Представлена технологія виробництва та рецептурний склад нового кисломолочного десерту підвищеної харчової цінності «Мартишка». Визначено вміст основних харчових компонентів, вітамінів і мінеральних речовин та проведена товарознавча оцінка якості даного продукту. За допомогою табличного процесору MS Excel проведено оптимізацію рецептури кисломолочного десерту за вмістом білку, кальцію та вітаміну С. Наведено графіки залежності в'язкості харчової системи від концентрації жиру в сирі

Ключові слова: кисломолочний десерт, товарознавча оцінка, харчова цінність, структурно-механічні властивості, технологічна схема виробництва, термін зберігання

Представлена технология производства и рецептурный состав нового кисломолочного десерта повышенной пищевой ценности «Мартышка». Определено содержание основных пищевых компонентов, витаминов и минеральных веществ и проведена товароведная оценка качества данного продукта. С помощью табличного процессора MS Excel проведена оптимизация рецептуры кисломолочного десерта по содержанию белка, кальция и витамина С. Представлены графики зависимости вязкости пищевой системы от концентрации жира в твороге

Ключевые слова: кисломолочный десерт, товароведная оценка, пищевая ценность, структурно-механические свойства, технологическая схема производства, срок хранения

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DEVELOPMENT OF A FERMENTED MILK DESSERT COMPOSITION «MARTYSHKA»

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1. Introduction

A unified state scientific and technical policy in the field of healthy nutrition was developed in the context of new economic relations and specific priorities of Ukraine.

The basis is the satisfaction of the physiological needs of man in essential nutrients and the organization of adequate healthy nutrition. The new nutrition system will ensure the physiological needs of the population in macro- and micronutrients, improve the health indicators of the population, as well as concentrate resources and scientific and technical potential of the country on solving problems that are vital to the nation.

The structure of nutrition of the Ukrainian population now does not correspond to modern principles of rational nutrition and practical dietology.

The diet of the population contains a large number of high-yield products but few basic sources of high-grade food protein, fiber, micro- and macronutrients.

Improving the structure of nutrition of the population of Ukraine provides for an increase in the production of food products through the improvement of existing and the creation of new technologies for functional food products.

Such products should have the following properties:
– a balanced chemical composition;
– a low energy value;
– low contents of sugar and saturated fatty acids;
– an increased content of healthy ingredients for functional and health-preventive purposes;
– be absolutely safe for humans.

These properties can be effectively provided in conditions of organized food through the system of restaurant facilities. The leading role in the implementation of these issues belongs to the development of research in food chemistry, food biotechnology, and molecular technology. Of significant importance is the development of new technological solutions and equipment, methods of analysis and a quality management system.

In the life of modern man, sweets occupy a very important place. On the modern food market, there are many different desserts that please not only by their taste but also by their look.

The word "dessert" is used to mean not only the usual sweets but all other dishes that are served after the main course: cottage cheese, berries, fruits, and nuts. Traditional desserts are sweet bakery (cakes, cupcakes, pies, muffins, and cookies), confectionery (sweets, chocolate, and jam), as well as dairy products (ice cream, soufflé, and curd desserts) [1, 2].

People eat sweet food every day. Therefore, today scientists of the food industry, as well as restaurateurs, try to make desserts not only beautiful and tasty but also useful. Due to the introduction of various biologically active additives into the recipes, the products acquire functional properties.

In this regard, it is important to develop a production technology and evaluate the quality of the new dessert of increased nutritional and biological value.

2. Literature review and problem statement

The nutritional value of sweet foods depends on the nutritional value of the products that make up their composition. Dishes have a sweet taste due to the content of various sugars in them: sucrose, glucose, fructose, etc.

However, it should be remembered that the average need of an adult in sugar should not exceed 100 grams per day. Excessive consumption of it leads to the accumulation of fat, increased blood cholesterol levels, and other negative phenomena.

Fructose, glucose, and maltose have less ability to accumulate fats in the body, so sweet dishes are considered valuable if they include milk, fresh and canned fruits and berries, as well as fruit and berry juices [3].

Sweet dishes are served at the end of lunch or dinner for dessert; sometimes, they are included in breakfast menus. By the composition and method of preparation, sweet dishes are classified into natural fruits, compotes and syrups, sweet dishes with substances that are able to form jelly, and hot sweet dishes. All the dishes of this group are divided into hot (about 55 °C) and cold (10–14 °C) according to the feeding temperature [4].

