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IMPROVEMENT OF FISH DISH TECHNOLOGY USING VEGETABLE RAW MATERIALS

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The study presents the development of an improved technology for fish patties based on fish mince with the addition of pumpkin puree as a functional ingredient. The feasibility of pumpkin application was substantiated due to its content of β-carotene and pectin substances. An experimental formulation of fish patties with pumpkin was developed, along with a technological scheme using poaching as a heat treatment method to preserve nutritional value.

***Keywords**: fish, pumpkin, technology, restaurant industry, nutritional value, quality, food safety.*

УДОСКОНАЛЕННЯ ТЕХНОЛОГІЇ СТРАВ ІЗ РИБИ З ВИКОРИСТАННЯМ ОВОЧЕВОЇ СИРОВИНИ

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У статті розроблено вдосконалену технологію рибних січених виробів із використанням гарбуза як функціонального інгредієнта. Обґрунтовано доцільність його застосування як джерела β-каротину та пектинових речовин. Сформульовано рецептуру страви «Котлети рибні з гарбузом» та розроблено технологічну схему з використанням припускання як щадного способу теплової обробки для збереження поживних речовин.

Установлено, що внесення гарбузового пюре до складу рибного фаршу покращує органолептичні показники готового продукту: забезпечує ніжну консистенцію, підвищену соковитість і привабливий природний колір. Розраховано технологічні параметри, зокрема втрати маси під час теплової обробки та вихід готової продукції, що підтверджує ефективність запропонованої рецептури.

Мікробіологічні показники розробленого продукту відповідають установленим вимогам безпечності, зокрема не виявлено патогенних мікроорганізмів. Отримані результати підтверджують доцільність використання гарбуза як багатофункціонального компонента у виробництві рибних напівфабрикатів для підвищення їх харчової цінності та споживчих властивостей.

***Ключові слова:** риба, гарбуз, технологія, ресторанне господарство, харчова цінність, якість, харчова безпека.*

Statement of the problem. The growing awareness of the population about the role of nutrition in maintaining health has led to increased interest in foods with an optimal balance of nutrients, dietary fiber, probiotics, antioxidants, and other biologically active substances [1–6].

Review of the latest research and publications. According to the recommendations of the World Health Organization (WHO), the daily intake of dietary fiber should be 25–35 g for an adult [7, 8]. However, actual consumption levels are significantly lower: in European countries the average intake is 18–22 g/day, in the United States it is 16–18 g/day, and in countries with a high proportion of refined foods it is less than 15 g/day [9, 10].

Insufficient fiber consumption is referred to as the "fiber gap" and is officially considered a risk factor for the development of non-communicable diseases [11].

According to the results of a survey conducted by U-Report, a digital platform of UNICEF, in 2019, 88% of Ukrainian respondents stated that they want or try to follow a healthy diet [12].

As is known, fish is rich in beneficial Omega-3 fatty acids, which have a positive effect on overall body support, as well as brain and heart health. Fish proteins contain all essential amino acids, which explains the particular value of fish as one of the most important sources of high-quality protein in human nutrition. Fish is rich in potassium, calcium, and magnesium. The phosphorus content in fish meat averages 0.2–0.25%. By consuming fish, it is possible to meet approximately 25% of the human body's protein requirement, 50–70% of phosphorus needs, and almost 20% of magnesium requirements. Amino acids present in fish meat are of particular importance. For example, methionine belongs to lipotropic anti-sclerotic substances. In terms of the content of this essential amino acid, fish occupies one of the leading positions among animal protein products. Due to arginine and histidine, as well as the high protein efficiency coefficient (for fish meat 1.88–1.9, for beef – 1.64), fish products are particularly beneficial for the growing young organism. According to experts, the significant amount of unsaturated fatty acids in fish may be one of the effective methods for prevention, and possibly even treatment, of certain oncological diseases. It is also known that fish fats reduce blood cholesterol levels and prevent the formation of blood clots.

Considering pumpkin as an ingredient that improves the dish and as an important component of the diet of people who adhere to healthy nutrition, it should be noted that pumpkin cultivation is widespread in Ukraine due to its low requirements for soil cultivation and its significant feed and nutritional importance. Moreover, Ukraine ranks second among the largest producers of crops of the pumpkin family (which includes pumpkins and zucchini), second

only China. The main importers of Ukrainian pumpkins are the United Kingdom (62% of export revenue), Romania (19%), and Moldova (4%) [13].

