

Conference Paper

Development of Fish Products Technology with Using Food Supplements from Fish Remaining Feedstock

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Abstract

The article describes the technology for the production of chopped fish products from blue whiting with the use of food additives from secondary fish raw materials. The sociological survey results and analysis of Murmansk city population nutritional structure are presented and the main factors that affect the choice of fortified foods are identified. The basic formulation of chopped fish products with the introduction of biologically active mineral components is developed and its optimization is carried out by computer simulation. To search close to optimal for a mineral composition that, taking into account the high organoleptic and rheological characteristics, a high orthogonal rotatable by mathematical modeling method. The results were processed Datafit 9.0 computer program by generally accepted statistical methods. The experimental results of the chemical composition of chopped fish products and their caloric value are presented. As a result of the studies, a technological scheme and recipe for chopped fish products from Northern Basin underutilized raw materials such as blue whiting with the secondary fish raw materials additives was developed. Experimentally was obtained, that the using a cutlet portion with the 15% addition from its net weight exceeds the daily share of calcium intake, which is unacceptable due to the presence of other food products containing it in the consumers daily diet. The previously developed optimization recipe for chopped blue whiting products with the fish bones flour addition based on organoleptic and structural-mechanical indicators obtained by mathematical modeling methods allowed us to establish the optimal ratio of the introduced components.

Keywords: chopped fish products, bioavailable calcium and phosphorus

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1. Introduction

Russia is one of the largest fishing countries in the world. Currently, the systematic supply of high-quality food products is the goal of the Russian Federation food and fishing industry. The "Doctrine of Food Security of the Russian Federation" dated January 30, 2010 contains the main directions for the development of fish food production:

- expansion and more intensive use of aquatic biological resources;

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- creation of new technologies for the deep and processing of food raw materials, methods of storage and transportation of agricultural and fish products [1].

Therefore, a lot of attention is paid to issues related to non-waste technologies for processing fish raw materials [2]. Culinary products range expanding from unprofitable species [3, 4] of Northern basin fish [5], enriched with bioavailable mineral compounds, is relevant for modern economic conditions. These products will be available to various population categories, allow economically profitable use of cheap fish raw materials, as well as minimize waste from fish cutting by their secondary use, which will positively affect the profitability of enterprises [6]. Waste from cutting cod species contains a large amount of bone tissue, which is rich in phosphorus and calcium, what is very promising for use as an additive to food products in order to enrich their mineral composition. Phosphorus and calcium seriously affect human health. Their presence is associated with muscular and nervous systems functioning, oxidative processes in the body; therefore, products enriched with these compounds should be used in preventive nutrition [7, 8].

In accordance with the Healthy State policy of nutrition for the period until 2020, one of the food production priorities is the range expanding of functional products, dietary (therapeutic and preventive) food products and biologically active food additives [9]. The purpose of this work is to scientifically substantiate and develop a technology for chopped fish products from Northern Basin underutilized raw materials with food additive from cutting fish raw materials waste.

To achieve this purpose, the following tasks were formulated:

- conduct a sociological survey and analysis of the Murmansk city population nutritional structure identify the main factors that affect the choice of fortified foods;
- develop a recipe for fish chopped products with functional additive inclusions.

2. Methods and Equipment

2.1. Methods

2.1.1. Diagrammatic representation

Marketing research of this task was carried out by the questionnaire method. The sample size was 100 random respondents. The object of study was chopped fish products from Northern Basin underutilized raw materials with food additives which was produced from cutting fish raw materials. All the main raw materials, consistency, regulatory additives

and other components met the requirements of the actual normative documents. To assess the organoleptic characteristics of the products, the method of point scales was used. For an objective assessment of the "consistency" indicator, the "stickiness" indicator was experimentally determined by the «Food Checker» R-1180 RAT gelometer. The calculation was made in accordance with the method published by [10]. Sampling of the finished product and preparing them for analysis was carried out in accordance with standard methods. The basic formulation of enriched fish cakes is presented in Table 1. The research results of organoleptic indicators are presented in the form of contour graphs. The mathematical modeling of the formulations was carried out by rotationally planned experiment. The adequacy of mathematical dependencies was evaluated by the value of the Fisher test (F-test). Statistical results research processing was carried out by the nonlinear regression method using the «Datafit 9.0» computer program to calculate nonlinear regression coefficients [11]. The surface of the response function is graphically presented in Figure 2.

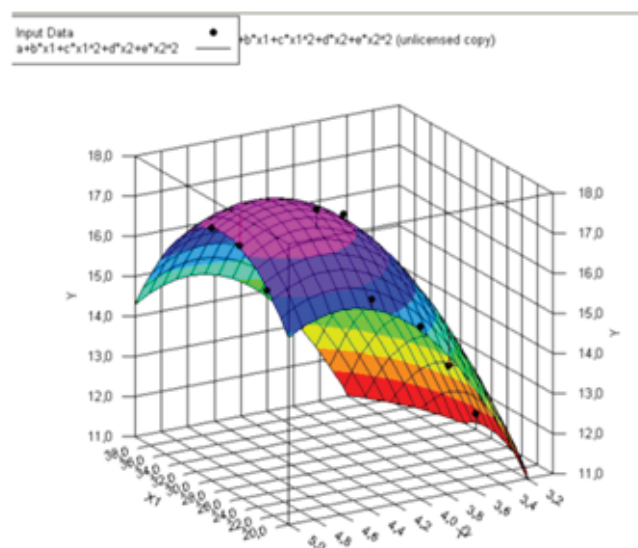


Figure 1: The surface of the response function.

