DOI: https://doi.org/10.21323/2414–438X-2021–6–1–66–77

Available online at https://www.meatjournal.ru/jour
Review article

SCIENTIFIC RATIONALE OF INGREDIENTS CHOICE FOR FUNCTIONAL FISH PASTES

Anastasia S. Kupriy*, Nina I. Dunchenko, Elena S. Voloshina
Russian State Agrarian University — Moscow Timiryazev Agricultural Academy, Moscow, Russia

Keywords: *multicomponent product, formulation, functional food, ingredient, technological properties*

Abstract

In recent years, the global demand for finished fish products is increased. Aquaculture raw materials are a rich source of nutrients for health. At the same time a large amount of fished fish raw materials are rejected and representing a losses. High-quality raw materials with technological defects are not in demand by the food production of fish products. Perishable substandard fish raw materials can be used in the production of combined fish products. The analysis of the fish catches global scale in the seas, oceans, farmed marine and freshwater aquaculture is carried out. An assessment of the market trends for the production and fish products consumption is made. This article provides an overview of targeted ingredient selection for balanced fish formulations. The characteristics of the most popular plant origin ingredients and their derivatives in the fish pates production are given. A comprehensive assessment of the biological, energy and nutritional value of plant products is given. Described technological approaches and production methods, the safety of vegetable ingredients. The results of research, technological solutions, substantiation of the choice of ingredients adopted by the developers for the formulations of multicomponent pate are summarized. The use of unclaimed raw materials, leftover fish meat with plant ingredients represents additional profit. Fish pate formulations are the basis for the production of complete, ready-to-eat products. Tests of multicomponent fish and vegetable products confirm their high performance. Pates, balanced in nutritional value, minerals, are a finished product that does not require additional preparation. The review article will generate awareness among the researchers, food technologists for the production of fish products and the general public.

Introduction

Providing the population with adequate nutrition is included in the list of global problems of the world. Many countries are interested in resource efficiency in food production. Scientific achievements in the food industry aimed at improving the food quality are relevant for all countries of the world. The food industry should make the most of the available resources for the raw materials processing. Scientists are considering the possibilities of elaborating product formulations to quality improve and profitability of production.

It is advisable to make the most of available and traditional sources of raw materials in food production technology. Food products from raw materials with specified characteristics will provide high quality products. Thus, the production of multicomponent products will provide an opportunity to expand the range of nutritionally balanced food sources.

Comprehensive approaches to formulation development promote complementarity of ingredients in the finished product.

The selection of ingredients for simulating new formulations must be scientifically evidenced. The components of this products should complement each other, be synergistic. The product with the specified technological characteristics will positively affect the consumer preferences of the finished product.

Planning, quality management and scientific rationale for the selection of ingredients are important steps in the development of new product formulations. Scientific approaches, research work related to the improvement of food formulations are relevant in modern conditions.

The development of new food products consists of theoretical and specific methods for implementing the balance principles. When modeling the formulation, the compatibility of the ingredients and the energy value of the product are assessed. Comparison of the content of essential nutrients in raw materials and finished products is crucial for formulation development. The quality characteristics of raw materials are the evidence to obtaining a finished product with the specified parameters. The composition of the products should include ballast substances, they have the ability to swell, retain moisture. Dietary fibers stabilize aqueous suspensions, improve the structural and mechanical properties of finished products [1,2,3]. Analysis of proteins, fats, carbohydrates, minerals, is the main assessment when modeling a product [4].

Balancing nutrition is one of the constituent factors affecting human health. The consumption of animal and plant products contributes to the correct metabolism. Proteins and fats of vegetable and animal origin are the source for the vital activity of the organism. The enzymes activity in metabolic processes depends on the presence of vitamins, macro- and microelements in the diet. The nutritional and biological value of the finished product characterizes its composition. The composition of products must be balanced, easily digestible, to ensure the normal functioning of the human organism.

FOR CITATION: Kupriy, A.S., Dunchenko, N.I., Voloshina, E.S. (2021). Scientific rationale of ingredients choice for functional fish pastes. *Theory and practice of meat processing*, 6(1), 66–77. https://doi.org/10.21323/2414–438X-2021–6–1–66–77

For many consumers, the sensory attributes of the product and the emotional component when choosing it are important. Products must be attractive to the human senses and satisfy their physiological needs. The acceptability of the product must be balanced against the expectations of the purchaser in order to generate consumer interest in proper nutrition.

Consumer behavior when choosing a product is a complex process. The most unifying characteristics of buyers are numerous personal, social and psychological factors. By offering new gastronomic combinations that can diversify the traditional menu, it is necessary not to lose consumer confidence. The growing interest of the population in a healthy lifestyle forms the basis for proper nutrition [5].

The nutrient requirements of the human organism vary and depend on age. Other factors and living conditions require adjustments in food intake. The compliance of food with the biological needs of a person is an important issue for a healthy diet. The solution to this problem is to expand the assortment variety of products, including fish products. The balanced combination of fish with vegetable, grain ingredients help to increase the nutritional value of the product. Research related to the improvement of food formulations is receiving a lot of attention.

The purpose of the work is to scientifically grounded the choice of ingredients for obtaining a multicomponent product of a functional tendency.

It is generally accepted that functional food products, when consumed, reduce the risk of developing diseases associated with metabolic processes in the organism. Proposals for the production of formulations for functional fish products are currently timely. The tasks set are aimed at solving the maximum use of high-quality fish raw materials. Scientific technologies of processing and quality management will make it possible to effectively use fish raw materials by increasing the range of finished products.

The purpose selection of research articles will provide information on the existing areas of production of fish products. The plan is to determine the functional ingredients promise when changing product formulations to meet the changing needs of the food market.

Materials and methods

The article presents research papers and overview scientific information in the field of the use of fish meat in the industry.

We carried out a targeted review of literary references. Selected research articles from domestic, foreign magazines, published in recent years. The criteria for considering the articles were the rationale and significance of studies of the muscle tissue of fish for the development of fish pates. Used scientific data from research in the food industry in different countries. Analysis of literature data is aimed at the prospects of scientific technologies in fish production. When selecting components for formulations, the functional orientation of the final product is desirable.

Results and discussion

Fish is a highly valuable food source. In a number of countries, fish products traditionally form the basis of the diet. Fish is considered one of the demanded products included in the people menu of the world. With its high nutritional characteristics, the fish is not inferior to other animal products. In terms of biological value, the muscle tissue of fish is better digested and is more quickly involved in metabolic processes [6]. Fish has high digestibility and nutritional value compared to meat from farm animals. Reduces the possibility of wider use of fish in the daily diet, its rather high price.

The fish presence in the diet provides the organism with biologically complete protein. The protein content in fish of different species ranges from 12 to 25% with a set of essential amino acids. Protein consists of the complex protein ichtulin, albumin and phosphorus-containing nucleoproteins. Albumin, water-soluble proteins globulin, myoalbumin, myogen, myoglobulin represent the structural part of the sarcolemma constituent. Salt-soluble proteins, globulins, actin, actomyosin, myosin, tropomyosin form myofibrils in fish muscle cells. The connective tissue of fish protein contains only collagen, elastin is absent. The connective tissue is evenly distributed in the muscles and accounts for 10 to 12%. Low connective tissue content, high water-holding capacity ensure quick readiness of fish products. It takes much less time to cook fish than to cook meat from animals. During heat treatment, fish collagen is converted to highly hydrophilic glutin. This transition of fish collagen gives tenderness and juiciness to the finished product. The amino acids glycine and L-alanine, when exposed to heat, give the fish a sweetish taste. Fish protein differs from the productive animals' protein by the absence of hydroxyproline, high content of lysine, methionine, cysteine, tryptophan.

Fish is a source of complete fats. Fish oil has better digestibility by the human organism compared to animal fats. The fat of marine fish contains eicosapentaenoic and docosahexaenoic acids, which have a known biological activity as ω-3.

