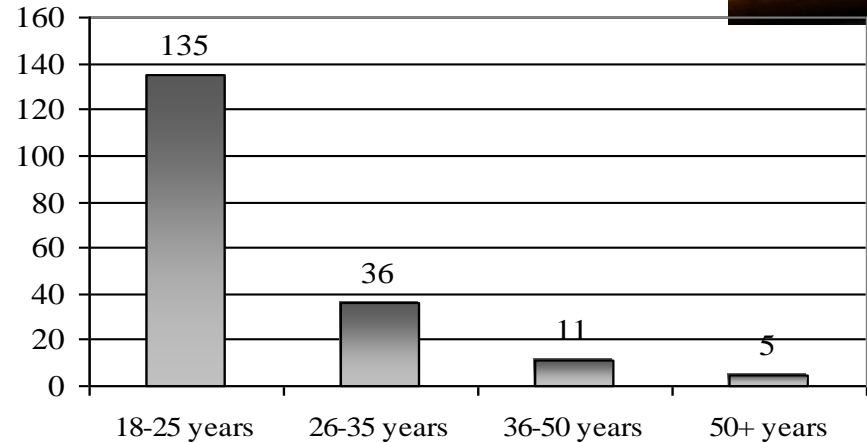


Fig. 2. Age group of surveyed people

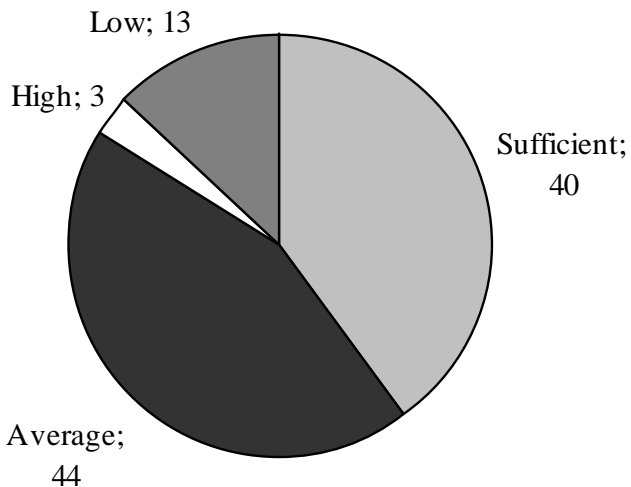


Fig. 3. Dairy product export in natural terms, thousands of tons

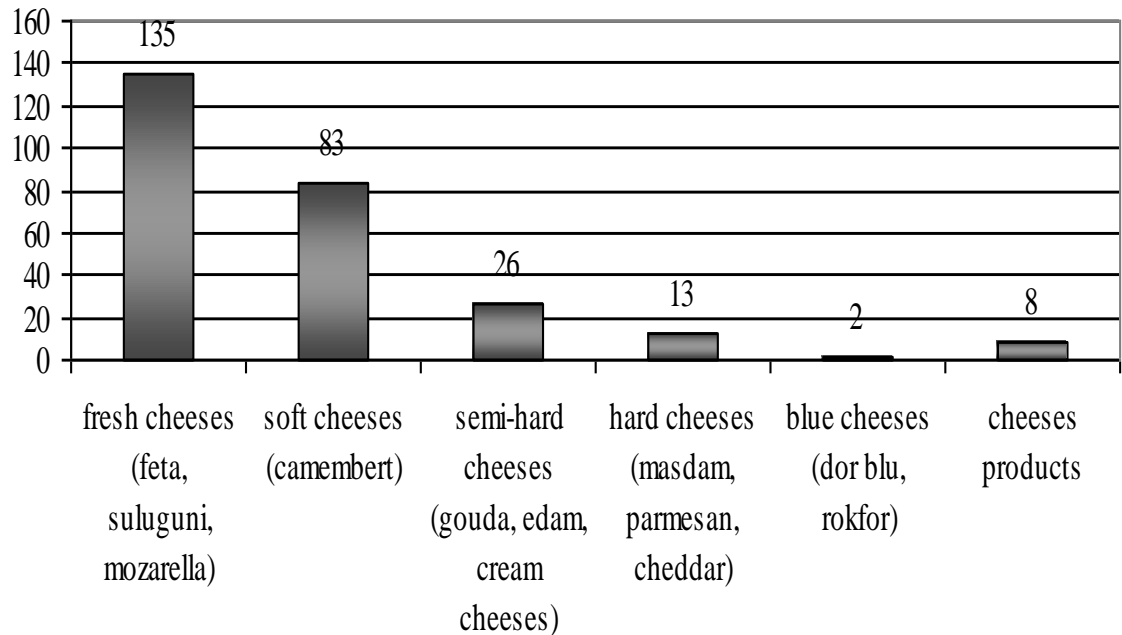


Fig. 4 . Frequency analysis of the choice of cheese when buying, persons





Research objective and tasks



The purpose of the scientific research was to determine the influence of the quality indicators of the milk of Holstein cows on the features of its processing into soft Camembert cheese with an extended shelf life 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 analyze the technology of soft Camembert cheese, the requirements for milk and milk-forming ingredients for its production, and to provide recommendations for the production of soft Camembert cheese with an extended shelf life at the Prykarpattia Dairy Farm of MUKKO LLC.
- 3.To determine the chemical composition and quality indicators of the milk of Holstein and Ukrainian black and white dairy cows and provide recommendations for their processing into hard and soft cheeses.
- 4.To determine the influence of pasteurization parameters of milk of Holstein cows on the yield of soft Camembert cheese, the composition of cheese and whey.
- 5.To substantiate the ripening parameters of soft Camembert cheese produced from the milk of Holstein cows at the Prykarpattia Dairy Farm of MUKKO LLC.
- 6.Determine the maximum shelf life of soft Camembert cheese made from the milk of Holstein cows.
- 7.Calculate the recipe and develop a science-based technology for the production of soft Camembert cheese from the milk of Holstein cows at the Prykarpattia Dairy Farm of MUKKO LLC.
- 8.To carry out an industrial trial of the developed technology of soft Camembert cheese from the milk of Holstein cows in the industrial conditions of the Prykarpattia Dairy Farm of MUKKO LLC, to determine the quality indicators of the produced cheeses.
- 9.To determine the economic efficiency and investment attractiveness of the introduction of the developed technology of soft Camembert cheese from the milk of Holstein cows at the Prykarpattia Dairy Farm of MUKKO LLC.



Research scheme

THEORETICAL STAGE

Characteristics of the Prykarpattia Dairy Farm "MUKKO" LLC

Requirements for milk and starters for the production of soft Camembert cheese

Characterization of lactic enzymes for the production of soft Camembert cheese

Analysis of soft production technology Camembert cheese

Prospects for Camembert cheese production at MUKKO LLC

Setting the goal and tasks of research

EXPERIMENTAL STAGE

Determination of the chemical composition and quality indicators of milk of cows of the Holstein and Ukrainian black-spotted dairy breeds

Determination of the effect of pasteurization parameters of milk of Holstein cows on the yield of soft Camembert cheese, composition of cheese and whey

Justification of ripening parameters of soft Camembert cheese produced from the milk of Holstein cows

Determination of the maximum shelf life of soft Camembert cheese produced from the milk of Holstein cows