Pumpkin is a valuable ingredient due to its rich complex of biologically active substances, including carbohydrates (4–11%), pectins (0.7–1.2%), organic acids (0.1%), minerals (potassium, calcium, magnesium, phosphorus, zinc, iron), as well as B-group vitamins and ascorbic acid [14].

It combines well with minced fish, harmoniously complementing the taste and aroma of the finished dish. Pumpkin pectins act as a natural stabilizer of the minced structure, functioning as a natural thickener. Due to its color, pumpkin in dishes made from minced fish can create a visual accent that improves the presentation of the dish, making it more aesthetic and attractive for guests of restaurant establishments. In addition to its culinary advantages, pumpkin is an accessible and economically beneficial product that helps optimize costs in restaurant businesses.

Scientific studies confirm that increasing fiber intake positively affects metabolic health: it reduces the risk of colorectal cancer and coronary heart disease, regulates blood glucose levels, and promotes normalization of the intestinal microbiota, which is crucial for the immune system and the overall homeostasis of the body. Moreover, dietary fiber can increase the feeling of satiety, thereby reducing total energy intake, making it an important tool in obesity prevention [15].

Improving the technology of producing dishes from minced fish with the addition of pumpkin will increase their nutritional value by adding beneficial vitamins and minerals, which will bring significant benefits to the human body.

The objective of the research. Substantiation of the feasibility of using vegetable raw materials and the development of an innovative technological solution aimed at expanding and improving the ассортимент of dishes made from minced fish mass.

Materials and methods. The main practical objectives of the study are defined as follows: substantiating the feasibility of using pumpkin in the production of dishes based on minced fish, developing a draft formulation of the dish and designing the technological process. To achieve these objectives, a comprehensive approach was employed to analyze modern scientific sources related to improving the technology of dishes based on minced fish with the addition of vegetable raw materials. The raw materials used in the fish patties with pumpkin formulation were chosen based on relevant regulatory standards. Table 1 outlines their key characteristics, normative references, and quality indicators.

Table 1

Characteristics of Raw Materials Used in the Dish "Fish Patties with Pumpkin"

Raw material	Regulatory document	Quality indicators
Pike perch	DSTU 2284:2010 "Live Fish. General Technical Conditions"	The fish must be active, with shiny and clean scales, without damage. The eyes should be clear and convex, and the gills bright red, without mucus or darkening. The odor must be fresh and characteristic of fish, without foreign or unpleasant smells. The muscles should be elastic, and the skin smooth, without spots or discoloration.
Bulb onion	DSTU 3234-95 "Fresh Bulb Onion. Technical Conditions"	Selected bulbs, mature, whole, fresh, dry, with shape and color typical of the botanical variety, with well-dried outer scales and a dried neck from 2 to 5 cm inclusive. Not damaged by pests or diseases, without mechanical damage.
Pork fat (back fat)	DSTU 4668:2006 "Boiled, smoked-boiled, smoked-baked, baked, fried, dry-cured pork products. General Technical Conditions"	High-quality pork fat should be white or slightly pink, without yellow or gray shades. The texture should be firm and elastic, yet tender. The odor should be neutral or characteristic of fresh pork fat, without foreign or unpleasant smells. The surface must be clean, without dirt residues, mechanical damage, or stains.
Garlic	DSTU 3233-95 "Fresh Garlic. Technical Conditions"	Fresh garlic should have firm, plump cloves tightly covered with a papery skin. The skins should be dry and free from any traces of mold or discoloration. It should have a strong, pungent aroma characteristic of fresh garlic. Fresh garlic should have a pronounced, vivid taste that is both sweet and spicy.
Pumpkin	DSTU 3190-95 "Fresh Pumpkins. Technical Conditions"	Fruits must be fresh, whole, healthy, clean, free from diseases, with color and shape typical of the given botanical species and variety, with or without a stalk. Fruits with deviations from the correct shape are allowed, provided they are not deformed and have no damage to the rind from cuts or scratches. Fruits must be mature, with fully formed seeds and rind coloration typical of the botanical species and variety. Taste: moderately sweet; no foreign flavors or odors.
Salt	DSTU 3583:2015 "Table Salt.	Edible salt is a crystalline, free-flowing product without odor (except for iodized salt), with a salty taste and no aftertaste. The presence of foreign

