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PRODUCTION TECHNOLOGY AND NUTRITIONAL EVALUATION OF FISH CUTLETS

[1]Farida Smolnikova, [2]Galiya Kazhybayeva, [3]Evgeny Tsapov, [4]Svetlana Sharipova , [5]Tamara Sharova, [6]Natalia Nikolaeva, [7]Vera Gribkova, [8]Larisa Garipova, [9]Anna Terehova

***ABSTRACT**--This paper studies the use of fish in school meals. The production technology and recipe of six samples of fish cutlets with different combinations of laminaria, rice, carrots, nonfat cottage cheese are presented. These components have the effect on the chemical composition and nutritional value of the finished product. According to the results of chemical composition, the protein content varies from 17.02% to 17.53%, fat from 1.80% to 2.73% and carbohydrates from 6.54% to 7.22%. According to the mineral composition, an increased content of calcium (28.51 mg/100g in sample 1 and 22.51 mg/100g in sample 2) was found in fish cutlets with the addition of curd whey (15 to 20 % to the recipe). The variety of the chemical composition and structure of the fish tissue make it an excellent diet product.*

***Key words**-- fish cutlets, protein, pollock, nutritional value, calcium, cottage cheese*

I. INTRODUCTION

The formulation of school meals must be based on a balanced diet, the enrichment of the food with beneficial micronutrients for increasing the learning potential of children and adolescents, improving the health of schoolchildren, reducing obesity, dystrophy and other nutrition-related diseases, reducing the risk of cardiovascular, endocrine, gastrointestinal diseases during and after school, and improving school academic performance [1].

Fish products are a source of highly digestible protein, phosphorus, polyunsaturated fatty acids and other substances. The fish and seafood's health, therapeutic and dietetic value and indispensability are determined by their well-balanced chemical composition. They are of great importance as sources of proteins, fats, minerals, contain such physiologically important elements as potassium, calcium, magnesium, iron, phosphorus and a complex of vitamins necessary for the human body [2, 3].

[1] *Shakarim State University of Semey, Semey, Kazakhstan*

[2] *S. Toraighyrov Pavlodar State University, Pavlodar, Kazakhstan*

[3] *Nosov Magnitogorsk State Technical University, Magnitogorsk, Russian Federation*

[4] *Orenburg State University, Orenburg, Russian Federation*

[5] *K.G. Razumovsky Moscow State University of technologies and management (the First Cossack University), Moscow, Russian Federation*

[6] *K.G. Razumovsky Moscow State University of technologies and management (the First Cossack University), Moscow, Russian Federation*

[7] *K.G. Razumovsky Moscow State University of technologies and management (the First Cossack University), Moscow, Russian Federation*

[8] *K.G. Razumovsky Moscow State University of technologies and management (the First Cossack University), Moscow, Russian Federation*

[9] *K.G. Razumovsky Moscow State University of technologies and management (the First Cossack University), Moscow, Russian Federation*

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The inclusion of fish and fish oils in the diet prevents such a serious disease as rickets. Invertebrates contain a large amount of vitamin E (tocopherol). It serves as an antioxidant of fats and promotes better absorption of fats and proteins, affects the function of sex and some other glands. Phospholipids (lecithin and choline) of fish oils prevent obesity of the liver and serve as a means of prevention and treatment of its diseases [4, 5].

The aim of the research work is to develop a recipe and technology for fish cutlets for school meals. It was suggested to use nonfat cottage cheese as protein additives, as plant components - ground carrots, laminaria, boiled rice. Laminaria is added for iodine enrichment, boiled rice should replace wheat bread, cottage cheese is added for calcium enrichment. The most acceptable use as a fish raw material in the school cafeteria is pollock fish [6, 7]. Fish must meet safety requirements.

II. MATERIALS AND METHODS

The technological process of fish cutlets production consists of the following operations: washing, cutting of fish, grinding, minced meat preparation, forming, panning, heat treatment of cutlets, food serving. Technology for cooking fish cutlets: prepared fish fillets without skin and bones washed, give water to drain, cut into pieces, pass through a meat grinder along with boiled rice, add - table iodized salt , egg emulsion, nonfat cottage cheese, carrots, dry crushed laminaria, black pepper, water, thoroughly stirred and beaten out.

