SECTION 7. FOOD AND LIGHT INDUSTRY TECHNOLOGY

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7.1 Improving the technology of shrimp mousse products

Pasty products from aquatic organisms are gaining popularity in the global market of fish products and are in great demand among consumers. This is due to their organoleptic characteristics, ease of consumption, high nutritional value and degree of assimilation, as well as the spread of low-waste industries. The technology of pasty products allows to obtain products enriched with various flavoring additives, functional ingredients, using raw materials with mechanical damage. The range of these products includes fish pates, pastes, oils, creams and mousses [173].

The current state of nutrition of the population of Ukraine is characterized by a deficiency of many essential nutritional factors. One of the main conditions for the vital activity of the human body is the mandatory presence in the diet of high-quality proteins, high-performance lipids, vitamins and minerals, which must be taken into account when choosing food ingredients.Therefore, the issue of expanding the range of pasty products based on valuable raw materials and natural ingredients that improve not only organoleptic properties, but also increase the nutritional, biological value and benefits of the product for the body. A promising direction for solving this problem is to improve the technology of mousse products from shrimp and raw materials of animal and vegetable origin.

Shrimp, like all seafood, is a source of complete protein. 100 g of cooked shrimp meat contains about 20-24 g of protein. So usually only 100 g is enough to cover 20-40% of the daily protein requirement. It has been established that shrimp meat is characterized by a relatively high content of essential amino acids (44.7%), of which leucine and lysine predominate.

Low fat content is another significant advantage of this raw material. Seafood makes it possible to easily balance your meal in terms of calories, proteins, fats, carbohydrates. Shrimp lipids contain biologically active polyunsaturated fatty acids

(22.9% of the total amount of fatty acids), which is an important structural element of many classes of lipids. Among the species composition of fatty acids, oleic, myristic, palmitic acids predominate in shrimp lipids. It should be noted that the measure of lipid resistance to oxidation, high iodine value, is associated with the amount of unsaturated fatty acids.

The advantage of shrimp is low calorie content and at the same time high nutritional value. This protein product is well saturating, satisfies hunger, and at the same time shrimp contains only 90-110 kcal per 100 g.

Shrimp meat is tender, tasty, contains valuable vitamins and minerals. The concentration of useful micro- and macroelements in shrimp is dozens of times higher than in meat. Thus, shrimp contain sodium, potassium, phosphorus, sulfur, magnesium, iron, zinc, copper, manganese, iodine, fluorine, cobalt, nickel, molybdenum and others. To get the daily norm of iodine, it is enough to eat only 100 grams of shrimp. Thanks to the calcium in the composition, shrimp strengthen bones, improve blood flow and normalize kidney function. This type of shellfish is rich in phosphorus (about 15-20% of the daily norm in 100 g of shrimp meat), which makes them useful for bones and teeth. Shrimp contain chromium, which removes excess fat and harmful cholesterol from the body. Literally 100 g is enough to provide 70% of the daily requirement for selenium. It is needed for immunity, hair and skin health, thyroid function and the reproductive system.

Shrimp is a powerful source of provitamin A. It is useful for our skin and vision. Shrimp meat is also rich in vitamins: E, C, PP, B1, B2, B3, B6, B9, B12, H. 100 g of shellfish meat contains 35% of the daily requirement of B12. This vitamin is needed for the nervous system, memory, digestive function and as a prevention of anemia.

Eating shrimp helps reduce the body's sensitization and prevent allergic reactions. When consuming shrimp, the body produces the hormone of happiness serotonin. Thanks to this, the body copes with stress more easily. Shrimp contain antioxidants that protect the body's cells from stress and negative influences. With regular consumption, shrimp prevent the appearance of cancer.

The main areas of use of shrimp are the production of delicatessen food products,

including cooked and frozen, canned food, culinary products. Waste from obtaining meat can be used for the production of chitin, chitosan, food coloring, as well as feed products [174].

Shrimp meat is advisable to use in mousses in combination with various plant and animal components to create balanced nutritional and biologically valuable products.

A significant part of the range of fish paste products is pate and paste, due to their nutritional properties and unique sensory characteristics. The attention of many scientists is focused on expanding the raw material base for the manufacture of pasty products, improving organoleptic and rheological parameters and replacing traditional raw materials [175, 176].

Fish pastes are made from herring, mackerel, salmon, culled for mechanical damage, as well as small fish species. Raw materials are used mainly in salt form [175]. The technology of salted herring and salmon paste is known, which includes the preparation of fish raw materials (soaking salted fish, filleting, washing) and auxiliary materials (butter, cheese, broccoli, bell pepper, carrots and lakonos), grinding, packaging. This method ensures the production of fish paste with a rich component composition and a bright taste range. The disadvantage is the use of expensive salmon grown in mariculture conditions, which has an unbalanced lipid and protein composition due to the use of artificial feeds.

Paste-like products made from minced meat of fresh sea or ocean fish or from minced fish are also common [176]. There is a known method for preparing fish paste, according to which the disassembled fish raw material is ground into minced meat, simultaneously salted, the resulting brine is separated, washed and filtered. The resulting product is subjected to fine grinding to obtain a uniform homogeneous paste structure with the simultaneous addition of vegetable oil, sugar, spices, baking soda and pomegranate extract. The disadvantages of the specified method include a significant duration and laboriousness of obtaining fish paste. The product obtained by the specified method has low nutritional and biological value, since the fish raw material is washed with water, resulting in the loss of extractive proteins, vitamins,

which significantly reduces the nutritional and biological value of the finished product.

There are well-known pastes that use milk and liver in addition to fish meat. The technology allows to obtain a food product with high nutritional and biological value and original taste. The technology of preparation of a pasty product is known, which includes preparation of a binary composition based on soy protein paste, with subsequent addition of pate mass from blanched liver and salmon milk, fried onion, salt and spices. The disadvantages of this method include the complexity of the technological process for obtaining a pasty fish product, as well as the presence of a technological sterilization operation, which significantly reduces the nutritional and biological value of the finished product. The technology of obtaining a food emulsion by heat treatment of fish milk, grinding it to a homogeneous consistency, adding flavorings, pasteurizing the resulting mixture and subsequent homogenization with the simultaneous addition of vegetable oil is known. The disadvantage of these products is low structural-mechanical and antibacterial properties and organoleptic indicators.

