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Experimental Justification for the Development of New Types of Emulsion Products for the Food Industry Enterprises

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***Abstract*—The observed imbalance in the food patterns of the population has become a prerequisite for the research. The optimal object for the correction of micronutrient deficiency is emulsion sauces, which allow for changing the formulation by incorporating functional ingredients and improving their digestibility. In the course of research, data confirming the feasibility of making emulsion sauces using a complex of oils which contain the optimum ratio of omega-3 and omega-6 polyunsaturated fatty acids and are enriched with a functional ingredient in the form of a symbiotic fermented milk complex as a fatty basis, have been obtained. These functional ingredients are capable of preventing cardiovascular diseases and dysbiotic conditions. During the experimental studies based on an assessment of organoleptic and physicochemical quality indicators, the optimal quantities and ratios of physiologically functional ingredients introduced have been set.**

Keywords—emulsion sauces, functional ingredients, polyunsaturated fatty acids, synbiotic fermented milk complex.

I. INTRODUCTION

One of the important tasks facing the food industry is to provide the population with food products balanced in the content of essential nutrients. Under the conditions of the observed imbalance in the food patterns of a modern person (lack of some nutrients and excessive consumption of others), the development of foodstuffs containing physiologically functional ingredients has become relevant. In order to solve this problem, emulsion products are a suitable object. They are direct “oil-in-water” or reverse “water-in-oil” emulsions and, thus, have both fat and water phases, allowing to expand the range of functional ingredients used, to improve the digestibility of crushed particles by the human body. The most popular among the emulsion products are emulsion sauces that can complement the taste and nutritive value of almost any dish. A refined deodorized vegetable oil, primarily sunflower oil, which contains mainly omega-6 fatty acids, is used as a fatty basis of emulsion sauces. In this regard, there is interest in balancing the fatty acid composition of the fatty base of the sauce in the ratio of omega-3 and omega-6 polyunsaturated fatty acids. For the purpose of preventing disorders of the microbiocenosis of the gastrointestinal tract, it is of interest to introduce synbiotics into the composition of emulsion sauces, including the partial replacement of the aqueous phase by the fermented milk component.

II. LITERATURE REVIEW

Currently, a fairly wide range of developments aimed at improving technology and increasing the nutritive value of emulsion sauces has been made. New emulsion products, in which a modification of turkey, chicken, and lamb fat involving hemp oil was used as a fat base, have been obtained [1]. A reduction in the share of total and saturated fat under the careful control of the emulsion structure, the persistence of the product, and the organoleptic characteristics has been carried out [2]. The structure of mayonnaise, enriched with nut oil, characterized by a high content of polyunsaturated ω-3 and ω-6 fatty acids [3] has been studied. A mayonnaise, which is stable during long-term storage and contains new types of flavors, has been made [4]. There is the experience of using wheat gluten as an affordable and inexpensive vegetable protein ingredient for the preparation and stabilization of emulsions with a high internal “oil-in-water” phase as a substitute for mayonnaise [5]. The potential of (ultra) homogenization of high pressure to obtain an emulsion (example of mayonnaise) with 28% sunflower oil without

thickeners and synthetic emulsifiers has been investigated [6]. The result had been a production method of emulsion sauce with high stability and long shelf life, which includes the emulsification of previously prepared brown seaweed with a mixture of vegetable oil, flavouring agent, and protein soybean product mixed with water, heating and homogenization of the mixture [7]. The possibility and feasibility of developing emulsion type sauces using the iodine protein supplement has been proven [8]. There are results of studies in the field of regulation of the structure of emulsion products based on fermented mince from low-profitable fish [9]. The formulation of a sauce containing spinach extract as a source of biologically active substances has been developed [11]. The laws governing the formation of the properties of emulsion fat products with the introduction of cedar gum [12] have been investigated. Specialized low-fat sauces of a functional orientation, in the production of which natural component extracts of berries and vegetable purees based on them are used, have been created [13]. The studies listed above and a number of others confirm the possibility of enriching emulsion sauces with various functional ingredients.

However, issues of an integrated approach that takes into account the balance of the sauce fatty basis and the possibility of introducing functional ingredients, taking into account the use of effective technological solutions for their production, have not been sufficiently explored.

The authors propose a comprehensive solution for the development of an emulsion sauce based on the combination of oils containing the optimal ratio of omega-3 and omega-6 polyunsaturated fatty acids and the introduction of its functional ingredient.

Vegetable oils balanced in the composition of PUFAs omega-3 and omega-6 are considered as the fatty basis. The role of omega-3 PUFAs consists in the prevention of cardiovascular diseases and atherosclerotic lesions, the progress of coronary heart disease, myocardial infarction, in maintaining normal brain, eye, and nerve development, children's growth, homeostasis of inflammatory reactions, in the formation of highly active immune regulators [14].

