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USE OF VEGETABLE RAW MATERIALS IN THE TECHNOLOGY OF FUNCTIONAL MAYONNAISE SAUCES

New generation food products are products with a balanced composition and ratio of biologically valuable substances that contribute to maintaining health, increasing the body's resistance to stress and negative environmental influences. Today, the development of innovative technologies in the field of healthy nutrition, in particular based on emulsions, is based on the use of traditional and non-traditional raw materials with a high content of biologically and physiologically valuable components. This makes it possible to create products that act directly on certain organs and systems of the human body. The main goal of the study is to develop a recipe and technology for manufacturing mayonnaise sauces with a given particle size of the dispersion phase that are resistant to thermal oxidation. This involves the use of stabilizers of natural origin and the addition of plant raw materials to give the product functional properties. The article presents the results of marketing research related to the consumption of mayonnaise products by the population. The survey showed that over 59% of respondents prefer products made from safe natural components, in particular, structure-forming agents, emulsifiers and flavoring additives. It is proposed to use gum arabic to enrich mayonnaise sauces with useful plant substances and improve their organoleptic characteristics. It is also noted that it is advisable to use a protein-fat additive as a stabilizer and emulsifier of natural origin in the production of mayonnaise sauces. The rheological properties of aqueous suspensions have been studied. The addition of gum arabic will allow to purposefully influence the mechanisms of formation and stabilization of emulsions, change their viscosity and increase resistance to thermal oxidation. It has been proven that a protein-fat additive reduces the surface tension of the system with the help of the functional groups present. It has been shown that heating an aqueous suspension of a protein-fat additive increases surface activity by 1.5 times compared to an aqueous suspension obtained under normal conditions. The obtained research results confirm the possibility and feasibility of using gum arabic, protein-fat additive and gum arabic in the technology of manufacturing mayonnaise sauces. A comprehensive evaluation of the new mayonnaise sauce, including a study of the organoleptic characteristics of the samples, showed an improvement in individual indicators, which gives grounds to consider the developed recipe competitive.

Keywords: sauces, vegetable hydrocolloids, protein-fat supplement, gum arabic, dietary fiber, biotechnology, technology.

АНТОНЕНКО АРТЕМ

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ВИКОРИСТАННЯ РОСЛИННОЇ СИРОВИНИ В ТЕХНОЛОГІЇ ФУНКЦІОНАЛЬНИХ МАЙОНЕЗНИХ СОУСІВ

Продукти харчування нового покоління – це вироби з збалансованим складом і співвідношенням біологічно цінних речовин, які сприяють збереженню здоров'я, підвищенню стійкості організму до стресів і негативного впливу навколишнього середовища. Сьогодні розвиток інноваційних технологій у сфері здорового харчування, зокрема на основі емульсій, ґрунтується на використанні традиційної та нетрадиційної сировини з високим вмістом біологічно і фізіологічно цінних компонентів. Це дає можливість створювати продукти, які діють спрямовано на певні органи і системи людського організму. Основною метою дослідження є розробка рецептури та технології виготовлення майонезних соусів з заданим розміром частинок дисперсійної фази, які є стійкими до термоокислювальної дії. Це передбачає використання стабілізаторів природного походження та додавання рослинної сировини для надання продукту функціональних властивостей. У статті наведені результати маркетингових досліджень, які стосуються споживання майонезної продукції населенням. Запитування показало, що понад 59% респондентів надають перевагу продуктам, які виготовлені з безпечних природних компонентів, зокрема структуроутворювачів, емульгаторів та смако-ароматичних добавок. Для збагачення майонезних соусів корисними рослинними речовинами та поліпшення їх органолептичних характеристик пропонується використовувати гуміарабік. Також зазначено про доцільність використання білково-жирової добавки як стабілізатора і емульгатора природного походження у виробництві майонезних соусів. Вивчено реологічні властивості водних суспензій. Додавання гуміарабіку дозволить цілеспрямовано впливати на механізми формування та стабілізації емульсій, змінювати їх в'язкість і підвищувати стійкість до термоокислення. Доведено, що білково-жирова добавка знижує поверхневий натяг системи з допомогою присутніх функціональних груп. Показано, що нагрівання водної суспензії білково-жирової добавки збільшує поверхневу активність в 1,5 рази по відношенню до водної суспензії, отриманої за нормальних умов. Отримані результати досліджень підтверджують можливість використання гуміарабіку, білково-жирової добавки і гуміарабіку в технології виготовлення майонезних соусів. Комплексна оцінка нового майонезного соусу, включаючи дослідження органолептичних характеристик зразків, показала покращення за окремими показниками, що дає підстави вважати розроблену рецептуру конкурентоспроможною.

