UDC 664.87

TECHNOLOGY AND QUALITY OF FOOD PRODUCTS WITH POWDERS OF HYDROBIONTS

D. Fedorova, Candidate of Technical Sciences, Associate Professor[1], *E-mail*: dina_fedorova@ukr.net
L. Diachuk, Candidate of Philological Sciences, Associate Professor[2], *E-mail*: brousls@ukr.net
K. Palamarek, Candidate of Technical Sciences, Associate Professor[3], *E-mail*: karinkap55@gmail.com
[1]Department of Technology and the Organization of Restaurant Business
[2]Department of Foreign Philology and Translation
Kyiv National University of Trade and Economics, 19 Kyoto str., Kyiv, Ukraine, 02156
[3]Department of Technology and the Organization of Restaurant Business
Chernivtsi Institute of Trade and Economics of KNUTE, 7 Tsentralna Sq., Chernivtsi, Urkraine, 58000

Abstract. The article is focused on researching and developing a technology of new pasty food products based on vegetable and fish raw materials made from powders of hydrobionts. The article presents the results of an experimental study into the effects of both domestic and imported hydrobiont powders on the organoleptic properties and chemical composition of new food products – vegetable paste and fish and vegetable paste. It was experimentally established that the use of hydrobiont powders in the production of pasty food products allows increasing the content of essential nutrients and contributes to the solution of fundamental problems of disorders caused by the deficiency of calcium and iodine, omega-3 PUFA and nutritional fibers in human nutrition. The analysis of experimental data shows that the consumption vegetable paste and fish and vegetable paste products with hydrobiont powders, according to to the recommended nutrition standards for the population of Ukraine, provides from 25 to 123% of daily intake of iodine, from 20 to 30% of calcium and from 6 to 30% of daily intake of essential nutrients – synergists of assimilation of iodine and calcium, which improves their bioavailability and makes it possible to classify such products as prophylactic. The use of semi-finished fish and plant powder products made from domestic fish Gobiidae and hydrobiont powders by Rieber Food Ingredients, a Norwegian company, enables the production of vegetable paste and fish and vegetable paste food products with high organoleptic quality parameters. These new technologies of food products can be recommended for introduction in catering establishments and industrial food production.

Key words: hydrobiont powders, Calcium, Iiodine, vegetable and fish and vegetable paste food products, combined snack foods.

ТЕХНОЛОГІЯ ТА ЯКІСТЬ ЗАКУСОЧНИХ ПРОДУКТІВ ІЗ ПОРОШКАМИ ГІДРОБІОНТІВ

Д.В. Федорова, кандидат технічних наук, доцент[1], *E-mail*: dina_fedorova@ukr.net
Л.С. Дячук, кандидат філологічних наук, доцент[2], *E-mail*: bousls@ukr.net
К.В. Паламарек, кандидат технічних наук, доцент[3], *E-mail*: karinkap55@gmail.com
[1]Кафедра технології і організації ресторанного господарства
[2]Кафедра іноземної філології та перекладу
Київський національний торговельно-економічний університет, вул. Кіото, 19, м. Київ, Україна, 02156
[3]Кафедра технології і організації ресторанного господарства
Чернівецький торговельно-економічний інститут КНТЕУ, Центральна площа, 7, м. Чернівці, Україна, 58000

Анотація. Статтю присвячено розробленню технології нових пастоподібних закусочних продуктів на основі овочевої та рибної сировини з використанням порошків гідробіонтів. У статті наведено результати дослідження впливу порошків з гідробіонтів вітчизняного та імпортного виробництва на органолептичні властивості та хімічний склад нових закусочних продуктів – паст овочевих та рибо-овочевих. Експериментально встановлено, що використання порошків із гідробіонтів у виробництві пастоподібних комбінованих продуктів дасть змогу підвищити вміст есенціальних нутрієнтів та наблизити вирішення проблеми дефіциту Кальцію та Йоду, ω-3 поліненасичених жирних кислот та харчових волокон у харчуванні людини. Аналіз експериментальних даних свідчить, що споживання овочевих і рибо-овочевих паст з порошками гідробіонтів щодо рекомендованих норм харчування населення України забезпечує від 25 до 123% добової потреби у Йоді, від 20 до 30% – у Кальції та від 6 до 30 % добової потреби в ессенціальних нутрієнтах – синергістах засвоєння Йоду і Кальцію, що створює умови для підвищення їхньої біозасвоюваності та уможливлює віднесення таких продуктів до категорії профілактичних. Використання порошкоподібних рибо-рослинних напівфабрикатів з вітчизняної рибної сировини Gobiidae та порошків гідробіонтів норвезького виробництва фірми «Rieber Food Ingredients», дозволяє виробляти пасти овочеві та рибо-овочеві із високими органолептичними показниками якості. Нові технології закусочних продуктів можуть бути рекомендовані для впровадження в закладах ресторанного господарства або промисловому виробництві харчових продуктів.

Ключові слова: порошки з гідробіонтів, Кальцій, Йод, овочеві та рибо-овочеві пасти, комбіновані закусочні продукти.

DOI: http://dx.doi.org/10.15673/fst.v13i2.1403

Introduction. Formulation of the problem

At the present stage of development of food production technologies, special attention must be paid to the production of foods rich in nutrients deficient in Ukrainian diets, in particular mineral elements, vitamins, polyunsaturated fatty acids, edible fibers, etc. Fish and other hydrobionts are a source of easily digestible protein, essential amino acids, polyunsaturated fatty acids and mineral elements. They belong to the category of healthy food due to high content of biological active substances that reduce blood viscosity, reduce blood pressure, have detoxifying, antioxidant properties, strengthen the cardiovascular system and increase the overall resistance of the body to infectious diseases and adverse environmental effects [1]. Nowadays, the topical issue is the enrichment of food products with deficient iodine and calcium compounds, omega-3 polyunsaturated fatty acids (PUFAs), antioxidant substances by developing and introducing new culinary products containing hydrobionts. Such products can improve metabolism, weaken the processes of sensitization of the body and increase its resistance to adverse environmental factors in order to preserve human health and enhance the ability to work [2,3].

Pasty snack products are very popular among consumers. Spread and paste are a homogeneous fine-grained mass, with a pasty consistency, pronounced taste, delicate aroma, high degree of readiness and convenient in consumption. A large proportion of semi-finished products on the domestic market is represented by spread and paste on the basis of cheese products, bird liver, walleye pollack, liver and caviar of bank cod, sprats.

Affordable for mass consumers, snack foods are limited by a range of sandwich pastes based on cheese products and spreads with low nutritional value. They are characterized by a high content of saturated fat and low content of proteins, food fibers, minerals and vitamins. In this regard, this research establishes the relevance of expanding a range of available food products of high nutritional value which contain essential nutrients.

Topical issues concerning the improvement of technology of food products are the use of vegetables and fish, introduction of alternative types of additional raw materials – hydrobiont powders, which will increase the nutritional value of products, in particular the content of essential nutrients – essential amino acids, mineral elements, omega-3 polyunsaturated fatty acids, vitamins, etc.

Analysis of recent research and publications

The issue of food technology of high nutritional value with hydrobionts presents a scientific and practical interest and it does not lose its relevance, as evidenced by the studies of domestic and foreign researchers: L.S. Abramova, T P. Kalynychenko, T.K. Lebska, T.M. Safronova, V.D. Bohdanova, S.V. Zhuravlova, Zh.G. Prokopets and others. However, the existing data available today to assess the quality and the possibility of rational use of hydrobiont powders in the production of combined pasty snack products is rather fragmentary and needs to be clarified. In this regard, search for raw sources of hydrobionts and development of innovative technologies for pasty snack products of high nutritional value are particularly relevant.

Theoretical and experimental research into creation of pasty snack products was carried out by many authors, in particular L.S. Abramova developed technologies of emulsion products on the basis of fish cream obtained by emulsifying fish soup with a structure-forming agent – sodium alginate, using laminaria and fish caviar. Finished products have minimal deviations from the PDCAAS by FAO [4,5].

