

Conference Paper

Use of Echinoderms and Marine and Terrestrial Plant Materials in the Technology of Mayonnaise Sauce

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Abstract

Sea urchin caviar is a valuable product, as well as a therapeutic and prophylactic agent for cancer, it removes radionuclides from the body, increases the body's resistance to various types of infections, with physical and mental fatigue, under stress. In addition to the above mentioned aspects, the ingestion of sea urchin caviar helps to increase the human body's resistance to adverse and harmful environmental factors, and has a positive effect on the cardiovascular system and thyroid function. The gonads of sea urchins contain a set of all amino acids not synthesized by the human body, moreover, in a ratio close to the composition of the "ideal protein". The technology for manufacturing a new mayonnaise sauce using such valuable ingredients as sea urchin caviar, kelp, and nettle has been scientifically substantiated and created. A prescription composition of a new product has been developed; samples of mayonnaise sauce were made and their study during storage was carried out. The implementation of such a technology will allow not only rational use of stocks of marine non-fish raw materials and plants, but also expand the range and properties of functional products.

Keywords: mayonnaise sauce, sea urchin caviar, kelp, nettle, prescription composition, quality indicators, storage.

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1. Introduction

Currently, a wide range of food products is known with a scientifically sound composition and directed action on the human body. However, insufficient attention is paid to the development of new recipes and technologies for culinary products, including sauces, which are an integral part of the daily human diet. Sauces improve the taste and aroma properties of the food product, give an attractive appearance to the finished dish and contribute to better absorption of food. In addition, the use of sauces allows you to optimize the nutritional value of the product by changing its chemical and biochemical compositions.

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A feature of mayonnaise products is the ability to obtain a large set of products with the optimal content of unsaturated fatty acids, vitamins and antioxidants, dietary fiber and trace elements, which fully meets the concept of a healthy diet. Currently, there is an increasing need for the use of natural products balanced in micronutrients and containing biologically active substances (BAS), which positively affect the functions of human organs and tissues. Today, the issue of enrichment of certain food products, in particular, mayonnaise, mayonnaise sauces with various valuable components contained in non-fish objects of fishing in plant raw materials is very urgent. One of them is caviar of sea urchins (*Strongylocentrotus droebachiensis*), kelp (*Laminaria saccharina*) and nettle (*Urtica dioica*). The useful properties of hedgehog caviar are in a wide range of active substances that make up its composition. They intensify metabolic processes in the body, increase energy, sexual activity, slow down the aging process, and at the same time have a beneficial effect on the cardiovascular system and thyroid function. Sea urchin caviar was successfully used in the development of the technology for the manufacture of preserves [1]. In addition, as food additives, it is possible to use kelp and nettle, which contain a set of valuable macro- and micronutrients, such as boron, iron, iodine, potassium, calcium, cobalt, manganese, copper, phosphorus, fluorine, etc. *Laminaria* belongs to the class brown algae, has a balanced macro- and microelement composition, contains vitamins in amounts 100-1000 times higher than terrestrial plants and are the richest sources of inorganic iodine, which stimulates the thyroid gland [2]. Using kelp, the technology of the molded light-salted fish product "Assorted Assorted" was previously developed [3]. In addition, nettle can be used as a food additive, which contains a set of valuable macro- and microelements, such as boron, iron, iodine, potassium, calcium, cobalt, manganese, copper, phosphorus, fluorine, etc. Thus, it is significant Scientific and practical interest is the creation of a new emulsion product - mayonnaise sauce with the addition of sea urchin caviar, kelp and nettle.

2. Methods and Equipment

Caviar of sea urchins, kelp, nettle and mayonnaise sauce with the addition of the above ingredients in different dosages were chosen as objects (materials) of research.

To identify consumer demand for mayonnaise production in the city of Murmansk, a marketing research method was applied - a survey by written questionnaire.

In the process of experiments, organoleptic, physicochemical, rheological and microbiological research methods were used.

The organoleptic characteristics of mayonnaise sauce were evaluated using the developed 20-point scale with the following values: excellent quality 18.1 - 20 points, good 16.1 -18 points, satisfactory - 14.1 - 16 points, less than 14 are of unsatisfactory quality.

The mass fraction of moisture, the mass fraction of salt, the acidity of the product, and the mass fraction of fat were determined according [4]; determination of the mass fraction of ash, the mass fraction of proteins was carried out according [5]; determination of the iodine number of fats was carried out according [5].