	General Technical Conditions"	impurities unrelated to the salt extraction method is not allowed. The color of extra and premium grades is white; for first and second grades, gray, yellowish, pink, or bluish shades are allowed depending on the origin of the salt.
Pepper	DSTU ISO 959-1:2008 Pepper (Piper nigrum L.), whole or ground. Technical Conditions. Part 1. Black Pepper (ISO 959-1:1998, IDT)	The peppercorns should be uniform, dense, and round. High-quality pepper has no cracks or damage. Peppercorns should be dark brown or black in color, with uniform size and color. Fresh black pepper has a rich, spicy, and slightly woody aroma. The taste should be mildly pungent and warm. A bland or bitter taste indicates loss of quality.
Butter	DSTU 4399:2005 "Butter. Technical Conditions"	Butter should have a specific characteristic taste and aroma and a plastic consistency at a temperature of 12 ± 2 °C, with a milk fat content of at least: 61.5–72.4% for sandwich butter, 72.5–82.5% for peasant butter, and 80.0–85.0% for extra butter. It should form a homogeneous emulsion of the "water-in-fat" type.

Experimental samples were prepared using raw materials that satisfied all established quality criteria. The finished products were subsequently subjected to organoleptic analysis to assess appearance, color, consistency, aroma, and taste; physicochemical and calculation methods to determine chemical composition, energy value, losses during heat treatment, and yield of finished products; and analytical methods to examine consumer preferences based on secondary data [16-18].

Presentation of the research material. Development of a draft formulation of minced fish dishes using pumpkin.

As a prototype for development, the dish "Fish Patties" was selected. In order to improve it, pumpkin in the form of puree was added to the minced fish. A draft formulation of the dish was developed, the raw materials were characterized, and the nutrient content was evaluated [19].

The main component of the improved dish is pike perch. The fish must be fresh and comply with all quality requirements. Pike perch is an excellent base for preparing Patties with the addition of pumpkin puree. Due to its delicate texture and neutral taste, pike perch fillet combines well with pumpkin, forming a harmonious flavor [20].

Since pumpkin puree was used to enrich the dish with additional nutrients, it should be noted that the puree was obtained by cutting the pumpkin into cubes, steaming it, and then mashing it. This method allows the preservation of most vitamins, especially water-soluble ones. In addition, it

minimizes the loss of minerals and other nutrients [21]. The proposed recipe composition of "Fish Patties with Pumpkin" presented in Table 2 is a list of the necessary ingredients for preparing the dish and their quantities.

Table 2

Recipe Composition Project of the Dish "Fish Patties with Pumpkin"

Raw material	Quantity of raw material per 1 portion, g	
	Gross	Net
Pike perch	115	55
Bulb onion	5	4
Pork fat (back fat)	20,8	20
Garlic	1,3	1
Pumpkin	30	20
Salt	1,3	1
Pepper	1,3	1
Semi-finished product mass		*102*
Finished Patties mass		*112*
Garnish (mashed potatoes)		*150*
Butter	10	10
Yield		*272*

After presenting the recipe composition of the dish "Fish Patties with Pumpkin," it is advisable to determine the organoleptic indicators of the dish, which are presented in Table 3. This is useful for consumers, as organoleptic indicators make it possible to assess the quality of the finished dish not only by technical characteristics but also from the perspective of taste perception, texture, aroma, and appearance. Such indicators also facilitate the choice of guests of restaurant establishments, making the dish more competitive among available alternatives.

Table 3

Organoleptic Indicators of the Dis "Fish Patties with Pumpkin"

Indicator	Characteristic
Appearance	The formed Patties have an even, smooth surface and retain a round shape. Due to the addition of pumpkin purée, an attractive orange hue is present, creating an aesthetic accent. The Patties are topped with butter.
Color	Orange in color.
Texture	The texture of the Patties is delicate, soft, and homogeneous due to the use of pumpkin purée as a natural thickening agent. The dish does not fall apart when cut and retains its shape.
Aroma	Characteristic fish aroma with fresh notes of pumpkin and pepper.
Taste	Characteristic of pike perch with a slightly sweet pumpkin aftertaste.

The next important aspect of the study is the analysis of the nutritional and energy value of the dish "Fish Patties with Pumpkin," which is presented

in Table 4. For consumers who focus on healthy nutrition, these data are important as they confirm the nutritional value of the dish. They are also useful for consumers who adhere to dietary nutrition.