Marine freshwater fish are rich in a significant amount of the group of water-soluble vitamins. Fat-soluble vitamins A, D, E are concentrated in the tissues of medium-fat and fat fish.

In the muscle tissue of fish, water is contained in a free and associate state. During heat treatment, water loss is about 20%. The moisture loss in meat of productive animals after heat treatment is up to 40% of water, which reduces digestibility.

Fish contains 2 times less extractive substances than meat of productive animals. During heat treatment, most of the extractives are released with fish juice and pass into broth. Fish products in an easily digestible form contain essential fatty acids, vitamins, iodine, selenium. The minerals of fish meat are represented by phosphorus, potassium, sodium, calcium, sulfur, chlorine, and manganese.

Fish raw materials and finished products are characterized by a large amount of microelements.

The chemical composition of commercial fish is unstable and depends on many factors: fish species, age, habitats. The proteins amount in the muscle tissue of fish averages up to 22%, fat from 0,1% to 55%. The concentration of free and bound water in fish can range from 48% to 93%. The fish minerals composition is stable within 2–3%. The fish meat calorie content is determined by the chemical composition of 100 g of the product. Average energy values of fish vary greatly from 100 kcal to 900 kcal. The energy consumption of sea fish oily species can be up to 1500 kcal. According to the degree of fatness, the following are subdivided: not fatty 3%; medium fat content up to 8%; fatty more than 10%. Fish products are classified by grades 1 and 2, by weight and length of the specimen.

Numerous scientific and practical studies confirm the advisability of using fish as a valuable food product. The exclusivity of the muscle tissue of fish lies in the ability to quickly digest and join the metabolic processes of the organism. Fish is rich in amino acids and is an important source of omega-3 fatty acids necessary for the human organism. The biological and nutritional value of fish is defined as a source of nutrients for a full human life. Fish and fish semi-finished products should be present in the human diet for a healthy lifestyle [7].

In recent years, in the food market, the demand for commercial fish and aquaculture products has increased. In a number of countries, fish farming is developing rapidly (Figure 1).

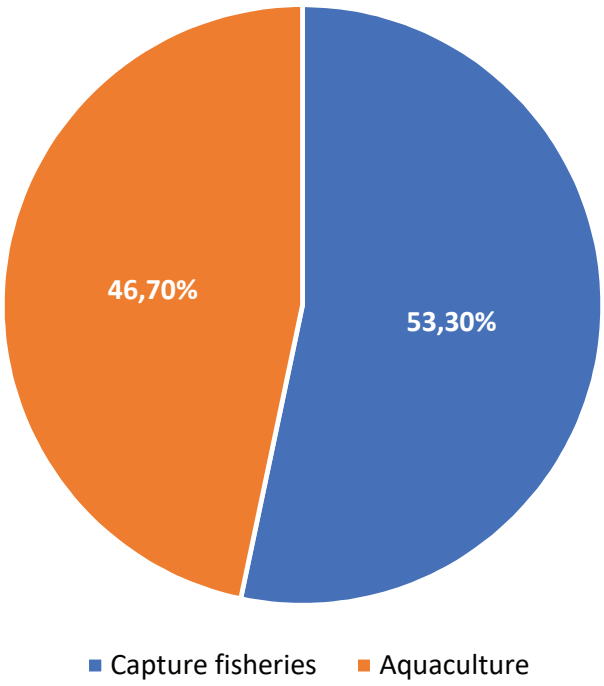

Figure 1. Aquaculture chart of world fish production

The global increase in the catch of farmed aquaculture is more than 8% annually. It is predicted that by 2030 aquaculture will account for more than 60% of the total fish production.

There are some peculiarities associated with the cost-effectiveness of artificial fish reproduction. The instability of the weight gain of reared individuals leads to the appearance of small specimens. At the same time, the cost of raising fish involves obtaining individuals with forecasted parameters [8].

By-catches occur when catching commercial fish species. By-catch usually has no commercial value and is therefore not used for product manufacturing. In order to save resources, it is necessary to make the most of the caught fish. By-catch should be involved in food production, where textural characteristics are determined by processing methods [9].

Food products with a modified texture of fish meat are minced fish, pates, riets and pastas. It is rational to use high-quality fish that is not standard in terms of size characteristics in the technology for the production of the above-mentioned products [10,11].

Fish raw materials must be safe in terms of chemical and microbiological parameters. Aquatic biological resources (WBR) caught in natural water bodies are characterized by instability. The quantitative and qualitative composition, size characteristics of wild fish have a fairly wide range of values.

Aquaculture produces fish with more stable technological characteristics. In the Russian Federation, the main objects of freshwater aquaculture are trout, carp, whitefish, salmon and catfish. The most promising species of the catfish order is the North African catfish (*Clarias gariepinus*). Its natural habitat is freshwater reservoirs in Africa, in the Jordan River basin, in South and Southeast Asia. The fishery development of clary catfish in Russia began in 1996. The production technology of this type of fish is characterized by the rapidity of growing to marketable weight [12].

In the Russian Federation, the fishing industry is being modernized in the areas of waste-free processing of raw materials and expanding the range of products. The geographic location of the country allows the use of rich natural waters for fishing. There is a trend towards a reduction in the share of imported fish products in the country's food market.

For 2020, science knows and describes 35 768 species of existing fish. Approximately 1500 fish species of commercial interest. In accordance with habitats and migration, fish are conventionally divided into marine, freshwater, anadromous and semi-anadromous. The water area of the Russian Federation is home to about 3 000 species of fish. In fresh water of rivers, ponds and reservoirs, there are up to 300 species of fish.

In addition to fresh fish, there are fish raw materials that can be chilled, slightly frozen, frozen, glazed.

The compatibility of products of animal and fish origin with plant representatives is now widely advertised. The technologies for the production of canned food have been studied quite comprehensively. Canned fish is produced from pieces of carcasses, liver, caviar and mict of commer-

cial fish. In the production of canned fish and vegetable products, vegetable components are added to fish raw materials. Depending on the plant component, canned fish and vegetables or fish cereal canned foods are produced. Combined canned food is produced for the purpose of combining nutritional factors in the form of meatballs, fricassee, cabbage rolls, cutlets.

Plant products represent a large group with many subgroups. As a result of cereals technological processing, grains are the raw material. In the production of combined products, cereals or flour are more often used. The most popular are rice, buckwheat, corn, barley.

Grain crops and their cereals, flour is characterized by a stable content of protein, fat and carbohydrates. The average nutritional composition of cereals is 10–12% protein, 4% fat, and up to 70% carbohydrates. At the same time, the grain part of the human diet can account for up to 40% of the daily protein requirement. From the carbohydrates of cereals supplied with food, the organism is provided with energy for 90%. Cereal fats have a high nutritional value due to polyunsaturated fatty acids. The germ of cereals has a high biological activity, which is widely used in the food and other industries. Cereal processing products are a source of water-soluble vitamins and minerals.

The legume is widely used in the production of combined food products. Most often, peas, beans, soybeans and various types of beans are used for the production of fish products. Legumes are characterized by a high protein concentration of up to 24%, and in soybeans up to 35%. The biological value of legumes is inferior to animal meat in terms of digestibility and balance of protein components. Peas and beans are used as independent dishes after prolonged thermal and culinary preparation. Technological processing and fermentation of these crops allows you to reduce the cost of manufacturing raw materials, finished, canned products.

The most popular crop is soybeans, with a high level of vegetable fat 15–17%, low starch content. Soy is popular as a protein product after industrial processing. As a result of high-tech impact, soy flour, isolate, soy protein hydrolyzate are obtained. Textured forms of soy are used in formulations for meat, fish semi-finished products, sausages, and canned food. Soybean biologically active substances, trypsin inhibitors and oligosaccharides, should be limited. Their uncontrolled presence in products can have an undesirable effect on human health.