Calculation of recipes and development of milk processing technology of Holstein cows in soft Camembert cheese with an extended shelf life

Production approval of the developed technology soft Camembert cheese

Determination of quality indicators of soft Camembert cheese produced from the milk of Holstein cows

Evaluation of the economic efficiency of the production of soft Camembert cheese from the milk of Holstein cows



1. Analysis of the state of raw materials in Molochnay Prykarpattia LLC "MUKKO"



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 milking herd will include 1,500 head, which means an increase of 600 head. The amount of milk that MUKKO LLC will receive additionally will be:

$$\text{Mn.m.} = \text{Kgol.} \times \text{Above.} = 600 \times 25 = 15000 \text{ kg/day,}$$

where Mn.m. – mass of whole milk obtained additionally at MUKKO LLC, kg/day; Kgol. - the number of cows that will be added to the dairy herd after 18 months, head; Over. - milk from 1 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:

$$\text{Ms.g.} = \text{MN.m.} / \text{VN.m.} * 1000 = 15000 / 11400 * 1000 = 1315.8 \text{ kg,}$$

where Ms.g. – 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; Vn.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 :

$$\text{Ms.k.} = \text{MN.m.} / \text{VN.m.} * 1000 = 15000 / 8900 * 1000 = 1685.4 \text{ kg,}$$

where MSc. – 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; Vn.m. – consumption of whole milk per 1000 kg of soft Camembert cheese, kg/ton.

1. Analysis of the state of raw materials in Molochnay Prykarpattia LLC "MUKKO"



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

$$\mathbf{GKs.g. = Ms.g. * Ts.g. = 1315.8 * 480 = 631,584 \text{ UAH.},}$$

where Ms.g. - mass of hard Gouda cheese with a mass fraction of fat in dry matter of at least 50% obtained per day, kg/day; Ts.g. - sale price of 1 kg of hard Gouda cheese, hryvnias
The money received from the sale of soft Camembert cheese, produced in one day, will add up:

$$\mathbf{GKs.k. = Ms.k. * Ts.k. = 1685.4 * 640 = 1,078,656 \text{ UAH.},}$$

where Ms.g. – mass of soft Camembert cheese with a mass fraction of fat in dry matter of 60% obtained per day, kg/day; Ts.k. - sale price of 1 kg of soft Camembert cheese, UAH.
The additional profit that the Prykarpattia Dairy Farm LLC "MUKKO" will receive on a daily basis, when processing the received excess cow's milk into soft Camembert cheese instead of hard Gouda cheese, will amount to :

$$\mathbf{DPR = GKs.k. - GKs.g. = 1,078,656 - 631,584 = 447,072 \text{ UAH.},}$$

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 sanatoriums and resorts.

2. Analysis of soft Camembert cheese technology



Based on the analysis of the production technology of soft Camembert cheese, it is shown:- prospects for the production of a product with an extended shelf life using high-quality dairy raw materials and modern milk-forming ingredients - leavening compositions for direct application and 100% chymosin.- for the production of soft Camembert cheese, it is necessary to build a new workshop at the Prykarpattia Dairy Farm of MUKKO LLC.