An important aspect of the food ration is the recommended ratio of omega-6 to omega-3 PUFAs. For a healthy person, it should be 10:1, in clinical nutrition—3:1 [15].

Flaxseed oil (4:1), mustard oil (1:2.6), and olive oil (1:13) can be considered as oils with an optimal or close to optimal ratio of omega-3 and omega-6 fatty acids, which allows them to be used as an ingredient in the formulation of emulsion sauces for the formation of a functional orientation [16].

A synbiotic complex has been proposed as a functional ingredient, aimed at preventing dysbiosis. Due to the fact that synbiotics have a beneficial effect on the intestinal microbiocenosis, they perform the function of providing the body with essential nutrients and beneficial biologically active products of the metabolism of lactic acid and bifidobacteria, thereby allowing to solve the problem of a healthy human microbial ecology [17, 18, 19]. Thus, the development of emulsion sauce technology, which can be recommended for the prevention of cardiovascular diseases and dysbiotic states, is relevant and reasonable.

III. RESEARCH METHODOLOGY

Emulsion sauce preparation

In order to prepare the emulsion sauce, a crude emulsion has been obtained: the mustard powder was steamed, the water was heated to 30–40°C, sodium chloride and sodium bicarbonate were poured and thoroughly mixed; egg powder and pre-steamed mustard powder were injected; and all were mixed until smooth. Next, a mixture of olive, mustard, and flaxseed oils were prepared. The mixture of oils at a temperature of 20-25°C was poured into the resulting crude emulsion during agitation. Then, a synbiotic fermented milk complex was introduced, including various types of bifidobacteria and lactic acid bacteria, propionibacteria, lactic acid streptococci, algal pectins, and vitamins. The prepared emulsion sauce was evaluated by organoleptic and physicochemical parameters.

Organoleptic testing methods

Evaluation of the organoleptic indicators of the emulsion sauce has been carried out in the following sequence: consistence, appearance, color, flavour, and taste according to the developed 5-point scale. Before determining, the sample was brought to a temperature of (20±2)°C.

The results have been processed and shown in the form of profilograms of the listed indicators.

Methods of physicochemical analysis

The mass fraction of the sauce moisture has been determined by an accelerated method according to GOST R 53590 [20].

Mass fraction of sauce fat [20] has been determined by centrifuging (accelerated method), based on the release of fat from the product under the action of concentrated sulfuric acid and isoamyl alcohol, followed by centrifugation (the amount of released fat has been measured in the calibration part of the butyrometer).

The determination of the resistance of the sauce emulsion has been carried out according to GOST R 53590 [20].

The determination of the sauce acidity has been carried out by the titrimetric method according to GOST R 53590 [20].

IV. EXPERIMENTAL RESULTS

The task of the study at this stage was to create an emulsion sauce of a functional orientation, not significantly different in organoleptic indicators from existing traditional mayonnaise. As a reference, a control sample prepared according to a traditional recipe has been used. When developing a sauce formulation, the optimal amount of injected oils has been determined taking into account a set of indicators that affect consumer characteristics of the sauce: organoleptic indicators, as well as the content of omega-3 and omega-6 PUFAs.

In the research, an assessment of the physicochemical quality indicators of the developed emulsion sauce has been

carried out: the content of fat, moisture, organic acids, and the stability of the emulsion.

The experiment had shown that a tasting sample with a ratio of olive, mustard, and flaxseed oils of 55%: 35% and 10%, respectively, had received higher points as a result of tasting.

In order to assess the organoleptic characteristics of the control and experimental samples of emulsion sauces, a point scale has been developed (Table 1). During the quality assessment, the following results have been obtained.

TABLE 1. BALL SCALE OF ESTIMATION OF ORGANOLEPTIC INDICATORS OF QUALITY OF EMULSION SAUCE

Figure of merit	*Organoleptic characteristic*	*Points*
Appearance, consistence	Homogeneous product with consistence of thick sour cream, with single air bubbles and point inclusions from mustard	5
	Homogeneous product with consistence of thick sour cream, with air bubbles and point inclusions from mustard	4
	Homogeneous product with an insufficiently dense consistence, with air bubbles and point inclusions from mustard	3
	Heterogeneous product with a stratified consistency, with significant inclusions from mustard	2
	Heterogeneous product with a stratified emulsion	1
Taste and flavour	Gentle, slightly sharp, sourish, without any traces of bitterness, inherent in the product, without foreign flavor and odor	5
	Insufficiently gentle , without any traces of bitterness, inherent in the product, without foreign flavor and odor	4
	Rude, without any traces of bitterness, without foreign flavor and odor	3
	Rough, with traces of bitterness, without foreign flavor and odor	2
	Not inherent, with foreign flavor and odor	1
Color	From light yellow to bright yellow, uniform throughout the mass	5
	From light yellow to bright yellow, slightly heterogeneous	4
	From light yellow to bright yellow, with shades. Minor heterogeneity in mass	3
	From light yellow to bright yellow, heterogeneous in mass	2
	Heterogeneous, unusual for the product	1

