ТВАРИННИЦТВО, КОРМОВИРОБНИЦТВО, ЗБЕРЕЖЕННЯ ТА ПЕРЕРОБКА СІЛЬСЬКОГОСПОДАРСЬКОЇ ПРОДУКЦІЇ

ANIMAL HUSBANDRY, FEED PRODUCTION, STORAGE AND PROCESSING OF AGRICULTURAL PRODUCTS

UDC 637.146.34:621.798.1
DOI https://doi.org/10.32782/2226-0099.2024.135.1.18

REDUCTION IN THE AMOUNT OF FRUIT FILLING IN YOGURT PRODUCTION

Balabanova I.O. *– Candidate of Agricultural Sciences,*
Associate Professor at the Department of Technology of Agricultural Products Production and Processing Named after Academician V.H. Pelykh,
Kherson State Agrarian and Economic University

Yogurt is a dairy product obtained from milk through heating and fermentation with special bacteria – Lactobacillus bulgaricus and Streptococcus thermophilus.

In ancient times Scythians and related nomadic peoples transported milk in skin bags on horses' and donkeys' backs. Bacteria entered the product from the air and wool, fermentation occurred, and regular juddering completed the process, turning the milk into a thick sour drink that did not spoil for a long time and at the same time retained all the useful properties.

The microflora of the Bulgarian yogurt was first studied by the Bulgarian student of medicine Stamen Grigorov, at the department of prof. MASSOLIT, at the University of Geneva. In 1905, he described its composition of one rod-like and one spherical lactic acid bacterium.

In 1907, the rod-shaped bacterium was named Lactobacillus bulgaricus with reference to Bulgaria, in which it was first discovered and used, and the spherical bacterium was called Streptococcus thermophilus.

Until recently, biotechnology was used in the food industry to improve the processes and for more advanced use of microorganisms, but the future belongs to genetic research to create more productive strains for specific needs, the introduction of new methods in fermentation technology.

The spectrum of food products manufactured by means of microorganisms is large. These are products that are obtained as a result of fermentation – bread, hard cheese, wine, beer, sour milk cheese, and so on.

Production of dairy products in the food industry is based on fermentation processes. Milk is the basis of dairy biotechnology.

In Ukraine, the state standard for yogurt DSTU 4343:2008 "Yogurts. General technical conditions". In accordance with this standard, yogurts are classified in the following way. Depending on the type of ferments used, they are divided into such types: yogurt, bio-yogurt, bifido-jogurt.

Yogurt enjoyed popularity in Europe due to the stomach disease of King Louis XI. The King could not recover and a doctor from Constantinople helped him giving Balkan yogurt. Being grateful, the French King shared information about the food which rescued his life. The paper gives a detailed description of the production of yogurts by the tank method, proves the

appropriateness a smaller amount of fruit filling, which reduces the cost of production and increases the naturalness of yogurt.

Key words: *yogurt, microflora, Bulgarian yogurt, fermentation, fermented milk products, acidity.*

Балабанова І.О. Зменшення кількості фруктової начинки при виробництві йогуртів

Йогурт – молочний продукт, одержуваний з молока з допомогою нагрівання і сквашування спеціальними бактеріями – Lactobacillus bulgaricus і Streptococcus thermophilus.

Скіфи і споріднені кочові народи здавна перевозили молоко в бурдюках на спинах коней і ослів. З повітря і вовни в продукт потрапляли бактерії, відбувалося бродіння, а постійна тряска довершувала справу, перетворюючи молоко в густий кислий напій, який довго не псувався і при цьому зберігав всі корисні властивості.

Мікрофлору болгарського йогурту вперше вивчив болгарський студент медицини Стам Григоров, на кафедрі проф. МАССОЛИТе, в Університеті Женеви. У 1905 р. він описав її як складається з однієї паличковидної і однієї сферичної молочнокислої бактерії.

У 1907 році паличкоподібну бактерію назвали Lactobacillus bulgaricus на честь Болгарії, в якій вона була вперше відкрита і використана, а сферичну – Streptococcus thermophilus.

Донедавна біотехнологія використовувалася в харчовій промисловості з метою вдосконалення освоєних процесів і більш вмілим використанням мікроорганізмів, але майбутнє тут належить генетичним дослідженням зі створення більш продуктивних штамів для конкретних потреб, впровадженню нових методів у технології бродіння.