In the modern Ukrainian cuisine, fresh, dried and canned fruits and berries, fruit and berry syrups, juices, aFnd extracts are used for the preparation of sweet dishes. Such raw and processed materials of plant origin contain various minerals, vitamins, carbohydrates, essential oils, food acids, and colorants.

Some sweet foods include dairy products: milk, cream, sour cream, butter, cottage cheese, as well as eggs and cereals rich in proteins and fats, and have high caloric value. The aromatic and flavoring substances of sweet dishes are vanillin, cinnamon, citrus peel, citric acid, coffee, cocoa, wine, raisins, nuts, etc.

The modern world market presents various sweet dishes and desserts, which can be divided into hot and cold (Fig. 1). Sweet dishes (Fig. 1), prepared from fresh fruits and berries, enhance the secretion of digestive juices and promote better digestion [4].

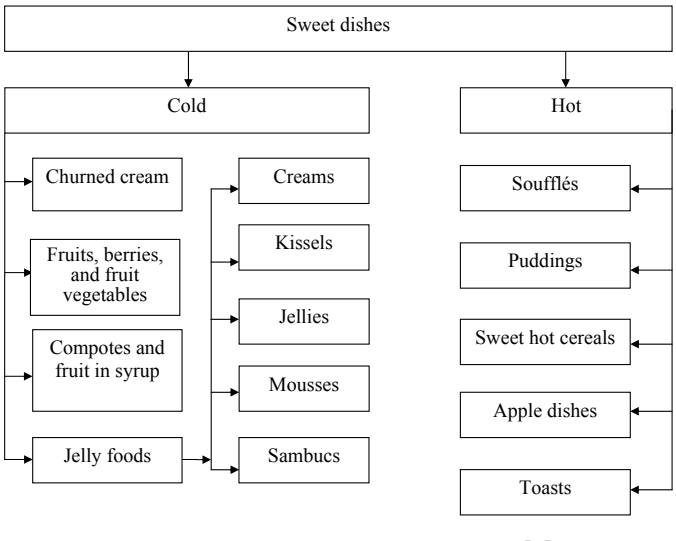

Fig. 1. A classification of sweet dishes [5]

At present, the world market of food technologies has a tendency to increase the number of qualitatively new products. Different plant raw materials are used to prevent various diseases, strengthen the body's defenses, as well as reduce the risk of exposure to toxic compounds and adverse environmental effects.

With the help of special technological processing and additional inclusion of dietary and preventive supplements in recipes, the quality and nutritional value of dishes and products, as well as the properties of a special or therapeutic and prophylactic profile, are provided.

Nowadays, fermented milk desserts are very popular because cottage cheese is a valuable source of protein, calcium, and phosphorus. It is also necessary for the growth and restoration of all tissues of the body, especially bone tissue; it strengthens the hair, nails, and teeth; it is useful for the work of the nervous system, and it helps strengthen the heart muscle. Cottage cheese contains amino acids such as methionine and tryptophan, involved in the process of hematopoiesis. Cottage cheese in dietary nutrition is included in case of diseases of the heart, gastrointestinal tract, liver, gallbladder, etc. [6].

The scientific approach to the creation of new types of combined food products, which in their nutritional, biological value and biological effectiveness correspond to physiological norms as well as specific professional and age groups of the population, has facilitated the intensive development of studies united by the concept of "food development" [7].

The production of dairy products involves the use of dietary fibers of vegetable origin, such as carrageenans, gums, pectins, agar, etc. Vegetable raw materials are known to enrich desserts based on milk raw materials: a milk dessert with carrot dietary fibers [8, 9], cottage cheese with food fibers [10], and vegetable-berry pastes based on cottage cheese [11].

Scientists in the development of combined food products on milk basis often combine milk with raw ingredients of plant origin. Such ingredients are rich in prebiotics, dietary fibers, biologically active substances [12–16], high-grade vegetable proteins [17], and essential polyunsaturated fatty acids [18].

There is a dessert based on milk proteins with the introduction of sprouted beans of lentils [25]. Dry whey protein is used as the milk protein. Based on the tests conducted, it has been found that to obtain a fermented milk dessert with the necessary properties, the optimal mass fractions of dry whey and sprouted beans of lentils are 6 % and 8 %.