S.V. Zhuravlova justified and developed a technology of pasty snack products using lactic acid microorganisms on the basis of muscle tissue of industrial fishes, which allows obtaining food products of probiotic purpose [6]. S.V. Zhuravlova and Zh. G. Prokopets developed a technology of pasty fish products using an active culture of microorganisms Lactobacterium Acidophillum. The resulting pasty snack foods – Pastes "Zhemchuzhyna", "Okeanichna", "Koryvka" are characterized by a high content of proteins – 13–16%, lipids – 9.2–9.7%, minerals – 1.27–1.33%, have a moderate energy value – 143–152 kcal [7]. However, these products do not contain a plant component, which can be considered as a certain disadvantage in the context of modern approaches to production of combined fish and plant products. Moreover, the content of calcium and phosphorus in them is low and does not exceed 6.5% of the average daily intake requirement.

A number of other researchers developed a technology for pasty products based on fish. S.N. Tashkevych developed a technology of production of paste-type preserves and preserves of blanched squid in various sauces [8]. T.P. Kalynychenko scientifically and experimentally established a technology of production of pasty salty products made from pink salmon and non-standard pollock's caviar on the basis of stimulation of proteolysis [9]. L.B. Dzantiyeva suggested a method of preparation of fish paste that allows, without preservatives, to produce finished fish paste products, in particular from low-value fish, with a long shelf life and high organoleptic properties, which allows to improve the production process, i.e. to reduce the length of a technological cycle [10] .

However, there is practically no data on the influence of dry products of processing hydrobionts (powders) on technological properties of pasty snack products on the basis of fish and plants; there is neither data on the biological value and digestibility of such products, nor evidence-based recommendations for a technology of use of hydrobiont powders in production of fish and vegetable pasty snack foods. That is why the work in this area has considerable scientific and practical value. Due to valuable chemical composition of fish raw materials, in particular high content of proteins,

polyunsaturated fatty acids and mineral substances, it is important to use the products of its complex processing in production of culinary products, which makes it possible to comprehensively improve their nutritional value and provide a positive physiological effect on the body. Due to a high content of bone tissue, products of complex fish processing have high mineral concentration, predominantly of calcium and phosphorus. Calcium is a scarce mineral nutrient in the diet, in particular in case of high psychoemotional and static pressure, hypodynamia, etc., which are typical for Ukrainians [11,12]. Some researchers argue that inadequate intake of calcium with food in the human body is one of the causes of osteoporosis, and its low levels in blood deteriorate the course of the disease, and disrupts bone marrow modeling [13]. Current situation requires healthy food products enriched with bioorganic compounds of calcium.

This forward-looking scientific and practical direction is the creation of combined food products based on a combination of fish and plants. The raw material for production of fish and plant products includes low-value commercial species or food waste from fish-processing industries. Saturation of the market with competitive products, their cost reduction, expansion of the product range on the basis of modern biotechnologies, use of non-traditional additives of high nutritional value are the main areas of development of technology of fish and plant products. From a modern scientific point of view, the development of new technologies of healthy food products with powders of hydrobionts as protein-mineral enrichers is relevant for both food industry and restaurant industry.

Monitoring of water bioresources in Ukraine indicates significant volumes of extraction (up to 30 thousand tons – 35% of the total annual production of aquatic biological resources), mixed by its species composition of catches of small fish, which include bullheads, sprats, bass fish of the second and third groups that do not find proper sales market [14]. Traditional processing technologies of this raw material do not allow to receive high-quality culinary products due to a significant amount of bones and low output of the muscular part. This determines the necessity to create technologies for integrated processing of the given fish; its introduction, while reducing the dependence on the external market, will reduce waste, allow for more efficient use of fish resources, reduce costs and improve the efficiency of fish-based food production.

As a result of multidisciplinary research, the technology of dry fish powder and plant semi-finished products was developed on the basis of complex processing of small fish stocks of Gobiidae in a complex with plant products (cellulose of wheat bran and flaxseeds), which are obtained by the method of step convection drying [15,16]. It was found that semi-finished products are characterized by a high content of protein substances (55.83–62.02%), balanced by the amino acid composition, containing 2.6–3.8% calcium and 12.26–31.64% omega-3 PUFAs from the total mass of lipids [17,18]. It is known that omega-3 PUFAs play an important role in vital functions of the human body; in particular, they participate in the formation of cell membranes of all organs and tissues (brain, visual analyzer, cardiomyocytes, platelets, etc.), synthesis of tissue hormones – eicosanoids (prostaglandins, prostacyclin, thromboxanes and leukotrienes) that regulate local cell and tissue processes, including inflammatory reactions, thrombocytes, leukocytes and erythrocytes, constriction and dilation of blood vessels, etc., normalize lipid blood spectrum [19]. The results of clinical studies by C. von Schacky et al. (1999), A.T. Erkkila et al. [20] demonstrate that a diet with sufficient consumption of omega-3 PUFAs from fish products contributes to slowing the progression of angiographically confirmed coronary atherosclerosis. As structural components of cellular biological membranes, omega-3 PUFAs have a direct influence on the fluidity of the lipid biolayer, membrane permeability; membrane-bound enzyme activity and functioning of membrane receptors and identification of antigens and electrophysiological properties of membranes [19,20].

The use of fish and plant semi-finished products from Gobiidae powder in the production of combined snack foods will increase the content of essential amino acids, omega-3 PUFAs, mineral elements, in particular calcium, phosphorus and magnesium, protein-bound iodine, B vitamins and other biologically valuable substances, and it will also provide it with certain functional properties for health-improving effect on the human body. In addition to that, the presence of certain functional and technological properties of dry fish and semi-finished plant products allow them to be used in technologies of combined snack foods as components connecting water in a heterogeneous system in order to provide it with certain functional and technological properties [17]. In semi-finished foods technology, powders of hydrobionts of domestic origin [17] and foreign, produced by Rieber Food Ingredients [21], were used to increase the nutritional value, expand the range and improve quality of the finished cuisine. Natural powders, made by the Norwegian company Rieber Food Ingredients from fish and sea shellfish, are used to produce a wide range of finished products [21].

Hydrobiont and laminaria powders are characterized by sufficiently high functional and technological characteristics – the ease and simplicity of use in the technological flow, possibility of uniform distribution within the product, as well as the ability to form a homogeneous structure of food compositions of pastes. Seaweed has been used for a long time in popular nutrition in many countries of the world, considered a source of unique naturally occurring nutrients. They contain (on a dry basis) organic matter (77–86%): cellulose (12.3–21.3%); nitrous compounds (6.5–38%); pectin (10–15%); alginic acid (15–381%); mannitol (4–18%); mineral substances (14–23%) [22,23].

Given the increasing effectiveness of hyposensibilizing nutrition, it is necessary to introduce certain measures for processing of such useful types of domestic vegetable raw materials as vegetables and leguminous crops, which would allow improving the digestive processes and promoting the expansion of the range of snack foods. It is assumed that the main structural elements of fast-food pastry products will be polysaccharide fibers of vegetable raw materials and protein substances made of fish raw materials, cheese products, which simultaneously serve as structural formers. The technology of similar products of adjustable pasty structure involves the production of vegetable puree (from carrots, beets, pumpkins, artichokes, etc.), which, in an amount not less than 70%, is sometimes mixed with a protein component (milk processing products – protein concentrate, dry whey, cottage cheese, bryndza, soft cheeses), fatty components and flavoring and coloring agents, are subjected to culinary processing; this allows to obtain products of a given consistency [24-26]. The research outlines possible prospects of using dried products of processing of fish raw materials in technologies of pasty snack products on the basis of plant and fish raw materials for increasing its nutritional value and expanding product assortment. It would improve the quality of pasty snack foods, which can be recommended for both mass and dietary nutrition.

The aim of the paper is to develop technology and research into the quality of semi-finished powdery products based on vegetable and fish and plant raw materials using hydrobionts from domestic bass fish Gobiidae and those produced by Norwegian "Rieber Food Ingredients" from laminaria powder, which provides high consumer properties of finished products; it will provide the ability to resolve the problem of deficiency of calcium and iodine, omega-3 PUFA and nutritional fibers in the diet.

Research tasks:

1. To investigate the chemical composition of powders based on small fish of Gobiidae (domestic production) and powders of hydrobionts manufactured by the Norwegian company Rieber Food Ingredients (imported); to prove the expediency of their use in the technology of snack products.

2. To develop the recipes and technologies of pasty food products on the basis of vegetable and fish and plant raw materials using hydrobionts from Gobiidae domestic fish and those produced by the Norwegian company Rieber Food Ingredients, to study the chemical composition, organoleptic quality parameters of the developed products.