The most numerous groups of plant products is represented by vegetables, fruits, berries and garnish. This group is represented by a significant range of traditional products that complement cereals and legumes. Representatives of this group are sources of ascorbic acid, β-carotene, bioflavonoids. Plant foods, especially their fruits, contain a lot of carbohydrates, potassium, magnesium, iron. The vegetable and fruit group is a source of biologically active compounds. Organic acids, essential oils promote enzymatic activity and regulation of gastrointestinal motility.

The chemical composition of vegetables indicates a high water content of up to 92%, carbohydrates 8%. Proteins and minerals account for approximately 1% in fresh vegetables. The roots of turnips, beets, carrots, pumpkin have a high content of easily digestible fiber. Dietary fiber includes parts of hemicelluloses and encrusting substances of cutin, lignin, suberin. Root hemicellulose is represented by hexose and pentose sugars of plant cells and is a source of nutrients. Some varieties of sugar beets contain 17 and more than 20% sugars. High carbohydrate energy content is not always in demand in the production of finished products. The biological value of plant materials with high fiber values in the formulation of combined products will be appropriate. The components introduced into the formulation change the chemical composition and quality of the finished products. Plant pigments during heat treatment will give a pleasant color to the finished product. Carrots, beets, pumpkins, turnips with many color shades will neutralize the taste of the fish component in the product. The sugar contained in root vegetables will pass into the product after mechanical and thermal processing with water. In addition, they will enrich the products with pleasant sweetish taste properties. The main indicators that determine the attractiveness of a product are color, aroma and taste [13,14].

The use of carrots and beets allows you to significantly expand the existing range of ready-made food products. The nutritional value of beets lies in the anticarcinogenic and antiradiation properties of betanin [15].

Turnip refers to low-calorie foods, when consumed has the ability to give a feeling of fullness. Saturation of the organism occurs thanks to sugars, easily settled polysaccharides, satisfying the feeling of hunger. The chemical composition of turnips is represented by proteins 1%, fats 0,1%, carbohydrates 7%, minerals 1%, fiber up to 2%. High content of vitamin C, water-soluble vitamins, provitamin A. A wide range of minerals is present in turnip fruits. Macro- and microelements of turnip are in the optimal compounds for assimilation by the organism. Magnesium, which is found in large quantities in turnips in humans and animals, helps to absorb calcium. Turnip has a number of therapeutic and wellness properties. In the modern rhythm of life, turnip is becoming a demanded raw material and product in the food industry. With the development of interest in functional products using dietary fiber, a turnip drying technology has been developed. Experimentally obtained samples of powdered turnip contain 7,2% protein, 3% ash, 2,8% starch, and 33,6% cellulose [16].

Pumpkin is a carotene source, the content of which is higher than in some varieties of carrots. Most of the pumpkin mineral's iron, copper, cobalt, zinc are involved in the hematopoietic metabolism. The concentrated trace elements complex and vitamins in pumpkin is recommended as a prophylactic product for cardiovascular diseases. The statistical chemical composition of pumpkin is represented by 1% protein, 0,1% fat, microminerals up to 3%. The prod-

uct contains up to 90,5% of bound water. Due to its high fiber content, dietary fiber plays a preventive role in the work of gastrointestinal motility. Possessing many positive properties and rich chemical composition, pumpkin is widely used in the multicomponent products technology. Currently, pumpkin powder is actively used in the food industry.

There are about 30 genuses and about 650 species of onions in the world. Onions are one of the high nutritional value vegetables with antibacterial properties. Onion protein is 50% nitrogen-containing substances. Carbohydrates contain up to 9%, which are represented by a wide range of sugars. Onions contain a lot of essential oils, vitamin C, water-soluble vitamins, citric and malic acid. The phytoncides contained in onions have a disinfecting effect. Onions are widely used in medicine as a stimulant, a sedative, for vitamin deficiency, a source of vitamin C. For prophylactic purposes, green onions and bitter varieties are consumed. Medicines are prepared from onion juice.

Onions are considered the most common. By chemical composition, onions are conventionally divided into varieties of spicy, semi-sharp and sweet. Sharp has a high solids content of 15%, with a essential oils high concentration 155 mg / 100 g, and sugars from 12% to 15%. Onion glycosides impart a bitter taste to the product and reduce the sweetness sensation. When fried in animal or vegetable fats, the onion takes on a yellow to golden color. Heat treatment destroys glycosides, essential oils give the onion a specific smell and a sweet taste appears. Onions are widely known in the cooking of many cuisines of the world, fresh, frozen and dry. The food industry uses onions in the production of many meat and fish products.

White cabbage is used in cooking in many countries around the world. Its advantages are represented by dietary properties and use in medical nutrition. Fresh cabbage is an average water content of 90% to 95%. The main energy part of cabbage is sugar content up to 5.4%, 2.2% protein. The fiber content in cabbage does not exceed 1.1%. White cabbage is especially rich in vitamin C up to 70.0 mg%, mineral salts and water-soluble vitamins. Many different first, second and independent dishes are prepared from cabbage. Fresh cabbage, fermented, boiled, stewed cabbage is used for making salads and fillings. In the technology of cooking vegetable, meat, fish semi-finished products, combined canned food, cabbage is included in the products formulation.

After drying vegetables, fruits, berries and garnish, the quality characteristics of the raw materials practically do not change. The preservation of the obtained product is influenced by the preparation carried out and the technological regime of drying and packaging. Dried carrots, beets, onions, cabbage are included in the formulations for meat and fish products. For a short and long shelf life of dried vegetables, a dry place and a moisture content of 14% are required. The introduction of dried vegetables, fruits, berries and garnish into formulations enriches products with biological nutrients. They increase the amount of minerals, give the finished product new aroma and taste properties.

In the 21st century, a difficult situation has developed for agriculture and producers of fat and oil products. The human society does not have comprehensive information from competent government organizations about the benefits and dangers of fats. Lack of information from the population led to a decrease in interest in fat and oil products: margarines, mayonnaise, combined fats. The economic situation on the market of food raw materials and fat and oil products poses complex and responsible tasks. Currently, more than 50 types of oilseeds are cultivated.

Agricultural specialists are developing improved technologies for growing oilseeds. Manufacturers are called upon to find new efficient production of healthy food products based on fat and oil products. Oilseed scientists have focused their efforts on improving quality and yield. The sphere of technological solutions is aimed at the development of raw materials processing processes and the functional orientation of product formulations. Finished products should be focused on improving quality and consumer properties.

After a long stable decline in demand for vegetable oils, their consumption began to increase since 2018. According to nutritional standards, the physiological human need for fats should be 65–120 g, but not less than 25–35 g per day. Vegetable fats should make up 30% of your daily fat intake.

In England, the annual consumption of vegetable fats is 18 kg per capita per year, in the USA and the Netherlands about 25 kg. To a large extent, this amount of vegetable oil is explained by preferences for vegetables in the diet of the population. The society of these countries is offered products to reduce the consumption of animal fats and oils. The health food policy in the Netherlands has resulted in the consumption of animal oil up to 4 kg per year. The consumption of fat stimulates the appetite, improves the taste of food and makes you feel full for a long time. A complete edible fat in the diet of a healthy organism should contain about 10% PFA, 60% MUFA (oleic) and 30% saturated. The recommended ratio of polyunsaturated to saturated fatty acids in the human diet is 2: 1. It was found that an increase in the amount of PUFA in the human diet reduces the risk of cardiovascular diseases. The essential fatty acids of fish have an antibacterial effect, inhibiting the growth of bacteria.

In recent years, the animal fat consumption is decreased in a number of countries. Interest in healthy eating, low price influenced the higher consumption of vegetable oil. With the change in lifestyle, human nutrition, the norms of vegetable oil consumption per capita have been changed.