In work [26], the developed semi-finished products are mixed with 35...70 % of dry substances that contain 16...40 % of coconut oil, 0.3...6 % of a mixture of casein and whey in a ratio of 0.24...3.8, and lecithin (E322) in an amount of 0.01...0.5 %. Semi-finished products produced by this technology are characterized by high stability at a temperature of 90 °C for 4...5 minutes, high foaming capacity (350 %), and foam stability (100 %).

Studies have been carried out on the possibility of using carrot fibers in the production of dairy products with the aim of enriching their composition with dietary fibers Hayama [27]. On the basis of the organoleptic evaluation of various samples of dairy products with the dietary fibers, sour cream with fat mass fractions of 20 % and 25 % was chosen as the milk base for the dessert production. The technique of introducing the carrot fiber into the product has been developed, and its optimal dose is chosen to be equal to 3 %.

A dairy dessert has been developed with enhanced antioxidant activity based on milk and whey with

food additives in the form of barley flour, topinambour and chicory powders for the prevention of diseases caused by oxidative stress [28]. The introduction of the dessert into the diet of an experimental group of animals contributed to an improvement in the parameters of peripheral blood as well as in a decrease in cholesterol by 10–11.1 % and triglycerides by 17–23.9 %. Based on the obtained results, the developed dessert can be recommended for increasing the antioxidant defense of the body and preventing cardiovascular diseases.

Among the structure-forming food preparations used in the dairy industry, the most known collagen-containing additive is gelatin. Due to the peculiarities of adding, the use of gelatin in the dairy industry complicates the technological process of production. Due to the wide spread of collagen among animal proteins, the fish industry has a significant resource of collagen-containing raw materials [19]. In addition to food and biological value, collagen has the property of good binding of moisture and the ability to form dense clots and gels. Belonging to food fibers, collagen gives the produced foods the expressed therapeutic and prophylactic characteristics [23]. Due to the content of the oxidized forms of lysine and proline, it is quickly integrated into the biological mechanism of the construction of connective tissues in the human body.

Thus, the development of a new fermented milk dessert enriched with collagen hydrolysate is promising. Such a product can be positioned as a prophylactic both for gerodietic nutrition and for a growing organism in terms of baby food.

3. The aim and objectives of the study

The aim of the study is to develop a new fermented milk dessert enriched with collagen hydrolysate.

To achieve this aim, the following tasks were set to be solved:

– to develop a dessert composition with a high content of vitamins and minerals;

– to conduct a commodity assessment of the quality of the new product;

to determine the optimal storage time for the fermented milk product.

4. Materials and methods for the development of a high-protein dessert

A sample of the fermented milk dessert «*Martyshka*» is shown in Fig. 2.

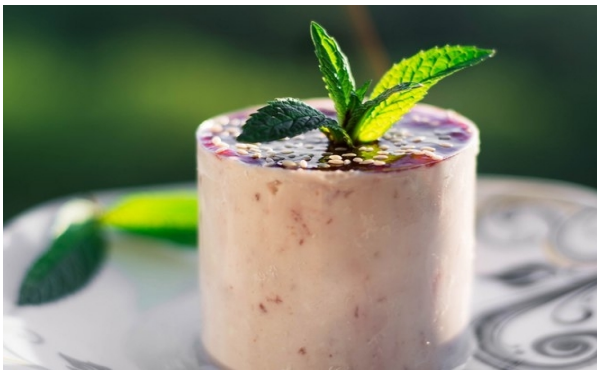

Fig. 2. A sample of the fermented milk dessert «*Martyshka*»

The research was carried out on the premises of modern scientific laboratories at the following:

– Department of Technology of Restaurant and Health Nutrition of Odesa National Academy of Food Technologies (Odesa, Ukraine);

– Department of Chemistry, Expertise and Food Safety of Odesa National Academy of Food Technologies (Odesa, Ukraine);

– Department of Biochemistry, Microbiology and Physiology of Nutrition of Odesa National Academy of Food Technologies (Odesa, Ukraine);

– Laboratory of the O. V. Bohatskyi Physicochemical Institute (Odesa, Ukraine);

– Department of Biochemistry and Plant Physiology of Odesa Selection and Genetics Institute of the National Center for Seed Growing and Variety Research of the UAAS (Odesa, Ukraine).