3. Organoleptic, physico-chemical, microbiological indicators, 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 index for cow's milk	
	Holstein	Ukrainian dairy black-spotted breed
Taste and smell	Clean, milky, sweetish taste, without extraneous flavors and smells that are not characteristic of fresh milk	
Consistency	A homogeneous liquid without lumps of fat, without flakes of protein, without sediment and clots	
Colour	Light cream, homogeneous throughout the mass of milk	
Acidity, °T	$16,5 \pm 0,5$	$16,5 \pm 0,5$
Degree of purity per standard, group	I	I
Viscosity, kg/m ³	$1028,0 \pm 0,5$	$1028,5 \pm 0,5$
Temperature, °C	4 ± 1	4 ± 1
Total bacterial insemination, thousand/cm ³	$25,0 \pm 0,5$	$30,5 \pm 0,5$
The number of somatic cells, thsd CFU, cm ³	$23,0 \pm 0,5$	$25,0 \pm 0,5$
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.:	$15,23 \pm 0,29$	$15,55 \pm 0,30$
fat	$3,8 \pm 0,1$	$4,0 \pm 0,1$
protein	$3,3 \pm 0,1$	$3,4 \pm 0,1$
including kasein	$2,70 \pm 0,05$	$2,75 \pm 0,05$
lactose	$4,70 \pm 0,03$	$4,70 \pm 0,05$
minerals	$0,70 \pm 0,02$	$0,72 \pm 0,02$

4. Influence of pasteurization parameters of milk from Holstein cowbreeds for the production of soft Camembert cheese, composition of cheese and whey



One control mode (which corresponds to the recommendations of literary sources) and three experimental modes were chosen for conducting experimental studies:

control mode of pasteurization of milk: temperature 80 °C, holding for 20 seconds;

the first experimental mode of pasteurization of milk: temperature 80°C, holding for 5 minutes;

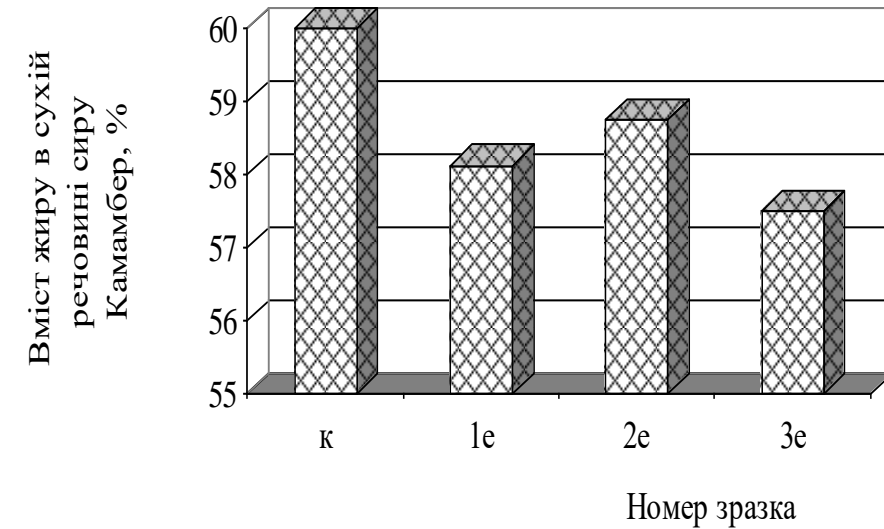
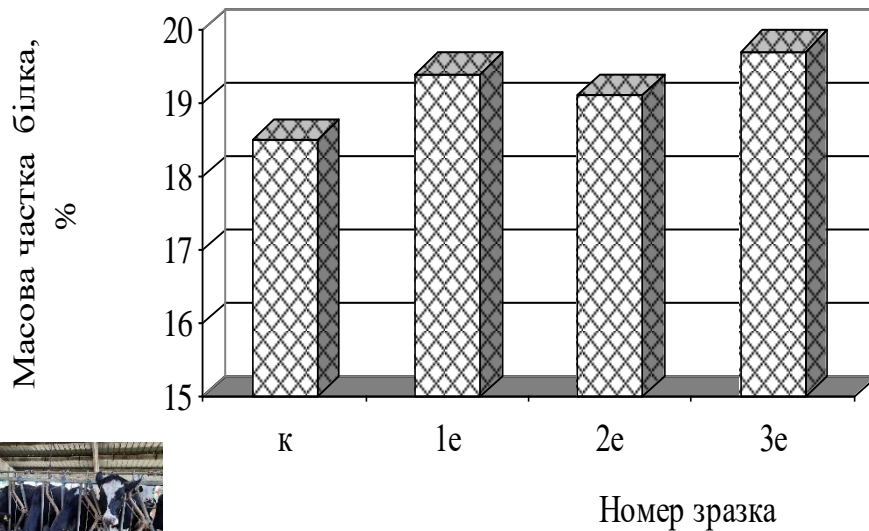
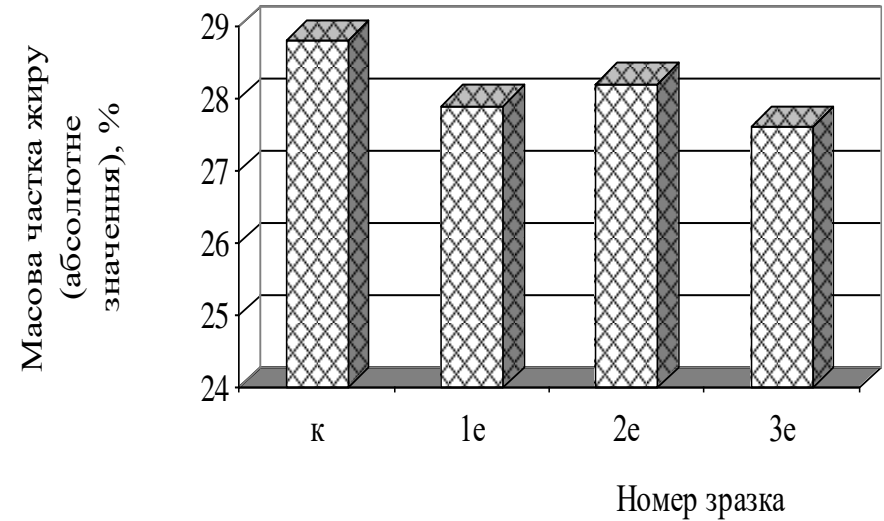
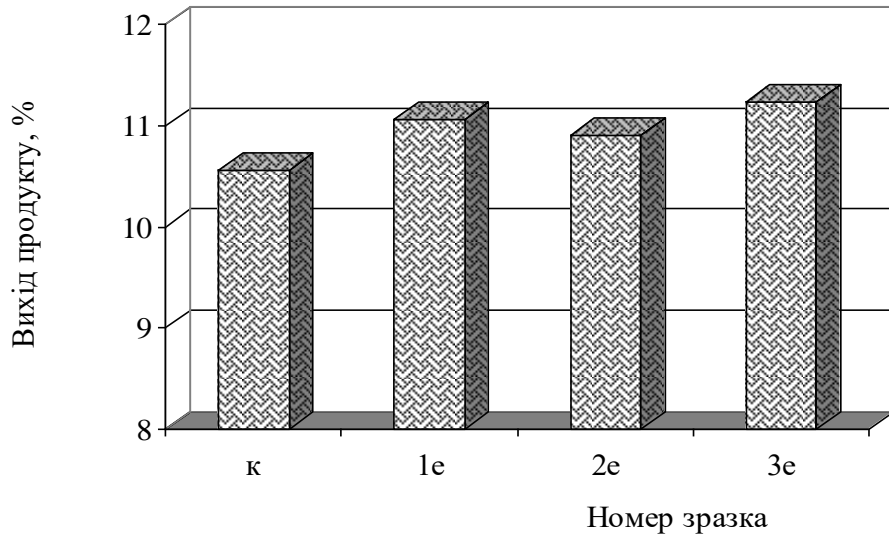
the second experimental mode of pasteurization of milk: temperature 85°C, holding for 20 seconds;