Valuable fish raw material for the production of paste-like products is caviar. Caviar pastes and oils are made from capelin, herring, salmon, flounder, hake, and cod caviar. The technology of paste-like products allows the use of substandard caviar, which ensures the comprehensive use of raw materials [177, 178]. There is a known technology for obtaining a food product with high nutritional and biological value, using salted caviar and herring fillet, butter, and flavorings in a certain ratio. When studying the quality of pastes based on fish, significant attention is paid to sensory properties and lipid oxidation. Theoretical and practical research is needed to create and improve the quality of paste-like products based on freshwater fish caviar. It is known that the protein and lipid components of fish caviar have emulsifying, structure-forming properties [179, 180]. This raises interest in using caviar in the technology of pasty products without additional addition of structure regulators to ensure the appropriate consistency of the finished product.

In the technology of pasty products, the trend of creating multicomponent products by combining different types of raw materials in order to increase their nutritional and biological value does not lose its relevance. The nutritional and biological value of pasty

products is increased by adding non-fish raw materials of aquatic origin, animal and plant raw materials, including fruit and vegetable raw materials, spicy and aromatic root crops, secondary high-protein products of plant processing. Squids are an attractive source of valuable components, with the addition of which a functional pate based on freshwater fish has been developed. The technology of fish pate from pike, bream, which additionally contains pumpkin, vegetable oil and algae is known. The positive effect of the use of red ginseng powder on the sensory properties and lipid oxidation indicators of fish pastes has been established [181, 182].

Analysis of technologies of pasty products showed that spicy-aromatic plants or their extracts are used in their prescription compositions [183, 184]. This improved not only the taste and aromatic characteristics of finished products, but also their quality and safety. The technology of production of vegetable-fish pastes and carp pates with the addition of pumpkin, onion and CO2-extract of black pepper, CO2-extract of garlic is known. The technology provides an increase in the nutritional and biological value of the product. A method of obtaining vegetable-fish pates using chitosan as a structure-forming agent and the addition of CO2-extracts of spices is presented. Silver carp, carp and catfish were used as fish raw materials; and carrots, onions, sweet peppers, tomatoes, wheat served as plant components. It was studied how oregano essential oil helped extend the shelf life of the roe paste taramastored at 4°C .

Among paste-like products, fish oils, creams, and mousses are also popular [185, 186]. A feature of these products is the combination of high nutritional value with a light, pleasant texture. Therefore, the selection of a fat base (butter, oil, mayonnaise), available fish raw materials, and their ratio to ensure appropriate rheological and organoleptic indicators is the subject of research by domestic and foreign scientists.

For the preparation of fish oil, such fish species as herring, mackerel, sardines (ivasi, sardinella, sardinops), and food waste from salmon dismemberment are used. A technology for preparing “Delicaciesne” and “Novynka” oils has been developed, which include boiled-frozen krill meat and salted pollock caviar. Shrimp oil, which is prepared from “Ocean” protein paste or krill meat and butter, has a good taste and delicate consistency. Shrimp oils have a pinkish-cream or pink color, a pleasant taste and aroma,

and a delicate consistency.

Due to their attractive appearance, light airy consistency, high nutritional value, and unique taste and aroma properties, creams and mousses from hydrobionts deserve the attention of discerning consumers. There are recipes for Scottish fish cream, which, in addition to skimmed haddock fillet, includes milk, butter, eggs, fresh wheat bread, salt, pepper, flavoring (with shrimp or parsley flavor) and some other components.

The technology for preparing a low-salt creamy product from hydrobionts (fish, squid, octopus, bivalves, and gastropods) is known. The technologies for mousse from fresh salmon with shrimp, fresh haddock meat with shrimp, and smoked haddock meat are known. Which contain at least 40.0% fish meat with mayonnaise and bechamel sauce.

In recent years, lactic acid microorganisms have been used in the technology of paste products. It has been proved that their use promotes the formation of harmonious smell and taste in minced products, and they also act as preservatives. There are technologies of fish pastes and pâtés, including those from freshwater fish, using different protective cultures for biopreservation [187]. The disadvantage of these technologies is the increased cost of manufacture of paste products.

An important task in developing paste-like emulsion products is ensuring a stable structure and appropriate consistency of the finished product. In order to improve the rheological properties of paste products, emulsifiers and thickeners are used, along with the appropriate technological processes and conditions of their preparation.

Hydrocolloids from plants and seafood (carob gum, pectin, maize phosphate starch, carboxymethyl starch, sodium alginate, agar-agar, carrageenan, chitin, chitosan) are used to regulate the consistency and improve the functional properties of paste products. Gelatine extract and milk concentrate, carotenoid extract can be used as additives [188, 189].

Some researchers believe that stabilisation of minced products, including pastes, requires simultaneous use of emulsifiers or thickeners of different chemical nature. Technologies of low-fatemulsions and moulded fish products based on binary compositions have been developed: chitosan –soya protein isolate; homogenised

laminaria –soya protein isolate; minced fish muscle tissue –starch.

It was found that the simultaneous use of emulsifiers and thickeners of different chemical nature expanded the functional and technological properties of a binary structurant, increased the water-retaining, water-absorbing and fat-absorbing capacity of minced fish, the yield of finished moulded products, allowed obtaining stable emulsions with the fat content not more than 35% [189].

According to the patent (US No. 20070254066), the consistency of fish pastes can also be regulated by adding enzyme preparations of animal, microbial, and vegetable origin. Theybreak down the biopolymer components of the raw materials and improve the mechanostructural, taste, and aromatic characteristics of the products.

Despite the wide world range and experience in the production of pasty products, their production in our country remains problematic. Modern technologies for the production of these products are based on the use of fish raw materials and a large number of synthetic flavoring and stabilizing additives. Therefore, an important task is to expand the range of pasty products based on crustaceans.

The purpose of the work is to improve the technology of multicomponent mousses based on aquatic organisms.

The object of research − indicators of quality of finished products.

The subject of research − technology of making shrimp mousse.

The organoleptic assessment of the quality of frozen shrimp was carried out in accordance with DSTU 4440:2005 “Frozen shrimp. Technical conditions”, which is given in table 1.

The results of organoleptic analysis showed that the indicators met the established requirements, which indicates the good quality of the raw materials.

Table 1.