In a more detailed way, the methods for developing the high-protein dessert are described in [29].

5. The results of the research on the dessert quality indicators

The dessert recipe includes sesame, which is characterized by a high content of saturated fatty acids, calcium, potassium, phosphorus, iron, and vitamin C [20].

Glutin (collagen hydrolysate) is a source of hydroxyproline, a rare amino acid, and immobilized amylase helps digestion as it breaks down the starch and glycogen that most people in Ukraine consume in excess with food [21].

To optimize the recipe for the dessert «*Martyshka*», the mathematical apparatus built into MS Excel was used to rationally correlate the basic macronutrients [22–24]. The dessert recipe is shown in Fig. 3.

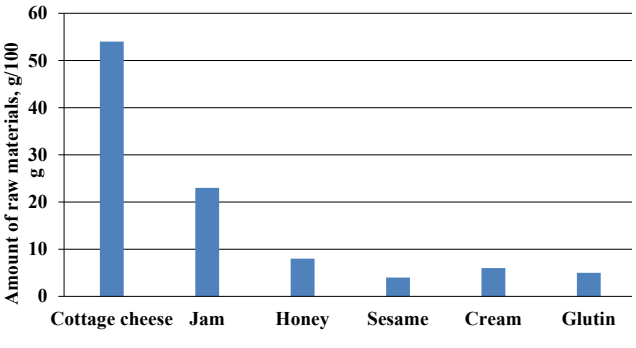

Fig. 3. The recipe for the dessert «*Martyshka*»

The production of the dessert requires quality control throughout the manufacturing process.

The required quality of the finished product is provided by a number of indicators:

– the level of quality of the raw materials and semi-finished products;

– perfection of the recipe and technology;

– compliance with the technological procedure;

– the level of the technical equipment of production;

– qualification of the staff;

– organization of production and maintenance of the equipment;

– efficiency of quality control of the product at all stages of production, storage, transportation, and sale.

The technological scheme for producing the dessert «*Martyshka*» is shown in Fig. 4.

Cottage cheese is milled by a blender. Glutin is subjected to a temperature treatment for 30 minutes and cooled. Cottage cheese, glutin, cream, jam and honey are mixed and churned for 5 minutes. Sesame is fried for 3–4 minutes, cooled and added to the mass, which is further mixed, portioned, cooled to a temperature of 8–10 °C, and slackened.

The use of glutin in the composition for the dessert affects the structural and mechanical properties of the food system: adhesion strength and viscosity.

Determination of the adhesive strength shows the value characterizing the specific force to break the adhesive contact that is established as a result of a contact between the equipment surface and the raw material. Determining the adhesive strength, plates of different materials were used under the interaction of the food system and the instrument plate for 15 minutes with a measurement step of 5 minutes (Table 1).

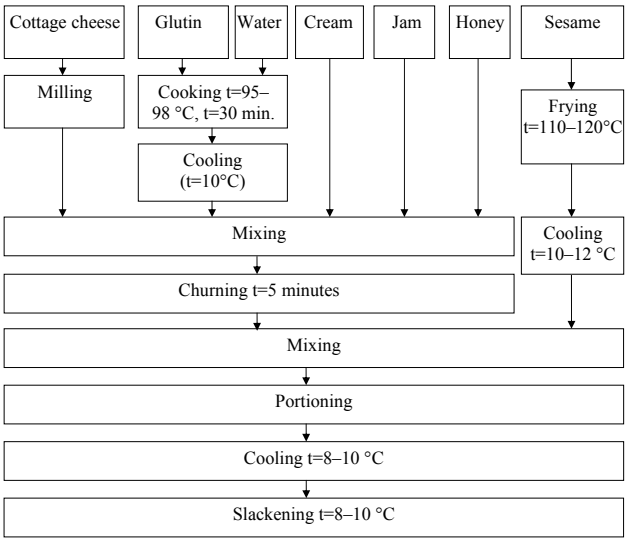

Fig. 4. The technological scheme of producing the dessert «*Martyshka*»

Table 1

The indicators of the adhesive ability of the dessert «*Martyshka*» (n=3, P=0.95)

Plate material	Adhesive strength, kg/m²		
	5 minutes	10 minutes	15 minutes
Ebonite	8.1±0.1	8.6±0.1	9±0.1
Aluminum	7.2±0.1	7.6±0.1	8±0.1
Ceramics	9.7±0.1	10.1±0.1	11±0.1

The main task of the viscosimetric study of the rheological properties consisted of the following:

– construction of the flow curve in coordinates;

– choice of equations that approximate this curve;

– determination, by means of analysis, of the experimental results on the values of rheological constants included in the equations.