the third experimental mode of pasteurization of milk: temperature 85°C, holding for 5 minutes.



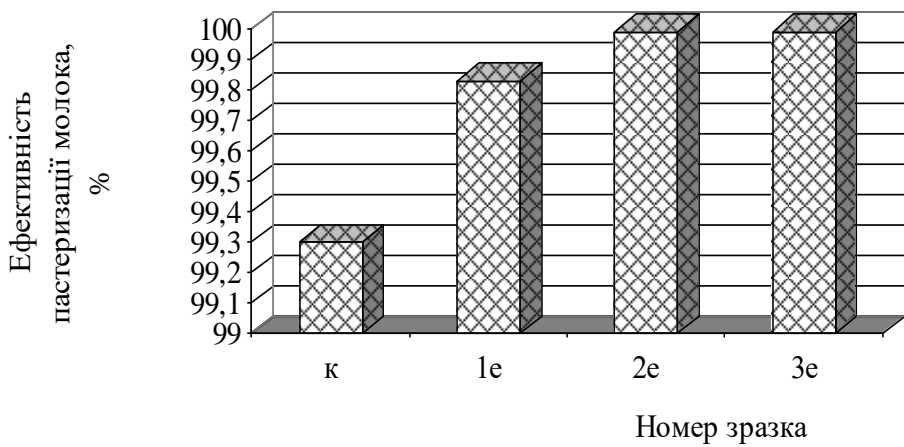
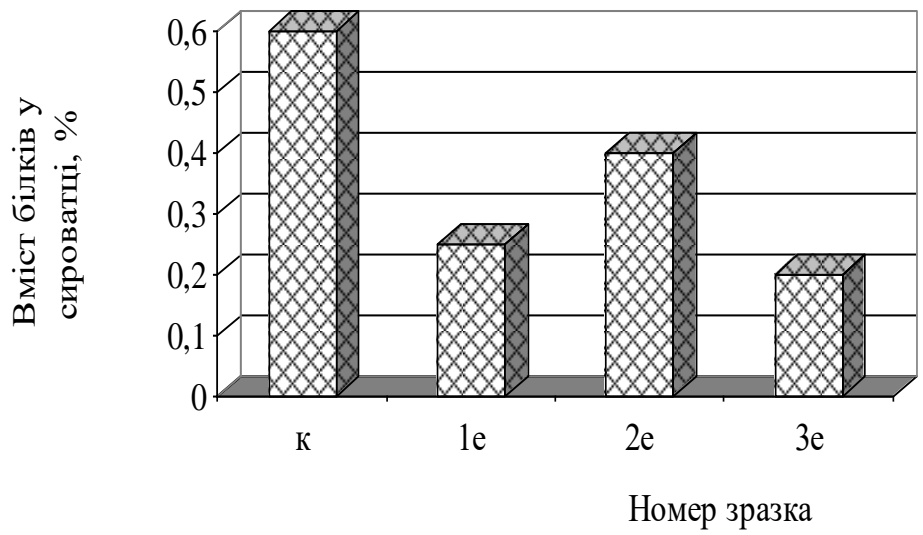
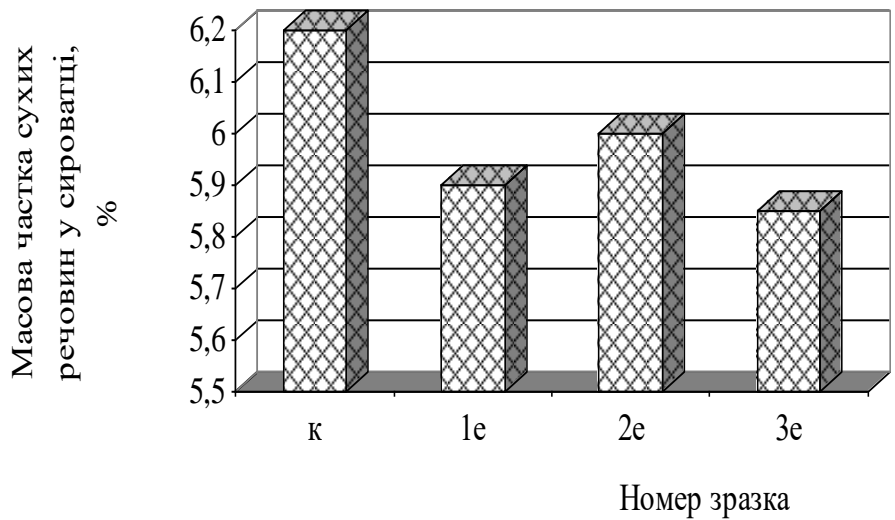