Спектр продуктів харчування, які одержують за допомогою мікроорганізмів, великий. Це продукти, які отримують у результаті бродіння – хліб, твердий сир, вино, пиво, кисломолочний сир і так далі.

Одержання молочних продуктів у харчовій промисловості побудовано на процесах ферментації. Основою біотехнології молочних продуктів є молоко.

В Україні впроваджений державний стандарт на йогурт ДСТУ 4343:2008 «Йогурти. Загальні технічні умови». Згідно цього стандарту йогурти класифікують наступним чином. Залежно від виду закваски, що її застосовують, поділяють на таки види: йогурт, біойогурт, біфідойогурт.

У Європі деяку популярність йогурт придбав у зв'язку з хворобою живота короля Людовика XI. Король ніяк не міг вилікуватися, і йому допоміг лікар з Константинополя, який приніс йому балканський йогурт. Будучи вдячним, французький король поширив інформацію про їжу, яка врятувала йому життя.

У роботі наводиться детальна характеристика виробництва йогуртів резервуарним способом, доводиться доцільність зменшення кількості фруктового наповнювача, що зменшує собівартість продукції та підвищує натуральність йогурту.

Ключові слова: *йогурт, мікрофлора, болгарський йогурт, бродіння, кисломолочні продукти, кислотність.*

Introductions. The word "yogurt" is of Turkish origin (Turkish : yoğurt) meaning "condensed". In ancient times Scythians and akin nomadic peoples transported milk in skin bags on horses' and donkeys' backs. Bacteria entered milk from air and wool, fermentation occurred, and regular juddering completed the process, turning milk into a creamy sour drink, which did not spoil for a long time and retained all useful properties.

Ukraine introduced the state standard for yogurt DSTU 4343:2008 "Yogurts. General technical conditions". In accordance with this standard, yogurts are classified in the following way. Depending on the type of ferments used, they are divided into such types: yogurt, bio-yogurt, bifido-yogurt.

Yogurt is a fermented milk product with a high content of dry substances obtained through milk fermentation [4].

Bio-yogurt is a fermented milk product which is manufactured using a ferment on lactic bacteria and probiotic cultures which have a favorable impact on the micro-flora of a human intestine.

Bifido-yogurt is a bifido-product based on yogurt with a content of Bifidobactericum, at the end of the shelf life. Bio-yogurt and bifido-yogurt production involves

probiotics – living microorganisms which have a beneficial effect on a consumer's body through normalization of the composition and functions of micro-flora of the digestive tract [3].

Yogurts are made using or without using food supplements or fillings. Different fruits: exotic – bananas, pineapples, kiwi, and traditional – cherries, strawberries and raspberries add incomparable aroma to this product and, moreover, enrich it with vitamins [1].

Along with natural fillings, artificial flavoring substances and dyes are used. Undoubtedly, nutritional value of yogurts with natural supplements are much higher. Depending on the raw materials used, yogurts and bio-yogurts are classified in the following way:

1. yogurt from natural milk;
2. yogurt from normalized milk or normalized cream;
3. yogurt from reconstitutes (or partly reconstituted) milk;
4. yogurt from recombined (or partly recombined) milk.

It is also necessary to pay attention to the fact that dairy factories produce "living" and "long-living" yogurts.

Living yogurt is yogurt containing living bacteria, which is more useful and nutritious. Moreover, you can find an inscription on its package: "Contains "living" yogurt culture". The shelf life of such yogurt does not exceed a month, in a fridge only. However, they say that "not all yogurts are equally useful". It is true. There are so-called thermised yogurt products. Most of them are "long-living", i.e. lactic acid bacteria are thermally killed in them to prolong their shelf life even under indoor temperature. Their main difference consists in the production method. Yogurt products undergo thermal processing after fermentation, as a result, all lactic acid bacteria perish. But it increases the product shelf life up to three months, even under indoor temperature [2].

Yogurt enjoyed popularity in Europe due to the stomach disease of King Louis XI. The King could not recover and a doctor from Constantinople helped him giving Balkan yogurt. Being grateful, the French King shared information about the food which rescued his life.