Research materials and methods

The object of research is the technology of pasty food products based on vegetable and fish and plant raw materials made from powders of hydrobionts. The subject of research is vegetable and fish and plant pastes of snack foods with powders of hydrobionic. The raw material used in these food products included: fresh carrot according to DSTU 7035:2009, beet – DSTU 7033:2009, beans – DSTU 292-91, fresh pumpkin fruits – DSTU 3190-95, fresh apples – GOST 21122-75, fresh spinach – RST USSR 306-89 , small frozen fish corresponding to the requirements of the SOU 15.2-34821206-033: 2010 (GOST 15-25-98), dill greens – RST USSR 304-89, edible salt – DSTU 3583: 2015, dry fish-plant semi-finished products - according to TU U 10.2-40220843-003: 2016 "Fish, products made from meat of fish, fish and molded caviar, caviar, milt, fish skin, seafood jerky, dried-smoked, dried, dry fish and plant semi-finished food products, powders of hydrobionts by Rieber Food Ingredients – according to the State Sanitary and Epidemiological Examination and ISO 14001:2004, Rieber Food Ingredients №05.03.02-03/127211, food laminaria powder – TU 15-1 206-79, milk cheese – DSTU 4554:2006, cheese – according to DSTU 4421, DSTU 6003, dairy whey DSTU 4552: 2006, butter – DSTU 4399:2005, fresh onion DSTU 3234-95, spices (black pepper melted, paprika, coriander) – GOST 29050-91, DSTU 7411:2013, ISO 7540:2006. ISO 6575:1982, inactivated yeast – according to the conclusion of the State Sanitary and Epidemiological Examination and ISO 14001:2004.

Sampling and preparation for analysis were conducted according to DSTU 7972:2015. The moisture content of the samples was determined according to DSTU 8029:2015, the content of ash was determined by burning the sample at 400–500ºC, the content of total protein and of non-protein nitrogen was determined by the Kjeldahl method according to DSTU 8030:2015. The amount of protein nitrogen was determined as the difference between total and non-protein nitrogen. The weight fraction of fat, in terms of dry matter, was determined by the Soxhlet extraction method. The mineral composition was determined with the atomic absorption spectrophotometer AAS-30. Vitamins were determined by standard methods [27].

The chemical composition and nutritional value of powders of hydrobionts are given in Table 1.

To determine the optimal content of hydrobiont powders in pasty food products, the model compositions were developed and experimental batches of semi-finished products were produced. Thus, we were tasked with the design of recipes of fish and plant and vegetable pastes with given organoleptic parameters that maximally satisfy the requirements of a balanced composition of iodine and its synergists [29,30] and which have rheological properties optimal for pasty masses. The criteria for optimization is organoleptic evaluation, the content of iodine synergists and physical and chemical parameters (marginal shear stress, adhesion) [31,32]. Control samples of vegetable pastes were made according to the formula of vegetable paste for functional

purpose [33], fish and vegetable pastes – according to the recipe of fish paste [34]. Investigation of organoleptic, functional and technological indicators of quality and the chemical composition of developed vegetable and fish and vegetable paste were studied by generally accepted methods [35-38].

Table 1 – Chemical composition of powders of hydrobionts, per 100 g

Name of indicator	Hydrobiont powders					
	Domestic production according to TU U10.2-40220843-003:2016 (own research)		Norwegian production by Rieber Food Ingredients [21, 28]			
	NRVHL*	NRV*	shrimps	pollocks	crabs	bank cod
Weight fraction of moisture,%	8.2	7.8	5.00	5.00	5.00	5.00
Crude protein,%	62.1	61.7	57	63	40	45
Crude fat,%	6.8	5.1	12.00	4.50	7.00	3.50
Starch,%	2.4	3.8	-	-	-	-
Crude fiber,%	8.6	8.7	-	-	-	-
Ash,%	11.2	11.8	20.00	21.00	36.00	8.00
Energy value, kcal	319.2	307.9	280	178	125	185
Mineral substances and vitamins:						
Calcium,%	3.38	3.13	3.50	1.20	1.20	0.65
Phosphorus,%	1.5	1.5	1.1	4.4	0.5	1.1
Potassium,%	0.4	0.4	13.7	1.8	0.6	1.6
Magnesium,%	0.27	0.32	0.40	0.35	0.25	0.20
Zinc, mg	1.09	1.14	0.55	0.70	0.24	0.28
Selenium, µg	16	17	200.00	150	20000	100.00
Iodine, µg	11.2	12.6	110.0	150.0	150.0	135.0
Thiamine, mg	1.05	1.0	0.31	0.20	1.00	0.47
Riboflavin, mg	0.87	0.85	3.00	4.00	3.00	3.00
Vitamin E, mg	1.84	1.13	11.98	1	58.53	4.85

*Note: NRL is a dry fish and plant semi-finished product (powder) based on minced meat from blanched fish raw Gobiidae and wheat bran; NRVHL is a dry fish and plant semi-finished product (powder) based on minced meat from hydrolyzed Gobiidae fish heads and wheat bran with flaxseed fibers.

Results of the research and their discussion

The design of the recipes of vegetable and fish and vegetable pastes with hydrobiont powders were carried out in view of the implementation of their technological and organoleptic properties, due to the introduction of plant components (pumpkin, beet, carrot, apple, beans, spinach purees, hydrated laminaria), and protein ingredients (bryndza, fat-free cheese, hydrated powders), as well as flavoring agents, which, according to the outlined scientific hypothesis, will provide high nutritional and biological value for the product.

The preliminary analysis determined the expediency of the combined use of vegetable (pumpkin, beet, carrot, apple, beans, spinah purees, hydrated laminaria) and protein ingredients (bryndza, fat-free cheese or soft fried cheese, hydrated powder from cod and sauces, shrimp and crabs), as well as inactivated yeast in vegetable paste, which, according to the outlined scientific hypothesis, will ensure a high level of iodine assimilation [39]. The creation of a technology of vegetable pastes requires the usage of pumpkin-apple, carrot-beet, spinach-carrot-beet-pumpkin, carrot-beet-apple-bean purees as the main component and iodine-containing raw materials (hydrated laminaria and hydrobiont powders), bryndza and cottage cheese – as additional [40]. The results of the study of the chemical composition of dry laminaria determined the expediency of using it in composition of combined pastes, based on high content of organical bound iodine, micronutrient elements, sufficiently large volume of production, availability on the market and the possibility of widespread use in culinary technologies [41]. The use of 0.2 to 1.0% dry laminaria powders will allow for 50 to 200% of the physiological daily iodine intake requirement for different segments of the population.

The main protein-containing components were used in the recipes of fish-plant pastes – small blanched fish raw and additional components such as fat-free cottage cheese or soft fried cheese, hydrated powders of hydrobionts and laminaria; carbohydrate-containing plant components – potatoe, carrot, beet, and beans purees; fat-free components – butter (Table 2). It was experimentally determined that the optimal amount of hydrobionts powders in the composition of the developed combined food pastes is 9% (Rieber Food Ingredients) and 6% (dry fish and plant semi-finished products from Gobiidae) [40,41].

Previous studies found that the introduction of hydrobiont powders do not allow to obtain a homogeneous consistency paste: due to high hygroscopicity of hydrobiont and laminaria powders form lumps, which, even with prolonged mixing, are unevenly distributed in the paste. The research determined the dependencies of technological and structural and mechanical properties of hydrobionts and laminaria powders on the hydromodule and duration of

swelling [42]. Research results show that an increase in the hydromodule of laminaria powder: inactivated yeast and powders of hydrobionts: water of more than 1:4 and 1:5, respectively, leads to a decrease in the values of structural and mechanical characteristics of the pastes. The conducted research established that the highest strength properties are registered in case of the hydromodule laminaria powder: inactivated yeast 1:4 and the duration of swelling $3 \cdot 10^2$s and hydrobiont powder: water 1:5 and the duration of swelling $6 \cdot 10^2$s [42].