Cutlets or rissoles shaped from fish cutlet mass, panned in breadcrumbs, fried on both sides in a pan in heated vegetable oil for 5 minutes. Then cutlets or rissoles are placed on a steamer and cooked at 100 C for 15 minutes.

The technology of fish cutlets was tested in the canteen of Semey secondary school № 18. Ready cutlets and semi-finished products were examined for physical and chemical indicators.

When developing the recipe of the fish cutlet, part of the mass of minced fish was replaced by cottage cheese, carrots, boiled rice, dry grinded laminaria. In order to select the rational ratio of the recipe components, six variants of model samples with different ratio of components were developed. The data are presented in Table 4.

Table 4: Formulation of fish cutlets

Sample	Pollock fillet	Cottage cheese	Carrots	Boiled rice	Dry grinded laminaria	Onion	Egg	Bread crumb	Salt	Pepper	Water
Sample 1	58.7	20.0	5.0	2.0	0.1	3.0	1.0	5.0	1.0	0.2	4
Sample 2	62.0	15.0	4.0	2.5	0.3	3.0	2.0	5.0	1.0	0.2	5
Sample 3	64.8	10.0	3.0	3.0	0.5	3.0	3.5	5.0	1.0	0.2	6
Sample 4	71.6	5.0	2.0	3.5	0.7	3.0	3.0	5.0	1.0	0.2	5
Sample 5	73.8	3.0	1.0	4.0	1.0	3.0	4.0	5.0	1.0	0.2	4

Sample 6	76.6	1.0	0.5	4.5	1.2	3.0	2.0	5.0	1.0	0.2	5
Control	81.3	-	-	-	-	3.0	3.5	5.0	1.0	0.2	6

Chemical and mineral compositions were determined according to the methods described in [8, 9]. Evaluation of organoleptic characteristics of presented model samples was carried out by tasting commission, which evaluated samples by organoleptic characteristics (appearance, consistency, color, taste, smell).

III. RESULTS AND DISCUSSION

The main source of fish contamination is microbial contamination of ponds and fish habitats before catching and supplying fish processing plants. Therefore, heavy contamination of water areas by industrial effluents and especially by household waste water causes contamination of fish body surfaces, which always contain microbes from water and bottom silt. Particularly dangerous are waters contaminated by faeces, animal carcasses and dead plants [10].

The requirements for Pollock safety indicators are shown in Table 1. In terms of microbiological indicators the pollock is completely safe. Pathogenic bacteria and microorganisms are not detected.

Table 1: Microbiological indicators of Pollock

Indicator	Permissible level	Obtained value
Total viable count, CFU/g	No more than $5*10^4$	$2.9*10^3$
Coliform bacterias in 0.001g	Prohibited	Not detected
S. aureus in 0.01g	Prohibited	Not detected
L. monocytogenes in 25g	Prohibited	Not detected
Pathogens, including salmonella in 25g	Prohibited	Not detected
V. parahaemolyticus	No more than 100	<10

In addition, the pollock contains no traces of toxic metals (lead, arsenic, cadmium, mercury), nitrosamines, pesticides and radionuclides (cesium-137, strontium-90).

Table 2 shows the organoleptic characteristics of pollock fish fillets.

Table 2: Organoleptic evaluation of pollock

Indicator	Characteristic
Appearance	Frozen fish, non-deformed, clean, dense

Consistency	Elastic, dense, typical of this fish species
Color	White, typical for this fish species
Flavor	Typical for fresh fish, without foreign smells.
Taste and flavor after cooking	Typical for this fish species

The analysis of tested samples of pollock for safety indicators shows that pollock can be used for cooking dishes without restrictions. Heavy metals, bacteria, pathogens are not found in fish.

The chemical composition of fish meat, which determines its nutritional value and taste, is characterized, primarily, by the content of water, nitrogen substances, lipids, minerals, carbohydrates and vitamins [11].