For the first time, microflora of the Bulgarian yogurt was examined by the Bulgarian student of medicine Stamen Grigorov, at the department of prof. MASSOLITE, at the University of Geneva. In 1905 he described its composition of one rod-like and one spherical lactic acid bacterium [5].

In 1907 the rod-like bacterium was named Lactobacillus bulgaricus with referring to Bulgaria in which it was discovered and used, and the spherical bacterium was called Streptococcus thermophilus.

Under the current conditions, yogurt production takes an important place in milk processing. Customers pay special attention to the quality and beneficial characteristics of such products. In addition, they must be competitive in comparison with other trademarks. Nowadays the issue of a healthy lifestyle and consumption of natural and healthy food products in the daily ration is getting more popular.

Many large-scale enterprises try to prolong the shelf life not due to chemical supplements, but owing to improvement of the conditions of product processing: complete hermetization of the system, control over all production stages, permanent equipment sterilization, control over employees' health, improvement of packaging materials which do not affect the finished products, and also a reduction in the content of those ingredients which contain unnatural components.

Problem statement. Optimization of the technology for producing fermented milk drinks, namely the drinking yogurt "Activia", the fruit filling "Apple–cereals" was carried out in the conditions of the farm enterprise in Kherson region. The technology of yogurt production and physical-chemical indicators of fruit fillings.

Currently, measures increasing natural content of the finished products based on a reduction in the amount of those ingredients which contain unhealthy components are promising in production of fermented milk drinks.

Fruit fillings are used for improving organoleptic indicators, the present variety of them can satisfy tastes of any consumer due to advanced development of production and processing of milk raw materials [6].

Due to a reduction in the content of fruit fillings, sugar content automatically decreases in yogurt, pH changes, its naturalness increases, and also profitability of production rises owing to a fall in the cost price of the product that has a positive impact both on the end consumer and the producer.

The given scheme shows the algorithm of investigating the amount of the fruit filling "Apple–cereals" in the drinking yogurt "Activia", consisting of a theoretical section, the problem statement, formation of the research samples with different amounts of the fruit filling and analysis of the research findings.

The research subject is a reduction in the amounty of fruit fillings in yogurts.

The research was conducted according to the scheme in the laboratory conditions of the farm enterprise in Kherson region. Adaptation of a new formula with decreased content of the filling was performed on the basis of the production facilities of this enterprise.

The research scheme includes several stages. The stage of theoretical research involves thorough analysis of publications on such issues as using fruit fillings in food industry, and also determination of their optimal amount in products.

The stage of the problem statement involves verifying the possibility of reducing the amount of filling to make products cheaper, in our case – determination of the characteristics of fruit fillings for adding them to drinking yogurts, a change in organoleptic indicators, and also adaptation of a new formula to the existing large-scale production [7].

The research object is the drinking yogurt "Activia" with 1.5% fat content "Apple–cereals" and the fruit filling "Apple–cereals". The drinking yogurt is evaluated by the organoleptic indicators, density, acidity, fat content, protein content, presence of ammonia, soda, hydrogen peroxide, antibiotics, the freezing point pH. It is tested for pasteurization and microbiological composition.

The scheme of distributing raw materials and the technological scheme of yogurt production are examined, and the average sample is selected. A lower amount of filling is added and its impact on the finished product with different amounts of the filling is tested, samples are formed and kept in a camera at the temperature of 25ºC. Acidity and thickness of the product (the rate of achieving thickness) are checked.

A production test is done only after the results of the laboratory research and lasts two days. On the first day, the amount of the fruit filling is measured, and all possible risks are analyzed. On the second day, the finished product is bottled. The research results are summarized.

Standard documents are used for evaluating the quality of production at the enterprise: TU U 15.5–31489175–008:2007 Yogurts. Product specifications; TU U 15.5–31489175–011:2008 Yogurts.