Organoleptic characteristics of frozen shrimp

Indicator name	Characteristic
Appearance	Clean, without damage to the carapace, of the same size group, slightly bent. The presence of caviar on the lower part of the neck was established, antennae broken off up to 5%

Continuation of table 1

Dismantling	Correct
Meat color	From white-pink to pink-orange
Meat consistency	Dense, juicy, slightly dry
Taste (after defrosting cooked)	Pleasant, typical of boiled shrimp meat, without any foreign taste
Scent	Typical for this type of product, without any foreign odor
Laying procedure	Bulk
Foreign impurities	Not detected

The product yield and waste during shrimp dissection are given in table 2.

Table 2.

Size and mass composition of shrimp

Output of products and waste, %	Shrimp			
	Raw		Vegetables	
	Very large and large	Medium and small	Very large and large	Medium and small
Losses during washing	2..4	2..4	10..15	10..15
Cephalothorax	38..48	23..40	35..45	20..35
Necks (with carapace)	50..60	60..75	40..55	55..65
Necks (without carapace)	40..52	50..65	30..45	40..55
Carapace and other losses	12..20	14..25	15..25	15..30

The results of studies of the dimensional and mass composition show that the yield of edible parts in medium and small boiled shrimps is 40-55%, which exceeds this figure in large specimens (30-45%).

Therefore, it is advisable to use medium and small shrimps for the production of mousses.

The results of studies of the chemical composition of the meat of boiled-frozen shrimps with and without shells are presented in table 3.

Table 3.

Chemical composition of shrimp meat

Object name	Mass fraction, %			
	moisture	protein	ash	fat
Boiled and frozen shrimp without shell	80± 0,19	17,2± 0,17	1,04±0,09	1,02±0,02
Boiled and frozen shrimp with shell	69,6± 0,24	18,6±0,18	1,89±0,02	1,05±0,01

According to the results of the analysis, it was found that shrimp are a high-protein raw material. The difference in chemical composition between shrimp with and without shells is observed in the increase in the proportion of protein and minerals in cooked-frozen shrimp with shells.

Having characterized the raw materials for the production of mousse, we can say that we chose it in order to harmonize the taste of new recipes and increase nutritional value.

The task of our work in improving the recipe composition was to select and arrange ingredients to create natural mousses without the use of synthetic flavors, flavor enhancers, thickeners.

Samples of shrimp-based mousses were developed with the addition of ingredients such as: cream cheese, cream, avocado and apple, which improve the organoleptic characteristics of finished mousse products, increase the nutritional and biological value of finished products, enrich the composition with additional minerals and vitamins.

The control was selected mousse based on minced cod without the addition of plant ingredients.

Justification of the recipe composition of mousse products was carried out on the basis of organoleptic evaluation.

Comparative characteristics of the control and experimental mousse samples are presented in table 4.

Table 4.

Comparative characteristics of the prescription composition of control and experimental samples of mousses

Name of ingredients	Ingredient content, %			
	Control	Experimental samples		
		№1	№2	№3
Shrimp meat	35	47	52	62
Minced cod fish	40	-	-	-
Minced trout is slightly salty	-	42	-	-
Cream cheese	15	-	-	24
Cream	-	-	-	12
Avocado	-	-	22	-
Apple	-	-	15	-
Stone salt	0,8	1,2	1,2	1
Garlic	-	0,6	-	0,8
Olive oil	-	8	9	-
Egg yolk	3,6	-	-	-
Water	3	-	-	-
Xanthan gum	0,25	-	-	-
Carob gum	0,15	-	-	-
Aroma of shrimp	0,05	-	-	-
Paprika	0,15	0,6	0,4	0,1
Ground black pepper	0,2	0,6	0,4	0,1

The prescription composition of mousses determines the appropriate organoleptic characteristics. In particular, the color of mousses depends on the use of vegetable raw materials. Avocado gave a green tint in sample №2.

Flavor and aroma indicators are improved by spices and vegetable cheese, which was added by us according to recipes. Adding black pepper, paprika and garlic adds spiciness and originality to the taste.

Determination of organoleptic parameters has been carried out by the profile method using a 5-point scale. Differentiated organoleptic analysis of mousses allows to establish the assessment of the intensity of individual quality indicators and to present the results in the form of a profilogram.

Comparison of the obtained samples of mousses with the help of a quality polygon is shown in fig. 1. Organoleptic evaluation of shrimp-based mousses was

performed on the following indicators: external appearance, color, consistence, taste, aroma.

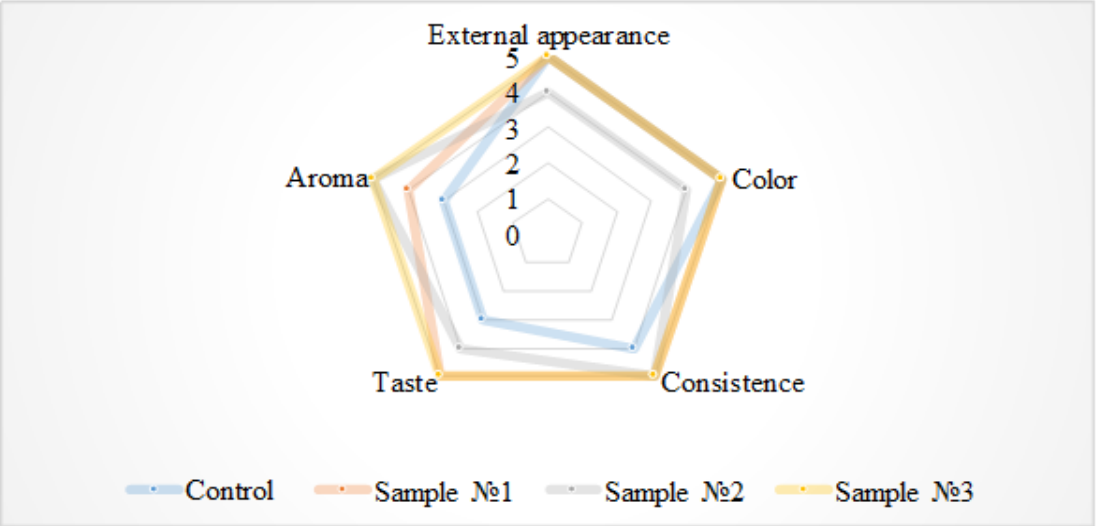

Figure 1. Organoleptic evaluation of mousse samples

It is clear that the developed samples of mousses differ in organoleptic evaluation. According to the results of organoleptic evaluation, sample №3 is the best, because its area is the largest, and control - the smallest.