4. Influence of pasteurization parameters of milk from Holstein cowbreeds for the production of soft Camembert cheese and the composition of the cheese





4. Influence of pasteurization parameters of milk from Holstein cowbreeds on serum composition and efficiency of milk pasteurization



For the pasteurization of milk from Holstein cows in the production of soft Camembert cheese at the Prykarpattia Dairy Farm of MUKKO LLC, it is recommended to use the third experimental mode: **pasteurization temperature 85°C, holding for 5 minutes.**



5. Rationale for ripening parameters of soft Camembert cheese



After salting, the soft Camembert cheese was sent for ripening. The produced cheeses were divided into two batches.

The first batch of soft Camembert cheese was ripened according to the regime:

1 chamber: $t = 11...12$ °C; $\tau = 10$ days; relative air humidity 85...90%;

2 chamber: (in laminated foil): $t = 6...7$ °C; $\tau = 2...3$ days; relative air humidity 70...75%.

The total duration of the ripening process of soft Camembert cheese of the first batch was 13 days (as foreseen by the classic technology of production of the target product).

The second batch of soft Camembert cheese ripened according to the regime:

1 chamber: $t = 11...12$ °C; $\tau = 17$ days; relative air humidity 85...90%;

2 chamber: (in laminated foil): $t = 6...7$ °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.



Organoleptic, physicochemical, microbiological indicators of the first and second batches of soft Camembert cheeses made from the milk of Holstein cowsbreeds at the Prykarpattia Dairy Farm "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



Appearance of soft Camembert cheeses after ripening



a)



b)

**Appearance and consistency of soft Camembert cheeses:
a) – cheese of the first series of studies; b) - cheese of the second**

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

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

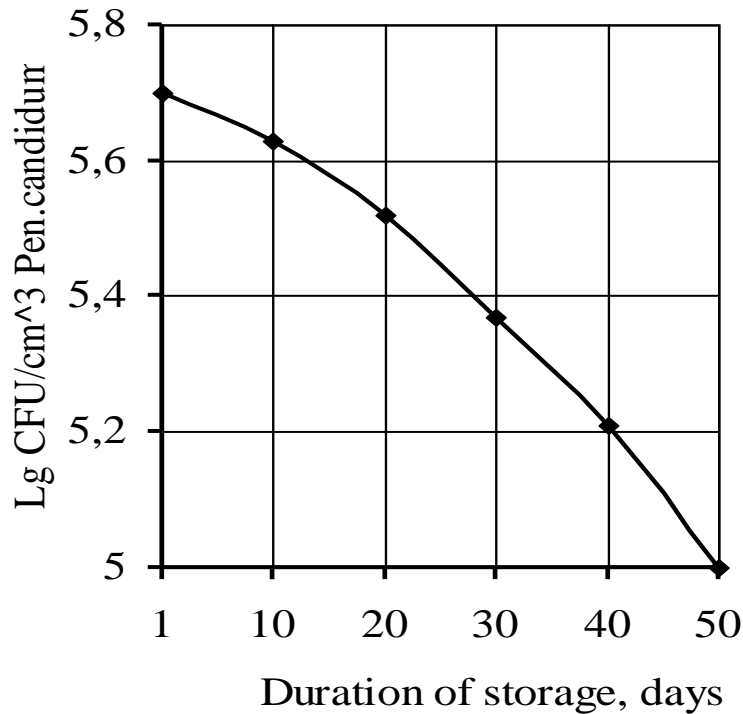
6. Determination of the maximum storage period for soft Camembert cheese