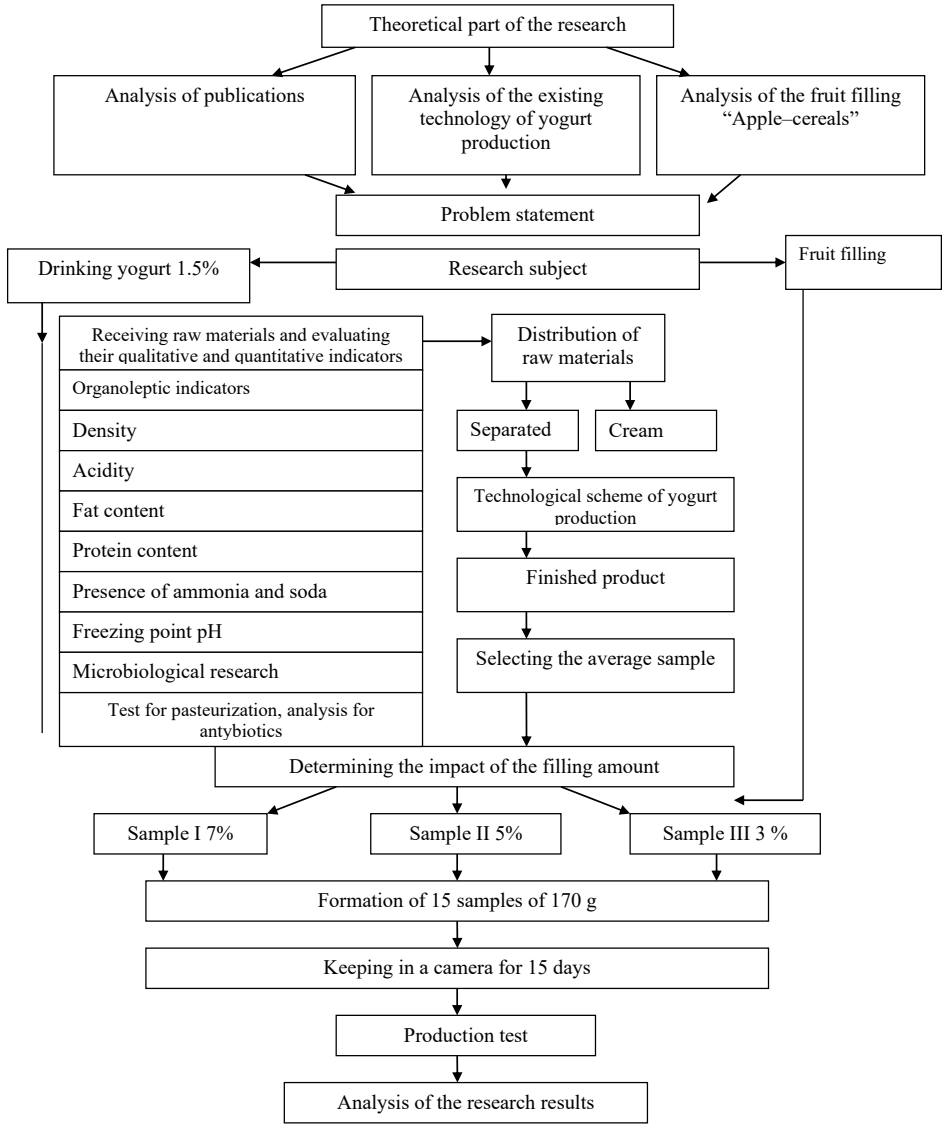

Fig. 1. Scheme of the research on the amount of fruit filling

Product specifications; State sanitary rules for milk processing enterprises in DSP 4.4.4–11–98; General Specification of Ingredients BPF–07–GMI–017; DSTU 52054–2003 Natural cow milk – raw materials; DSTU 3662–7 Unskimmed cow milk. General product specifications; DSTU 10970–87 Dry milk. Product specifications; Specification for a product DD_08_YOG_ACT_breakt_6058.

The yogurt quality was evaluated by such indicators as percentage of fat, pH, the amount of dry substances, thickness and organoleptic indicators.

The amount of dry substances was determined through drying 1g of the product at the temperature of 110ºC over 7 minutes by means of the moisture analyzer Sartorius

MA-150. The obtained result was written in the list of the finished products. The standard amount of dry substances is 22–25%.

The acid butyrometric method for measuring fat is based on fat excretion from milk and dairy products under the influence of concentrated sulfuric acid and isoamyl alcohol with further centrifugation and measurement of the volume of the excreted fat in the graduation of the butyrometer section.

