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RESEARCH OF NUTRITIONAL AND BIOLOGICAL VALUE OF FUNCTIONAL MINCED PRODUCTS

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ДОСЛІДЖЕННЯ ХАРЧОВОЇ ТА БІОЛОГІЧНОЇ ЦІННОСТІ ФУНКЦІОНАЛЬНИХ ПОСІЧЕНИХ ВИРОБІВ

Objective is an estimation of indicators of food and biological value of finished goods on the basis of the developed semi-finished products in comparison with traditional cut products.

Methods. The content of substances was determined by the following methods: total nitrogen — chloramine method (the amount of protein was found by multiplying the content of total nitrogen by a conversion factor of 6,25); fat — Soxhlet extraction-weight method in Rushkovsky's modification; carbohydrates — by the Bertrand-Bierry method; starch — by hydrolysis; ash — by burning a dried portion in a muffle furnace at a temperature of 450–500 °C; minerals — X-ray fluorescence and photoelectrocolorimetric methods. The energy value of the products was determined by the Atwater coefficients, taking the energy value of 1 g of protein and 1 g of carbohydrates — 4,0 kcal, 1 g of fat — 9,0 kcal. Amino acid composition of experimental cutlets with Jerusalem artichoke and control samples according to traditional recipes, we determined by liquid chromatography using amino acid analyzer LKV 4151 "Alpha Plus" (Sweden), tryptophan content — by the Grecher's method in the modification of O. Ermakov. Amino acid index (E/T index) was defined as the ratio of the number of essential amino acids to the total number of amino acids.

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Results. *The indicators of the chemical composition of cut products with a functional plant additive and compared with the indicators of traditional cut products are studied. It is proved that the developed cut products are characterized by low fat and starch content, as well as low caloric content. The amino acid composition of the products was studied, the amino acid score was calculated and the limiting amino acids were determined. The use of a new vegetable filler has been shown to improve the amino acid composition of minced meat by reducing the number of limiting amino acids from five to two in meat products and from three to one in fish products.*

Key words: *nutritional value, amino acid composition, amino acid speed, vegetable semi-finished product, minced products.*

Formulation of the problem. In today's unfavorable environmental conditions, the problem of the spread of functional nutrition, aimed at strengthening the body's defense systems and reducing the risk of exposure to harmful substances, becomes especially acute. In Ukraine, a large part of the population has deformed diets due to existing food stereotypes, declining purchasing power, a sharp deterioration in the environmental situation, increased consumption of refined products, which negatively affects the intake of the required amount of biologically active substances.

Medico-biological requirements for the chemical composition, biological and functional properties of food can not be sufficiently met without the use of non-traditional ingredients as carriers of certain specific therapeutic and prophylactic properties. Therefore, an important problem today is the search for promising sources of raw materials and the development of methods for its processing, studying the biological value of new products and the specifics of their impact on the human body.

One of the ways to create functional products is to combine animal raw materials with raw materials of plant origin, which allows to obtain products with a high content of animal protein, enriched with plant biologically active compounds. Particular attention in this regard deserve minced meat products, which are in great demand among the population, allow more complete and comprehensive use of raw materials and require low production costs in the implementation of technology.

In recent decades, functional foods in Ukraine [1] are considered an effective means of maintaining the health of the body and reducing the risk of many diseases [2]. Production of functional food products improves the structure of nutrition and health of the population of Ukraine, allows to expand and improve the range of products of restaurants and food industry [3].

Given the above, scientific substantiation and development of semi-finished technology of vegetable raw materials for minced fish and meat mass is a promising and urgent task that will expand the range of products of the restaurant industry and food industry, increase food and biological value of products, influence technological changes indicators, ensure a high level of safety of these products, prevention of chronic diseases and improve human health.

Analysis of recent research and publications. A significant amount of theoretical and practical research on the study, improvement, development and production of new functional foods performed and reflected in the scientific works of leading scientists of Ukraine and other countries: G. I. Kasyanov, M. I. Peresichny, L. V. Kaprelyants, K. G. Iorgacheva, A. P. Levitsky, M. G. Gaparov, A. F. Doronin, F. Bellisle, A. Diplock, G. Hornstra, P. Verschuren and other scientists.

In the domestic market as semi-finished products for food production offers many concentrates in the form of purees and extracts that contain functional compounds. Their use in the cut products provides rational processing and maximum use of available plant resources, provides high quality products in organoleptic and functional-technological characteristics with specified properties, different purposes and reduce production costs and selling prices [4]. In the production of restaurants and the food industry, the use of pureed semi-finished products made from vegetable raw materials is quite limited [5].

Therefore, the problem of increasing the efficiency of the use of vegetable puree semi-finished products and their use in such products from minced fish and meat mass becomes especially important in the development of the latest technologies of functional foods [6].