For organoleptic evaluation, the flavor profile method was used. The concept of flavor is understood as the combined effect of taste properties, aromatic perception and tactile sensations in the oral cavity.

The method is based on the creation of a product flavor profile by the tasting commission by achieving agreement among all tasters at each stage of its development.

Identification of descriptors, assessment of their intensity, order of perception, aftertaste in the meat product are carried out under the guidance of the head of the commission.

The process of creating a flavor profile of a mousse product includes:

- selection and training of tasters, selection of products and preparation for the tasting;

- preliminary session for creating a flavor profile;

- formation of a descriptor dictionary and assessment of product characteristics;

- compilation of the final flavor profile and presentation of the evaluation results.

In order to study the taste of shrimp mousses, descriptors of the organoleptic profile were selected and the “ideal” organoleptic profile (standard) was determined.

To construct the “ideal” organoleptic profile, a consumer tasting was conducted to obtain data on the level of desirability of the intensity of the descriptors according to five samples of their intensity scale.

The results of the profile analysis of the palatability of shrimp mousses are given in table 5.

Table 5.

Profile analysis of the palatability of shrimp mousses

Descriptors	Intensity of characteristics, score				
	Standard	Shrimp mousse recipes			
		Control	№1	№2	№3
Aroma and taste characteristics					
Pleasant	5	4	4	4	5
Shrimp	4	3	3	3	4
Salt	3	2	4	2	3
Sweet	1	2	1	3	2
With a fishy taste	1	3	3	1	1
Bittersweet	0	1	0	1	0
Aroma and flavor of added plant materials	1	0	0	2	0
Harmonious	5	4	4	4	5
Spicy	4	2	4	4	5
Consistency characteristics					
Plastic	4	1	4	4	4
Gentle	5	4	4	4	5
Homogeneous	5	4	5	5	5
Overall impression	5,0	3,5	4,5	4,0	5,0

All samples have a pleasant taste, but sample No. 3 is the closest to the standard. It is most pronounced in sample No. 3. A fishy aftertaste is present in the control and sample No. 1, since they contain minced fish. A slightly bitter aftertaste is noticeable in samples No. 2 and the control. A vegetable aftertaste is present in sample No. 2, due to the presence of avocado and apple in its recipe.

A plastic consistency is observed in all samples, except for the control, since a

structuring gum was added there, which gave the product a more gel-like consistency, the same can be said about the uniformity of the consistency of the samples.

As a result of the assessment of the compatibility of ingredients in shrimp mousses using the flavor profile method, it was found that adding dairy products to minced shrimp, namely butter, cream, and cream cheese, improves the taste, appearance, and creates a delicate consistency of the mousse.

The taste and aroma indicators are improved by spices and vegetable curd, which we added according to the recipes.

The addition of black pepper, paprika, and garlic gives piquancy and originality to the taste.

Relevant organoleptic characteristics were confirmed by the results of physicochemical parameters. Physico-chemical parameters include salt content, penetration index, and water activity. These parameters significantly affect the quality of the product and its shelf life.

Thus, the salt content in the control is 2.5%, and in test samples 1 and 2 is 2.3%, which corresponds to the norm of 1.5-2.5%, according to the requirements of the standard.

To assess the consistency of the mousse, penetration measurements were performed and the shear stress was determined.

The ultimate shear stress was determined using a penetrometer Ulab 3-31 M, in accordance with GOST 30469 – 95.

The measurement results are given in tabl. 6.

Table 6.

Maximum shear stress of mousses (n = 3, p ≤0.05)

Name of samples	Maximum shear stress, Pa
Control sample	254,0
Sample №1	196,3
Sample №2	208,3
Sample №3	196,0

The results of the studies are shown in tabl. 6 show that the control sample is characterized by the highest value of the shear stress - 254 PA and, accordingly, has

the densest structure compared to the developed samples. Sample №1 has a limit voltage of 196.3 Pa, sample №2 - 208.3 Pa, sample №3 - 196 Pa.

One of the important physical and chemical indicators is water activity. This indicator determines the resistance of the product to damage. The higher the activity of water, the more favorable conditions for the reproduction of microorganisms, the higher the damage to the product by pathogenic microflora. According to this indicator, you can determine how perishable the product is, or vice versa.

Water activity index was measured using a highly sensitive device Hygro Palm HP23-AW (UK), according to DSTU ISO 21807. The activity of water in the finished product is shown in tabl. 7.

Table 7.

Mousse water activity

Name of samples	Water activity	Microorganisms that can develop
Control sample	0,967	Bacteria, mold, yeast
Sample №1	0,989	
Sample №2	0,981	
Sample №3	0,979	

According to tabl. 7, we conclude that shrimp mousses are perishable products, as the rate of water activity in shrimp mousses is high. The range of such values suggests that the product is a favorable environment for the development of microorganisms (bacteria, mold, yeast).

The main indicator of nutritional value is the chemical composition. Studies of the chemical composition have been performed according to the following methods: mass fraction of moisture – by drying the product sample to a constant weight in an oven SNOL at a temperature of 100-105ºC according to DSTU 8029:2015; mass fraction of ash – by a weightning method, after the mineralization of a portion of the product in a muffle furnace SNOL at a temperature of 500−600°C according to DSTU 8718:2017; mass fraction of lipids – by the Soxhlet extraction-weight method according to DSTU 8718:2017 on the SOX 406 Fat Analyzer; mass fraction of protein

– by Kjeldahl method of the determination of a total nitrogen, which is based on the ability of organic matter of the product sample to be oxidized with concentrated sulfuric acid in the presence of a catalyst according to DSTU 8030:2015, while samples ashing has been performed on a DK6 digester, with a vacuum pump JP, distillation has been carried out on a steam distillation apparatus UDK 129. The results of studies of the general chemical composition of formulations are given in tabl. 8.

– **Table 8.**

– General chemical composition of recipes

Name of samples	Chemical composition, %			
	moisture	fat	protein	carbohydrates
Control sample	50±2,0	44±0,2	5±0,7	0,5±0,1
Sample №1	64,5±1,5	7,5±0,2	18,7±0,7	0,4±0,1
Sample №2	67,25±2,25	9,95±0,2	15,7±0,7	3,63±0,1
Sample №3	66,89±2,1	12,3±0,2	16,6±0,7	1,48±0,1

From the tabl. 8 shows that the highest moisture content in the recipe of sample №2, and the lowest in the control sample, the highest fat content in the control sample, and the lowest in the recipe №1, the protein content is highest in sample №1, and the lowest in sample №2, the highest carbohydrates the content in the recipe №2, in the control and sample № 1 the carbohydrate content is minimal.