To determine the viscosity of the dessert based on cottage cheese, tests were conducted using cottage cheese of standard fat concentrations: 0.2 %, 9 %, and 15 % (Fig. 5).

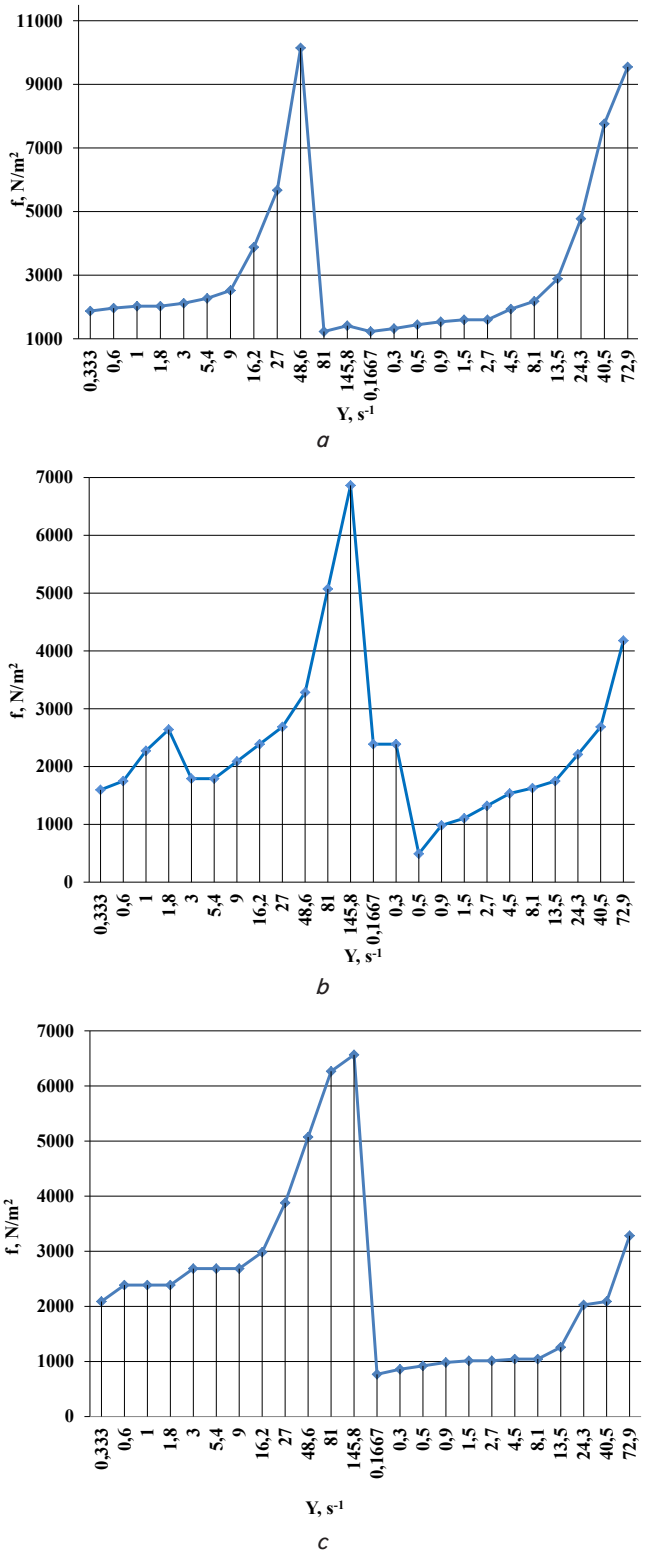

Fig. 5. Dependence of the viscosity of the food system on the concentration of curd fat (*a* – 15 %; *b* – 9 %; *c* – 0,2 %)

When glutin concentration is reduced to 1 %, moisture binding occurs more slowly, and the food system acquires a more viscous consistency. With an increase in the concentration of glutin to 10 %, moisture binding occurs faster, and the product acquires a stronger structure. When carrying out the tests on a rotary viscometer, it was

found that the dessert with 5 % of glutin content refers to non-Newtonian fluids.