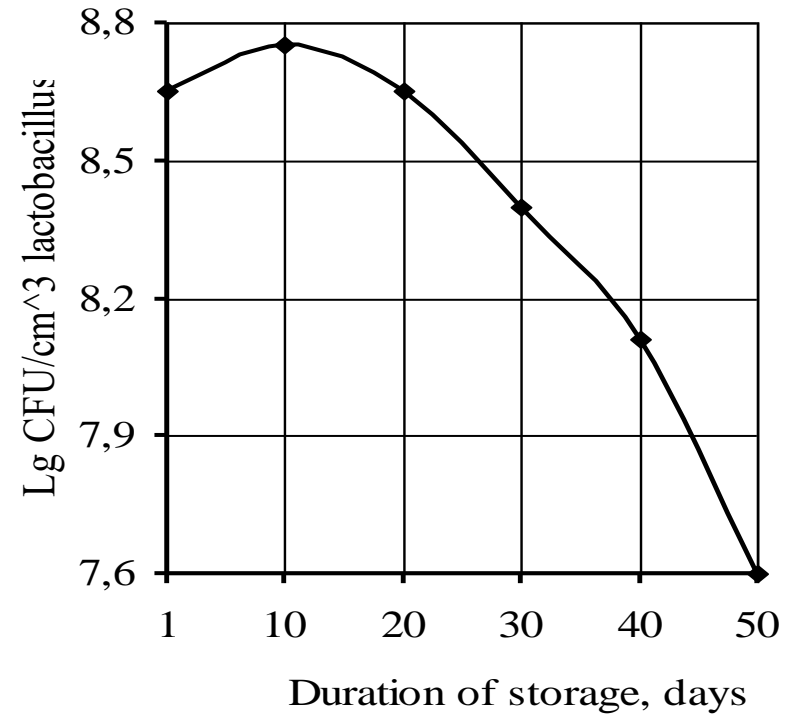
Changes in the organoleptic and physicochemical parameters of soft Camembert cheese produced from the milk of Holstein cows during storage

The name of the indicator	The value and characteristics of the indicator for soft Camembert cheese in the process of storage through, days					
	1	10	20	30	40	50
Taste and smell	Clean, cheesy, delicate taste, with the taste and aroma of mushrooms					Clean, cheesy taste, with the taste and aroma of mushrooms and a slight aftertaste
Consistency and appearance	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	Absent					
Colour	Light yellow cheese dough with white mold on the surface					Light yellow cheese dough with white mold and slight light brown spots on the surface
Mass fraction of moisture, %	51,8 ± 0,1	51,8 ± 0,1	51,7 ± 0,1	51,7 ± 0,1	51,6 ± 0,1	51,6 ± 0,1
Mass fraction of fat in dry matter, %	60,0 ± 0,1	60,0 ± 0,1	60,1 ± 0,1	60,1 ± 0,1	60,2 ± 0,1	60,2 ± 0,1
Mass fraction of salt, %	1,8 ± 0,1	1,8 ± 0,1	1,8 ± 0,1	1,8 ± 0,1	1,8 ± 0,1	1,8 ± 0,1
Active acidity, units pH	6,2 ± 0,1	6,2 ± 0,1	6,3 ± 0,1	6,3 ± 0,1	6,4 ± 0,1	6,6 ± 0,1

6. Determination of the maximum storage period for soft Camembert cheese



a)



b)

Change in the number of viable cells Pen. candidum (a) and lactobacillus (b) in soft Camembert cheese produced from the milk of Holstein breeds during storage

The maximum shelf life of soft Camembert cheese made from milk of Holstein cows according to the developed technology, at a temperature of 4...6 °C and a relative humidity of 80% is 40 days.

7. Recipe calculation and development of technology for the production of soft Camembert cheese from the milk of Holstein cows