The control sample had a cream color, pleasant, slightly sharp, balanced taste and aroma, viscous consistence.

Such indices of the preproduction model, such as color, appearance, and texture, have been highly appreciated.

The preproduction model of the emulsion sauce has been characterized by a bright yellow color, slightly sour, lemon-like flavour, slightly sharp, balanced taste, and viscous creamy consistence.

The color of the preproduction model due to the oils used has turned out to be bright yellow. For this indicator, it has received higher marks compared to a control sample whose color was creamy (Figure 1).

In terms of appearance and consistence indicators, the preproduction model has also received rather high marks, since the introduction of oils other than traditional sunflower did not affect it in any way.

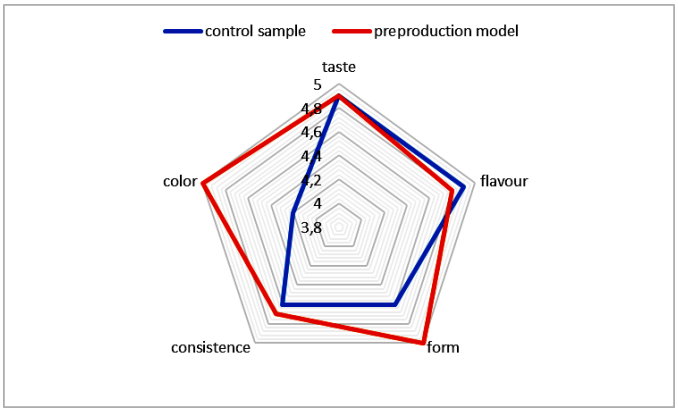

Fig. 1. Profilograms of control sample and preproduction model

The organoleptic and physicochemical studies have shown, and the optimal dosage of the synbiotic fermented milk complex is 40.0%. With such a concentration, the preproduction model has acquired a creamy consistency and a rather high resistance of the emulsion.

Physicochemical indicators of the emulsion sauce are shown in Table 2.

TABLE 2. PHYSICOCHEMICAL INDICATORS OF THE EMULSION SAUCE

Indicator	Sauce characteristic
Moisture content, %	49.71±1.03
Mass fraction of fat, %	52.78±2.61
Acidity, %	0.544±0.008
Stability of the emulsion,% fat released	98.00±1.01

[a.] In terms of acetic acid

A sufficiently high value (98%) has been experimentally obtained in terms of the emulsion resistance of the developed emulsion sauce for 2 days, when the structure of the emulsion product reaches the most stable state. In terms of the mass fraction of the fat (52.78%), the developed sauce can be attributed to the group of medium-caloric emulsion sauces.

V. CONCLUSION

Comprehensive research on the development of formulation and technology of an emulsion sauce has been conducted.

The possibility of using a combination of olive, mustard, and flaxseed oils in the production of sauce based on studies of organoleptic and physicochemical characteristics has been justified. It has been established that the required ratio of vegetable oils for the production of an emulsion sauce with high consumer properties should be 55%: 35% and 10%, respectively, for olive, mustard, and flaxseed oils. A technology for the production of enriched omega-3 and omega-6 PUFAs emulsion sauce has been developed.

The introduction of polyunsaturated fatty acids has been substantiated: for the purpose a high content of biologically active complexes in the finished product and the

creation of the necessary consistency, their introduction is provided at the stage of preparing a thin emulsion.

The organoleptic and physicochemical characteristics of the developed emulsion sauce have been established.

It has been shown that the products developed have a high nutritive value due to a complex of physiologically valuable ingredients.

VI. THE DISCUSSION OF THE RESULTS

Due to the high estimates obtained by organoleptic quality indicators, the developed emulsion sauce can be used as a universal condiment for first, second courses, salads.

Due to the inclusion of oils containing the optimal ratio of omega-3 and omega-6 fatty acids and synbiotic fermented milk complex into emulsion sauces, they are able to prevent cardiovascular diseases and dysbiotic conditions, provided that mayonnaise and other sauces are replaced in the food ration (the amount of 50-75 g/day).

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