Table 2 – Recipes of fish and vegetable paste made from powders of hydrobionts

No	Name of raw materials	Consumption of raw materials (net weight) per 1000 g of finished products, g						
		Paste "Berdianska" with beans and NRV	Paste "Berdyanska" with cheese and NRV	Paste "Berdyanska" with beet and NRVHL	pumpkin-apple-cheese paste with shrimp powder	carrot-beet-cheese paste with pollack powder	spinach-carrot-beet-pumpkin paste with crab powder	carrot-beet-apple-bean paste with bank cod powder
1	Fish (blanched fish meat)	280	280	280	-	-	-	-
2	Semi-finished dry fish-plant (powder) (NDV, NNWGL)	75	75	75	-	-	-	-
3	Milk	165	165	165	-	-	-	-
4	Onion	80	80	80	-	-	-	-
5	Carrot	100*	100*	100*	-	-	-	-
6	Bean	110**	-	-	-	-	-	-
7	Cheese (Bryndza)	-	110	-	80	80	80	80
8	Beet	-	-	110	-	-	-	-
9	Oil for pan frying	50	50	50	-	-	-	-
10	Smoked fish fillet	30	30	30	-	-	-	-
11	Salt	15	15	15	-	-	-	-
12	Butter	160	160	160	-	-	-	-
13	Black pepper powder	1	1	1	-	-	-	-
14	Coriander powder	2	2	2	-	-	-	-
15	Hydrated powder made from laminaria	-	-	-	30	30	30	30
16	Hydrated powder made from hydrobionts	-	-	-	480	480	480	480
17	Pumpkin-apple puree	-	-	-	330	-	-	-
18	Carrot-beet puree	-	-	-	-	330	-	-
19	Spinach-carrot-beet-pumpkin puree	-	-	-	-	-	410	-
20	Carrot-beet-apple-bean puree	-	-	-	-	-	-	410
21	Cottage cheese	-	-	-	80	80	-	-
Weight of finished products		**1000.0**	**1000.0**	**1000.0**	**1000.**	**1000.**	**1000.0**	**1000,0**

* weight of peeled and fried carrots; ** weight of boiled beans, beets

According to the results of the study of the functional and technological properties of dry fish and plant semi-finished products from Gobiidae, it is justified to carry out their hydration in water, milk or milk whey at a temperature of 20±2ºC and a hydromodule 1:4 during (8–10)•60s at the rotational speed of the working organ 1.2 S^{-1} before their use in the production of culinary products [43]. This allows for the uniformity of their dispersion in food systems and high organoleptic characteristics of the finished product. The conducted researches allowed to develop the product formulation and technological process of production of vegetable and fish and vegetable paste with hydrobionts, which is established in technological instructions (TU U 10.8-3162124072-001:2016 "Ready dishes, side dishes, desserts, sauces, drinks and semi-finished dishes", TU U 10.8-05476322-002:2013 and TI "Cooking products. Rolls with vegetable fillings"). The results of experimental studies formed the basis for the development of a technological scheme for the production of vegetable and fish and vegetable pastes with different fillings and powders of hydrobionts (Fig. 1).

For the preparation of vegetable paste, cottage cheese is pulpified, bryndza is grated and combined with vegetable puree, with hydrated powders of laminaria and hydrobionts. All ingredients are stirred for $\tau = (7–8)\cdot60$ s in the MSP II-I mixer at the rotation frequency of the working organ $\omega=6.2\ S^{-1}$ (Fig. 1).

To prepare fish and vegetable paste, small fish is washed in water and passed through a meat-bone separator for separating meat, which is steam blanched at a temperature of 80–85°C for (8–10)·60 s, cooled to a temperature of 20±2°C and combined with vegetable puree, cottage cheese, grated spreadable processed cheese, softened dairy butter and hydrated powders of laminaria and hydrobionts.All ingredients are stirred for $\tau=(7–8)\bullet60$ s in the MSP II-I mixer at the rotation frequency of the working organ $\omega=6.2\ S^{-1}$, packaged in consumer containers weighing no more than 0.25 kg, or sold as custom dishes – cold snacks in restaurants.

The organoleptic parameters of vegetable and fish and vegetable pastes were studied using powders of hydrobionts (Fig. 2). To determine the organoleptic characteristics of vegetable and fish and vegetable pastes with hydrobionts, a sensory assessment scale was developed, which is presented graphically in the form of separate descriptors for organoleptic profilographs, where the quantity of each of the components of the organoleptic evaluation was scored on a 50-point scale [38]. The results of sensory studies indicate an improvement in color, taste and appearance, namely, the improvement of the naturalness and balance of the taste of vegetable and fish and vegetable pastes with powders of hydrobionics (Fig. 2).

According to the scientific principles of creation of culinary products with biologically active substances, a technology of their production must ensure maximum preservation of these substances in the enriched products. To confirm the effectiveness of the developed technology, the chemical compositions of products were investigated. The nutritional values of vegetable and fish and vegetable pastes with powders of hydrobionts were examined (Table 3).

The analysis of the nutritional value of fish and vegetable pastes (Table 3) shows an improvement in the quality of the chemical composition, in particular, an increase in the content of complete proteins in paste in the amount of 3.6–8.2 times compared with control samples due to the use of hydrobiont powders, fish raw materials and cheese products. The total fat content in fish and vegetable paste is 1.9–3.2 times lower than the control. In this case, the developed pastes with hydrobionts contain 0.13–0.16% ω-3 PUFA, which indicates an increase in the biological efficiency of fats in these products. Another positive result is the presence of 1.13 to 3.05% of food fibers in the composition of fish and vegetable paste, which allows to provide 5–12% of their average daily intake requirement.

The mineral composition of vegetable and fish and vegetable pastes with powders of hydrobionts is investigated (Table 4).

The results of the conducted studies (Table 3) showed high content of calcium, potassium, phosphorus, magnesium, zinc and iodine in the developed vegetable and fish and vegetable pastes. The addition of hydrated laminaria in yeast extract, hydrobionts powders, cheese and vegetable raw materials into test samples of vegetable pastes made it possible to increase the content of mineral elements in them (Table 4). For example, experimental samples of vegetable paste contained 3 times more iodine than the control, 1.2-2.3 times more zinc. Test samples of paste contain 2.5–4.0 times more calcium than in the control, due to the addition of hydrobionts powders, vegetable bryndza and cottage cheese. The developed vegetable pastes with hydrobionts contain 281.8–430.98 mg of calcium, which allows to provide 23–36% of its daily intake requirement, and 185–190 μg iodine, which allows to provide 123–127% of its daily intake requirement (Table 4).

The analysis of the mineral composition of fish and vegetable pastes (Table 4) shows an increase in calcium content in paste from 67.5 mg in the control to 282.3-325.6 mg in the experimental samples, which is due, above all, to the use of hydrobiont powders, which contain hydrolyzed bone tissue of Gobiidae fish raw material. Adding 6% of dry fish and plant semi-finished products to the total mass of fish and vegetable paste can provide 20–30% of daily calcium intake in them, 11–13% in magnesium, 9–12% in phosphorus, 8–12% in ferum, 3–7% in selenium, and 25–27% in iodine (Table 4).

The content of vitamins and vitamin-like compounds in vegetable and fish and vegetable paste with hydrobiont powders were investigated (Table 5).