Trying not to wet the mouth, 10 cm^3 of sulfuric acid (the density from 1810 to 1820 kg/m^3) is poured with a dosing unit into two milk butyrometers (types 1–6 or 1–7) and 11 g of yogurt is carefully added to avoid mixing the fluids, putting the end of the pipet to the butyrometer angle-wise. 1 cm^3 of isoamyl alcohol is added to the burytometer with a dosing unit. The mixture level in the butyrometer is set 1–2 mm lower than the basis of the butyrometer neck, a few drops of distillated water is allowed to add. Dry plugs are put into the butyrometers, not much deeper than to the half of the butyrometer neck. The butyrometers are shaken until protein substances are dissolved, turning them over not less than 5 times to completely mix the fluids.

The butyrometers are put with the plugs down into the water bath for 5 minutes at the temperature of 65°C. After taking them out of the water bath, they are put into the glasses of the centrifuge with the graded section directed towards the center. The burymeters are placed symmetrically, one being opposite the other. If the number of butyrometers is odd, the butyrometer is filled with water instead of milk, with sulfuric acid and isoamyl alcohol is put into the centrifuge in the same ratio as for analysis. The butymeters are kept in the centrifuge for 5 minutes.

Each butyrometer is taken out of the centrifuge and, moving the rubber plug, the fat bar is regulated to shift it to the graded section.

The butyrometers are submerged with plugs down for 5 minutes into the water bath at the temperature of (65±2)°C, the water level in the water bath should be a little higher than the fat level. The butyrometers are taken individually from the water bath and the fat is quickly measured. They are kept vertically when measuring, the fat level should be at eye level. Moving the plug, a lower limit of the fat bar is established at the zero level or at the entire graduation of the burymeter scale. The number of scale divisions is measured from it to the lower point of the meniscus of the fat bar within the accuracy of the smallest division of the fat scale.

The indicator of yogurt pH is determined using the device pH-meter Lab-860, which also measures the sample temperature. The standard indicator equals 4.55-4.25.

Main research materials. Yogurt is produced using tank and thermostatic methods.

Technological process of fermented milk drinks by a tank method includes the following technological operations: preparation of raw materials, normalization, pasteurization, homogenization, cooling, fermentation, ripening in special containers, curd cooling, curd ripening, adding fruit filling and packaging.

Previously purified milk which is not lower than the 2nd grade with acidity not higher than 19°T is used for yogurt production.

Fat-free milk, cream, dry milk, and fruit fillings should be of high quality, without alien tastes, and consistency defects.

Normalized raw materials are thermally treated.

Pasteurization results in elimination of microorganisms in milk and in creation of conditions favorable for the development of ferment microflora.

Therefore, the raw materials are pasteurized at the temperature of 90–92°C for 2–3 minutes in yogurt production.

Thermal treatment of milk is usually related to homogenization. Homogenization at the temperature of 55–60°C and the pressure of 17.5 Mpag results in improvement of the consistency of fermented milk products and a reduction in the amount of whey.

Milk ripening occurs at the temperature of fermentation. The process of ripening leads to the reproduction of ferment microflora, acidity increases, casein coagulates and a curd is created. The end of ripening is determined by the creation of a sufficiently dense curd and achievement of the necessary acidity.

After the end of ripening, the product is immediately cooled.

Milk ripening occurs in special double-walled vertical tanks, equipped with mixers with an automatic device.

Containers of 2000, 4000, 6000 and 10000 l are used for producing fermented milk products.

Fermented milk ripens in a container to achieve the necessary acidity. The obtained curd is cooled in the same container, every 30–40 minutes the mixer is switched on for mixing the curd and for cooling it more quickly.

The finished product is stored at the temperature of 4±2°C.

Checking the quality at the stage of receiving raw materials is a basis for the functioning of all enterprises of the company. It is an important and effective instrument of the control system on the level of quality control at the stage of the finished product.

Obligatory analyses include determination of the group of purity, acidity, bacterial contamination, peroxidase and phosphatase tests.

Systematic analysis of all tanks with raw milk delivered to the factory involves two types.