Ключові слова: соуси, рослинні гідроколоїди, білково-жирова добавка, гуміарабік, харчові волокна, біотехнологія, технологія.

Formulation of the problem

New generation food products are products with a balanced composition and ratio of biologically valuable nutrients that contribute to maintaining health, increasing the body's resistance to stress and adverse

environmental influences. Therefore, the development of technologies for emulsion products with a balanced nutrient, protein and fatty acid composition that meets the physiological needs of the human body is a pressing problem. Emulsion-type sauces are widely used in everyday life and in the restaurant industry as dressings. The growing demand for sauce products contributes to the expansion of their range and the improvement of existing technologies. A promising direction for expanding the range of mayonnaise sauces is the use of non-traditional raw materials. In this regard, the use of a protein-fat additive as a stabilizer and emulsifier of natural origin in the production of mayonnaise sauces is relevant. The introduction of gum arabic, a protein-fat additive, into mayonnaise compositions will allow for a targeted influence on the mechanisms of formation and stabilization of oil-fat emulsions, change their viscosity, and increase resistance to thermal oxidation. To enrich mayonnaise sauces with useful substances of plant origin and improve their taste properties, it is proposed to use gum arabic in the sauce recipe.

Analysis of recent sources

Mayonnaise sauces include emulsion products with a finely dispersed structure, containing from 15 to 50% fat, and made from a water-fat base, with the possible introduction of food additives and other food components into the recipe. The use of non-traditional ingredients allows balancing the structural and rheological properties of mayonnaises and sauces [13; 14].

Dudarev I. M. and Kuzmin O. V. identified priority strategies for improving mayonnaise sauce with oat milk and its manufacturing technology, as well as strategies for bringing the product to the market. These strategies involve the use of plant-based raw materials to reduce the fat content in the sauce and its calorie content and enrich the sauce with vitamins, macro- and microelements. In particular, within the framework of priority strategies, it is proposed to replace egg products in the sauce with beans and use freeze-dried fruit, vegetable or berry powder or their mixture as a useful additive [6].

Scientists Gelikh A., Prymenko V., Vasilenko O., Prykhodko I. proposed to solve the problem of optimizing nutrition in terms of the content of essential nutrients, such as fatty acids, by introducing vegetable oils containing a significant amount of polyunsaturated fatty acids ω -3 and ω -6 into the recipe composition as an oil-fat base. A promising direction in the production of emulsion-type sauces is the introduction of blends of sunflower and hemp oils into the standard recipes, which will improve the biological value and preserve the organoleptic, structural-mechanical properties and safety indicators [4]. To enrich mayonnaise sauces with useful substances of plant origin and improve their taste properties, it is proposed to use the following in the sauce recipe: berry puree; ginseng root, sugar kelp, Chinese lemongrass berries; grape skin premixes [3]; pea, rice or buckwheat flour [9–11]; pumpkin processing products. Also, to enrich mayonnaise sauces with vitamins and beneficial elements, it is recommended to use the juice of mountain ash, wild rose, viburnum or cranberry [5; 6; 7; 12]. To reduce the calorie content of emulsion-type sauces and enrich them with vitamins, macronutrients and microelements, scientists and manufacturers introduce plant components from both traditional and non-traditional raw materials into the recipe composition. At the same time, it is important to ensure high organoleptic indicators of the finished product and compliance of its physicochemical indicators with the requirements of regulatory documents.

The purpose of the study is to develop a recipe and technology for obtaining mayonnaise sauces with a given particle size of the dispersion phase, resistant to thermal oxidation, using a protein-fat additive as a stabilizer for the emulsion and as a flavoring additive and to give the product functional value, gum arabic.

To achieve the goal, the following tasks were formulated and solved: to analyze the modern market of mayonnaise sauces and identify the main trends in their production; to substantiate the possibility of using a protein-fat additive as an emulsifying and stabilizing component of emulsion systems; to investigate the rheological properties of aqueous suspensions with a protein-fat additive and determine the conditions under which the emulsifying and stabilizing properties are most pronounced; to investigate the content of useful components in gum arabic; to develop a recipe and technology for the production of mayonnaise sauce; to conduct a comprehensive assessment of the resulting mayonnaise sauce, which includes the study of organoleptic characteristics.