Table 4

Nutritional and Energy Value of the Dish "Fish Patties with Pumpkin"

Raw material	Content, %							Energy value per 100 g, kcal (kJ)
	Water, %	Proteins, %	Fats, %	Carbohydrates, %				
				Sugars, %	Starch, %	Dietary fiber, %	Ash, %	
Pike perch	15,95	3,72	0,22	0,00	0,00	0,00	0,24	16,78 (70,23)
Bulb onion	1,26	0,02	0,00	0,07	0,01	0,02	0,01	0,60 (2,51)
Pork fat (back fat)	0,42	0,18	6,54	0,00	0,00	0,00	0,01	58,60 (245,34)
Garlic	0,21	0,02	0,00	0,00	0,09	0,01	0,01	0,53 (2,22)
Pump kin	6,74	0,10	0,01	0,15	0,07	0,09	0,04	1,62 (6,78)
Salt	0,00	0,00	0,00	0,00	0,00	0,00	0,37	0,00 (0,00)
Pepper	0,34	0,00	0,00	0,02	0,00	0,00	0,00	0,10 (0,42)
Butter	0,58	0,02	3,03	0,03	0,00	0,00	0,01	27,50 (115,06)
Total	25,50	4,06	9,80	0,27	0,17	0,12	0,69	105,73 (442,57)

Based on the table above, it can be seen that pike perch is the main source of protein, while pork fat and butter provide the majority of fats. The carbohydrate content of the dish is insignificant, which indicates its low-carbohydrate profile.

The obtained research results make it possible to conclude that the selected dish is sufficiently balanced. As expected, pike perch is the main source of protein, while pork fat and butter provide the majority of fats. The carbohydrate content of the dish is insignificant, which indicates its low-carbohydrate profile**.**

After conducting the developments, research, and justifications, it is necessary to develop regulatory documentation for the improved signature dish “Fish Patties with Pumpkin”.

The technological scheme is part of the enterprise’s regulatory documentation and represents a graphical interpretation of the required set of technical, technological, and culinary operations, compliance with which is necessary to obtain the finished dish. In turn, the technological card ensures the standardization of the dish preparation process and serves as a quality control tool. Thus, a single standardized recipe is established for all chefs, and the taste of the dish does not depend on the individual who prepares it [22, 23].

The technological scheme for the production of the dish “Fish Patties with Pumpkin” is presented in Figure 1.

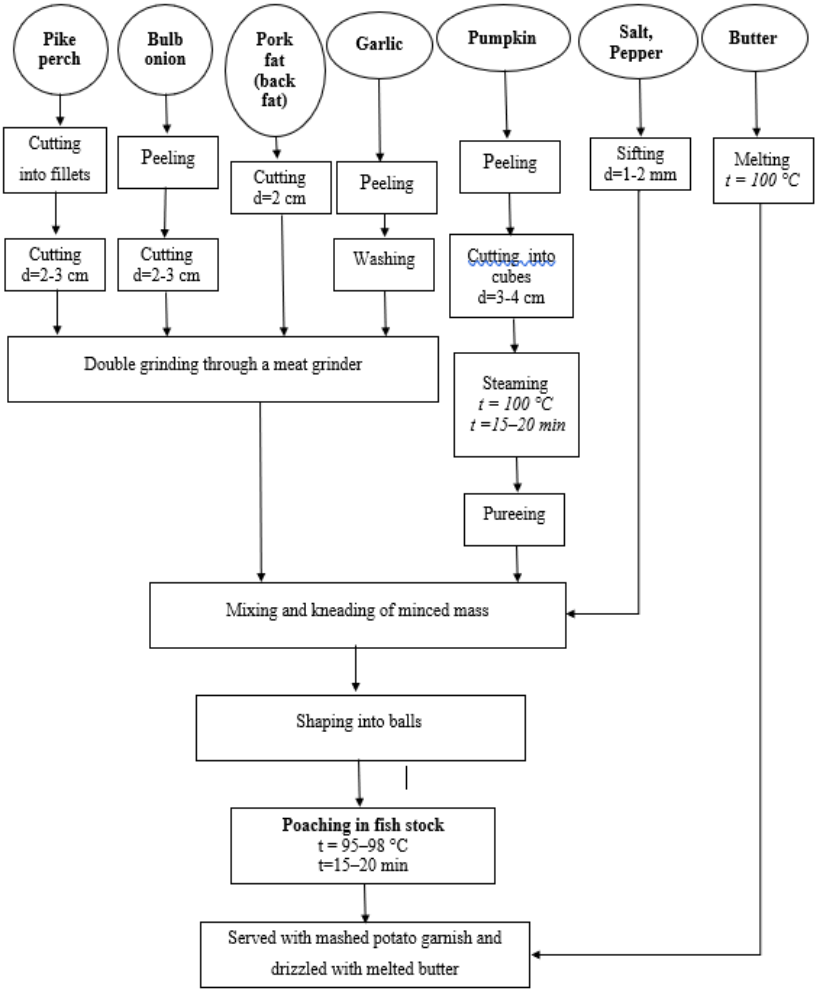

Fig. 1. Technological scheme of the dish "Fish Patties with Pumpkin"

AGREED
_____ «____»
_____ 20___ p.