The viscosity of such liquid systems at the given temperature and pressure does not remain constant, but it varies with the shear rate and its duration (Fig. 6). Therefore, this dependence is curvilinear. The form of these dependences, called flow curves, differs for non-Newtonian liquids of various types.

According to the graphs obtained (Fig. 5), the dessert can be referred to dilatant liquids, since the latter are usually suspensions with a high content of solids. Thus, the introduction of glutin in a concentration of 5 % in the dessert reduced the amount of free moisture in it and increased the amount of bound moisture.

From the graphs in Fig. 5, it can be seen that as the product temperature increases, its fluidity increases, too. Thus, as the product temperature increases from 4 °C to 26 °C, the product's fluidity increases 4.83 times. Further increase in temperature does not affect the fluidity, which is due to the binding of free moisture by glutin and the formation of a homogeneous product structure.

To determine the dynamics of the change in the fluidity of the fermented milk dessert «*Martyshka*», the Bostwick consistometer was used. The results are shown in Fig. 6.

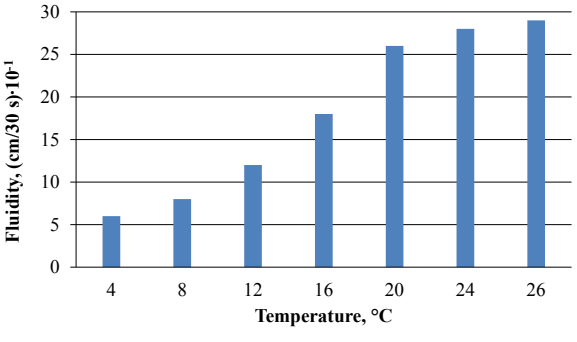

Fig. 6. The dynamics of changes in the fluidity depending on temperature

Based on the results obtained, the optimum temperature for the dessert serving at restaurants is the temperature range of 8–16 °C.

The developed dessert «*Martyshka*» was studied for its parameters of nutritional, biological and energy values (Table 2).

Based on the data of Table 2, it can be argued that the use of the fermented dessert «*Martyshka*» will benefit the human body, since the dessert contains a balanced composition of macronutrients (proteins, fats, and carbohydrates) that corresponds to a norm of 1:1:4.

The dessert is a source of vitamin C, and it covers from 30.5 % to 43.57 % of daily requirements. By introducing glutin to the dessert composition, the protein content of the finished product increases, and it covers from 11.28 % to 22.56 % of the daily requirement. Moreover, the dessert is rich in calcium, so one portion of the dessert covers 25 % of the daily human need.

One of the most important indicators of the quality of the finished food product is the indicator of microbiological safety, as it is inextricably linked with the health of consumers. Negligence in determining microbiological indicators entails not only significant harm to human health but also significant economic losses for the producer country. Microorganisms that become agents of food poisoning usually do not cause organoleptic changes in the product; therefore, the products need to be checked.

The study of changes in the microbiological biomass of the dessert during storage is presented in Table 3. The dessert was stored in a closed container at a temperature of (4±2) °C.

Table 2

The chemical composition and nutritional value of the dessert «*Martyshka*» (n=3, P=0.95)

Name	Contents in 1 portion	Adequate consumption per day
Macronutrients, g		
Proteins	13.2	58...117
Fats	11.6	60...154
Carbohydrates	46.3	257...586
Energy value, kcal		
Caloric value	209.8	1,800...4,200
Micronutrients, mg		
Ascorbic acid (C)	30.5	70...100
Niacin (PP)	0.6	14...28
Riboflavin (B2)	0.25	1.3...2.4
Retinol (A)	0.12	800...1,000
Thiamine (B1)	0.1	1.1...2.1
Tocopherol (E)	0.4	300...350
Phosphorus	206.3	1,200
Calcium	207.6	800
Potassium	219.05	2,500...5,000
Sodium	45.5	4,000...6,000
Magnesium	53.26	400
Iron	1.56	10–18