Rheological studies of mayonnaise sauce, emulsion stability and effective viscosity were carried out on the basis [4].

Mayonnaise and mayonnaise sauce were examined for compliance with the requirements [7] according to such microbiological indicators as *E. coli* bacteria (coliform bacteria) (coliforms) according [8], determination of yeast and molds according [9]. In addition, salmonella was determined according [10], *Staphylococcus aureus* according [11], *L. monocytogenes* according [12].

3. Results and Discussion

Based on the analysis of consumer preferences for mayonnaise products in the city of Murmansk, we can state the following: the majority of respondents in Murmansk are young and middle-aged people who use mayonnaise from 2 times a week to 1 time per month and prefer mayonnaise products in stable Doy packs net mass and the quantitative composition of the ingredients determines its functions and properties.

In addition to vegetable oil, water, egg protein, the sauce also includes ingredients such as sea urchin caviar, kelp and nettle, as well as flavoring, functional and other natural food additives that give mayonnaise sauce nutritional and physiological value.

Thus, mayonnaise sauce is a functional food product, the properties of which can be improved and modified due to various ingredients.

The results of the chemical composition of sea urchin caviar, kelp, and nettle (Tables 1-7), of course, indicate the high nutritional and biological value of this raw material, since it contains a rich set of macronutrients, as well as trace elements and vitamins. The development of the optimal composition (recipe) of mayonnaise sauce with the addition of nettles, sea urchin caviar and kelp was proposed. At the first stage, formulations were developed and search experiments were conducted to make mayonnaise sauce based on traditional ingredients (vegetable oil, egg white, lemon juice, mustard, etc.) with the

addition of finely ground dry nettle with dosages of 0.5; 1.0; 2.0; 3.0 and 4.0 g per 100 g of sauce.

TABLE 1: General chemical composition of caviar of sea urchins, %.

Protein substances	Lipids	Carbohydrates	Water	Minerals
13.8	4.3	2.5	77.2	2.2

The nutritional value 104 kcal / 100 g

TABLE 2: Microelement composition of sea urchin caviar, mg / 100 g.

Cu	Zn	Co	Mg	Fe	Ni	Cr	Mn	Na
2.18	29.42	0.25	10.16	8.18	0.49	0.25	0.28	4.1

Since it was decided to introduce such natural ingredients as sea urchin caviar, kelp, and nettle into the recipe composition of mayonnaise sauce, it is of interest to analyze their chemical composition given in Table 1 - 7 based on data from the technical literature [13-15].

TABLE 3: Vitamin composition of sea urchin caviar, mg / 100 g.

A	E	D
2.37	9.14	0.17

Making mayonnaise sauce was carried out as follows. Bulk components - salt, granulated sugar are sieved and dosed by weight in accordance with the recipe. In the preparation of the sauce, ready-made table mustard is used, for which the necessary amount of mustard is weighed on the scales. Defrosting sea urchin eggs is carried out in air. For this, frozen caviar is laid out on shelves in a room with a temperature of 15 - 20 °C. The duration of defrosting is from 8 to 24 hours, depending on the size and thickness of the caviar block. 12 hours before the preparation of mayonnaise sauce, the required amount of kelp is placed in an enameled or stainless steel dish and poured with water at a temperature of 70 - 80 ° in a ratio of 1: 3. The product is thoroughly mixed until a homogeneous consistency. The container is tightly closed with a lid. After 12 hours, excess water is drained from the kelp. To do this, the kelp is placed in a container with side holes and holes in the bottom. Then the kelp is crushed to a size of not more than 3 mm in a machine with narrow transverse strips of a length of not more than 70 mm and the required amount is weighed in accordance with the recipe. 4 hours before the sauce starts, the required amount of nettle is placed in an enameled or stainless steel dish and poured with water at a temperature of 70 - 80 °C in a ratio of 1: 3. The mixture is well mixed and covered with a lid. After 4 hours, excess water is drained from the nettle. Then the nettle is crushed to a size of not more than 3 mm in

TABLE 4: Chemical composition of kelp.