The chemical composition and energy value of chopped fish products are presented in Table 2. Determination of minerals is according to standard methods.

3. Results

At the initial stage of the survey, a marketing study of the Murmansk city population nutritional structure was conducted. It was found that only 22% of the respondents considered their food to be correct and balanced. When assessing the main factors for choosing fortified foods, 41% of respondents said that they pay attention to the medicinal

and prophylactic properties of the product, while 14% regularly use foods with added micronutrients. As the main reason for the irregular and rare consumption of this group of food products, 45% of the respondents indicated that this was due to the lack of assortment, 37% associated this fact with insufficient information regarding beneficial properties of enriched products, and 8% noted an unattractive appearance. Thus, simultaneously with the development of new formulations of enriched food products aimed at expanding the assortment, it is necessary to increase public awareness of their benefits using modern advertising means, as well as to work on improving organoleptic properties in order to attract the consumer audience to enriched products. It was also found that the Murmansk city population very little consumes foods rich in calcium and phosphorus: half of the respondents eat dairy products no more than twice - once a week, fish and seafood - not more than once or twice a month. About 35% of the city's population prefers the use of medical vitamin preparations

The employees of the Department of Food Production Technologies of the Federal State Budget Educational Establishment of Higher Education "Murmansk State Technical University" developed a technology for the production of bone fish meal, which was later introduced into the chopped fish semi-finished products recipe from Northern Basin underutilized raw materials.

The basic formulation of enriched fish cakes was developed based on traditional recipes [12].

TABLE 1: The basic formulation of fish cakes.

Product designation	The quantity of 1000g		The quantity of 1portion	
	Gross mass (g)	Net mass (g)	Gross mass (g)	Net mass (g)
Blue whiting stuffed	670	67	120	120
Fresh carrots	230	190/157*	41	34/28*
Fresh onions	146	123/90	26	22/16*
Chicken egg	90	90	16	16
Baking wheat flour, premium	34	34	6	6
Vegetable oil	56	56	10	10
Exit		1000		180

* weight of sauteed vegetables

Prototypes were produced according to the developed technological schemes [8 articles on cutlets with amaranth].

To determine the effect of fish bone meal on the quality of fish cutlets, prototypes of products with developed mineral additives various percentages were made. During the survey, only the amount of bone meal introduced was varied in an amount of 5 to 15% minced meat mass in 5% increments. Sample No. 1 was made on the basis of the

basic formulation and was a control. An analysis of the organoleptic evaluation results is presented in the form of contour graphs-profilograms in Figure 2-3.

To determine the optimal formulation for the semi-finished fish products manufacture, a main orthogonal plan for a two-factor experiment was developed. The response functions were the value of the organoleptic evaluation indications (Y_1), as well as the stickiness value (Y_2). Variable factors were the amount of bone meal and amaranth flour as the mass of minced meat (variable depending on the total mass of bone and amaranth flour) - X_1 and the calcium content from the mass of minced meat - X_2 . All other components included in the formulation remained unchanged. The obtained regression equation (1) adequately describes the effect of changes in the introduced amaranth flour amount and flour from fish bones on a generalized quality indicator

$$Y_{o6} = -55.9 + 1.32x_1 - 0.023x_1^2 + 23.93x_2 - 2.61x_2^2. \tag{1}$$

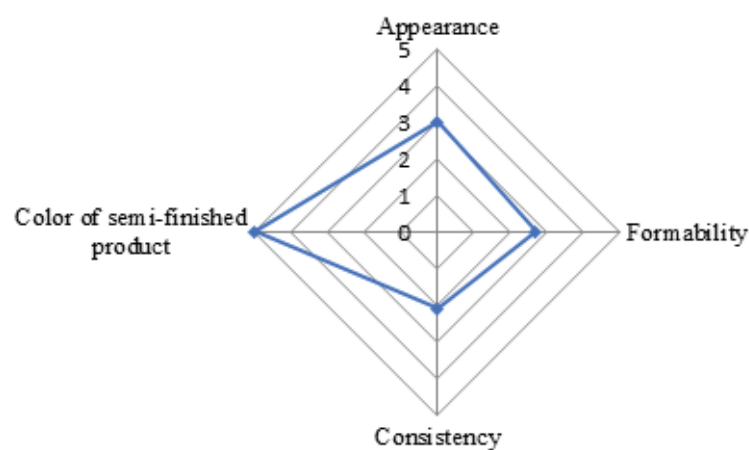


Figure 2: Quality profile of cutlets with the addition of 5% bone meal.