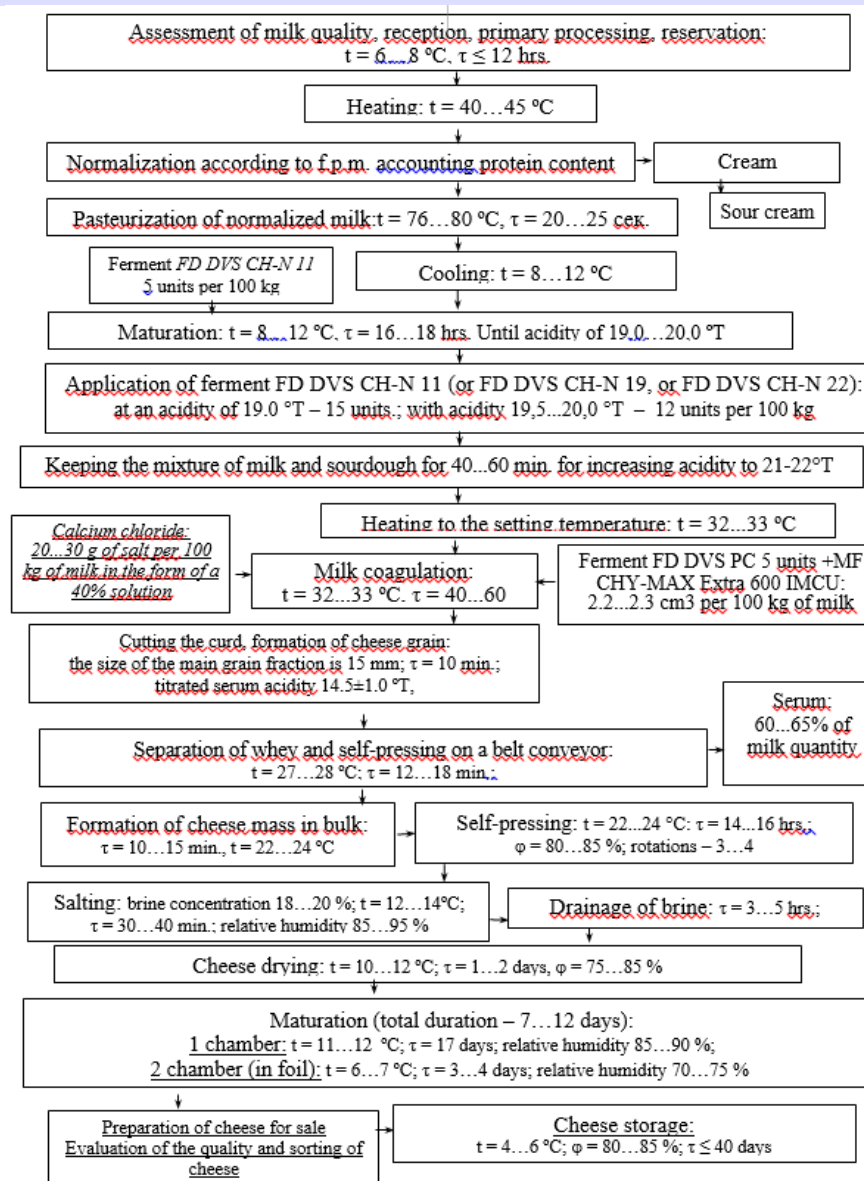


The recipe for soft Camembert cheese from the milk of Holstein cows (in kg per 1000 kg of finished product, excluding losses)

Raw material name	Raw material mass, kg
1. Milk from Holstein cows	8900,00
2. 40% calcium chloride solution	6,67
3. Lactobacillus CHY-MAX Extra 600 IMCU	0,20
4. Ferment for direct application FD DVS CH-N 11	1780,0
5. Ferment for direct introduction of FD DVS PC	445,0
Output of soft Camembert cheese	1000,0



7. Recipe calculation and development of technology for the production of soft Camembert cheese from the milk of Holstein cows



7. Recipe calculation and development of technology for the production of soft Camembert cheese from the milk of Holstein cows

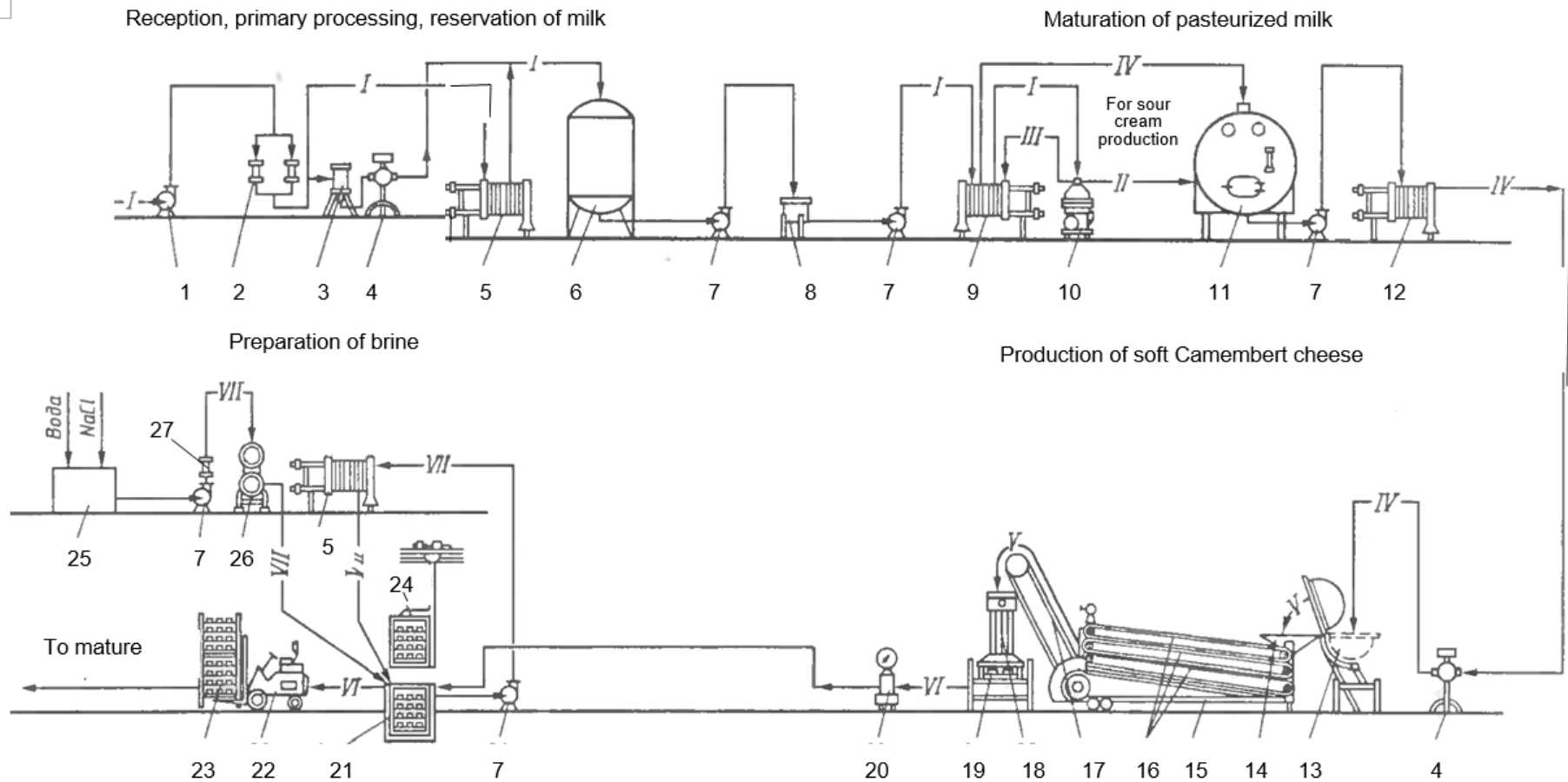


Fig. 2.2 - Technological diagram of the production of soft Camembert cheese in the hardware representation