The chemical composition determines the caloric content of the product, which is presented in fig. 2.

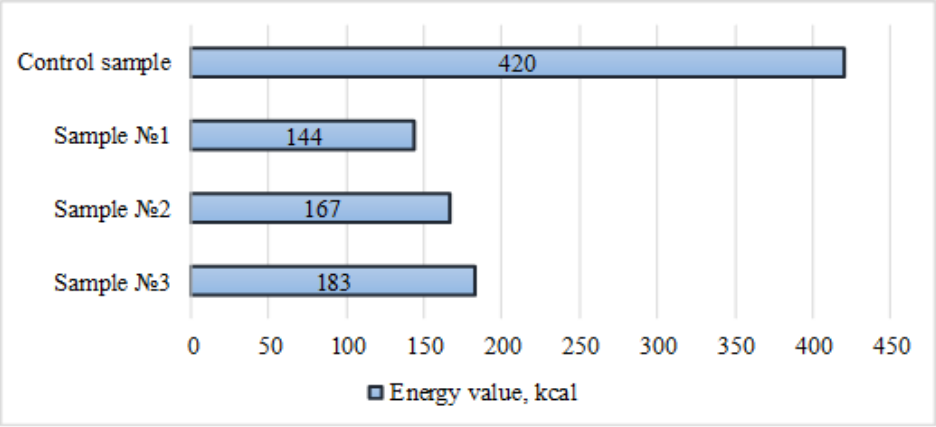

Figure 2. Comparative characteristics of the energy value of mousse recipes

It is estimated that the energy value of the control sample exceeds the

experimental ones, due to the fact that the bulk of the control formulation consists of butter and cream. Experimental samples have a much lower energy value, but the benefits are much greater, due to the high content of complete protein, the source of which is shrimp meat.

Based on the results of theoretical and experimental research, a technological scheme for the production of shrimp mousses has been developed (fig. 3).

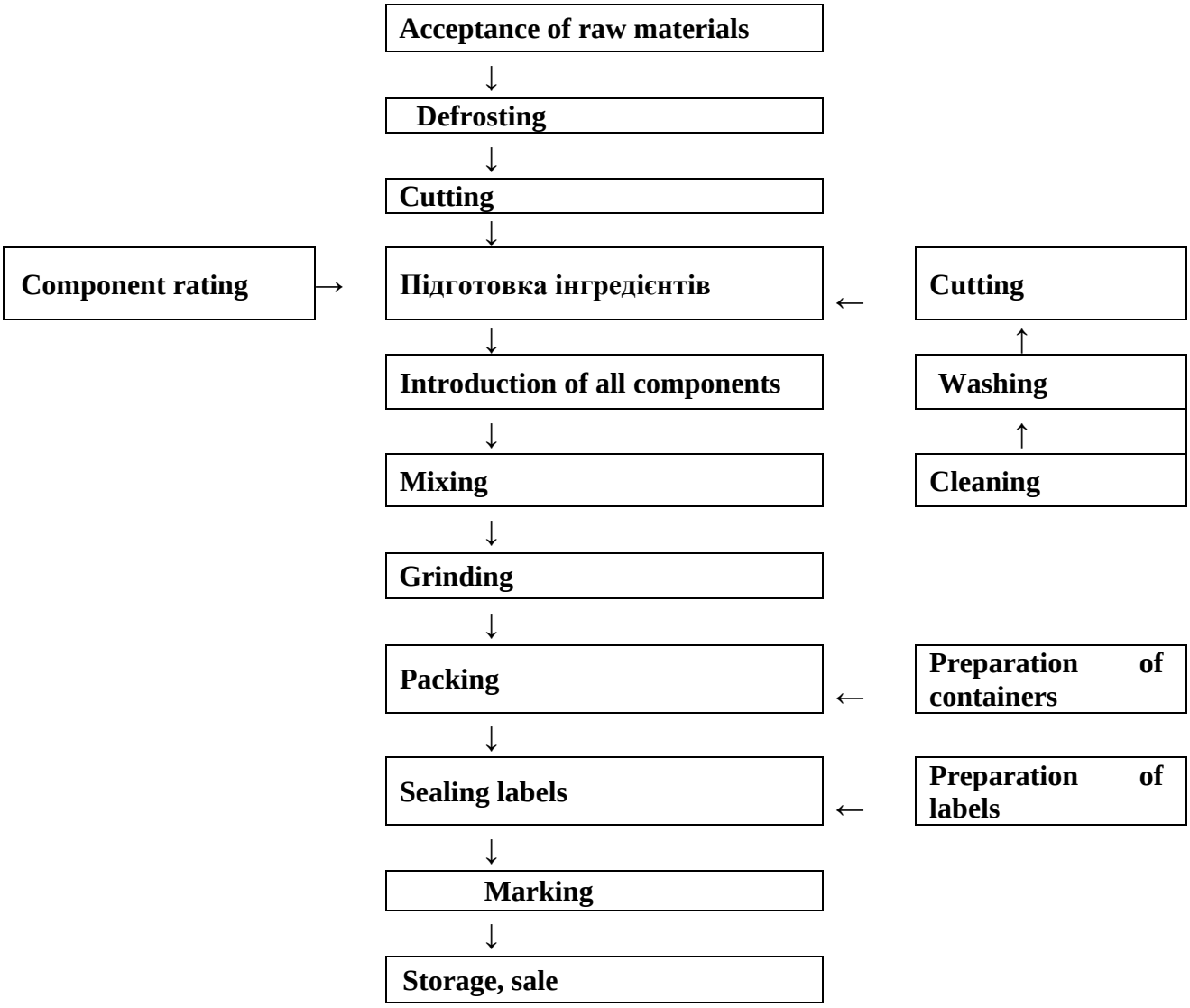

Figure 3. Technological scheme of mousse production

The main technological operations are preliminary preparation of fish and vegetable raw materials, mixing of ingredients according to the recipe, fine grinding, packaging.