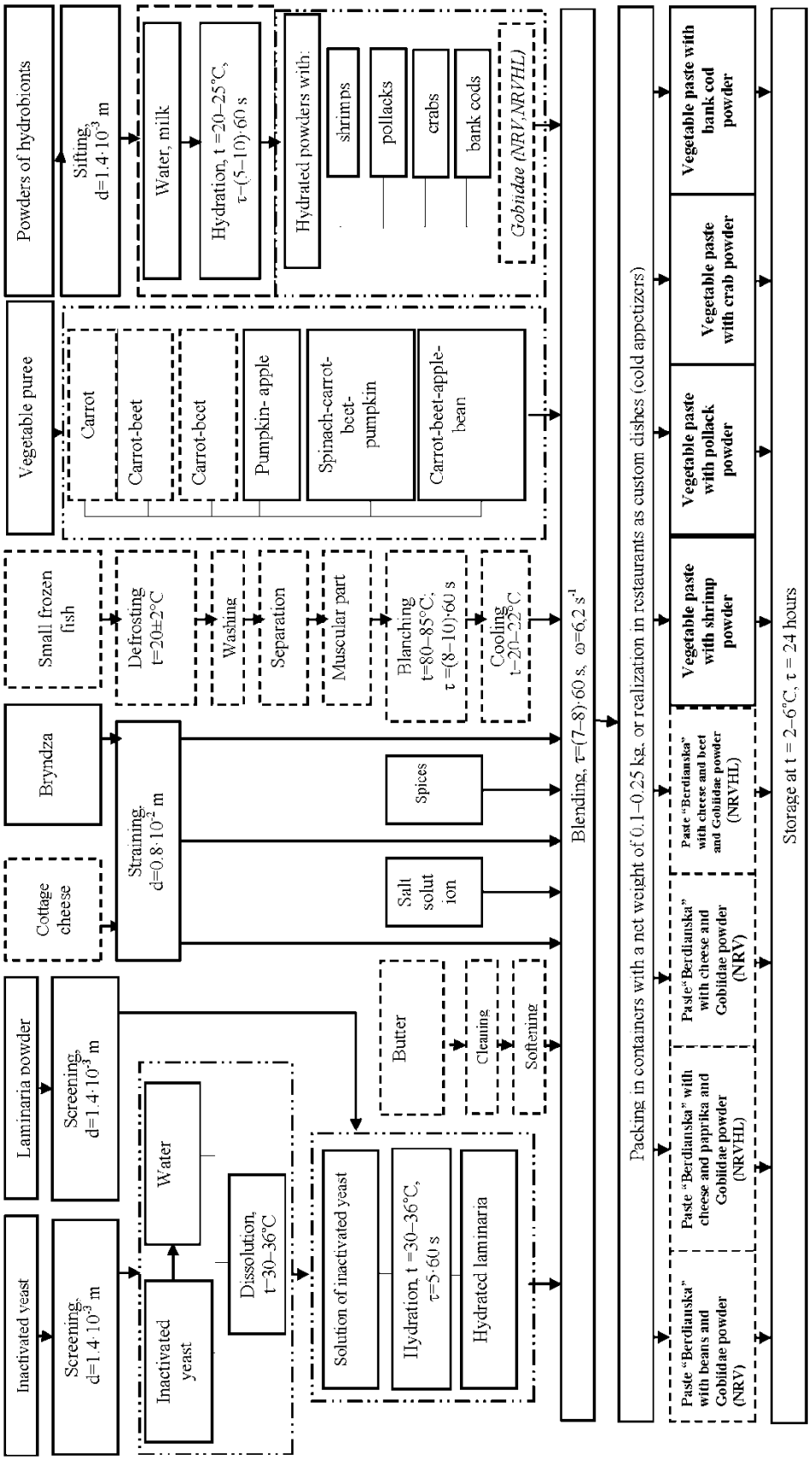
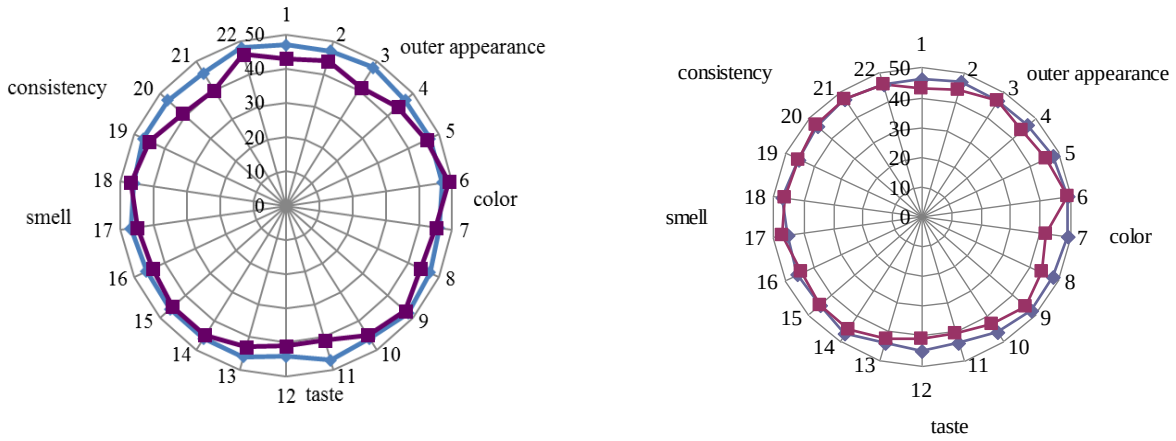


Fig. 1. Technological scheme of production of vegetable and fish and vegetable paste with hydrobionts: fish and vegetable paste; vegetable paste



a) Vegetable paste b) Fish and vegetable paste

Fig. 2 Profiles of organoleptic quality assessment of vegetable and fish and vegetable pastes with hydrobiont powders:

Experiment: a) carrot-beet-cheese paste with pollack and laminaria powder; b) paste "Berdyanska" with cheese and paprika and Gobiidae powder (NRV)

Control: a) vegetable paste of functional purpose [33]; b) fish paste "Admiral" by Private Company "Silver Food".

With the distinguishing of the appropriate descriptors:

outer appearance: 1 – smooth surface; 2 – presence of lustrous surface; 3 – absence of pressed moisture; 4 – absence of winding areas; 5 – absence of lumps; color: 6 – homogeneity; 7 – saturation; 8 – naturalness; 9 – conformity with the type of raw material used; taste: 10 – saturation; 11 – cleanliness; 12 – naturalness; 13 – balance; 14 – conformity with the type of raw material used; smell: 15 – saturation; 16 – purity; 17 – naturalness; 18 – conformity with the type of raw material used; consistency: 19 – homogeneity; 20 – plasticity; 21 – spreadability; 22 – fine dispersity.

Table 3 – Nutritional value of vegetable paste and fish and vegetable paste with powders of hydrobionts, per 100 g

Name of sample	Crude protein, g	Fat, g	omega-3 PUFAs	Carbohydrates, g	Aood fibers, g	Energy value, kcal
Vegetable pastes						
Control [1]	1.72	2.1	-	10.01	3.64	65.92
Pumpkin-apple-cheese paste with shrimp and laminaria powder	12.42	3.94	0.15	2.51	1.13	68.33
Carrot-beet-cheese paste with pollack and laminaria powder	12.69	3.31	0.16	3.45	1.47	67.74
Spinach-carrot beet-pumpkin paste with crab powder and laminaria	8.57	3.42	0.16	3.49	1.62	55.97
Carrot-beet-apple-bean paste with bank cod powder and laminaria	14.11	3.14	0.16	11.31	3.05	100.71
Fish and vegetable pastes						
Control [2]	5.9	46.1	-	3.7	-	453.3
Paste "Berdianska" with beans and NDV	24.4	17.2	0.14	8.2	2.6	270.4
Paste "Berdianska" with cheese and NRV	28.6	15.5	0.13	4.7	1.5	262.7
Paste "Berdianska" with cheese and paprika and NRVHL	19.8	23.7	0.13	5.2	1.9	301.7
Paste "Berdyanska" with beet and NRVHL	19.0	22.6	0.13	7.7	1.8	294.6

Control [1] – vegetable paste of a functional purpose; Control [2] – "Admiral" fish paste by Private Company "Silver Food"

Table 4 – Mineral composition of vegetable and fish and vegetable pastes with powders of hydrobionts, g (µg)/ 00 g

Name of sample	Calcium, mg	Magnesium, mg	Ferum, mg	Potassium, mg	Phosphorus, mg	Copper µg	Iodine, µg	Zinc, µg	Selenium, µg
	Vegetable pastes								
Control [1]	107.09	26.0	1.06	228.06	77.1	73.81	60.26	180.65	10
Pumpkin-apple-cheese paste with shrimp and laminaria powder	430.98	44.36	2.65	232.64	214.05	425.36	185.01	200.65	23.24
Carrot-beet-cheese paste with pollack and laminaria powder	249.52	50.28	2.49	277.97	478.91	292.8	189.16	270.14	17.59
Spinach-carrot beet-pumpkin paste with crab powder and laminaria	353.71	44.88	1.66	467.8	234.86	298.3	189.15	225	17.16
Carrot-beet-apple-bean paste with bank cod powder and laminaria	281.78	42.93	3.57	369.0	239.59	186.9	190.1	261.68	12.41
	Fish and vegetable pastes								
Control [2]	67.5	10.2	0.22	-	2.3	-	-	-	-
Paste "Berdianska" with beans and NRV	325.6	52.3	1.78	94.6	143.7	107.5	39.7	75.3	5.2
Paste "Berdianska" with cheese and NRV	310.4	46.3	1.56	87.3	112.3	99.5	41.2	65.6	2.0
Paste "Berdianska" with cheese and paprika and NRVHL	282.3	44.0	1.23	66.3	109.5	118.2	38.3	60.4	2.6
Paste "Berdyanska" with beet and NRVHL	290.7	45.6	1.45	96.0	110.6	136.8	38.3	69.7	4.8

Control [1] – vegetable paste of a functional purpose; Control [2] – "Admiral" fish paste by Private Company "Silver Food".

