ІННОВАЦІЙНІ ПРОЦЕСИ ХАРЧОВИХ ВИРОБНИЦТВ

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OPTIMIZATION OF MAYONNAISE SAUCE TECHNOLOGY WITH ORANGE JUICE AND GUM ARABIC

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Abstract. *Modern life and negative environmental factors require the body to be provided with natural vitamins and macro- and micronutrients. Therefore, it is advisable to use fat emulsion products that supply the necessary physiologically active substances. The inclusion of orange juice and gum arabic in mayonnaise helps to create an original taste and increase its nutritional value. The carbohydrates contained in the juice (monosaccharides, pectin substances), together with micro- and macroelements, tannins and organic acids, have a positive effect on the body, strengthening protective mechanisms and improving energy balance. The use of gum arabic helps to achieve the required consistency of mayonnaise, prevents the delamination of ingredients, maintaining product homogeneity. The use of gum arabic allows to extend the shelf life of mayonnaise. The use of orange juice and gum arabic in mayonnaise sauces increases their nutritional value by adding physiologically active components. The article presents the results of optimizing the technology of mayonnaise with the addition of orange juice and gum arabic. The influence of orange juice and gum arabic on the quality of mayonnaise was studied. A comprehensive quality indicator of mayonnaise with an optimal content of ingredients was calculated. To determine the optimal ratio of components, a local optimum was calculated according to the comprehensive quality indicator. The optimal proportions of mayonnaise ingredients were established, which ensured a high value of the comprehensive quality indicator. The studied quality indicators make it possible to optimize the technology of mayonnaise sauce based on orange juice and gum arabic with increased biological value. The introduction of this technology will expand the range and contribute to obtaining a high-quality and safe food product. Based on the nutritional value of the sauces, the developed products can be recommended for inclusion in the diet of all segments of the population, especially workers in hazardous industries and the population of contaminated areas.*

Key words: *mayonnaise, sauce, orange juice, plant hydrocolloids, gum arabic, dietary fiber, safety, quality, biotechnology, technology.*

Formulation of the problem in general form. Mayonnaise and mayonnaise sauces are among the important fat-containing products. They have high taste, nutritional and energy value, which is due to the recipe composition of food, flavor components included in the product. When choosing mayonnaise products, domestic consumers primarily pay attention to its organoleptic properties (color, taste, smell, consistency), cost and type of packaging (convenience of use and cost-effectiveness) [1, 2].

The development opportunities of the mayonnaise and mayonnaise sauces market are associated with increasing their nutritional and biological value and reducing energy value due to adjusting the recipe composition, namely improving the fat phase content, introducing water- and fat-soluble vitamins, minerals, dietary fiber and other functional food ingredients. New types of mayonnaise-based sauces are increasingly gaining popularity in the market. Their range is growing much faster than the demand for traditional white mayonnaise. Analysis of the situation in the Ukrainian food market shows that the range of mayonnaise sauces is very limited and is represented mainly by premium segment products. The creation of elite sauces is unprofitable from the point of view of production, since the recipe mainly uses imported components, in particular flavor components, fillers, thickeners, and flavorings. The use of raw materials only of domestic production will allow to reduce the cost of mayonnaise sauces and satisfy the demanding tastes of consumers [3, 4].

When developing mayonnaise sauces, it is advisable to use affordable domestic raw materials as a basis. The use of orange juice with a high content of antioxidants and a sweet and sour taste is promising. Such domestic fruit and berry raw materials have a unique chemical composition and are one of the richest sources of vitamins, polyphenolic compounds, minerals and biologically active substances that are necessary to maintain the normal state of the human body. Wild fruit and berry raw materials can be a source of the listed useful biologically active components without the use of artificial preservatives, dyes and flavors [5].

The technology of mayonnaise sauce production allows you to maximally preserve vitamins and other biologically active components contained in the raw materials. In connection with the above, we can conclude that the use of orange juice will allow you to increase the content of biologically active components in mayonnaise products, use promising raw materials and expand the range of mayonnaise sauces on the market [1, 6].