Name	Content, %
Water	93...95
	The content in terms of dry weight, %
Squirrels	5...15
Carbohydrates	70
Mannitol	before 25
Alginic acid	11...40
Lipids	1...3
Iodine	0.1...0.5
Minerals:	Content, mg %
Potassium	970
Calcium	40
Magnesium	170
Phosphorus	55
Iron	16
Vitamins:	Content, mg %
B-carotene	0.15
C	2.0
B ₆	0.02
Niacin	0.4
Riboflavin	0.06
Thiamine	0.04
Folacin	2.3

TABLE 5: Chemical composition of the nettle dioecious.

Protein substances N • 6,25	Carbohydrates	Food fiber	Organic acid	Water	Mono and disaccharides	Starch	Ash
1.5	5.0	0.5	0.1	90.0	4.0	0.5	1.0
Nutrition value of 24.8 kcal / 100 g							

TABLE 6: Microelement composition of the nettle dioecious, mg / 100 g.

Ca	Mg	Na	K	P	Fe	J ₂
40.0	30.0	70.0	260.0	50.0	0.5	9.0

TABLE 7: Vitamin composition of the nettle dioecious, mg / 100 g.

Vitamin A	Vitamin PP	Retinol equivalent	Vitamin B ₁	Vitamin B ₂	Vitamin C	Niacin equivalent
0.1	0.5	100.0	0.03	0.03	10.0	0.749

a machine with narrow transverse strips not exceeding 70 mm long and the required amount is weighed in accordance with the recipe. Before separating the egg protein

from the yolk, the eggs are thoroughly washed with water at a temperature of 45 °C. Next, the egg protein is carefully separated from the yolk and placed in a clean bowl.

To obtain lemon juice, use fresh lemons. After preparing all the ingredients of the sauce, they are mixed and homogenized to a homogeneous consistency at a temperature of + 4.4... up to +21.1 °C. Raw egg white, lemon juice, salt, sugar and mustard are mixed in one bowl, whipped. When the mass becomes homogeneous, a vegetable oil is poured into it with a thin stream and continues to beat and then water is added. Next, prepared and chopped kelp, nettle and caviar of sea urchins are added and continue to beat until the sauce acquires its characteristic consistency. Then take a sample to check the quality of the sauce for viscosity, color and taste. The finished product must comply with the requirements [16]. Ready mayonnaise sauce is packed in a Doy pack with a fitting using a vertical packaging machine.

If too warm oil and other ingredients are introduced into the emulsion, the resulting mayonnaise sauce will have lower stability and a more liquid consistency than that prepared from cold ingredients. Recommended mixing and homogenization temperature is from +4.4 to +21.1 °C. At a final temperature of mayonnaise sauce above 23.9 °C, emulsion does not form.

After making mayonnaise sauce, it was found that the most acceptable dosage was 2.0 g of nettle per 100 g of sauce, and a larger amount of this ingredient slightly worsened the appearance of the product. It is this content of ground nettle in the sauce formulation that was decided to be used in further experiments.

The next task was to find the optimal dosages of sea urchin caviar and kelp after special preparation (dry kelp was soaked in water, blanched and chopped).

Six recipes for mayonnaise sauce were developed, in which the dosages of lemon juice, sodium chloride, mustard, egg white, water, and nettle remained unchanged. Test formulations are shown in Table 8. At the same time, the dosages of sea urchin caviar, kelp and vegetable oil were varied, the dose of which was forced to vary depending on the contents of the above ingredients in the sauce.

In accordance with the developed formulations, experiments were carried out to produce mayonnaise sauce in six variations, which were then subjected to organoleptic studies in accordance with the developed rating scale for evaluating the product by appearance and color, texture, taste, smell and general acceptability. The results of degustation studies are presented in Table 9. Variable factors - the number of caviar of sea urchins is indicated by the value X_1 (g / 100 g), the number of kelp is X_2 (g / 100 g), the organoleptic evaluation of the product is Y (points).

TABLE 8: 6 formulations of mayonnaise sauce with a constant and variable ingredient composition.

Used Ingredients	The mass of the ingredient, g / 100 g of the finished product					
	Recipe Number					
	1	2	3	4	5	6
Refined deodorized vegetable oil	67.0	59.5	52.0	44.5	44.5	27.0
Lemon juice	3.5	3.5	3.5	3.5	3.5	3.5
Salt	0.5	0.5	0.5	0.5	0.5	0.5
Mustard	1.0	1.0	1.0	1.0	1.0	1.0
Sugar	1.0	1.0	1.0	1.0	1.0	1.0
Protein	8.0	8.0	8.0	8.0	8.0	8.0
Water	12.0	12.0	12.0	12.0	12.0	12.0
Sea urchin caviar	2.5	2.5	10.0	10.0	17.5	17.5
Kelp	2.5	10.0	10.0	17.5	10.0	17.5
Nettle	2.0	2.0	2.0	2.0	2.0	2.0

TABLE 9: Results of the organoleptic evaluation (Y) of six variants of mayonnaise sauce depending on the dosage of sea urchin caviar (X₁) and kelp (X₂).