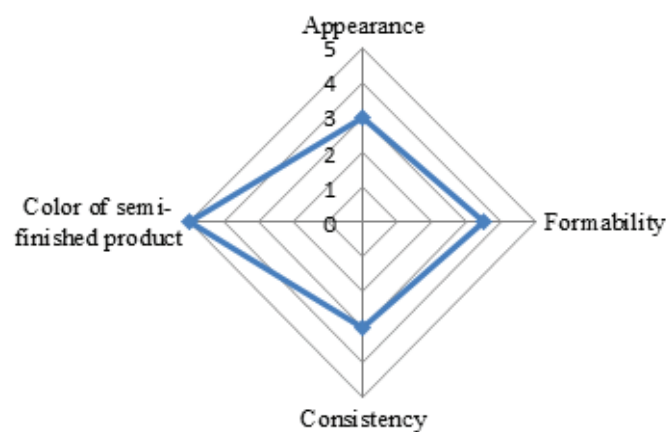


Figure 3: Quality profile of cutlets with the addition of 10% bone meal.

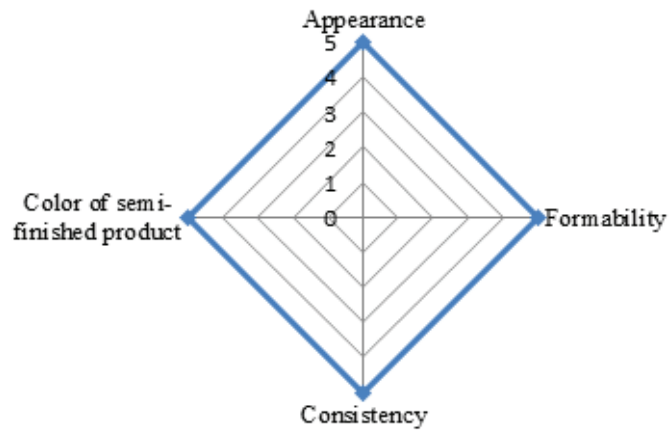


Figure 4: Quality profile of cutlets with the addition of 15% bone meal.

During the process of the survey, the chemical composition and energy the finished cutlets value was determined, brought to the degree of culinary readiness in the main way - hot. The results are rounded according to the current regulatory documentation [9] and are presented in table 2.

TABLE 2: Chemical composition and energy value of chopped fish products.

Protein	Fat	Carbohydrate	Energy value, kcal / kJ
13.4	7.4	4.2	137.8 / 577.3

4. Discussion

As a result of the research, the amount of flour was fixed at 15%. At the indicated amount of bone meal introduced, the semi-finished products of fish cakes were well formed and kept in shape when brought to the level of culinary readiness. The consistency of the finished products was tender and juicy.

During the assessment, a calcium content of 13% was determined in the fish bone supplement. So, when using one portion of cutlets with a net weight of 100 g, the amount of calcium consumed will be 1.3 g, which fully satisfies the adult's daily requirement for calcium. Due to the fact that people consume other products containing calcium and phosphorus, it was decided to replace part of the bone meal and wheat flour with amaranth flour in order to reduce the calcium content in the product, but to maintain the required formability of the semi-finished product.

Based on the data obtained by mathematical modeling, the recipe for cutlets was selected with a mass fraction of amaranth flour from the net weight of minced fish - 4.5% and a calcium content of 30% from the net minced meat composition weight. The

obtained parameters make it possible to obtain a high-quality product with a pleasant, moderately pronounced taste and aroma, without extraneous smack of amaranth flour and bone fish meal, with good formability of the semi-finished product.

In the developed chopped products, the ratio of proteins: fats: carbohydrates is 3: 2: 1, the energy value per 100g of the product is 137.8 kcal / 577.3 kJ. Therefore, the dish refers to protein products with an average calorie content. The calcium content in 100 grams finished product is 30% of the recommended average daily intake of an adult [13]. Taking bioavailable calcium drugs along with food activates the absorption of macronutrients, this is due to the stimulation of the digestive tract and the digestive enzymes activation [7]. The developed dish is considered enriched and can be recommended as an additional source of bioavailable calcium and phosphorus [14, 15].

5. Conclusion

So, as a result of the studies, a technological scheme and recipe for chopped fish products from Northern Basin underutilized raw materials - blue whiting with the addition of additives from secondary fish raw materials was developed. It was found that the use of a cutlets portion with a 15% addition its net weight completely satisfies the daily need for such a macroelement as calcium. However, in the diets of both the adult population and children there are other products that contain this macro element in their composition. Therefore, mathematical modeling and optimization of the basic chopped blue whiting products formulation with the flour addition from fish bones based on an analysis of organoleptic and structural-mechanical indicators made it possible to establish the optimal ratio of the introduced components. The finished course has excellent organoleptic characteristics, increased nutritional value and can be used as an additional source of calcium and phosphorus.

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Conflict of Interest

The authors have no conflict of interest to declare.

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