Preliminary preparation of fish and vegetable raw materials consists of washing,

cleaning, and grinding. The main raw materials for the production of shrimp mousses are boiled-frozen shrimps, both with and without shells. Each batch of frozen products must be accompanied by a document of the established form, certifying its quality.

Shrimp are thawed in air at a temperature of 18-20 °C for two hours, or in water at a water temperature of 15 °C and washed.

The choice of the defrosting method was made based on a study of the moisture-retaining capacity of minced meat using different defrosting methods. As a result of studying different methods of defrosting boiled-frozen shrimps, the following indicators were obtained: microwave oven - 76.9%; in water - 77.5%; at room temperature - 75.25%.

Figure 4 shows the dependence of moisture retention capacity on the defrosting method.

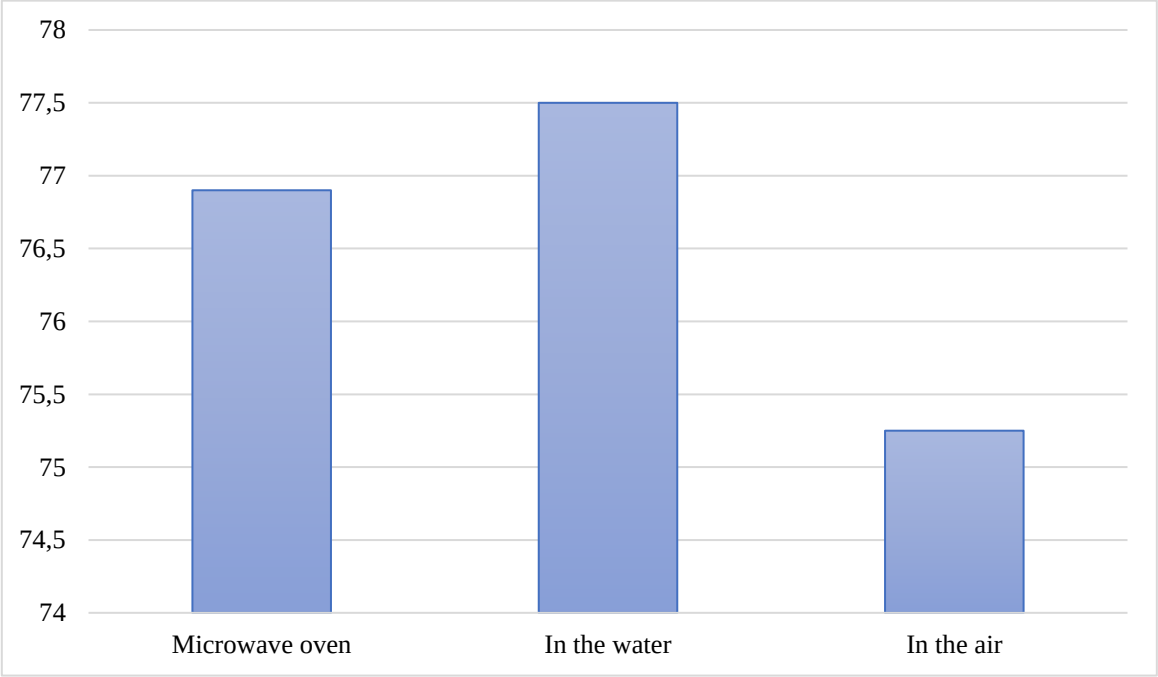

Figure 4. Dependence of moisture retention capacity on the defrosting method

According to studies, the results of which are presented in figure 4, the highest moisture retention capacity is achieved when defrosting in water, and the lowest when defrosting in air at room temperature.

For sorting, the shrimp are sent to a separator, washed under a powerful water pressure, then transferred to a distribution tray on a conveyor belt. The shrimp meat,

peeled from the shell, is sent to a special screen equipped with rotating rollers and grates. At this stage, the shrimp are further cleaned, particles of shells and films are removed through the holes in the grates, allowing the peeled shrimp meat to move further.

When making the mousse recipes we have developed, it is necessary to additionally wash and cut the apples and avocados. All auxiliary components also require additional preparation: cream, butter, olive oil, paprika, ground pepper, salt, garlic - grinding, weighing, dosing.

The prepared ingredients are mixed in the appropriate recipe ratio. The components are combined using a mixer.

Grinding and homogenization of the mixture to a homogeneous finely ground mass is carried out in a cutter. The consistency should be uniform and without compacted grains.

In order to choose a rational method of grinding, it was investigated how the degree of grinding affects the value of moisture-holding capacity.

The lowest indicator is in medium-sized minced shrimp with particles of at least 1 mm in size. The moisture-holding capacity increases with a particle size of more than 1 mm, this is due to a decrease in the degree of damage to the initial structure of muscle tissue. At a size of less than 1 mm, a decrease in the indicator is also observed, since the destruction of small fractions of proteins that are soluble in water and swell in the process of binding water occurs. With fine grinding, the homogenized mass is more tender, the consistency becomes more viscous, which gives the product an aesthetic appearance and structure.

The prepared mass is immediately transferred to packaging, without holding the mass for more than 30 minutes. The mousses are packaged by machine in polymer consumer containers "for sealing" with aluminum foil lids. The container must be clean, strong and dry, weighing from 0.1 to 0.5 kg.

Marking is carried out in accordance with DSTU 4518-2008.

Store the finished product at temperatures from -2 to +2 ^{o}C for no more than 72 hours from the date of manufacture.

Food quality is a set of product properties that determine its suitability to meet certain needs in accordance with the purpose. The quality of any food product is determined by its characteristic properties, which are called quality indicators.

Shelf life was determined by the dynamics of changes in the complex of organoleptic, physicochemical and microbiological indicators.

The results of studies of organoleptic characteristics of the product during storage for 72 hours are shown in fig. 5.