Analysis of recent research and publications. Theoretical and practical aspects of the production of mayonnaise and mayonnaise sauces are systematized in the works of modern scientists [1–9]. Of considerable interest are the applied studies of the authors on the development of emulsion food products for daily use based on oil raw materials. In addition, this direction has prospects for further development by involving new types of plant raw materials and modern innovative methods and methods of its complex processing. taste and digestibility of food, as well as as an additive during the preparation of various dishes. This product, intended for direct consumption as a seasoning, is subject to certain requirements, such as bacterial purity, optimal consistency and stability during manufacture and storage. The development of mayonnaises with the addition of orange juice will allow expanding the range of mayonnaises and mayonnaise sauces as functional products, in particular in cooking and restaurant technologies. [7]

Formation of article goals. Mayonnaise and mayonnaise sauces are among the most commonly used (almost daily) products on the table of the population, used as a seasoning to improve the taste and digestibility of food, as well as as an additive during the preparation of various dishes. This product, intended for direct consumption as a seasoning, is subject to certain requirements, such as bacterial purity, optimal consistency and stability during manufacture and storage.

The aim of the work is to optimize the technology of mayonnaise sauce with orange juice and gum arabic.

The development of mayonnaises with the addition of orange juice and dietary supplements will allow to expand the range of mayonnaises and mayonnaise sauces as functional products, in particular in cooking and restaurant technologies.

Presentation of the main research material. The main components of orange juice are carbohydrates (sucrose, fructose, glucose, mannose, galactose, xylose, rhamnose, arabinose, polysaccharides, pectin); organic acids; triterpenoids (derivatives of α-amyrin and β-amyrin, oleanolic and hederagenic acids and their acetyl derivatives, ursolic acid); steroids (β-sitosterol); vitamins C, carotenoids; phenolcarboxylic acids and their derivatives (chlorogenic, neochlorogenic, derivatives of *n*-dihydroxycinnamic acid); tannins; catechins; flavonoids (quercetin, kaempferol, peonoside); anthocyanins (sambucin); higher fatty acids (myristic, palmitic, stearic, oleic, linoleic, linolenic, arachidic, behenic, lignoceric, cerotic). They also contain the minerals K, Ca, Mg, Fe, Mn, Cu and Zn. Ni, Br, Sr and J have also been detected. The seeds contain fatty oil, which contains such higher fatty acids as myristic, palmitic, stearic, oleic, linoleic, linolenic, and arachic.

Gum arabic is a natural thickener and stabilizer used in the food industry, in particular in the production of mayonnaise. Gum arabic helps to achieve the desired consistency of mayonnaise, giving it a creamy texture, prevents the ingredients from separating, maintaining the homogeneity of the product. As a natural polymer, gum arabic is considered a healthier alternative to synthetic additives. The use of gum arabic can extend the shelf life of mayonnaise. Gum arabic has practically no taste, which allows you to preserve the original taste of mayonnaise and is able to improve the creaminess and visual appeal of the product. Gum arabic is usually added at the emulsification stage, when oil and water are mixed.

Therefore, the use of orange juice and gum arabic in the manufacture of mayonnaise and mayonnaise sauces will enrich the product with vitamins and other useful micronutrients. [1]

Mayonnaise is prepared by emulsifying previously prepared components of the fat and water phases, and the finished product is an emulsion of the "oil in water" type.

The first stage of the work is the development and study of recipes for mayonnaise with orange juice, as well as the analysis of the impact of the components on the human body and compliance with permissible standards. To build a matrix for planning the experiment, we will determine the main factors and their levels of variation, which are given in Table 1.

Table 1

Levels of research factors and their variation intervals

Levels of variation of factors	Marking	Research factors		
		Orange juice content, x_1, %	Sugar content, x_2, %	Water content, x_3, %
Upper	+1	7,0	2,5	20,0
Average	0	5,5	1,75	15,0
Lower	–1	4	1,0	10,0
Step	Δ	1,5	0,75	5,0

The quality of mayonnaise products is the main aspect of the technology of production of emulsion products. Organoleptic analysis allows you to quickly and easily assess the quality, identify deviations from the production technology, which makes it possible to respond promptly and take measures to eliminate possible shortcomings.

According to the experimental matrix (Table 2), mayonnaise samples were produced, the organoleptic

evaluation of which was carried out according to the developed scale (Table 3), the results obtained are given in Table 4.

The optimization parameter was a complex indicator of mayonnaise quality, and the recipe of the classic mayonnaise "Provencal" was selected as a control sample. The evaluation was carried out using a descriptive method based on the developed quality assessment scale. The mayonnaise samples under study were evaluated using four quality indicators, such as "excellent", "good", "satisfactory" and "poor". The assessment of "poor quality" always corresponds to zero points, since this assessment determines the level of quality, and not the degree of suitability of the product for use.