For the first time, the possibility of producing mayonnaise sauces using a protein-fat additive and gum arabic, which allow creating systems that are stable over time, has been experimentally proven. It has been proven that a protein-fat additive is able to stabilize food emulsions by forming a structure and reducing surface tension at the interface of the phases. The rheological properties of aqueous suspensions with a protein-fat additive have been studied. It has been determined that the best structuring effect occurs when the protein-fat additive is previously kept in hot water. It has been proven that the thermal oxidation of particles of the dispersed phase of mayonnaise systems in the presence of a protein-fat additive occurs at a slower rate than in its absence. A technology for the production of mayonnaise sauce using a protein-fat additive and gum arabic has been developed.

Presenting main material

Marketing research on the preferences of consumers of mayonnaise products was conducted in food retail stores: supermarkets "ATB-Market" and "Silpo" located in Kyiv and Kyiv region, with different social orientation of buyers.

Respondents were offered questionnaires in which they had to indicate personal preferences for mayonnaise sauces and determine their attitude to food additives based on natural and synthetic components.

The number of respondents was 86 people, including 49 women and 37 men of different ages (from 18 to 75 years).

According to the results of the questionnaire, it was determined that more than 59% of respondents prefer products made using safe natural components, in particular, structure-forming agents, emulsifiers and flavoring additives.

It should be noted that more than 12% of respondents do not use mayonnaise sauce for dietary reasons, since they believe that the components included in the sauce can negatively affect the body. Therefore, this category of respondents can also eat mayonnaise sauces if emulsifiers and thickeners are replaced by natural analogues that have a positive effect on the body.

Based on the analysis of the theoretical basis, a decision was made to develop a recipe composition of mayonnaise sauce using a protein-fat additive and gum arabic.

The presence of polar groups in the polysaccharide and protein molecules of the protein-fat additive suggests that aqueous solutions have both surface-active and structure-forming properties. According to the experimental data presented in Figure 1, in aqueous suspensions of the protein-fat additive, there is a decrease in surface tension with an increase in the amount of the protein-fat additive in aqueous solutions, and for suspensions obtained at $t = 95^{\circ}\text{C}$, this decrease occurs to a greater extent than for suspensions obtained at $t = 19^{\circ}\text{C}$.

The change in surface tension from the concentration of the protein-fat additive can be expressed by the empirical equation of B. A. Shishkovsky:

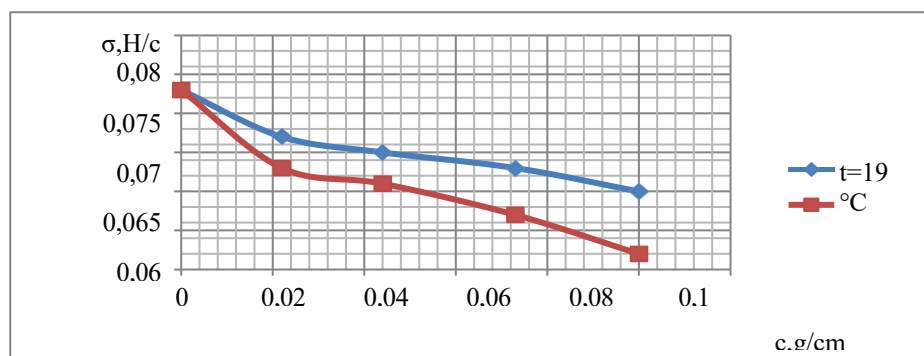


Fig. 1. Surface tension isotherm of aqueous suspensions of flax flour obtained at $t = 19^{\circ}\text{C}$ and $t = 95^{\circ}\text{C}$

When comparing the data, we can conclude that the constant depends little on the method of preparation of aqueous suspensions of protein-fat additives, while $1/A$ is 1.419 larger for a colloidal solution obtained at 95°C than for a solution obtained at 19°C .

Thus, the main influence on the value of surface tension is exerted by the method of preparation of aqueous suspensions of protein-fat additives. An increase in temperature reduces surface tension, which is caused by an increase in the specific capillary constant in the B. A. Shishkovsky equation.

According to rheological studies, the increase in the viscosity of aqueous solutions of protein-fat additives obtained at $t = 95^{\circ}\text{C}$ relative to the viscosity of solutions obtained at $t = 19^{\circ}\text{C}$ is associated with a more complete dissolution of the polymer component of the protein-fat additive, insoluble in cold water.