Obligatory analysis: a test for inhibitors. This analysis is performed either on the farm, or by a driver during transportation, or at the reception station of milk (an enterprise or a supplier who is responsible for receiving raw milk), according to the methods of analysis. Each tank is tested before discharge using the express-test capable of identifying at least the main antibiotics of the group (Beta-lactic antibiotics). If the result is positive, it should be confirmed by means of a tentative test. If the second test is positive, the milk cannot be used in production;

Research of a change in the percentage of fruit filling added to yogurt. The aim of the research was to analyze how organoleptic and physical-chemical properties of the drinking yogurt “Activia” change when the amount of the fruit filling is reduced.

The research scheme includes several stages. The stage of theoretical research involves thorough analysis of publications on such topics as using fruit fillings in food industry, and also determining their optimal amount in products.

The stage of the problem statement involves establishing the possibility of reducing fruit filling to make products cheaper, in our case – determining characteristics of fruit fillings when adding them to drinking yogurts, a change in organoleptic indicators, and also adapting a new formula to the existing large-scale production.

The research subject is the drinking yogurt “Activia” with 1.5% of fat content “Apple–cereals” and the fruit filling “Apple–cereals”.

The formula of the yogurt “Activia” looks in the following way (Tabl. 1).

According to the formula of production of 1000 kg of the drinking yogurt “Activia”, we need: 55.4 kg of pasteurized cream with 30% of fat content, 0.3 kg of frozen ferment, 880.6 kg of pasteurized skimmed milk 0.05%, 15.0 kg of dry skimmed milk, 28.7 kg of sand sugar.

To produce 2000 kg of yogurt, the necessary component in the corresponding amounts are added.

Table 1

The formula of making the yogurt "Activia" with 1.5% of fat content

Ingredients	By formula, kg	Actually, kg
Pasteurized cream with 30% of fat content	55.4	110.8
Frozen ferment	0.3	0.6
Pasteurized skimmed milk 0.05%	880.6	1761.2
Dry skimmed milk	15.0	30.0
Sand sugar	48.7	97.4
In total	1000.0	2000.0

To conduct research and form samples for analysis, we need 2000 kg of yogurt, therefore, all the ingredients of the formula should be doubled to obtain the necessary amount of all the components.

After obtaining the finished white substance, we can start packaging the samples of the products with different amounts of the fruit filling.

For doing the research, we formed three samples of the products with different percentages of the fruit filling added: 7%, 5%, 3%. Each sample was evaluated by organoleptic and physical-chemical indicators. Organoleptic indicators of yogurt. Organoleptic method is the method for determining indicators of product quality by means of organs of senses: sight, smell, taste and others.

To evaluate organoleptic properties, special procedures of assessment involving target values and acceptable limits of the examined indicators were developed.

The look – smooth, homogenous surface, an appropriate color of the product, noticeable fruit pieces. The texture is liquid, homogenous, and smooth. The taste is fresh, sweet, a bit sour, fruity, corresponding to the fruit filling, without alien tastes.

The smell is characteristic of this type of product. To perform organoleptic analysis, a team of employees of the production laboratory who always evaluate the quality of finished products was organized to do a special training course.

After examining all the obtained samples by organoleptic indicators, we can draw a conclusion that all of them comply with the requirements of the specifications.

The research of physical-chemical indicators was carried out in the production laboratory of the enterprise by means of modern certified equipment.

The dry yogurt substance involves the substances remaining in yogurt after drying at the temperature of 115ºC to achieve the permanent weight.

The amount of dry substances was determined through drying 1 g of the product at the temperature 115ºC over 7 minutes by means of the moisture analyzer Sartorius MA-150.

The acceptable range of the amount of dry substances is 16.5–18.7%. The target value of this indicator is 17.7% (when adding 10% of fruit filling). The obtained analyses are given in the comparative table (Tabl. 2).

Taking into consideration that the target value of this indicator equals 17.7%, we can draw a conclusion that Sample 3 has the best value, and the rest of the samples comply with the acceptable limits.

Yogurt fat.

According to the product formula and specifications, its fat content should be 1.5%.

Fat content is measured using the acid-butyrometric method.