Samples of the produced mayonnaises were stored for 5 weeks and changes in their quality indicators were checked during the storage period. Based on the results obtained, we will calculate a weighting factor that will help determine a comprehensive indicator of product quality.

Table 2

Experimental matrix of a three–factor experimental design

Experiment No.	Factor levels in an expression					
	amount of orange juice, x_1, %		amount of sugar, x_2, %		amount of water, x_3, %	
	Coded	Nature	Coded	Nature	Coded	Nature
1	+1	7	+1	2,5	+1	20
2	+1	7	–1	1,0	–1	10
3	–1	4	+1	2,5	–1	10
4	–1	4	–1	1,0	+1	20
5	+1	7	+1	2,5	–1	10
6	–1	4	+1	2,5	+1	20
7	+1	7	–1	1,0	+1	20
8	–1	4	–1	1,0	–1	10

Table 3

A scale of organoleptic quality indicators for mayonnaises has been developed

Indicator name	Number of points				
	5	4	3	2	1
Consistency and appearance	Homogeneous sour cream–like product, presence of particles of flavoring and aromatic additives, mustard	Homogeneous sour cream–like product, presence of particles of flavoring and aromatic additives	Homogeneous product with occasional air bubbles, slightly uneven distribution of additives	Heterogeneous product, uneven distribution of flavoring particles	Heterogeneous product with air bubbles
Taste and smell	Very well expressed, corresponding to the taste and smell of the introduced flavorings and aromatic additives	Well–pronounced, corresponding to the taste and smell of the introduced flavoring and aromatic additives	Unexpressed or strongly expressed taste of additives	Unclear expressed	Unpleasant, sharp, sour
Color	White to yellow–cream, uniform throughout	Homogeneous throughout, light yellow	Heterogeneous throughout the mass, light yellow	Heterogeneous throughout the mass, yellow	The color is too intense

Table 4

Characteristics of mayonnaise quality indicators

Indicators	Characteristics of indicators by quality levels		
	excellent (5 points)	good (4–2 points)	satisfactory (1 point)
1. Taste and smell	Inherent in an emulsion product of a specific commercial (brand) name in accordance with the technical description. The taste is slightly sharp, sour, with the smell and aftertaste of added flavorings		
		A faint or strongly pronounced taste of additives is allowed	
2. Appearance, consistency	Homogeneous thick (sour cream or creamy consistency) product. Single air bubbles are allowed in accordance with the technical description for the emulsion product of a specific commercial (brand) name. The presence of particles of spices, vegetables, flavorings, spices, mustard inclusions in accordance with the description for the emulsion product of a specific name is allowed		
		Slightly uneven distribution of additives is allowed	A more liquid or slightly viscous and jelly-like consistency is allowed
3. Color	Homogeneous thick (sour cream or creamy consistency) product. Single air bubbles are allowed according to the description of the emulsion product name		
			The color is excessively intense, not typical of mayonnaise

A complex indicator of product quality is an indicator that belongs to several of its properties. A product quality indicator is a quantitative characteristic of one or more properties of a product that determine its quality and are considered in relation to certain conditions of its creation and consumption. The calculation of the complex indicator of quality (CPQ) was carried out using qualimetry methods (Table 5). The obtained calculation results are given in Table 6.

Table 5

Calculation of weighting factors

Expert	Weighting factor *Mi* of the property indicator			
	P_1	P_2	P_3	*CMi*
1 expert	0,2	0,5	0,2	1,0
2 expert	0,3	0,6	0,1	1,0
3 expert	0,3	0,5	0,3	1,0
4 expert	0,4	0,4	0,2	1,0
5 expert	0,2	0,5	0,3	1,0

Table 6

Weight coefficient values for mayonnaise samples

Sample	1	2	3	4	5	6	7	8
The meaning of CPQ	0,9	1,0	0,8	0,72	0,6	1,0	0,9	0,6

The "excellent" rating was given to samples 1, 2, 6, 7. The "good" rating was given to sample 3. The "satisfactory" rating was given to samples 4, 5, 8. In order to find the optimal ratio of the component composition, we determine the local optimum according to the complex quality indicator. We obtain the optimal ratio of the recipe components of mayonnaise. So, the amount of orange juice is 5.0 g/100 g, the amount of sugar is 1.5 g/100 g, the amount of gum arabic is 5 g/100 g, the amount of water is 11.5 g/100 g. The developed recipe for mayonnaise using orange juice compared to the traditional recipe "Provencal" is given in Table 7.