Chemical composition and nutritional value of experimental samples are given in Tables 3, 4, 5. Analysis of the tables show that in terms of protein content, sample 1 and sample 2 contain more protein comparing with other samples. In addition, they contain more calcium. With an increase in the proportion of rice and pollock, there is an increase in carbohydrates (from 6.54% to 7.22%). The vitamin composition of samples with less curd whey and carrots shows a decrease in beta-carotene (from 3.20 to 0.60 micrograms).

Table 3: Chemical composition of fish cutlets

Indicator	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
Protein, %	17.53	17.43	17.32	17.21	17.11	17.02
Fat, %	2.61	2.64	2.68	2.71	2.73	1.80
Carbohydrates, %	6.54	6.89	6.93	7.04	7.21	7.22

Fish proteins (5-25% and more) comprise about 85% of the amount of nitrogen substances and are the same in biological value as proteins of meat of warm-blooded animals. The amino acid composition includes important essential amino acids: phenylalanine, lysine, methionine, tryptophan [12]. Fish proteins are complete proteins, and represented mainly by simple proteins, which are subdivided into water-soluble (myoglobin, Globulin-X, myoalbumin); soluble proteins (meosin, actin, actomeozine, tropomeozine); complex proteins that are not soluble in water and salt solutions, but soluble in alkalis and acids: nucleoproteins, phosphoproteins, glucoproteins [13].

The animal starch - glycogen - is the most abundant carbohydrate in fish meat (0.9-1.0%). In addition to glycogen, the tissues of fish contain products of its hydrolysis: glucose, pyruvic acid, lactic acid, etc. [14]. Although the amount of carbohydrate fraction included in fish meat is small, but its impact on the quality of fish products (especially smell, color, taste) is significant [15].

Table 4: Mineral composition of fish cutlets, mg/100g

Indicator	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
Na	11.66	9.92	8.60	6.35	5.98	9.57
K	290.47	300.31	310.27	332.52	345.46	360.78
Ca	28.51	22.55	16.83	10.56	8.20	5.34
Mg	41.14	42.38	43.26	45.31	46.70	48.20
P	185.0	370.0	555.4	555.2	641.2	370.8
Fe	0.68	0.71	0.79	0.86	0.92	1.13
I	0.32	0.95	1.51	2.10	3.08	3.60

Table 5: Vitamin composition of fish cutlets

Indicator	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
Beta carotene, mcg	3.20	2.50	1.90	1.30	0.60	0.60
Vitamin A, mg	13.5	13.1	13.05	12.90	12.87	12.50
Vitamin B_1, mg	0.40	0.30	0.4	0.42	0.40	0.41
Vitamin B_2, mg	0.11	0.11	0.11	0.12	0.10	0.10
Vitamin PP, mg	0.59	0.61	0.61	0.66	0.67	0.68
Vitamin C, mg	0.33	0.29	0.26	0.20	0.19	0.19

The next stage, therefore, was the organoleptic evaluation of the cutlets.

Based on the results of the organoleptic evaluation, sample 2 was selected, which best meets the established requirements. The weight increase of cottage cheese in this sample has a better effect on its taste and also allows to enrich the food with a large amount of calcium. The evaluation results were expressed in scores and are presented in Table 6.

Table 6: Organoleptic evaluation of fish cutlets

Sample	Characteristics			Total score
	Appearance, consistency, color	Flavor	Taste	
Sample 1	4.7	5.0	4.8	14.5

Sample 2	5.0	5.0	5.0	15.0
Sample 3	4.9	4.9	4.8	14.6
Sample 4	4.4	4.9	4.5	13.8
Sample 5	4.4	4.8	4.5	13.7
Sample 6	4.4	4.9	4.3	13.6

The results of research showed that the best prototype was sample 2, which served as a further development of technology for cooking fish cutlets.

IV. CONCLUSION

The variety of the chemical composition and structure of the fish tissue make it an excellent diet product. The developed fish cutlets can expand the range of molded fish products through involvement in the processing of animal and plant products. This method of preparation of fish cutlets allows obtaining a product with improved organoleptic properties, and more balanced nutrient composition.

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