Table 5 – The content of vitamins and vitamin-like compounds in vegetable pastes and fish and vegetable pastes with hydrobiont powders, mg (µg)/100 g

Sample	Thiamine (vitamin B1), mg	Riboflavin (vitamin B2), mg	Niacin (vit B3), mg	Pantothenic acid (vitamin B5), mg	Pyridoxine (vitamin B6), mg	Folacin (vitamin B9), µg	Cyanocobalamin (vitamin B12), µg	β-carotene, mg
Vegetable pastes								
Control [1]	0.06	0.06	1.12	0.13	0.06	3.4	-	1.4
Pumpkin-apple-cheese paste with shrimp and laminaria powder	0.5	0.65	8.0	0.5	0.48	73.52	0.99	1.4
Carrot-beet-cheese paste with pollack and laminaria powder	0.49	0.72	7.94	0.54	0.52	67.55	0.83	2.0
Spinach-carrot beet-pumpkin paste with crab powder and laminaria	0.5	0.63	7.8	0.52	0.46	72.08	0.89	1.7
Carrot-beet-apple-bean paste with bank cod powder and laminaria	0.5	0.62	8.3	0.53	0.59	76.29	1.05	2.0
Fish and vegetable pastes								
Control [2]	0.01	-	0.2	0.1	-	-	-	-
Paste "Berdianska" with beans and NDV	0.44	0.53	6.7	0.69	-	22.4	-	1.8
Paste "Berdianska" with cheese and NRV	0.39	0.38	5.5	0.57	-	13.6	-	1.7
Paste "Berdianska" with cheese and paprika and NRVHL	0.32	0.37	4.6	0.50	-	9.1	-	1.5
Paste "Berdyanska" with beet and NRVHL	0.41	0.48	6.3	0.62	-	9.7	-	1.5

Note: Control [1] – vegetable paste of a functional purpose; Control [2] – "Admiral" fish paste by Private Company "Silver Food".

It was established that the content of certain vitamins (Table 5) in experimental samples exceeds that in the control due to the use of hydrobiont powders (from pollack, shrimp, crabs and cod), vegetable raw materials (carrots, beets, pumpkins, apples, spinach, beans, laminaria), and yeast extract. Thus, the content of vitamin B6 in the developed vegetable pastes exceeds control by 9.6; 10.4; 9.2 and 11.8 times; vitamin B2 – respectively by 10.3-12 times; Vitamin B9 – 20.5–23.1 times.

The content of investigated vitamins in fish and vegetable pastes is also higher than in the control (Table 5). Thus, the content of vitamin B1 in the developed fish and vegetable paste exceeds that in the control by 32-44 times; vitamin B3 – by 23–33.5 times, vitamin B5 – by 5–6.9 times, they contain 0.37–0.53 mg of vitamin B2, and 1.5–1,8 mg of β-carotene.

Conclusion

The results of the conducted research demonstrated the expediency of using hydrobiont powders in order to improve the nutritional value of snack foods based on vegetable and fish and vegetable raw materials. The introduction of new technologies in production will allow to obtain vegetable and fish and vegetable pastes with hydrobiont powders with increased content of proteins, polyunsaturated fatty acids, mineral elements, in particular calcium, phosphorus, magnesium, iodine, food fibers with new flavoring properties, improved qualitative characteristics, which will allow to use more rationally domestic small fish raw material (Gobiidae), which is not used in production of culinary and confectionery products. Within the segment of mass and social catering, it will also allow to expand the range of affordable protein-based snack culinary products, to improve the provision of the population of Ukraine with fish products, high-grade protein and bioavailable calcium, and to increase the food security of the country. The analysis of experimental data shows that the consumption of vegetable and fish and vegetable pastes with hydrobiont powders, according to the recommended nutrition standards for the population of Ukraine, provides from 25 to 123% of daily intake in iodine, 20–30% in calcium and 6–30% of daily intake requirement in essential nutrients – synergists of assimilation of iodine and calcium (vitamins B, magnesium, phosphorus, ferum, zinc, copper, selenium), which creates conditions for increasing their bioavailability and makes it possible to classify such products as prophylactic.

List of references:

1. Парац А. М. Гігієнічна оцінка морських водоростей і харчових продуктів з ними, як засобів мінімізації дії радіації та ендемії : автореф. дис. на здобуття наук. ступеня канд. мед. наук : 14.02.01. «Гигиена». Київ : Ін-т гігієни та мед. екології ім. О.М. Марзеєва, 2004. 20 с.
2. Смоляр В. И. Рациональное питание. Київ : Наук. Думка, 1991. 368 с.
3. Haldimann M., Blanc A., Blondeau K. Iodine content of food groups. Journal of Food Composition and Analysis. 2005. Vol 18, № 6. P. 461–471. https://doi:10.1016/j.jfca.2004.06.003
4. Абрамова Л.С., Радыгина Л.С. Эмульсионные продукты на основе рыбной икры. Рыбное хозяйство. 2003. №3. С. 57-59.
5. Богданов В.Д., Сафронова Т.М. Структурообраэователи и рыбные композиции. Москва: ВНИРО, 1993. 172с.
6. Журавлева С.В., Прокопец Ж.Г. Биологическая и пищевая ценность пробиотических пастообразных продуктов из сырья морского генеза. Техника и технология пищевых производств. 2012. № 4. С. 1-6.
7. Ташкевич С. Н. Новые технологии пресервов из малосозревающих гидробионтов. Рыб. хозяйство. 2008. №3. С. 93-96.
8. Журавлева С. В. Разработка технологии рыбных паст из сырья прибрежного лова с использованием молочнокислых микроорганизмов: автореф. дис. …. канд. техн. наук: 05.18.04. Владивосток, 2008. 25 с.
9. Калиниченко Т. П. Технологии малосоленой пастообразной продукции из горбуши и некондиционной икры минтая с применением протеаз. Известия вузов. Пищевая технология. 2002. № 5-6. С. 22-24.
10. Способ приготовления рыбной пасты: пат. 2537502 РФ: МПК A23L1/325; заявл. 08.07.2013, опубл. 10.01.2015. Бюл.№1. 6 с.
11. Струков В. И., Елистратов Д. Г. Нарушение кальциевого обмена. Гиперкальциемические состояния. Пенза : Родной дом, 2011. Ч. 1. С. 48.
12. Свешников А. А., Хвостова С. А. Остеопороз: новые научные изыскания и способы лечения. Международный журнал прикладных и фундаментальных исследований. 2016. № 7-1. С. 54-58.
13. Raisz L. G. Pathogenesis of osteoporosis: concepts, conflicts. and prospects. Journal of Orthopaedic Science 2007. № 12. P. 405–412. https://doi 10.1007/s00776-007-1133-2.
14. Добування водних біоресурсів за 2016 рік. Статистичний бюлетень. Київ, 2016. URL: http://ukrstat.org/uk/druk/publicat/kat_u/publ7_u.htm.
15. Притульська Н.В., Федорова Д.В. Ресурсозберігаюча технологія сухих рибо-рослинних напівфабрикатів. Вісник Львівського торговельно-економічного університету. Технічні науки. Львів: Видавництво Львівського торговельно-економічного університету. 2017. Вип. 18. С. 65-71.
16. Притульська Н.В., Шаповал С.Л., Федорова Д.В., Романенко Р.П. Обґрунтування раціональних технологічних параметрів і режимів сушіння рибо-рослинних фаршів. Науковий вісник ЛНУВМБ ім. С.З. Гжицького. Львів: ЛТЕУ. 2017. Т.19 №80. С. 154-164.
17. Піддубний В.А., Мазаракі А.А., Притульська Н.В., Кравченко М.Ф., Федорова Д.В. Інновації в харчових технологіях: монографія / за ред. д.т.н., проф. Піддубного В.А. Київ: Кондор-Видавництво, 2015. 568 с.
18. Федорова Д.В., Карпенко П.О., Васильєва О.О. Жирнокислотний склад сухих риборослинних напівфабрикатів. Харчова наука і технологія. Одеса: ОНАХТ, 2017. №3(11). С. 61-70. https://doi.org/10.15673/fst.v11i3.608.
19. Riediger N.D., Othman R.A., Suh M. et all. A systematic review of the roles of the n-3 fatty acid in health and disease. Journal of the American Dietetic Association**.** 2009. №109(4). P. 668-679. doi: 10.1016/j.jada.2008.12.022.
20. Erkkila A.T., Lichtenstein A.H., Mozaffarian D., Herrington D.M. (2004) Fish intake is associated with a reduced progression of coronary artery atherosclerosis in postmenopausal women with coronary artery disease. Am. J.Clin. Nutr. 2004. № 80(3). P. 626-32.
21. Кардаш С. Знакомство с порошками морепродуктов компании Rieber&Son. Рыбпром. 2007. № 3. С. 23-24.
22. Быков В.П., Ионас Г.П., Головкова Г.Н., Шумкова Л.В., Лебская Т.К. Справочник по химическому составу и технологическим свойствам водорослей, беспозвоночных и морских млекопитающи; под. ред. В. П. Быкова. Москва, 1999. 262 с.