Lipids are esters of glycerol and fatty acids of different carbon chain lengths and degrees of saturation. The main function of lipids in the human organism is to provide energy. Fat-soluble vitamins A, D, K, E are necessary for the

regulation of metabolism in the organism. Fats are part of the cells, are involved in the organism thermoregulation.

Vegetable oil is obtained from seeds or fruit pulp. Separately, there is a group of processed modified fats, in particular margarine, culinary, combined fats.

Hard fats containing low molecular weight fatty acids include coconut oil, mutton fat. The greatest amount of lauric, myristic, palmitic, palmitoleic low molecular weight acids is concentrated in milk fat. It is believed that there are no low molecular weight fatty acids in cocoa butter, pork, bone, and beef fats. Most animal fats are hard at room temperature.

Vegetable oils have a liquid consistency at 20 °C, with the exception of cocoa butter. Depending on the ability to polymerize, vegetable fats are divided into drying, semi-drying, non-drying. The drying group includes linseed and hemp oils containing acid esters with 2–3 double bonds. Semi-drying oils, sunflower, corn, soybean, cottonseed, sesame, poppy, contain acid residues with 1–2 double bonds. Castor, palm oil contains mainly esters of glycerin and saturated acids, a small amount of monounsaturated oleic acid.

When heated, liquid fats of marine animals and fish thicken and form soft, fragile polymer films. Fish oil is used as a dietary supplement due to its beneficial properties for the human organism.

Depending on the raw materials used, 16 types of vegetable oils are distinguished. The most popular are sunflower, olive, cottonseed, soybean, peanut, mustard, sesame, corn, linseed and hemp oils. Rapeseed, coconut, cocoa, palm, palm kernel, tung, poppy, and almond oils are considered specific or technical types.

Vegetable oil is obtained by pressing, pressing under high pressure or extraction with a chemical solvent.

Oils that have undergone only mechanical treatment by filtration, centrifugation or settling are unrefined. From the seeds from which the oil is made has a specific color, pronounced smell and taste. Hydrated oil is made from unrefined oil. Hydrated oil has a less intense color than unrefined oil.

Refined oils are used in food production technology. The oil is purified from mechanical impurities, treated with alkali, so fatty acids and phospholipids are removed from it. Thus, the purified oil rises up, and the sediment remains at the bottom, then the vegetable oil is bleached. Refined sunflower oil is characterized by weak sensory attribute. Its biological value is lower, since it contains less tocopherols and does not contain phosphatides.

Deodorized sunflower oil is obtained from refined in the process of exposure to water vapor under vacuum. The purpose of this process is to eliminate all aromatic substances that can lead to premature oil deterioration. Deodorized D-grade sunflower oil is used in the production of baby and dietary food. The acid number of grade "D" has no more than 0,4 mgKOH / g, and grade "P" — 0,6 mgKOH / g.

Vegetable fats enter the organism through the use of nuts, with the fruits of oilseeds. Vegetable oils are consumed with salads or as part of sauces, seasonings.

Animal fats in large quantities are contained in pork fat up to 92%, butter 82,5%. In animal fats, there is a lot of cholesterol, which plays an important role in the life of the organism, its daily rate is 300 mg. Plant products contain p-sitosterol, which forms insoluble complexes with cholesterol. The combination of vegetable and animal fats in the diet improves the technological, biochemical and sensory attributes of the product.

The population is saving time by consuming semi-finished products and high-calorie foods. Often, the diet of the working-age population consists of a large amount of fat, table salt and sugar or substitutes. Lack of fat-soluble and most B vitamins is detrimental to health.

It is important to develop formulations for products that do not require additional culinary processing. Balancing fatty acid, amino acid and vitamin compositions will allow us to offer the buyer products for a healthy diet. The design of functional multicomponent products is aimed at balancing the composition of vegetable ingredients. Pates based on fish raw materials are promising in terms of nutritional and biological values.

The tendency in the global food market since 2016 is assessed as positive. According to experts, by 2025, the demand for fish products should increase by 1,3% annually [17]. The growth rate in the food market is associated with changes in consumer preferences for food. With the development of the tourism industry and the adoption of a Western diet, the range of world cuisine is expanding. This path is popular due to its convenience, it fits into the tempo of modern human life. Today's food culture is based on saving time by snacking on fish products (Table 1).

Table 1. The tendency of the market for the consumption of fish products

Usage data	Average annual volume (million tons)					
	1990	2001	2015	2016	2017	2018
Food use	70,8	97,8	128,3	148,7	151,8	155,2
Non-food use	30,9	28,7	21,1	18,7	19,3	23,5
Population (billion)	5,4	6,2	7,0	7,5	7,5	7,6
Per capita consumption (kg)	13,1	15,8	18,3	19,8	20,2	20,4

The global aquaculture market is represented by fish suppliers, product manufacturers and country merchants. The main representatives determining the fish market policy are the countries of Europe and the USA. Agreements are accepted for the export of fresh, chilled, frozen, canned, pickled aquaculture products. The variety of fish and aquaculture species has a significant impact on the catch, production of finished products, semi-finished products. The abundance of aquatic organisms in the world's oceans has led to the formation of traditional fish products and a culture of consumption (Table 2).

Table 2. The tendency fish raw material production market

Production	Average annual volume (million tons)					
	1990	2001	2015	2016	2017	2018
In inland waters	6,3	8,4	10,1	11,5	11,7	11,9
In the seas and oceans	80,6	83,1	79,4	78,2	81,5	84,0
Industrialised fishing	86,9	95,5	89,5	89,7	94,2	95,9
Aquiculture in inland waters	8,5	19,7	36,7	48,1	49,5	51,2
Aquiculture in the seas and oceans	6,3	14,3	22,6	28,4	30,3	30,7
Aquiculture, total amount	14,8	35,0	59,3	76,5	79,8	81,9
World fisheries and aquaculture, total amount	101,7	125,5	148,8	166,2	174,0	177,8

The fish food processing industry additionally produces fish products with plant components. The fillers of such products are vegetable oils, sauces with a wide range of spices. The formulation for fish pates consists of fillets, spices, seasonings, vegetable fillers. All ingredients of the pate during the production process are brought to a homogeneous pasty consistence. In addition to fresh fish fillets, frozen, salted, pickled, smoked fish are used. Pates can be made from many species of fish. Fillets of tuna, mackerel, trout, salmon are often used in the production of pâtés. The popularity of fish pates is growing thanks to the possibility of a quick snack. Packaged in jars, fish pastes are convenient for making sandwiches, as an addition to garnish [18].

Europe is the largest regional market with very high consumption. Fast food is especially developed in France, where 68% of people use this service. Initially, dietary food advertisements focused on chicken liver products. Many nutritional theories that exist today focus on the consumption of beef, lean pork. Fish contains about 20% more easily digestible protein compared to the muscle tissue of animals. Fish products can be useful in improving and enriching the human diet. Consuming even small amounts of fish can have a positive nutritional effect on metabolism. Modern food production facilities are equipped with technologies that can avoid strong fishy smell and taste. Among the consumers of fish products, there are many supporters of a healthy diet.

The psychological processes study that the authors describe is one of the consciousness determining factors. Memory potential that lasts throughout life and accumulates all previously received information. The changes in the effect of random learning on memory related to the texture and taste of foods are very important. Experiments show that nutritional characteristics are memorized at a certain level of memory.

The research authors note that the combination of sensory and rheological characteristics supports the objective determination of food texture. t is important for experts in the classification of the texture of the food profile for all segments of the population. Food producers ultimately rely on the preferences of the consumer for whom their regional market is created.