The physicochemical parameters of the developed sample of mayonnaise with orange juice and gum arabic are given in Table 8.

The presented results of the study of the physicochemical parameters of mayonnaise using orange juice indicate that the test samples have high quality indicators in accordance with current regulatory documentation.

Conclusions on the above problems and prospects for further research in the given direction. Using a three-factor experiment plan, a mayonnaise recipe with orange juice and gum arabic was developed. The effect of adding orange juice and gum arabic on mayonnaise quality indicators was studied. A complex quality indicator of mayonnaise with an optimal content of components: orange juice, sugar and water was calculated. In order to find the optimal ratio of the component composition, the value of the local optimum was calculated for the complex quality indicator of mayonnaise. Solving the complex system of equations made it possible to establish the optimal parameters of the ratio of mayonnaise components, which ensured obtaining a high value of the complex quality indicator of the product. A test sample of mayonnaise was produced and organoleptic and physicochemical indicators were determined in accordance with the requirements of current regulatory documentation.

Table 7

Comparative mayonnaise recipes

№	Component name	Mayonnaise	
		"Provencal"	"Orange"
1	Mass fraction of refined deodorized sunflower oil, %	70,0	70,0
4	Mass fraction of dry egg yolk, %	1,6	3,0
5	Mass fraction of ready-made hot mustard, %	3,5	3,0
6	Mass fraction of sugar, %	1,5	1,5
7	Mass fraction of table salt, %	1,0	0,9
8	Mass fraction of vinegar, %	4,0	–
	Mass fraction of citric acid in the form of monohydrate, %	–	0,1
9	Mass fraction of orange juice, %	–	5,0
10	Mass fraction of gum arabic, %	–	5,0
11	Mass fraction of water, %	18,4	11,5
	Total	100	100

Table 8

Physico-chemical parameters of mayonnaise using orange juice and gum arabic

№	Indicator name	Characteristic
1	Consistency, appearance	Homogeneous cream-like product
2	Taste and smell	Inherent in mayonnaise with the addition of orange juice
3	Color	Creamy, homogeneous
4	Mass fraction of fat, %	71,6
5	Mass fraction of egg products, including fermented ones, calculated on dry egg yolk, %	5,0
6	Mass fraction of moisture, %	16,2
7	Acidity, %, calculated as citric acid	0,41
8	Emulsion stability by special method, % of unbroken emulsion	100

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Анотація. *Сучасне життя та негативні фактори зовнішнього середовища вимагають забезпечення організму натуральними вітамінами та макро- мікронутрієнтами. Доцільно вживати жирові емульсійні продукти, які постачають необхідні фізіологічно активні речовини. Включення апельсинового соку та*

гуміарабіка до складу майонезу допомагає створити оригінальний смак та підвищити його харчову цінність. Вуглеводи, що містяться в соці (моносахариди, пектинові речовини), разом із мікро- та макроелементами, дубильними речовинами та органічними кислотами позитивно впливають на організм, зміцнюючи захисні механізми та покращуючи енергетичний баланс. Використання гуміарабіка допомагає досягти необхідної консистенції майонезу, запобігає розшарування інгредієнтів, зберігаючи однорідність продукту. Використання гуміарабіку дозволяє продовжити термін зберігання майонезу. Використання соку апельсина та гуміарабіка в майонезних соусах підвищує їх харчову цінність за рахунок додавання фізіологічно активних компонентів. У статті представлені результати оптимізації технології майонезу з додаванням апельсинового соку та гуміарабіка. Досліджено вплив апельсинового соку та гуміарабіка на якість майонезу. Розраховано комплексний показник якості майонезу з оптимальним вмістом інгредієнтів. Для визначення оптимального співвідношення компонентів, розраховано локальний оптимум за комплексним показником якості. Встановлено оптимальні пропорції інгредієнтів майонезу, що забезпечили високе значення комплексного показника якості. Досліджені показники якості дають можливість оптимізувати технологію соусу майонез на основі апельсинового соку та гуміарабіка з підвищеною біологічною цінністю. Впровадження цієї технології розширить асортимент і сприятиме отриманню якісного та безпечного харчового продукту. Виходячи з харчової цінності соусів, розроблені продукти можна рекомендувати для включення в раціон харчування всіх верств населення, особливо працівників шкідливих виробництв і населення забруднених територій.

Ключові слова: *майонез, соуси, апельсиновий сік, рослинні гідроколоїди, гуміарабік, харчові волокна, безпека, якість, біотехнологія, технологія.*