Room recipes	X ₁	X ₂	Y	
			Points	Quality characteristic
1	2.5	2.5	17.0	good
2	2.5	10.0	17.2	good
3	10.0	10.0	18.2	great
4	10.0	17.5	17.5	good
5	17.5	10.0	16.2	good
6	17.5	17.5	15.0	satisfactory

In order to establish the optimal dosages of sea urchin caviar and kelp using the DataFit 9.1 program, mathematical data processing was performed and the corresponding regression equation was obtained that adequately describes the effect of the ingredients used on the organoleptic assessment of the quality of mayonnaise sauce:

$$Y = 15.55 + 0.53 \cdot X_1 - 0.03 \cdot X_1^2 + 0.15 \cdot X_2 - 0.01 \cdot X_2^2 \tag{1}$$

The obtained regression equation allows not only predicting the value of the response function for the given conditions of the experiment, but also provides information on the shape of the response surface, which is shown in Figure 1.

The optimal parameters X₁ and X₂ were determined by the method of differentiation (finding extrema) and have the following values:

X₁ - dosage of sea urchin caviar was 8.75 g / 100 g; X₂ - dosage of kelp - 7.57 g / 100 g.

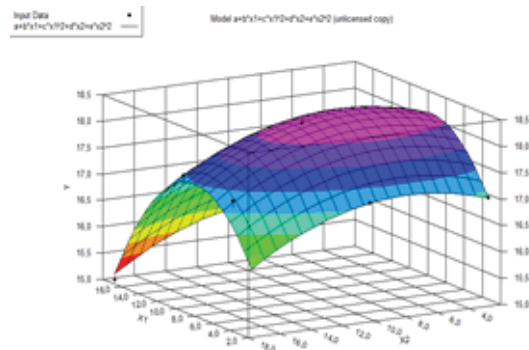


Figure 1: Surface of the response function in the selected region of the factor space (equation 1).

Based on the calculations and data obtained on the variable ingredients X_1 and X_2 , an optimized formulation was prepared for the manufacture of a new mayonnaise sauce, which is shown in Table 10.

TABLE 10: Recipe for mayonnaise sauce per 100 g of product.

Oil vegetable	Lemon juice	Salt	Mustard	Sugar	Protein	Water	Sea urchin caviar	Kelp	Nettle
52.0	3.5	0.5	1.0	1.0	8.0	15.6	8.8	7.6	2.0

Based on the found optimal values of X_1 and X_2 , other experiments were conducted to make mayonnaise sauce, which was subjected to sensory studies by the tasting committee.

The total organoleptic evaluation of the sauce made was 18.4 points, which, in accordance with the developed quality assessment scale (18.1 - 20 points), is assessed as excellent.

The resulting mayonnaise sauce was a homogeneous product of a liquid estimate-like consistency, slightly stretching and jelly-like. The taste is slightly sharp, pleasantly sour, with a touch of caviar of sea urchins and kelp. The finish is pleasant, typical for caviar of sea urchins and kelp. The color is yellowish-cream throughout the mass.

Physico-chemical studies of mayonnaise sauce are shown in Table 11. In the prepared mayonnaise sauce, the content of the mass fraction of ash, water, sodium chloride, lipids, protein substances, carbohydrates, acidity and iodine number of the fat component were determined.

The data given in Table 11 indicate a relatively balanced composition of the product, in particular, mayonnaise sauce contains a significant amount of easily digestible lipids (53.3 %), which are a part of vegetable oil and sea urchin caviar and which contain a

TABLE 11: Results of a study of mayonnaise sauce with the addition of various ingredients (sea urchin caviar, kelp and nettle).