In the European part, depending on the region, there is a common and specific formulation for a fish product. Preferences are determined by the species composition of the fish. Formulations for cooking fish products are based on preferences for water, type of fish, vegetable fats, salt, spices. The competition for smell and taste is the desire and speed of adaptation of consumers to new fish products. The specific production technology of various fish species helps to adapt to new products. The fate of the product depends on the amount of fish and other ingredients, the method of production, nutritional value, and the effectiveness of the ways of implementation. Product distribution, already at the formulation stage, is linked to the quality of the finished product. Appearance, smell, texture, taste is compared with similar products competing in the food market. For a permanent category of consumers of fish, fish products, there is an attribute standard of sensory characteristics [19].

Among the fast food products derived from fish are pates. They represent a pasty product of different consistency, depending on the ingredients. The formulation basis for minced fish is fish, fish liver, fat, chopped vegetable ingredients, garnish, spices. In industrial production, it is possible to add chemical preservatives to increase the shelf life of fish pates.

Currently, there is a tendency in consumer demand for the supply of products with no chemical preparations. Official publishing sources report the demand for natural preservatives. Over the past 10 years, there has been an increasing interest in biological and natural preservation in food production. The answer to the demand for preservatives is scientific publications on preventing bacterial spoilage of products. Competitive bacteria are used for natural preservation. The result of such work was fish sausages, shrimps, squid, mussels, scallops, raw and cooked trepangs [20, 21].

Having received the status of biological preservatives, not all bacteria meet the safety requirements for the food category [22]. Research work on the study of the bacteriological product of nisin bacteriocin has shown that the strain can be free from virulence factors, antibiotic-resistant models and biogenic amines. During the experiments, high resistance to heat, pH environment and chemicals was

noted. The bacterial product was able to inhibit the growth of microflora. In fish paste, the microbiological load during storage decreased, without affecting the properties of the finished product.

There are known studies of the moisture-retaining capacity in fish pates made from barracuda meat with fat replacement. Water, inulin and monioca starch are added to the fish. The inclusion of ingredients in the fish paste formulation significantly influenced the texture and consistence of the product. To obtain a fish paste with the desired properties, a comprehensive knowledge of the raw materials characteristics study used is required. The inclusion of cassava starch and inulin in the formulation reduced the water content with a high water-holding capacity of the product. To obtain a product of low hardness, it is suggested to use low concentrations of cassava starch. High values of the bound water content in the fish product improve its plasticity. The researchers recommend revising the quality characteristics for the standardization of fish pates. This need is associated with the tendency of quality to fish and fish raw materials in demand on the food market [23].

Studies on the physical and chemical properties of pate when replacing animal fat with vegetable oils are relevant. The texture characteristics of the new pate have less hardness and viscidity. Fat replacement studies with olive oil do not affect the protein, fat, moisture content of the finished product. Olive oil has changed the fatty acid composition by increasing monounsaturated and lowering saturated and polyunsaturated fatty acids. With the addition of olive oil to the pate formulation, the cholesterol amount is significantly reduced. Olive oil enriches its composition and, being a natural antioxidant, gives new properties to the pate. The authors insist on the need for a comprehensive study. It is required to study the influence of the fat substitution and oils on the sensory abilities and characteristics of pates [24, 25, 26].

When developing functional foods with enhanced nutritional properties, interest in natural antioxidants is emerging. Taking care of your health requires a balanced diet. The fruits antioxidant activity, berries and extracts are important for the beneficial physiological activity of metabolism at the cellular level. The potential of some fruits and berries used in nutrition has not been fully studied for many years. Preliminary tests to study the antioxidant activity of the strawberry tree confirm the oxidative stability of meat and fish products. Strawberry tree extract 3% and 6% does not affect the energy value of fish pates. The crushed fraction of the fruit significantly increases the fiber content in finished fish products. The vegetable fiber source changes texture when mixed to give the product a uniform consistency. A comprehensive study showed high values when included in the product 6% active extract of strawberry tree. Natural antioxidant activity was shown within 90 days. Oxidative stability, improvement in uniformity and nutritional value allowed to obtain results of confirmation of a quality product [27,28,29].

To maintain a continuous demand for fish, fish products, it is necessary to improve the management of non-standard aquaculture samples. Non-standard, high-quality fish raw materials are used for the production of non-food products or disposed. Due to non-standard quality raw materials, it is intended for non-food products. Through the efforts of the scientific community, research and technologies for the processing of fishery losses are encouraged. The strategy of maximizing the fish use for food consumption is becoming an important incentive for production. Technological alternative solutions must be urgently found and offered to production in the form of additional profit. The solution to waste-free use of aquaculture is the production of multicomponent nutritionally balanced fish and fish pates.

The authors of the articles assessed the replacement of commercial fish with fish grown under artificially created conditions. With a maximum feeding base, stable climatic conditions, up to 10% of fish specimens differ from standard specimens. The methods of catching, processing, storing, processing are of great importance for the final result of fish products. As a result, it was concluded that the protein source has a significant potential to meet human needs [30,31,32].

The modern consumer is selective, picky about food products, excluding any health risks. The development of innovative, functional organic food products is a hot topic. A productive dialogue of scientific potential with industrialists with the interest of governments and state institutions is the way to provide the world's population with high-quality products.

The main part of salt, up to 80%, comes with products produced by the food industry. In addition, salt is consumed by a person with cooked food or in the process of eating [33]. An excess of salt raises blood pressure and provokes the development of cardiovascular diseases. This situation leads to financial costs for society, costs associated with treatment [34,35].

Salt performs many important functions, reduces water activity, growth and development of microorganisms. The shelf life of finished products and semi-finished products depends on the salt concentration. Salt affects the sensory attributes of the products consumed. Food manufacturers do not have the technological ability to abandon salt as an ingredient in flavor and preservative. Changes in the products formulation with a lower salt concentration may adversely affect competitiveness in the food market [36].

There is a strong demand on the part of manufacturers for the production of low salt products. Satisfying the requirements of consumers, the food industry is interested in maintaining the sensory properties of products, shelf life, purchasing power [37, 38, 39].

All seafood contains a small concentration of table salt 20–150 mg per 100 g of fresh raw materials. During the processing of fish and seafood, the concentration of sodium salts differs significantly. Significant differences in

products are associated with food preferences and habits of the population. Large differences are observed in salty foods from 1000 to 6000 mg per 100 g. A high concentration is typical for canned foods. Salted and smoked fish products usually do not exceed the salt content of more than 1100 mg per 100 g.

A number of strategic decisions help to reduce sodium content in ready-made seafood, while maintaining quality and shelf life. The application of a strategic decisions number can reduce the sodium content in the finished seafood, while maintaining the quality and shelf life. Compliance with regulations and consumer interests is of paramount importance to food production. The offered flavor enhancers, herbs, spices are used in combination with mineral salts. Other solutions are not capable of producing the desired characteristics, achieving acceptable shelf life. Only mineral salts can provide with their functional properties the processes associated with preservation [40].

Fish pates prepared in the Swedish city of Gothenburg contained eggs, cream, sour cream, dill, salt, water. The basis of the pate is freshly caught salmon, the fillet of which is processed into minced meat. The amount of salt in the standard recipe is 1%. To reduce sodium chloride, a mixture of sodium and potassium salts is proposed, with a content of 35% less sodium. During testing of prototypes, a decrease in sodium by 22% is found, compared to the standard formulation. Microbiological, taste properties are stable during the entire experimental period. Organoleptic differences in texture, taste, salinity of fish pates are not significant. The proposed salt mixture can be used in the recipe for fish pastes based on farmed salmon. The work noted the specificity of replacing sodium chloride with potassium in high concentrations. Products from other fish species with potassium chloride are often bitter and leave a metallic aftertaste [41]. In recent years, commercial proposals have been received for a mixture of salts with a sodium chloride content of less than 35% [42].

Freshwater fish species in many countries, due to the seasonality of the catch, are not used effectively. The main reasons are bony flesh, textural properties, specific taste, odor, uneven weight and size. For the industrial production of products from freshwater fish, it is necessary to assess the nutritional properties and food processing. A commercial approach to the use of local fish raw materials is of economic importance for expanding the products range [43].