The theory of functional nutrition requires a new approach to the development of technologies of functional products, which is based on professional knowledge of nutrition [7]. Substan-

tiation and creation of products containing functionally interdependent ingredients of different nature and construction should be based on reliable facts about their functional impact (taking into account the synergistic and complex action) on metabolic [8] and regulatory functions of the body [9].

Among the variety of consumer products (as objects of enrichment) of special interest to scientists are chopped fish and meat masses, the technology of which allows the introduction of plant supplements [10]. This makes it possible to expand the range of cut products and give them the status of functional products.

The research is based on the idea of creating a semi-finished product based on Jerusalem artichoke and pumpkin with lactulose, which can simultaneously act in the technology of chopped fish and meat products as a technological additive (water-binding component) and as a source of functional ingredients. The research aimed at increasing the nutritional and biological value of fish products, as well as the rational use of raw materials, are relevant, timely and in line with the state policy of Ukraine in the field of healthy nutrition.

Objective of the article is an estimation of indicators of food and biological value of finished goods on the basis of the developed semi-finished products in comparison with traditional cut products.

Presentation of the main study material. The analysis of literature sources shows the rationality of combining animal and plant raw materials in terms of obtaining products of high nutritional and biological value. In addition, it should be noted a very important physiological phenomenon, first discovered by A. Pokrovsky: when combining heterogeneous proteins in the diet, their digestibility almost always improves, which was later confirmed by many researchers on the example of meat and fish, meat-dairy, as well as meat and fish and vegetable systems [11].

Table 1 — Chemical composition of minced products (raw weight)

Name of indicators	Meat minced products		Fish minced products	
	checkup	experiment	checkup	experiment
Dry matter, %	23,2	25,4	21,3	20,7
Proteins, %	13,0	12,8	15,0	14,2
Fat, %	11,0	7,8	5,6	3,7
Carbohydrates, %				
- simple carbohydrates	1,6	traces	1,3	traces
- non-starch polysaccharides	13,6	11,0	14,2	12,5
Starch, %	12,0	traces	12,9	traces
Ash, %	1,42	1,69	1,54	1,87
Energy value, kcal /100 g	211,4	165,4	172,4	140,1

Analyzing the data in table 1, it can be noted that the replacement of the bread component with developed semi-finished product allows you to get low-calorie products against the background of a radical change in the quality of carbohydrate composition. Quite a large discrepancy between the fat content in the control and experimental samples, we explain the different ability of fat absorption of the bread component and vegetable puree.

In addition, we determined the content of calcium, magnesium and phosphorus in developed semi-finished product: for meat minced products it is 40,0; 32,8 and 71,6 mg / 100 g, for fish minced products — 27,9; 25,4 and 45,2 mg / 100 g. To assess the nutritional value is important not so much the absolute content of these elements, as their ratio in these products.

According to the formula of a balanced diet according to FAO / WHO, the optimal ratio of calcium and magnesium is 1 : 0,7 and calcium and phosphorus 1 : 1,5. In meat minced products, these ratios are equal to Ca : Mg = 1 : 0,82 and Ca : P = 1 : 1,79; in fish minced products — Ca : Mg = 1 : 0,91 and Ca : P = 1 : 1,62. As you can see, the actual ratio of macronutrients is not optimal, but it is close to the optimal values. In this regard, we can recommend the release of these products with vegetable garnishes (stewed cabbage, boiled carrots, etc.), which have a reduced ratio of Ca : P, which will balance the dish as a whole.

The term «biological value of proteins» means the effectiveness of food nitrogen utilization in the body to maintain nitrogen balance, which is due to the content of essential amino acids and their absorption.

When combining proteins of different origins, first of all, it is necessary to pay attention to their qualitative characteristics. The effect of true enrichment is achieved only by limiting the mixed proteins to various essential amino acids, their sufficiently high content in the enrichment and compliance with certain proportions when mixing.

In case of violation of one of these conditions, mutual enrichment of proteins may not occur or it will be insufficiently effective [12]. When combining high-protein raw materials with vegetable raw materials with low protein content (in the developed semi-finished product — 1,2...1.4% in terms of raw weight), do not expect enrichment. But important in this regard is the inadmissibility of a significant reduction in biological value, the main chemical indicators of which are the amino acid composition and the rate that can be calculated by determining the content of essential amino acids.

Data from amino acid composition studies are shown in table 2.