The work investigated the stability of an aqueous emulsion of vegetable oil using a protein-fat additive as a stabilizer during storage for 4 hours at $t = 25^{\circ}\text{C}$. The stability of emulsions is the ability to maintain the size of the droplets of the dispersed phase unchanged over time. According to the results of experimental studies, it was found that with increasing exposure time, the size of oil particles increases, which is associated with the coalescence of droplets. The dispersed layer formed around the emulsion droplets creates an energy barrier that prevents the particles from approaching distances at which the forces of molecular attraction prevail over the forces of electrostatic repulsion. This stability factor is very important for emulsions stabilized by colloidal surfactants and polyelectrolytes. However, even with a 4-hour exposure, these changes are insignificant.

The structure, as well as the surface-active properties of aqueous suspensions of the protein-fat additive, ensure the stability of this emulsion over time, which allows the use of the protein-fat additive as an emulsifier and structure-forming agent for food emulsions.

In addition to vegetable oil, water, egg white, and protein-fat additive, the composition of mayonnaise sauce includes an ingredient such as gum arabic, which improves the nutritional and physiological value of mayonnaise sauce and gives the product functional properties. Since it was decided to introduce gum arabic into the recipe composition of mayonnaise sauce.

Analysis of the chemical composition of gum arabic indicates the high nutritional and biological value of this raw material, since it contains a wide range of dietary fibers.

According to the studies conducted, it was found that the optimal introduction of the protein-fat additive corresponds to 10 g, and gum arabic - 4 g per 100 g of mayonnaise sauce. Recipes of mayonnaise compositions are presented in Table 1.

Table 1

Ingredients	Composition of mayonnaise compositions	
	Content in 100 g of mayonnaise sauce, g	
	Composition 1	CONTROL
Refined, deodorized sunflower oil	15	17
Egg yolk	5	10
Sugar	3	4
Salt	1,5	2
Citric acid	1,5	2
Protein-fat supplement	10	-
Gum Arabic	4	-
Water	60	65

One of the objectives of the study was to conduct an organoleptic evaluation of the test samples, the results of which are shown in Fig. 2.

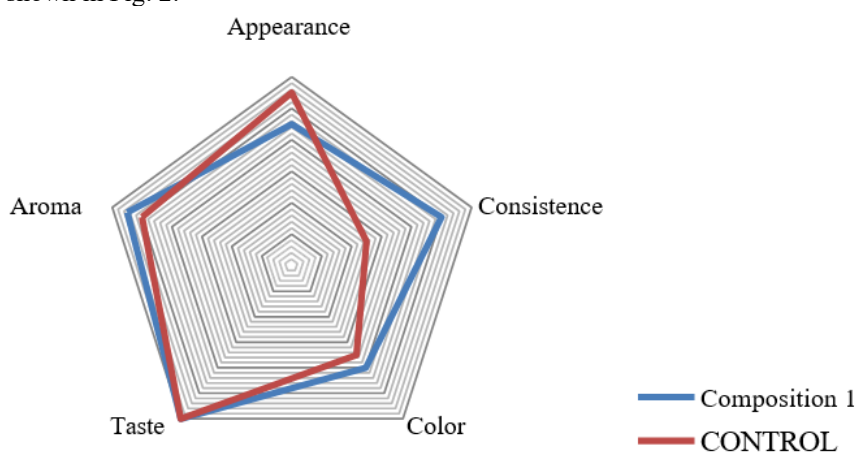


Fig. 2. Profile of organoleptic quality assessment of samples

As can be seen from the profilograms, the developed mayonnaise sauce composition is not inferior in organoleptic indicators to the control sample.

Conclusions

As a result of the analysis of the modern market of mayonnaise products, as well as the study of methods for producing emulsion-type sauces, the need to find alternative structure-forming agents and emulsifiers for mayonnaise sauces was established. It was proven that the protein-fat additive reduces the surface tension of the system with the help of the functional groups present. It was shown that heating an aqueous suspension of a protein-fat additive increases the surface activity by 1.5 times compared to an aqueous suspension obtained under normal conditions. The rheological properties of aqueous suspensions with a protein-fat additive were studied. It was proven that the suspensions obtained in aqueous solutions at a temperature of 95°C have the highest viscosity. A recipe and technology for the production of mayonnaise were developed, using a protein-fat additive as an emulsifier and stabilizer and gum arabic as a biologically active additive. A comprehensive assessment of the resulting mayonnaise sauce was carried out, in particular, a study of the organoleptic characteristics of the samples showed an improvement in the values of individual indicators, which makes it possible to draw conclusions about the competitiveness of the developed composition.

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