In Italy, studies have been carried out on the possibility of using freshwater fish tenchu from Lake Trasimeno in pate. The caught fish specimens were salted in 22% brine, followed by drying. The dried fish were smoked by convection for 6 hours. Prepared smoked minced meat from fish muscle tissue. In 1 experimental group, minced meat was mixed with olive oil 41.5%, parsley 1,65%, lemon juice 1.65%. Group 2 added 42,55% mascarpone cheese, 12% cream, 1,28% parsley, 0,85% lemon juice. The difference between group 3 and group 2 was 40% cream. All samples were sterilized according to heat treatment standards for canned fish. Analysis of pates showed high nutritional and energy values. The images with olive oil received the optimal evaluation characteristics. Thanks to the selected ingredients, 2 experimental groups showed specific sensory sensory attributes, compared to group 3. The sample with olive oil received a higher rating from consumers; the formulation is recommended for smoked fish pate [44].

The most economically inexpensive freshwater fish are bream and perch. These types of fish are not demanding on feeding and living conditions. The nutritional value of these fish is maximized in the fall. Among the large number of freshwater fish, bream has a high nutritional value and low cost with large catches. A sample of an average bream contains 75% water, 18% protein, 1% minerals, and up to 6% fat. When making fish pate, minced fish was prepared from bream meat. The vegetable product pumpkin, seaweed, vegetable oil, fish broth, and dill were added to the minced meat. A homogeneous pasty mixture was prepared. After heat treatment and obtaining a canned fish paste, samples were taken for analysis. As a result of comparing the energy value of fish products, an increase in protein fractions and a low content of fat were noted. The protein content ranged from 17 to 18%, with a high content of essential amino acids. The mineral composition was significantly higher than the control sample. Dietary fiber, a rich set of mineral complexes in fish paste are a complete product [45,46,47]. Expanding the range of products, offering formulations for fish pates from freshwater fish meat is relevant for the food industry. Multicomponent fish pate has a high biological value with functional properties of a food product [48].

The staff of the Brazilian University is developed a method for preparing fish paste with fiber elements. The basis of the pate is a mustache-striped catfish of the genus pseudoplastistoma, which lives in the fresh waters of South America. Muscle tissue is valued for its juiciness and is in demand among consumers. This type of catfish grows well and reproduces in artificially created conditions. For the preparation of fish pate, fragments of meat left after the separation of the fish fillet were used. Frozen losses after technological processing are used as plant material. The composition of the fish pate formulation is represented by catfish meat 60%, sunflower oil 20%, water 16,7%, spices, additives 3,3%. The ingredients were crushed and homogenized. Heat treatment of the pate was carried out in a steam autoclave in accordance with the developed technology. Jars with fish paste were stored for 180 days at 25 °C. As a result of experimental studies, the positive effect of the thermal preservation process on the increase in the shelf life of fish paste. The nutritional value of the finished product was 15 g of protein and 7,92 g of fat per 100 g, respectively. The average moisture content was 75,5% and 1% minerals. A comprehensive analysis of the fish product is confirmed the safety for humans throughout the entire experience. The transformation of

quality food losses can compete with seafood and aquaculture products [49].

Studies of the fish resources of the Baltic Sea indicate the concentration of small herring for the sprat production. As a result of the analytical work of the processing enterprises, a high catch culling rate of 25% was established. Cull fish represents quality food loss. After processing the caught fish, up to 80% of the raw material is discharged into solid loss. Developing new approaches to fish processing requires expanding the range of ready-to-eat foods. An increase in the range of culinary and canned products based on fish raw materials will be similar to existing delicacies [50].

From losses of by-products, smoked fish, a fish pate has been developed with variations of flavor, color and flavor additives. To remove the smell of smoke, smoky taste, strong spices are included in the formulations. Vegetable ingredients of garlic, pepper, fried onions, carrots help to improve the smell and taste in the finished product. Fatty dairy products, starch, fried flour, fragrant herbal fiber reduce the concentration of smoke odor in the product. From the ethical point of view, the consideration of smoked heads as a raw material in the production of products for humans causes protest. Such pates have a non-uniform structure with fragments of the raw product, strong smoke odor and satisfactory taste. The formulations made it possible to produce fish pates with acceptable sensory attribute. A pate with a neutral aroma can be used to produce a product with a wide range of smells and tastes [51].

The ratio of components in fish pates is considered optimal from the point of view of the balance of fats, proteins, plant components. The functional purpose in comparison with the proposed classic formulations expands the range of fish pates. The consumption of functional pates will have a beneficial effect on digestion and absorption of nutrients by the human organism.

Conclusions

Based on the results of research on the selection of ingredients, it should be noted its versatility. Biological compatibility, nutritional balance, individual approach, taking into account the preferences of consumers, determines the recipe for the finished product. The process constituting the selection of components consists of scientific research, technological solutions to problems in the fishing industry. Targeted management of technological processes for the use of related raw materials stimulates the production of full-fledged functional products. Research has allowed us to determine the preferences of fish products, sustainability, the value of the main attributes of consumption. By objectively combining ingredients from the food industry, multicomponent, balanced food products can be developed.

Additional research on the compatibility of ingredients for fish pates is needed to expand the range of finished products. Extending shelf life requires formulations to incorporate functional ingredients.

REFERENCES

1. Petrov, N. Yu., Kalmykova, E.V., Kalmykova, O.V. (2015). Development of canned vegetables preparation technology of high nutritional value. *Bulletin of Northern Trans-Ural State Agricultural University,* 4(31), 57–63. (In Russian)
2. Merenkova, S.P., Lukin, A.A. (2015). Analysis of the rheological properties of vegetable and mayonnaise sauce, produced with the use of functional herbal supplements. *Processes and food production equipment*, (4), 96–105. (In Russian)
3. Gontareva, E. N., Ageeva, N. M., (2016). The research of possibility of using of sugar beet fiber to improve the safety of grapes wines. *Fruit growing and viticulture of South Russia,* 38(2), 156–161. (In Russian)
4. Lipatov, N.N. (1990). Principles and methods for designing food formulations that balance diets. *Food technology,* 6(199), 5–10. (In Russian)
5. Ranilovich, Ya., Bebek, Io., Tomich-Obrdali, Kh., Gadzhari, D., Tsvetkovich, T. (2020). A practical application of sensory and rheological measurement in the development of fish pate quality attributes. *Croatian Journal of Food Technology, Biotechnology and Nutrition,* 15(3–4). https://doi.org/10.31895/hcptbn.15.3–4.1
6. Jamshidi, A., Cao, H., Xiao, J., Simal-Gandara, J. (2020). Advantages of techniques to fortify food products with the benefits of fish oil. *Food Research International*, 137. Article 109353. https://doi.org/10.1016/j.foodres.2020.109353
7. Kaktcham, P. M., Tchamani Piame, L., Sandjong Sileu, G. M., Foko Kouam, E. M., Temgoua, J. -B., Zambou Ngoufack, F. at al. (2019). Bacteriocinogenic lactococcus lactis subsp. lactis 3MT isolated from freshwater nile tilapia: Isolation, safety traits, bacteriocin characterisation, and application for biopreservation in fish pâté. *Archives of Microbiology,* 201(9), 1249–1258. https://doi.org/10.1007/s00203–019–01690–4
8. Palmeira, K. R., Márs ico, E. T., Monteiro, M. L. G., Lemos, M., Conte Junior, C. A. (2016). Ready-to-eat products elaborated with mechanically separated fish meat from waste processing: Challenges and chemical quality. *CYTA — Journal of Food*, 14(2), 227–238. https://doi.org/10.1080/19476337.2015.1087050
9. Silva, F., Duarte, A. M., Mendes, S., Borges, P., Magalhães, E., Pinto, F. R. at al. (2021). Adding value to bycatch fish species captured in the portuguese coast — development of new food products. *Foods,* 10(1), Article 68. https://doi.org/10.3390/foods10010068
10. Husein, Y., Secci, G., Dinnella, C., Parisi, G., Fusi, R., Monteleone, E. at al. (2019). Enhanced utilisation of nonmarketable fish: Physical, nutritional and sensory properties of 'clean label' fish burgers. *International Journal of Food Science and Technology*, 54(3), 593–601. https://doi.org/10.1111/ijfs.13858
11. Borgogno, M., Husein, Y., Secci, G., Masi, S., Parisi, G. (2017). Technological and nutritional advantages of mechanical separation process applied to three European aquacultured species. *LWT-Food Science and Technology*, 84, 298–305. https://doi.org/10.1016/j.lwt.2017.05.068
12. Claret, A., Guerrero, L., Gartzia, I., Garcia-Quiroga, M., Ginés, R. (2016). Does information affect consumer liking of farmed and wild fish? *Aquaculture*, 454, 157–162. https://doi.org/10.1016/j.aquaculture.2015.12.024
13. Borisov, V.A., Yanchenko, E.V, Yanchenko, A.V., Gasparyan, Sh.V., Maslovsky, S.A., Zamyatina, M.E. at al. (2019). A change in the content of dry matter, carotenoids, sugars in the drying process of varieties and hybrids of carrot. *News of FSVC,* 1, 39–42. https://doi.org/10.18619/2658–4832–2019–1–39–42 (In Russian)
14. Borisov, V.A., Yanchenko, E. V., Filroze, N. A., Soloveva, E.A., Gasparyan, S.V., Maslovskiy, S.A., at al. (2019). Technological assessment of varieties and hybrids of beet-root as raw materials for manufacturing mashed semi-finished products. *Polythematic online scientific journal of Kuban State Agrarian University*, 149, 116–127. https://doi.org/10.21515/1990–4665–149–021 (In Russian)
15. Silva, D. V. T. D., Baião, D. D. S., Ferreira, V. F., Paschoalin, V. M. F. (2020). Betanin as a multipath oxidative stress and inflammation modulator: A beetroot pigment with protective effects on cardiovascular disease pathogenesis. *Critical Reviews in Food Science and Nutrition*, (unpublished data). https://doi.org/10.1080/10408398.2020.1822277