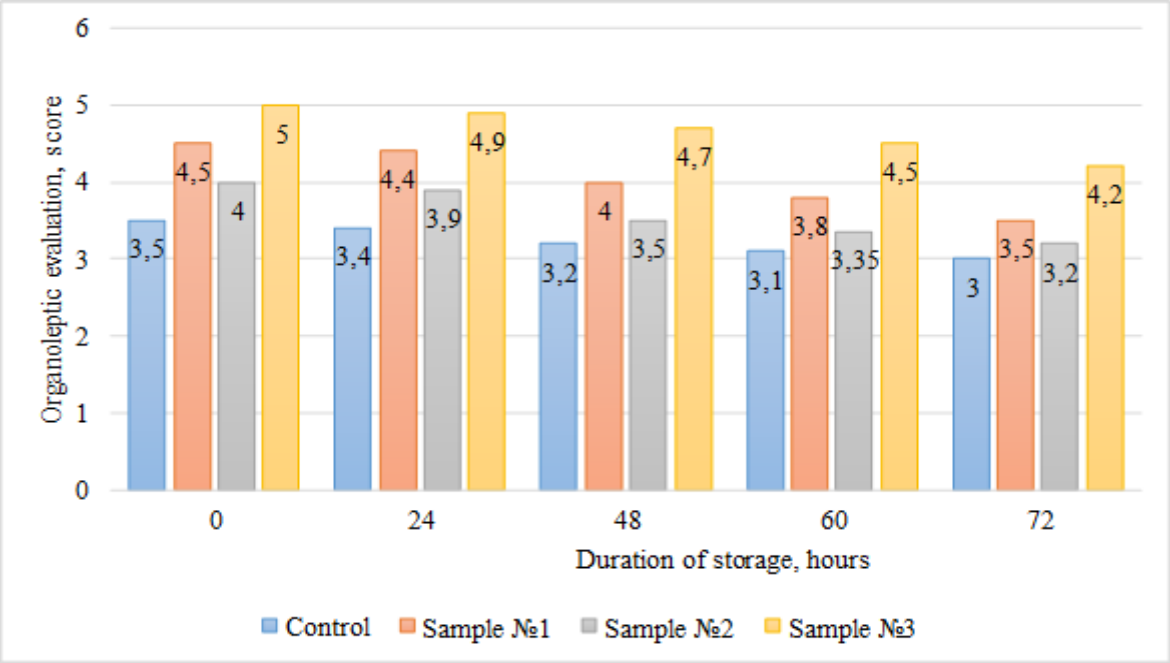

Figure 5. Organoleptic evaluation of shrimp mousses during storage

Fig. 4 shows that gradually during storage mousse products reduce their organoleptic characteristics.

Acid and peroxide values are important indicators that must be determined during storage. The acid number of lipids was determined according to DSTU 4350: 2004 (ISO 660: 1996, NEQ), DSTU 4560: 2006. Peroxide number of lipids, according to DSTU 4570: 2006, DSTU 4560: 2006.

Acid number is the amount of caustic potassium required in milligrams to neutralize free fatty acids. The acid number depends on the quality of raw materials used for production, methods and modes of its production, conditions and duration of storage of the product. The presence of lipid oxidation processes in the initial stages

characterizes the peroxide value.

Fig. 6 and 7 show the changes in peroxide and acid numbers during storage.