APPROVED
_____ «____»
_____ 20__ p.

TECHNOLOGICAL CARD № 1
“Fish Patties with Pumpkin”
(name of the dish)

Raw material	Raw material mass, g				Regulatory documentation governing quality requirements
	Per 1 portion		Per 10 portions		
	Gross	Net	Gross	Net	
Pike perch	115	55	1150	550	DSTU 2284:2010
Bulb onion	5	4	50	40	DSTU 3234-95
Pork fat (back fat)	20,8	20	208	200	DSTU 4668:2006
Garlic	1,3	1	13	10	DSTU 3233-95
Pumpkin	30	20	300	200	DSTU 3190-95
Salt	1,3	1	13	10	DSTU 3583:2015
Pepper	1,3	1	13	10	DSTU ISO 959-1:2008
Semi-finished product mass		*102*		*1020*	
Finished Patties mass		*112*		1120	
Garnish (mashed potatoes)		*150*		*1500*	
Butter	10	10	100	100	DSTU 4399:2005
Yield		*272*		*2720*	

COOKING TECHNOLOGY

The pike perch is processed into clean fillets, cut into small pieces, pork fat, garlic, and onion are added, and the mixture is passed through a meat grinder twice. The pumpkin is peeled, cut into cubes, steamed for 15–20 minutes, and mashed into a purée. Pumpkin purée, salt, and pepper are added to the minced fish mass, after which the mixture is thoroughly beaten. The prepared semi-finished product in the form of balls is placed in a deep baking tray or saucepan in a single layer, poured with hot fish broth to one-third of the volume, and gently poached. Mashed potatoes are usually served as a garnish, and the Patties are topped with butter.

Shelf life of semi-finished products: 6–8 hours under refrigerated conditions.

CHARACTERISTICS OF THE FINISHED DISH

Indicator	Characteristic
Appearance	The formed Patties have an even, smooth surface and retain a round shape. Due to the addition of pumpkin purée, an attractive orange hue is present, creating an aesthetic accent. The Patties are topped with butter.
Color	Orange in color.
Texture	The texture of the Patties is delicate, soft, and homogeneous due to the use of pumpkin purée as a natural thickening agent. The dish does not fall apart when cut and retains its shape.
Aroma	Characteristic fish aroma with fresh notes of pumpkin and pepper.
Taste	Characteristic of pike perch with a slightly sweet pumpkin aftertaste.

Microbiological indicators of the finished dish

Total count of mesophilic aerobic and facultative anaerobic microorganisms, CFU per 1 g/cm³	Product mass (g/cm³) in which the presence is not allowed				
	Coliform bacteria (BGKP)	E. coli	S. aureus	*Proteus* bacteria	Pathogenic microorganisms, including *Salmonella* spp. and viruses
1×10^3	1	1	1	0,1	25

Nutritional value and caloric content

Proteins, g	4,06
Fats, g	9,80
Carbohydrates, g	0,9804
Energy value, kcal	105,73

Conclusion. The combination of dietary fish protein (pike perch) with biologically active substances of pumpkin corresponds to the principles of healthy nutrition and allows the expansion of the assortment of dishes in restaurant establishments.

The optimal use of pumpkin in the form of puree as a component of a new formulation of minced fish has been substantiated. On the basis of the traditional technology for preparing the dish “Fish Patties”, an improved formulation was developed in which pumpkin acts as a natural corrector of texture and color, as well as enriches the dish with biologically active

substances and makes it possible to obtain a product with improved quality indicators.

A comprehensive technological production scheme has been formed, which includes specific stages of steam processing of vegetable raw materials in order to preserve thermolabile vitamins to the maximum extent.

The use of the poaching method for the finished products ensures a delicate consistency and high digestibility of the product.

Regulatory documentation in the form of a technological card was developed, which regulates precise heat treatment modes and quality requirements.

The implementation of the improved dish will allow restaurant establishments to reduce production costs through the use of accessible local raw materials and obtain a higher-quality product. The developed dish has a balanced complex of biologically active substances due to the content of pectins, beta-carotene, and minerals found in pumpkin. This makes it possible to recommend “Fish Patties with Pumpkin” for preventive and dietary nutrition in restaurant establishments.

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