16. Anosova, M. V., Popov, I. A., Zhukov, A. M., Shchedrin, D. S. (2020). Developing a technique for obtaining powdery prefabricated turnip. Paper presented at the *IOP Conference Series: Earth and Environmental Science,* 422(1), Article 012007. https://doi.org/10.1088/1755–1315/422/1/012007
17. Grand View Research. (2019). Pates market size, share & trends analysis report by product type (chicken, fish, duck), by region (North America, Europe, APAC, CSA, MEA), and segment forecasts, 2019–2025. Retrieved from https://www.grandviewresearch.com/industry-analysis/pates-market/segmentation Accessed January 10, 2021
18. Colakoglu, F., Kunili, I., Ormanci, H. (2019, 22–23 November). *Fisheries food industry of* Canakkale. Proceedings of the International scientific and practical conference "Bulgaria of regions", 2(1), 707–710. Plovdiv, Bulgaria.
19. Okuskhanova, E., Rebezov, M., Yessimbekov, Z., Tazeddinova, D., Shcherbakov, P., Bezhinar. T. at al. (2018). Rheological Properties of Low-calorie Red Deer Meat Pate. *Journal of Pharmaceutical Research International,* 23(1), 1–9. https://doi.org//10.9734/JPRI/2018/42317
20. Hwanhlem, N., Jaffrès, E., Dousset, X., Pillot, G., Choiset, Y., Haertlé, T. at al. (2015). Application of a nisin Z-producing lactococcus lactis subsp. lactis KT2W2L isolated from brackish water for biopreservation in cooked, peeled and ionized tropical shrimps during storage at 8 °C under modified atmosphere packaging. *European Food Research and Technology,* 240(6), 1259–1269. https://doi.org/10.1007/s00217–015–2428–8
21. Nga Ombede, S. N., Kaktcham, P. M., Seydi, M., Zambou Ngoufack, F. (2019). Changes in sensory, physicochemical, and microbiological properties of fresh captured tropical pink shrimps (penaeus duorarum notialis) inoculated with lactobacillus plantarum Lp6SH, lactobacillus rhamnosus yoba, and their cell-free culture supernatants during storage at 4 °C. *Journal of Food Safety*, 39(1), Article e12579 https://doi.org/10.1111/jfs.12579
22. Goldstein, E. J. C., Tyrrell, K. L., Citron, D. M. (2015). Lactobacillus species: taxonomic complexity and controversial susceptibilities. *Clinical Infectious Diseases*, 60, S98-S107. https://doi.org/10.1093/cid/civ072
23. Estanech, A. F. D. C., Oliveira, N., Amorim, E., Valadão, R., Torrezan, R., Oliveira, G. (2020). Effect of the addition of manioc starch, water and inulin on the technological characteristics of bicuda pâté (sphyraena tome, fowler, 1903). [Efecto de la adición de almidón de mandioca, agua e inulina sobre las características tecnológicas del paté bicuda (Sphyraena tome, fowler, 1903)] *Revista Chilena De Nutricion*, 47(3), 359–365. https://doi.org/10.4067/S0717–75182020000300359
24. Dominguez, R., Agregan, R., Goncalves, A., Lorenzo, J.M. (2016). Effect of fat replacement by olive oil on physico-chemical properties, fatty acids, cholesterol and tocopherol content of pate. *Grasas Aceites*, 67(2), Article e133. http://dx.doi.org/10.3989/gya.0629152
25. Issaoui, M., Delgado, A. M., Caruso, G., Micali, M., Barbera, M., Atrous, H. at al. (2021). Phenols, flavors, and the mediterranean diet. *Journal of AOAC International*, 103(4), 915–924. https://doi.org/10.1093/jaocint/qsz018
26. Jimenez-Lopez, C., Carpena, M., Lourenço-Lopes, C., Gallardo-Gomez, M., M. Lorenzo, J., Barba, F. J. at al. (2020). Bioactive compounds and quality of extra virgin olive oil. *Foods,* 9(8), Article 1014. https://doi.org/10.3390/foods9081014
27. Pinheiro, J., Rodrigues, S., Mendes, S., Maranhao, P., Ganhao, R. (2020). Impact of Aqueous Extract of Arbutus unedo Fruits on Limpets (Patella spp.) Pate during Storage: Proximate Composition, Physicochemical Quality, Oxidative Stability, and Microbial Development. *Foods,* 9(6), Article 807. https://doi.org/10.3390/foods9060807
28. Zitouni, H., Hssaini, L., Ouaabou, R., Viuda-Martos, M., Hernández, F., Ercisli, S. at al. (2020). Exploring antioxidant activity, organic acid, and phenolic composition in strawberry tree fruits (arbutus unedo l.) growing in morocco. *Plants,* 9(12), Article 1677, 1–24. https://doi.org/10.3390/plants9121677
29. Tavares, L., Fortalezas, S., Carrilho, C., McDougall, G. J., Stewart, D., Ferreira, R. B., Santos, C. N. (2010). Antioxidant and antiproliferative properties of strawberry tree tissues. *Journal of Berry Research*, 1(1), 3–12. https://doi.org/10.3233/BR-2010–001
30. Gokoglu, N., Yerlikaya, P. (2015). Freezing and frozen storage of fish. Seafood chilling, refrigeration and freezing: Science and technology. John Wiley & Sons, 186–207.
31. Lyu, F., Huang, R.-J., Liu, L., Zhou, X., & Ding, Y.-T. (2015). Effect of slaughter methods on the quality of Chilean jack mackerel (Trachurus murphyi) during refrigerated storage. *Journal of Food Science and Technology*, 52(3), 1742–1747. https://doi.org/10.1007/s13197–013–1114–8
32. Raoofi, P., Ojagh, S. M., Shabanpour, B., Eighani, M. (2015). Effects of catching methods on quality changes of Rutilus kutum (Kamensky, 1901) during storage in ice. *Journal of Applied Ichthyology*, 31(4), 729–732. https://doi.org/10.1111/jai.12795
33. Allison, A., Fouladkhah, A. (2018). Adoptable interventions, human health, and food safety considerations for reducing sodium content of processed food products. *Foods*, 7(2), Article 16. https://doi.org/10.3390/foods7020016
34. Grillo, A., Salvi, L., Coruzzi, P., Salvi, P., Parati, G. (2019). Sodium intake and hypertension. *Nutrients,* 11(9), Article 1970. https://doi.org/10.3390/nu11091970
35. Afshin, A., Sur, P. J., Fay, K. A., Cornaby, L., Ferrara, G., Salama, J. S. at al. GBD2017 Diet Collaborators. (2019). Health effects of dietary risks in 195 countries, 1990–2017: A systematic analysis for the global burden of disease study 2017. *The Lancet,* 393(10184), 1958–1972. https://doi.org/10.1016/S0140–6736(19)30041–8
36. Cepanec, K., Vugrinec, S., Cvetkovic, T., Ranilovic, J. (2017). Potassium chloride-based salt substitutes: a critical review with a focus on the patent literature. *Comprehensive Reviews in Food Science and Food Safety,* 16(5), 881–894. https://doi.org/10.1111/1541–4337.12291
37. Martelo-Vidal, M.J., Guerra-Rodriguez, E., Pita-Calvo C., Vazquez M. (2016). Reduced-salt restructured European hake (Merluccius merluccius) obtained using microbial transglutaminase. *Innovative Food Science and Emerging Technologies*, 38, 182–188. https://doi.org/10.1016/j.ifset.2016.10.004
38. Martelo-Vidal, M.J., Mesas, J.M., Vazquez, M. (2012). Low-salt restructured fish products from Atlantic mackerel (Scomber scombrus) with texture resembling turkey breast. *Food science and technology international*, 18(3), 251–259. https://doi.org/10.1177/1082013211415175
39. Martelo-Vidal, M.J., Fernandez-No, I.C., Guerra-Rodriguez, E., Vazquez, M. (2016). Obtaining reduced-salt restructured white tuna (Thunnus alalunga) mediated by microbial transglutaminase. LWT — *Food Science and Technology*, 65, 341–348. https://doi.org/10.1016/j.lwt.2015.08.032
40. Pedro, S., Nunes, M.L. (2019). Reducing salt in seafood products. Woodhead Publishing Chapter in a book: Series in Food Science, Technology and Nutrition, 185–211. Woodhead Publishing. https://doi.org/10.1533/9781845693046.3.256
41. Giese, E., Meyer, C., Ostermeyer, U., Lehmann, I., Fritsche, J. (2019). Sodium reduction in selected fish products by means of salt substitutes. *European Food Research and Technology,* 245, 1651–1664. https://doi.org/10.1007/s00217–019–03277–1
42. Petit, G., Jury, V., de Lamballerie, M., Duranton, F., Pottier, L., Martin, J. (2019). Salt intake from processed meat Products: benefits, risks and evolving practices. *Comprehensive Reviews in Food Science and Food Safety*, 18(5), 1453–1473. https://doi.org/10.1111/1541–4337.12478
43. Branciari, R., Galarini, R., Giusepponi, D., Trabalza-Marinucci, M., Forte, C., Roila, R. at al. (2017). Oxidative status and presence of bioactive compounds in meat from chickens fed polyphenols extracted from olive oil industry waste. *Sustainability*, 9(9), Article 1566. https://doi.org/10.3390/su9091566
44. Branciari, R., Roila, R., Valiani, A., Ranucci, D., Ortenzi, R., Miraglia, D. at al. (2019). Nutritional quality, safety and sensory properties of smoked tench (Tinca tinca) pate from Trasimeno Lake. *Italian Journal of Food Safety*, 8(2), 143–148. https://doi.org/10.4081/ijfs.2019.8130
45. Okuskhanova, E., Smolnikova, F., Kassymov, S., Zinina, O., Mustafayeva, A., Rebezov, M. at al. (2017). Development of minced meatball composition for the population from unfavorable ecological regions. *Annual Research and Review in Biology,* 13(3), Article ARRB.33337, 9p. https://doi.org/10.9734/ARRB/2017/33337
46. Kakimov, A.K., Kabulov, B.B., Yessimbekov, Z.S., Kuderinova, N.A. (2016). Use of meat-bone paste as a protein source in meat product production. *Theory and practice of meat processing*, 1(2), 42–50. https://doi.org/10.21323/2414–438X-2016–1–2–42–50 (In Russian)
47. Kakimov, A., Suychinov, A., Mayorov, A., Yessimbekov, Z., Okuskhanova, E., Kuderinova, N. at al. (2017). Meat-bone paste as an ingredient for meat batter, effect on physicochemical properties and amino acid composition. *Pakistan Journal of Nutrition*, 16(10), 797–804. https://doi.org/10.3923/pjn.2017.797.804
48. Kazhibayeva, G., Issaeva, K., Mukhamejanova, A., Khayrullin, M., Kulikov, D., Lebedeva, N. at al. (2019). Development of formulation and production technology of fish pate for therapeutic and prophylactic purposes. *International journal of engineer-*