Nº	Name of indicator, unit of measure	Test result
1	The actual content of the mass fraction of ash, %	3.01±0,05
2	The actual content of the mass fraction of moisture, %	38.1±1,2
3	The actual content by weight of a fraction of sodium chloride, %	0.7±0,04
4	The actual content of the mass fraction of fat, %	53.3±0,7
5	The actual content of the mass fraction of proteins, %	1.70±0,03
7	Acidity, in terms of acetic acid, %	0.31±0,02
8	The iodine number of fats, g I ₂ / 100g	161.0±2,0

large amount of valuable unsaturated fatty acids, which is confirmed by the high value of the iodine number (161.0 g I₂ / 100 g).

In addition, the created mayonnaise sauce contains a minimal amount of sodium chloride (0.7 %) and has a very low acidity (only 0.31 %). Therefore, the sauce made can be attributed to a healthy food product.

Rheological studies of mayonnaise sauce. In order to study the new mayonnaise sauce by its possible predisposition to delamination, which is an extremely undesirable process, in accordance with the applied methods [1], work was carried out to determine such rheological parameters as the stability of the emulsion product and its effective viscosity and comparing them with the normative indicators specified [16]. The research results are presented in Table 12.

TABLE 12: Results of rheological studies created mayonnaise sauce.

Nº	Name of indicator, unit of measure	ND indicator value	Test result
1	The stability of the emulsion, % intact emulsion	97	90
2	Effective viscosity, Pa •s	-	2,72

The analysis of the research results in terms of emulsion resistance (Table 12) indicates that the obtained value is slightly lower (by 7 %) of the standard indicator. At the same time, it should be noted that the actual value of the rheological indicator probably depends on the introduction of new ingredients (caviar and kelp) into the formulation and does not lead to any deterioration in the consistency of the product. At the same time, to increase the durability of the new mayonnaise sauce and its compliance with the requirements [16] (at least 97 %), a decision was made in the manufacture of subsequent product samples to increase the duration of homogenization (whipping) of its ingredient composition.

As for the effective viscosity of the sauce (Table 12), there are no regulated values for this indicator in the regulatory documents for these emulsion products.

Since during the tasting studies and, in particular, on the general acceptability of the product, no comments were made regarding its viscosity, therefore, the obtained value should be considered acceptable for the created mayonnaise sauce.

The microbiological studies of a new mayonnaise sauce. The samples of new mayonnaise sauce made according to optimal parameters were sent for storage at a temperature of (+2) -- (+5) °C and were subjected to microbiological studies immediately after manufacture, as well as on the fifth, tenth and fifteenth day of storage. The results of microbiological studies of the new product during storage are presented in Table 13. Research data on the created mayonnaise sauce (Table 13) indicate that for 15 days the microbiological parameters of the product bacteria of the Escherichia coli group (coliform bacteria), the content of molds and yeast did not exceed the normative values specified [7], which indicates the sanitary and hygienic well-being of the product during this storage period. The results of organoleptic studies of the sauce confirmed the good quality of the product throughout the entire shelf life.

TABLE 13: Data of microbiological studies of mayonnaise sauce with the addition of various ingredients (sea urchin caviar, kelp and nettle) during storage.

Name indicators	Normative value	Test results			
		0 days storage	5 days storage	10 days storage	15 days storage
1	2	3	4	5	6
E. coli bacteria (coliform bacteria)	in 0.1 g not allowed	not detected	not detected	not detected	not detected
Staphylococcus aureus	not standardized	not detected	not detected	not detected	not detected
Salmonella	not standardized	not detected	not detected	not detected	not detected
L. monocytogenes, in 25g	not standardized	not detected	not detected	not detected	not detected
Yeast, KOE/ g, not more	500	less 10	20	70	80
Mold, KOE / g, not more	50	less 10	less 10	10	10

According to the results of studies of the quality of a new product during storage, the following shelf life is established: at a temperature of plus 2 °C to plus 5 °C -- 10 days (taking into account the reserve ratio, which for perishable products with shelf life of up to 10 days is 1.5).

The samples of mayonnaise sauce with the addition of sea urchin caviar, kelp and nettle were exhibited at the 16-th International Specialized Exhibition "Sea. Resources.

Technologies -- 2015" (Murmansk), where they were awarded diplomas "For active participation in the exhibition and contribution to the scientific support of the development of new technologies for obtaining food products from aquatic biological resources".

4. Conclusion

The results of the studies indicate that a formulation of easily digestible mayonnaise sauce with a high biological and nutritional value, excellent taste and rheological properties has been developed.

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Conflict of Interest

The authors have no conflict of interest to declare.

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