23. Подкорытова А. В. Лечебно-профилактические и биологически активные добавки из бурых водорослей. Рыбное хозяйство. 2001. № 1. С. 51-52.
24. Спосіб виробництва пектиновмісного овочевого пюре: пат. 02158 Україна, МПК 51 A23L 01/06 (2006.01) A23L 1/212 (2006.01) ; заявл. 24.02.12; опубл. 10.06.13, Бюл. № 11.
25. Топінамбурова-морквяна паста функціонального призначення: пат. 06301 України, МПК 51 A23L 1/212 (2006.01) ; заявл. 25.05.10; опубл. 25.11.10, Бюл. № 22.
26. Паста гарбузова: пат. 04701 України, МПК 51 A23L 1/212 (2009.01) ; заявл. 11.04.2008; опубл. 16.08.2008, Бюл. № 16.
27. Буланов М. И., Калинкин И. П. Практическое руководство по фотоколориметрическим и спектрометрическим методам анализа. Москва. 1976. 376 с.
28. Кардаш С. Вкус северных морей в натуральных экстрактах и порошках морепродуктов компании Rieber&Son. Пищевые ингредиенты, сырье и добавки. 2007. № 2. С. 50-51
29. Нечаев, А. П., Светлана Е. Т., Кочеткова А. А. Пищевая химия : учебник / под ред. А. П. Нечаева. 2-е изд., перераб. и доп. СПб.: ГИОРД, 2003. 640 с.
30. Скурихин И. М. Химический состав пищевых продуктов. Книга 2. Справочные таблицы содержания аминокислот, жирных кислот, витаминов, макро- и микроэлементов, органических кислот и углеводов. 2-е изд., перераб. и доп. Москва: Агропромиздат, 1987. 360 с.
31. Паламарек К. В., Пересічний М. І. Мінеральний та вітамінний склад сирно-рослинних паст з підвищеним вмістом йоду. Товари і ринки. 2013. № 2 (16). С. 125-131. http://doi.org/10.31617/tr.knute
32. Паламарек К. В., Романенко Р. П. Структурно-механічні властивості овочевих паст з використанням йодовмісної сировини. Сборник научных трудов SWorld. 2013. Вип. 4, Т. 14. 2013. С. 44-49.
33. Овочева паста функціонального призначення: пат. 04450 України, МПК 51 A23L 1/212 (2006.01) ; заявл. 09.04.12; опубл. 10.10.12, Бюл. № 19.
34. Сборник рецептур рыбных изделий и консервів /авт.-сост.: М.В. Гольдин, А.А. Рыжков, Т.И. Слабко. Санкт-Петербург: Гидрометеоиздат, 1998. 206 с.
35. Рыба, морские млекопитающие, морские беспозвоночные и продукты их переработки. Методы анализа. ГОСТ 7636–85. М. Госстандарт России, 1998. 15 с. URL: http://vsegost.com/Catalog/20/20210.shtml.
36. Руководство по методам анализа качества и безопасности пищевых продуктов / под ред. И. М. Скурихина, В. А. Тутельяна. Москва : Брандес, Медицина, 2006. 380 с.
37. Рыба, морские млекопитающие, морские беспозвоночные и продукты их переработки. Правила приемки, органолептические методы оценки качества, методы отбора проб для лабораторных испытаний. ГОСТ 7631-85. Москва, 1985. 16 с.
38. Sensory analysis. Methodology. Flavour Profile Method Draft International Standart: ISO/DIS 6564. 1983. 11 p.
39. Паламарек К. В., Пересічний М. І. Оптимізація рецептурного складу овочевих паст з йодовмісною сировиною. Технологічний аудит та резерви виробництва. 2016. № 2/4 (28). С. 11-17. http://dx.doi.org/10.15587/2312-8372
40. Паламарек К. В., Пересічний М. І. Проектування білково-рослинних паст з підвищеним вмістом йоду. Обладнання та технології харчових виробництв ; Донецьк. 2013. Вип. 30. С. 135-143. https://doi.org/10.31866/2616-7468.1.2018.151640
41. Клочкова Н. Г., Березовская В. А. Водоросли камчатского шельфа. Распространение, биология, химический состав. Владивосток : Дальнаука, 1997. 156 с.
42. Паламарек К. В., Пересічний М. І. Функціонально-технологічні властивості йодовмісної сировини та екстракту інактивованих дріжджів. Вісник Львівської комерційної академії. Серія товарознавча. Львів : ЛКА. 2016. Вип. 16. С. 63-68.
43. Федорова Д.В. Дослідження технологічних властивостей сухих рибо-рослинних напівфабрикатів та напрями їх використання у харчових технологіях. Технічні науки та технології : науковий журнал. Чернігів : Черніг.нац. технол. ун-т, 2017. № 4 (10). С. 217-227. https://doi: 10.25140/2411-5363-2017-4(10)-217-227.

References:

1. Parats AM. Hihiienichna otsinka morskykh vodorostei i kharchovykh produktiv z nymy, yak zasobiv minimizatsii dii radiatsii ta endemii. avtoref. dis. …kand. med. nauk : 14.02.01. Kyiv, 2004.20.
2. Smolyar VI. Ratsionalnoe pitanie. Kyiv; 1991.368.
3. Haldimann M, Blanc A, Blondeau K. Iodine content of food groups. Journal of Food Composition and Analysis. 2005; 18(6):461-471. https://doi:10.1016/j.jfca.2004.06.003
4. Abramova LS, Radygina LS. Emul'sionnye produkty na osnove rybnoj ikry. Rybnoe hazyajstvo. 2003; 3:57-59.
5. Bogdanov VD, Safronova TM. Strukturoobraehovateli i rybnye kompozicii M.: VNIRO; 1993.
6. Zhuravleva SV, Prokopec ZhG. Biologicheskaya i pishchevaya cennost' probioticheskih pastoobraznyh produktov iz syr'ya morskogo reneza. Tekhnika i tekhnologiya pishchevyh proizvodstv. 2012; 4:1-6.
7. Tashkevich SN. Novye tekhnologii preservov iz malosozrevayushchih gidrobiontov. Ryb. hoz-vo. 2008; 3:93-96.
8. Zhuravleva SV. Razrabotka tekhnologii rybnyh past iz syr'ya pribrezhnogo lova s ispol'zovaniem molochnokislyh mikroorganizmov: avtoref. dis. …kand. tekhn. nauk: 05.18.04. Vladivostok. 2008.25.
9. Kalinichenko TP. Tekhnologii malosolenoj pastoobraznoj produkcii iz gorbushi i nekondicionnoj ikry mintaya s primeneniem proteaz. Izvestiya vuzov. Pishchevaya tekhnologiya. 2002; 5-6:22-24.
10. Sposob prigotovleniya rybnoy pasty: Pat. 2537502 RF: MPK A23L1/325; zayavl. 08.07.2013, opubl. 10.01.2015. Bul. 1. 6 p.
11. Strukov VI. Narushenie kal'cievogo obmena. Giperkal'ciemicheskie sostoyaniya. Penza : Rodnoj dom; 2011.
12. Sveshnikov AA. Osteoporoz: novye nauchnye izyskaniya i sposoby lecheniya. 2016; 7(1):54-58.
13. Raisz LG. Pathogenesis of osteoporosis: concepts, conflicts. and prospects. Journal of Orthopaedic Science. 2007;12:405-412. https://doi 10.1007/s00776-007-1133-2.
14. Dobuvannya vodnykh bioresursiv za 2016 rik.. Statystychnyy byuleten'.: K, 2017. URL: http://ukrstat.org/uk/druk/publicat/kat_u/publ7_u.htm.
15. Prytulska NV, Fedorova DV. Resursozberihaiucha tekhnolohiia sukhykh rybo-roslynnykh napivfabrykativ. Visnyk Lvivskoho torhovelno-ekonomichnoho universytetu. Tekhnichni nauky. 2017; 18:65-71.
16. Prytulska NV, Shapoval SL, Fedorova DV, Romanenko RP. Obgruntuvannia ratsionalnykh tekhnolohichnykh parametriv i rezhymiv sushinnia rybo-roslynnykh farshiv. Naukovyi visnyk LNUVMB im. S.Z. Hzhytskoho. 2017; 19(80):154-164.
17. Piddubnyi VA, Mazaraki AA, Prytulska NV, Kravchenko MF, Fedorova DV. Innovatsii v kharchovykh tekhnolohiiakh: monohrafiia. Ed. Piddubnyi V.A. K.: Kondor-Vydavnytstvo; 2015.
18. Fedorova DV, Karpenko PO, Vasylieva OO. Doslidzhennia zhyrnokyslotnoho skladu sukhykh rybo-roslynnykh napivfabrykativ. Food Science and Technology. 2017; 3(11):61-70. https://doi.org/10.15673/fst.v11i3.608
19. Riediger ND, Othman RA, Suh M, Moghadasian MH. A systemic review of the roles of n-3 fatty acids in health and disease. Journal of the American Dietetic Association. 2009;109(4):668-679. doi: 10.1016/j.jada.2008.12.022.