ing and advanced technology, 8(5), 1355–1359. https://doi.org/10.35940/ijeat.E1193.0585C19
49. de Oliveira Lobo, C. M., Torrezan, R., de Furtado, Â. A. L., Antoniassi, R., de Grandi Castro Freitas, D. at al. (2015). Development and nutritional and sensory evaluation of cachapinta (pseudoplatystoma sp) pâté. *Food Science and Nutrition*, 3(1), 10–16. https://doi.org/10.1002/fsn3.183
50. Miles R. D., Chapman F. A. (2006). The benefits of fish meal in aquaculture diets. IFAS Extension University of Florida, 1–7.
51. Silovs, M. (2018). Fish processing by-products exploitation and innovative fish-based food production. *Research for Rural Development*, 2, 210–215. https://doi.org/10.22616/rrd.24.2018.074

AUTHOR INFORMATION

Anastasia S. Kupriy — graduate student, Department "Product quality management and merchandise knowledge", Russian State Agrarian University — Moscow Timiryazev Agricultural Academy. 127550, Moscow, Timiryazevskaya str., 49. Tel.: +7–499–976–15–46, E-mail: a.kuprii@mail.ru
ORCID: https://orcid.org/0000–0003–0641–9083
* corresponding author

Nina I. Dunchenko — doctor of technical sciences, professor, the head of the Department "Product quality management and merchandise knowledge", Russian State Agrarian University — Moscow Timiryazev Agricultural Academy. 127550, Moscow, Timiryazevskaya str., 49. Tel.: +7–499–976–15–46, E-mail: dunchenko.nina@yandex.ru
ORCID: https://orcid.org/0000–0002–6158–9854

Elena S. Voloshina– candidate of technical sciences, docent, Department "Product quality management and merchandise knowledge", Russian State Agrarian University — Moscow Timiryazev Agricultural Academy. 127550, Moscow, Timiryazevskaya str., 49. Tel.: +7–499–976–08–65, E-mail: yudakovaes@gmail.com
ORCID: https://orcid.org/0000–0002–8165–5230

All authors bear responsibility for the work and presented data.

All authors made an equal contribution to the work.

The authors were equally involved in writing the manuscript and bear the equal responsibility for plagiarism.

The authors declare no conflict of interest.

Received 14.01.2021 Accepted in revised 20.03.2021 Accepted for publication 25.03.2021