Table 3

Microbiological indices of the dessert «*Martyshka*» quality (n=3, P=0.95)

Indicator name	Storage, day(s)				
	1	2	3	4	5
Coliform bacteria, CFU in 0.01 g of the product	Not found				
Pathogenic microorganisms, *Salmonella*, in 25 g of the product	Not found				
The amount of mold fungi, CFU per 1 g of the product, not more than	2	5	7	12	23
The amount of yeast, CFU per 1 g of the product, not more than	45	47	50	68	76
Staphylococcus aureus, in 1 g of the product	Not found				

The organoleptic evaluation of the developed dessert «*Martyshka*» (Fig. 7) during storage showed that for all the analyzed parameters during 5 days of storage, the product retained relatively high organoleptic characteristics.

Particles of sesame and glutin add a slight crumbliness to the product. Adding honey and cream to the composition increases the viscosity of the product; however, the introduced glutin effectively binds moisture, which affects the homogeneity of the product during storage and prevents separation of free moisture.

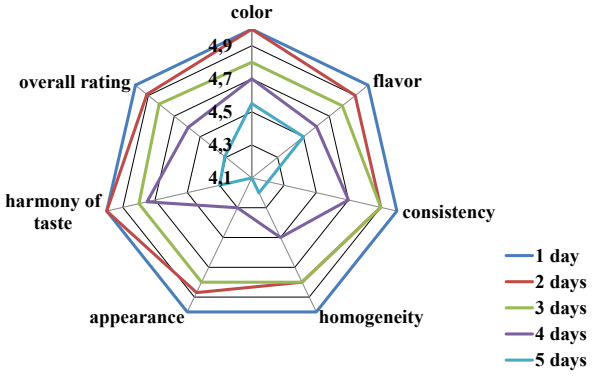

Fig. 7. The dynamics of changes in the organoleptic parameters during storage

6. Discussion of the results of studying the quality indicators of the dessert *Martyshka*

Advantages of this study consist in the development of the recipe of a high-protein product with a balanced composition. The analysis of the chemical composition of the developed dessert «*Martyshka*» indicates its high nutritional characteristics. The use of the selected components makes it possible to obtain the product with high nutritional, biological and functional properties.

An advantage of the product is provided by introducing glutin into its composition, as it is a source of valuable amino acids. Oxiproline and oxylizine play an important role in the formation of connective tissues of the human musculoskeletal system. Such a product can be recommended for both a growing organism and for maintaining health of elderly people.

The dessert «*Martyshka*» can be recommended for children and as gerodietic nutrition. It can be included into diets at health institutions and also be sold through retail trade. The developed technology can be applied both at restaurant enterprises and at dairy enterprises.

To launch the dessert production, it is planned to carry out a SWOT-analysis of the product received as well as to determine the comprehensive commodity index. In the future, it is planned to study a complex of the quality indicators of the fermented milk dessert «*Martyshka*» and to calculate the competitiveness index.

7. Conclusions

1. The study was focused on screening plant raw materials for the development of a composition of a fermented milk dessert. The selected optimum component rich in calcium was sesame. As a fruit and berry additive, jam was selected as an element that contains a high amount of dietary fiber. Thus, the dessert can produce a positive effect on the digestive system.

2. The components of the new dessert include (g/100 g): cottage cheese – 54, jam – 23, honey – 8, sesame – 4, cream – 6, and glutin – 5. The data obtained from the research on the nutrient composition of the product allow asserting that the dessert «*Martyshka*» is a source of easily assimilated macro- and micronutrients.

3. The new dessert technology has been developed, including the preparation of semi-finished products (milling, boiling, and frying) and the main technological stages (churning and cooling). The developed technology can be applied both at restaurant enterprises and at dairy enterprises. Thus, the payback of introducing the new product to the Ukrainian market will be minimal.

4. The study of the chemical composition of the dessert «*Martyshka*» makes it possible to position it as an effective source of protein, calcium, and vitamin C.

5. The data obtained in terms of evaluating microbiological and organoleptic indices during storage make it possible to assert that the new dessert «*Martyshka*» will be competitive on the consumer market of Ukraine. According to the microbiological and organoleptic indicators, the developed dessert «*Martyshka*» meets the requirements of the current sanitary legislation of Ukraine. The shelf life of this product is 5 days at a temperature of (4±2) °C.

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