Table 2

The amount of dry substances in the research samples

Indicator	Sample 1 (4%)	Sample 2 (5%)	Sample 3 (7%)
Amount of dry substances, %	16.87	17.06	17.25

This method is based on fat excretion from milk and dairy products under the influence of concentrated sulfuric acid and isoamyl alcohol with further centrifuging and measuring the volume excreted in the graduated section of the butyrometer.

Trying not to wet the neck, two milk butyrometers (types 1–6 or 1–7), are filled with 10 cm^3 of sulfuric acid (the density being from 1810 to 1820 kg/$м^3$) using a dosing unit and 11 g of yogurt are carefully added putting the end of the pipet angle-wise not to mix the fluids. 1 cm^3 of isoamyl alcohol is added with a dosing unit. The butyrometers are closed with dry plugs, pushing them not deeper that to the half of the neck, carefully mixing their content, and placed into the water bath for 5 minutes at the temperature of 65ºC. Then the dry butyrometers are evenly put into the centrifuge and centrifuged over 10 minutes under 1000 rotations per minute. After that, the butyrometers are placed into the water bath and then the results are taken.

The obtained results are registered in Table 3.

Table 3

Percentage of fat in the research samples

Indicator	Sample 1 (4%)	Sample 2 (5%)	Sample 3 (7%)
Percentage of fat, %	1.5	1.5	1.5

Given the fact that the target value of this indicator equals 1.5%, we can draw a conclusion that all the samples comply with it.

The pH indicator characterizes product acidity and quantitatively equals the negative decimal logarithm of thermodynamic activeness of hydrogen. Yogurt pH is determined by means of the pH-meter Lab-860, which also measures the sample temperature. The standard value of this indicator is 4.45, the acceptable range is 4.25–4.60. After evaluating the three samples of products, the results are entered in Table 4.

Table 4

pH in the research samples

Indicator	Sample1 (4%)	Sample 2 (5%)	Sample 3 (7%)
pH	4.40	4.41	4.43

After analyzing the obtained data, we can draw a conclusion that all the samples comply with the value of the acceptable limits by the pH indicator.

Viscosity is a phenomenon of sticking together, the property of liquid substances to resist movement of one part of them in relation to others.

Yogurt viscosity depends on many factors. Firstly, it depends on its components, namely, on the amount of dry substances, starch and other ingredients for condensing, temperature, the pressure of placing the product on the packaging line and others.

Yogurt viscosity was determined by means of the device Reomat 200, under the following parameters: system 11, speed 64, reading for 10 seconds, temperature 10ºC.

The target value of this indicator is 390 m/Pa, the acceptable range in accordance with the specifications is 230–470 m/Pa.

After evaluating the three samples of products, the results are registered in Tabl. 5.

Table 5

Viscosity in the research samples

Indicator	Sample 1 (4%)	Sample 2 (5%)	Sample 3 (7%)
Viscosity, m/Pa	347	353	370

After analyzing the obtained data, we can draw a conclusion that all the samples comply with the value of the acceptable limits by the indicator of cohesiveness.

All the research samples were placed for temperature stress-tests in the laboratory of quality for their further evaluation by micro-biological indicators and assessment of the mass structure.

After analyzing all the research indicators, we can draw a conclusion that, when reducing the amount of the fruit filling "Apple–cereals" in the yogurt "Activia" with 1.5% of fat content, all the quality indicators comply with the acceptable limits in accordance with the specifications for the finished product.

The less percentage of fruit filling in yogurt is, the higher its naturalness is.

We think that the optimal percentage of fruit filling is 5%, since such a reduction does not have a significant impact on qualitative indicators of the product and, at the same time, increases its beneficial characteristics.

Conclusions. The enterprise has modern equipment for producing yogurts. When reducing the percentage of the fruit filling, we had the indicators of physical-chemical and organoleptic analysis which met the requirements of the specifications, and the level of profitability increased by 3.4% and equaled 12.1%. We suggest investments in launching powerful farms to produce milk for providing production with high-quality raw materials in sufficient amounts with maximum use of production facilities, expanding the range of products to occupy the main place in the market of dairy products.

The research results show that the main physical-chemical indicators (viscosity, pH and the amount of dry substances) were almost unchanged. Organoleptic indicators improved due to a smaller amount of sugar. Naturalness of the products increased owing to a reduced amount of the fruit filling. The profitability increased by 10%.

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