20. Erkkila AT, Lichtenstein AH, Mozaffarian D, Herrington DM. Fish intake is associated with a reduced progression of coronary artery atherosclerosis in postmenopausal women with coronary artery disease. Am. J.Clin. Nutr. 2004 Sep; 80(3):626-32.
21. Kardash S. Znakomstvo s poroshkami moreproduktov kompanii Rieber&Son. Rybprom; 2007. 3:23-24.
22. Byikov VP, Ionas GP, Golovkova GN, Shumkova LV, Lebskaya TK. Spravochnik po khimicheskomu sostavu i tekhnologicheskim svoystvam vodorosley, bespozvonochnykh i morskikh mlekopitayushchikh: VNIRO; 1999.
23. Podkoryitova AV. Lechebno-profilakticheskie i biologicheski aktivnyie dobavki iz buryih vodorosley. Rybnoe khazyaystvo. 2001; 1:51-52.
24. Sposib vyrobnyctva pektynovmisnogho ovochevogho pjure. Pat. 02158 Ukrajiny, MPK 51 A23L 01/06 (2006.01) A23L 1/212 (2006.01); zajavl. 24.02.12; opubl. 10.06.13, Bjul. №.11.
25. Topinamburova-morkvjana pasta funkcionaljnogho pryznachennja. Pat. 06301 Ukrajiny, MPK 51 A23L 1/212 (2006.01); zajavl. 25.05.10; opubl. 25.11.10, Bjul. №. 22.
26. Pasta gharbuzova. Pat. 04701 Ukrajiny, MPK 51 A23L 1/212 (2009.01); zajavl. 11.04.2008; opubl. 16.08.2008, Bjul. №. 16.
27. Bulanov MI, Kalinkin IP. Prakticheskoe rukovodstvo po fotokolorimetricheskim i spektrometricheskim metodam analiza. Moskva; 1976.
28. Kardash S. Vkus severnyih morey v naturalnyih ekstraktah i poroshkah moreproduktov kompanii Rieber&Son. Pischevyie ingredientyi, syire i dobavki. 2007; 2:50-51
29. Nechaev AP, Svetlana ET, Kochetkova AA. Pischevaya himiya. SPb.: GIORD; 2003.
30. Skurihin IM. Himicheskiy sostav pischevyih produktov. Kniga 2. Spravochnyie tablitsyi soderzhaniya aminokislot, zhirnyih kislot, vitaminov, makro- i mikroelementov, organicheskih kislot i uglevodov. Moskva; 1987.
31. Palamarek KV, Peresichnyi MI. Mineralnyi ta vitaminnyi sklad syrno-roslynnykh past z pidvyshchenym vmistom yodu. Tovary i rynky; 2013. 2(16):125-131. http://doi.org/10.31617/tr.knute
32. Palamarek KV, Romanenko RP. Strukturno-mekhanichni vlastyvosti ovochevykh past z vykorystanniam yodovmisnoi syrovyny. Zbirnyk naukovykh prats SWorld; 2013. 4(14):44-49
33. Ovocheva pasta funktsionalnoho pryznachennia. Pat. 04450 Ukrajiny, MPK 51 A23L 1/212 (2006.01); zaiavl. 09.04.12; opubl. 10.10.12, Bjul. 21.
34. Sbornik receptur rybnyh izdelij i konservov. /avt.-sost.: M.V. Gol'din, A.A. Ryzhkov, T.I. Slabko. Sankt-Peterburg: Gidrometeoizdat; 1998.
35. GOST 7636-85. Ryba, morskie mlekopitajushhie, morskie bespozvonochnye i produkty ih pererabotki. Metody analiza. M. Gosstandart Rossii, 1998. Available from: http://vsegost.com/Catalog/20/20210.shtml.
36. Rukovodstvo po metodam analiza kachestva i bezopasnosti pishhevyh produktov / pod red. I. M. Skurihina, V. A. Tutel'jana. Moskow : Brandes, Medicina; 2006.
37. GOST 7631-85. Ryba, morskie mlekopitayushchie, morskie bespozvonochnye i produkty ikh pererabotki. Pravila priemki, organolepticheskie metody otsenki kachestva, metody otbora prob dlya laboratornykh ispytaniy, 1985. URL: http://vsegost.com/Catalog/20/20210.shtml.
38. ISO/DIS 6564. Sensory analysis. Methodology. Flavour Profile Method Draft International Standart, 1983; 11.
39. Palamarek KV, Peresichnyi MI. Optymizatsiia retsepturnoho skladu ovochevykh past z yodovmisnoiu syrovynoiu. Tekhnologhichnyj audyt ta rezervy vyrobnyctva; 2016. 2/4 (28):11–17. http://dx.doi.org/10.15587/2312-8372
40. Palamarek KV, Peresichnyi MI. Proektuvannia bilkovo-roslynnykh past z pidvyshchenym vmistom yodu. Obladnannia ta tekhnolohii kharchovykh vyrobnytstv. 2013; 30:135-143. https://doi.org/10.31866/2616-7468.1.2018.151640
41. Klochkova NG, Berezovskaya VA. Vodorosli kamchatskogo shelfa. Rasprostranenie, biologiya, himicheskiy sostav. Vladivostok; 1997.
42. Palamarek KV., Peresichnyi MI. Funktsionalno-tekhnolohichni vlastyvosti yodovmisnoi syrovyny ta ekstraktu inaktyvovanykh drizhdzhiv.. Visnyk Lvivskoi komertsiinoi akademii. Seriia tovaroznavcha. Lviv. 2016; 16:63-68.
43. Fedorova DV. Doslidzhennia tekhnolohichnykh vlastyvostei sukhykh rybo-roslynnykh napivfabrykativ ta napriamy yikh vykorystannia u kharchovykh tekhnolohiiakh. Tekhnichni nauky ta tekhnolohii : naukovyi zhurnal Chernih. nats. tekhnol. un-t. 2017; 4 (10):217-227. https://doi: 10.25140/2411-5363-2017-4(10)-217-227.

Отримано в редакцію 14.05.2018 Received 14.05.2018
Прийнято до друку 07.06.2019 Approved 07.06.2019

Цитування згідно ДСТУ 8302:2015

Fedorova D., Diachuk L., Palamarek K. Technology and quality of food products with powders of hydrobionts // Food science and technology. 2019. Vol. 13, Issue 2. P. 136-148. DOI: http://dx.doi.org/10.15673/fst.v13i2.1403

Cite as Vancuver style citation

Fedorova D, Diachuk L, Palamarek K. Technology and quality of food products with powders of hydrobionts. Food science and technology. 2019;13(2):136-148. DOI: http://dx.doi.org/10.15673/fst.v13i2.1403