Table 2 — Amino acid composition of minced products, g / 100 g of protein

Name of indicators	Meat minced products		Fish minced products	
	checkup	experiment	checkup	experiment
Essential amino acids:	30,68	30,50	34,39	33,04
valine	4,06	4,58	4,12	4,09
isoleucine	4,04	3,92	4,04	4,28
leucine	7,18	6,90	7,83	7,20
lysine	5,60	6,12	6,34	6,85
methionine	1,27	1,29	2,23	2,08
threonine	4,24	3,31	5,11	4,42
tryptophan	1,03	1,06	1,10	0,96
phenylalanine	3,26	3,32	3,62	3,16
Substitute amino acids:	60,23	62,59	57,52	52,71
alanine	7,97	11,56	4,79	4,18
arginine	4,72	5,34	4,72	5,11
aspartic acid	8,42	8,58	9,60	8,03
histidine	2,49	2,48	1,92	1,96
glycine	6,40	6,41	6,41	6,41
glutamic acid	16,58	15,14	16,61	14,43
cystine	1,32	1,38	1,28	1,31
serin	5,66	5,03	6,37	5,42
tyrosine	3,01	3,06	2,87	2,99
proline	3,66	3,61	2,95	2,87
The sum of all amino acids	90,91	93,09	91,91	85,75
Amino acid index	0,34	0,33	0,37	0,39

Using the data in table 2, we calculated the amino acid rates of the control and test samples compared to the standard amino acid scale FAO / WHO. The results of the calculations are shown in table 3.

Analyzing the data in table 3, it should be noted that the test samples have better performance than traditional (control). Experiment meat products are unbalanced in valine and methionine + cystine complex, fish products — only in valine. The balance of the control samples is much lower: in meatballs, five amino acids are limiting, in fish — three.

Conclusions. The indicators of chemical composition of cut products with functional vegetable semi-finished products and their comparison with the indicators of products using traditional filler are studied. It is proved that the developed chopped ones are characterized by low fat and starch content, as well as low caloric content. The amino acid composition of the products was studied, the amino acid score was calculated and the limiting amino acids were determined. The

Table 3 – Amino acid rate of minced products, %

The name of the amino acid	Meat minced products		Fish minced products	
	checkup	experiment	checkup	experiment
isoleucine	101	98	101	107
leucine	103	99	112	103
lysine	102	111	115	125
methionine + cystine	74	76	100	97
phenylalanine + tyrosine	105	106	108	103
threonine	106	83	128	111
tryptophan	103	106	110	96
valine	81	92	82	82

addition of a functional vegetable semi-finished product has been shown to improve the amino acid composition of chopped products by reducing the number of limiting amino acids from five to two in meat products and from three to one in fish products.

The conducted research testifies to the high quality of the developed semi-finished product, which makes it possible to recommend it for use in the production of a wide range of minced meat culinary products. It is especially expedient to include products with the use of the developed semi-finished product in the diets of children and adolescents, ie to supply them to canteens of schools, kindergartens and homes, and it is also recommended for elderly nutrition.

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Мета — оцінка показників харчової і біологічної цінності готових виробів на основі розроблених напівфабрикатів в порівнянні з традиційними посіченими виробами..

Методи. Вміст речовин визначали за наступними методиками: загального азоту — хлорамінним методом (кількість білку знаходили помноженням вмісту загального азоту на коефіцієнт перерахунку 6,25); жиру — екстракційно-ваговим методом Соклета в модифікації Рушковського; вуглеводи — методом Бертрана-Бьєррі; крохмаль — методом гідролізу; золу — спалюванням висушеної наважки у муфельній печі при температурі 450–500 °С; мінеральні речовини — рентгенофлуоресцентним і фотоелектроколориметричним методами.

Енергетичну цінність продуктів визначали за коефіцієнтами Атвотера, прийнявши енергетичну цінність 1 г білка і 1 г вуглеводів — 4,0 ккал, 1 г жиру — 9,0 ккал. Амінокислотний склад дослідних котлет з топінамбуром і контрольних зразків за традиційною рецептурою ми визначали методом рідинної хроматографії за допомогою амінокислотного аналізатора LKB 4151 «Альфа плюс» (Швеція), вміст триптофану — за методом Грехера в модифікації О. І. Єрмакова Амінокислотний індекс (індекс Е/Т) визначали як відношення кількості незамінних амінокислот до загальної кількості амінокислот.

Результати. Вивчено показники хімічного складу посічених виробів з функціональною рослинною добавкою та порівняно з показниками традиційних посічених виробів. Доведено, що розроблені посічені вироби відрізняються зниженим вмістом жиру і крохмалю, а також низькою калорійністю. Вивчено амінокислотний склад виробів, розраховано амінокислотний скор і визначено лімітуючі амінокислоти. Визначено, що використання нового рослинного наповнювача покращує амінокислотний склад фаршевих виробів, знижуючи кількість лімітуючих амінокислот з п'яти до двох в м'ясних виробках і з трьох до однієї в рибних. Перетравність виробів з рослинною добавкою вище, ніж с хлібом, що пояснюється низьким вмістом жиру і крохмалю в виробках на фоні підвищеного — мінеральних сполук і органічних кислот.

Ключові слова: харчова цінність, амінокислотний склад, амінокислотний скор, рослинний напівфабрикат, посічені вироби.