8. Determination of quality indicators of soft Camembert cheese from the milk of Holstein cows



Indicator name	Characteristics and value of the index for soft Camembert cheese	
	1st batch	2nd batch
Organoleptic indicators		
Taste and smell	Clean, cheesy, delicate taste, with the taste and aroma of mushrooms	
Consistency	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	Single spots of irregular shape are present	Absent
Colour	Light yellow cheese dough with white mold on the surface	
Physico-chemical parameters		
Moisture mass part, %	51,6 ± 0,1	51,8 ± 0,1
Fat mass part in dry fraction, %	60,2 ± 0,1	60,0 ± 0,1
Sodium mass part, %	1,7 ± 0,1	1,8 ± 0,1
Active acidity, units	6,3 ± 0,1	6,2 ± 0,1
Microbiological indicators		
The number of lactic acid bacteria in 1 g, CFU	(6,5 ± 0,5) × 10 ⁸	(6,0 ± 0,5) × 10 ⁸
Number of molds in 1 g, CFU	(6,0 ± 0,3) × 10 ⁵	(6,4 ± 0,2) × 10 ⁵
BGKP in 1 g	Absent	Absent



8. Determination of the economic efficiency and investment attractiveness of the implementation of the developed production technology of soft Camembert cheese from the milk of Holstein cows at the Prykarpattia Dairy Farm of MUKKO LLC

The main technical and economic indicators of the project of processing the milk of Holstein cows at the Prykarpattia Dairy Farm of MUKKO LLC into soft Camembert cheese

Indicator name	Indicator values defined in the project
Production capacity, t/day	1,685
Manufactured products at current wholesale prices, thousand UAH.	291 168,0
Number of employees, people	27
Average annual volume of production per employee, thousand UAH/people	10 784,0
The cost of manufactured products, thousand UAH	242 639,8
Profit, thousand UAH.	48 528,2
Net profit, thousand hryvnias	39 793,12
Capital investments, thousand UAH.	83 536,4
Payback period of capital investments, years	2,1
Mode of operation, shifts per year	600



GENERAL CONCLUSIONS ON THE WORK



Based on the results of our own experimental and statistical research, the technology for the production of soft Camembert cheese from the milk of Holstein cows, produced at the Prykarpattia Dairy Farm of MUKKO LLC, has been developed.

1. Based on the analysis of the state of raw materials at the Prykarpattia Dairy Farm of MUKKO LLC, the prospects for the production of soft Camembert cheese at the enterprise were determined and it was established that a new workshop should be built at the enterprise for its production.
2. The prospects for the production of soft Camembert cheese with an extended shelf life using high-quality dairy raw materials and modern milk-forming ingredients - leavening compositions of direct application and 100% chymosin are shown.
3. Based on the determination of the chemical composition, quality indicators, and sirupability of milk from Holstein cows and Ukrainian dairy black-spotted breeds, it is recommended at the Prykarpattia dairy farm MUKKO LLC to use milk from Holstein cows for the production of soft Camembert cheese, and to use milk for the production of hard cheeses cows of the Ukrainian dairy black and spotted breed.
4. The expediency of pasteurizing milk from Holstein cows in the production technology of soft Camembert cheese at a temperature of 85 °C with a holding time of 5 minutes has been substantiated, since when applying such a mode of pasteurization of milk, the yield of cheese increases by 6.3%, the protein content in whey decreases by 66 ...67%, the biological value of the target product increases, and the pasteurization efficiency is 99.99%.
5. The possibility and expediency of maturing soft Camembert cheese, produced from the milk of Holstein cows at the Prykarpattia Dairy Farm of MUKKO LLC, according to a stepwise regime for 21 days in two chambers: 1 chamber: $t = 11...12$ °C; $\tau = 17$ days; relative air humidity 85...90%; 2 chamber: (in laminated foil): $t = 6...7$ °C; $\tau = 3...4$ days; relative air humidity 70...75%.
6. The storage parameters of soft Camembert cheese produced from the milk of Holstein cows at the Prykarpattia Dairy Farm of MUKKO LLC according to the developed technology using modern milk-forming ingredients were determined: temperature 4...6 °C, relative humidity 80%, duration - no more 40 days
7. A scientifically-based recipe was calculated and a scientifically-based technology for the production of soft Camembert cheese from the milk of Holstein cows at the Prykarpattia Dairy Farm of MUKKO LLC was developed.
8. The quality indicators of samples of soft Camembert cheeses produced from Holstein cows in the laboratory conditions of the Department of Technology of Milk, Oil and Fat Products and the Beauty Industry of ONTU and Dairy Farm Prykarpattia LLC "MUKKO" according to the developed technology fully meet the requirements of regulatory documentation.
9. The performed calculations testify to the high economic efficiency and investment attractiveness of the introduction of the developed technology of soft Camembert cheese from the milk of Holstein cows at the Prykarpattia Dairy Farm of MUKKO LLC, since the payback period for capital investments is 2.1 years.



THANK YOU FOR
YOUR ATTENTION