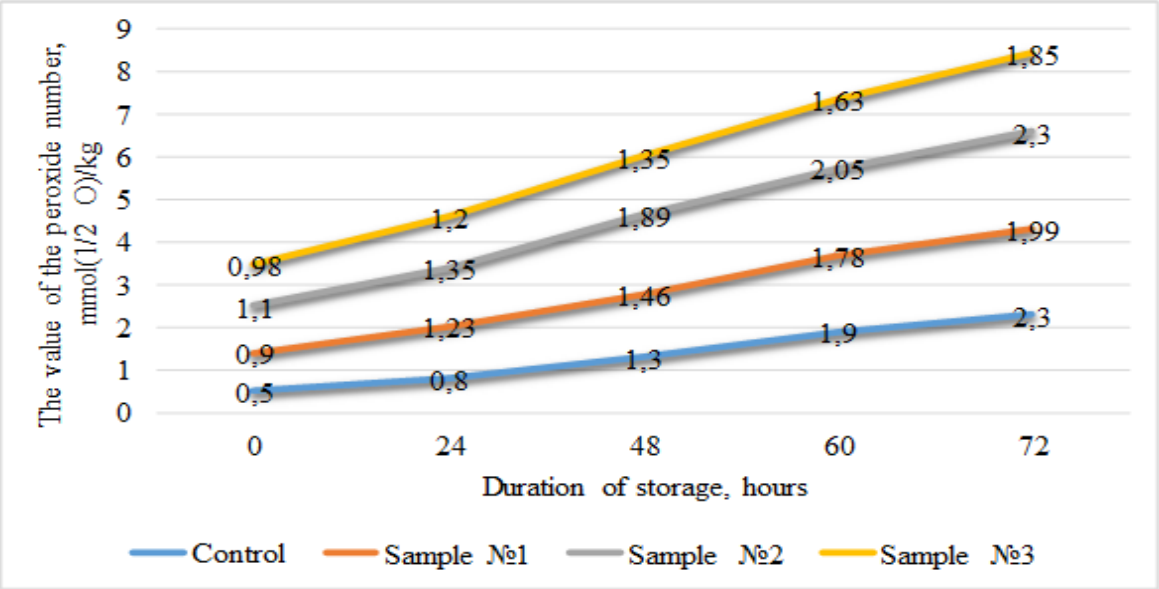

Figure 6. Dynamics of lipid peroxide values in shrimp mousses

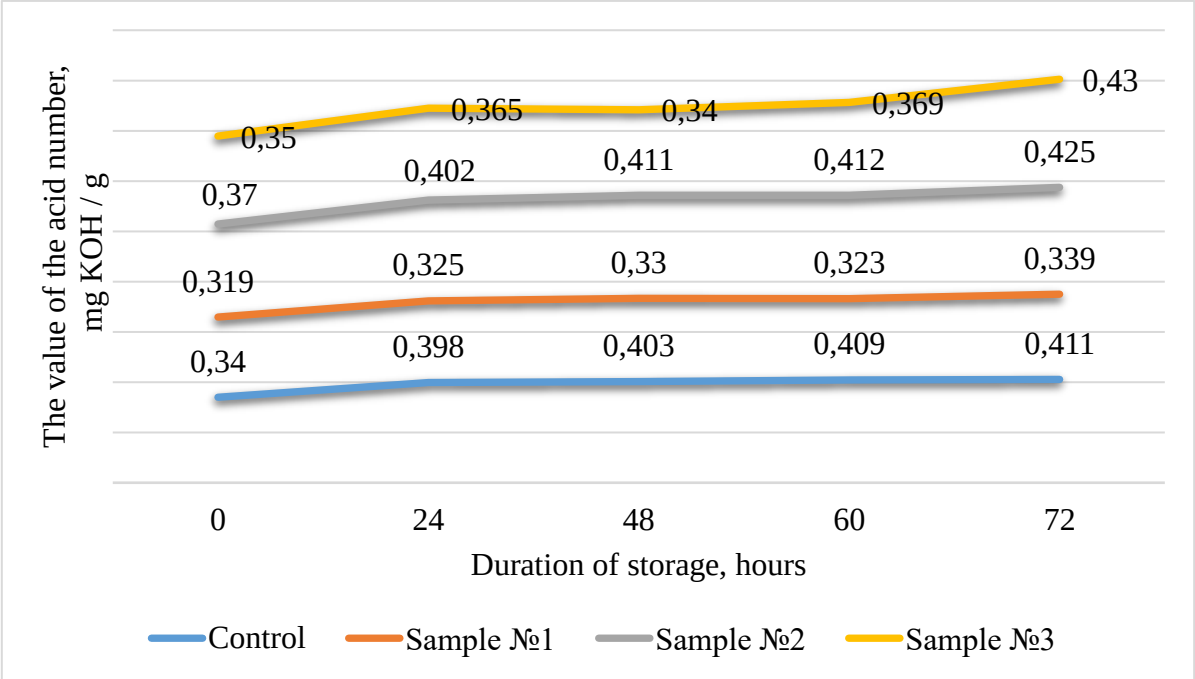

Figure 7. Dynamics of lipid acid counts in shrimp mousses

In fig. 5 and 6 we can see that the indicators of acid and peroxide numbers during storage gradually increase, but these indicators, even at the end of the storage period are within acceptable limits.

The degree of microbiological processes and proteolysis was studied by changes in the total volatile basic nitrogen contents (TVBN). The total volatile basic nitrogen

contents bases increases during storage under the action of enzymatic processes and the activity of microorganisms and is accompanied by the breakdown of amino acids to form ammonia, mono-, di- and trimethylamines. The total volatile basic nitrogen according to GOST 7636– 85. The dynamics of TVBN content during storage is shown in fig. 8.

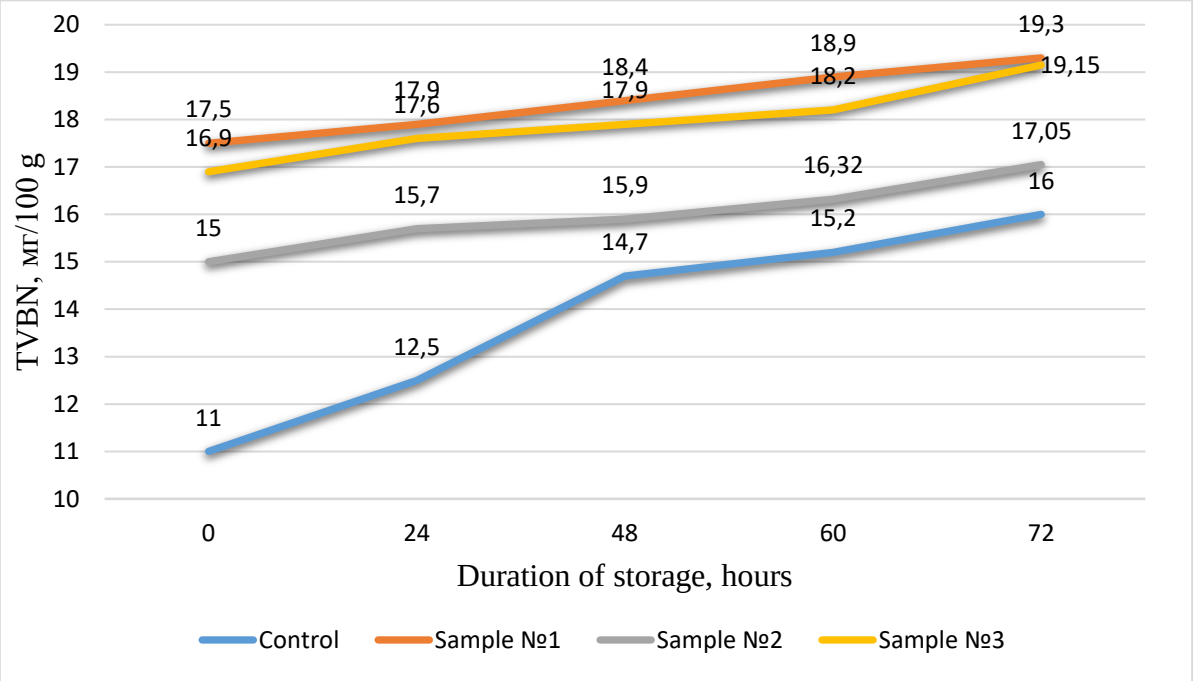

Figure 8. Changes in TVBN indicators during mousse storage

Fig. 7 shows that at the expiration date of the product, ie after 72 hours, the content of TVBN in the control sample 16 mg %, in sample №1 − 19.3 mg %, in sample №2 − 17.05 mg %, in sample № 3 - 19.15 mg g % at the permissible level of 30 mg %.

The quality and safety of shrimp mousses were determined according to microbiological quality indicators. The state of the microbiological composition of shrimp mousses directly depends on the initial state of the microflora of raw materials, on the microbiological and sanitary condition of equipment and the enterprise as a whole, on compliance with sanitary norms of employees.

The raw materials may contain microorganisms of the families Psevdomonas, Micrococcus, Achromobacter, Flavobacterium, Bacillus, Aeromonas, Cytrophage, Vibrio, and yeast and mold fungi. Staphylococcus aureus may be found in oil, especially in unrefined oil, which contains protein particles.The quantitative and species diversity of the microflora of plant raw materials is very diverse. Therefore,

these ingredients require careful processing, washing and cleaning.

The number of mesophilic aerobic and facultative anaerobic microorganisms was determined in accordance with DSTU 8446:2015; bacteria of the Escherichia coli group, according to DSTU GOST 30726: 2002; Staphylococcus aureus, according to GOST 10444.2-94; pathogenic microorganisms, including genus Salmonella, according to DSTU ISO 11290-1, DSTU ISO 11290-2.

The quality of shrimp mousses according to microbiological indicators when stored for no more than 72 hours is given in table 9.

– **Table 9.**

Changes in microbiological parameters of mousses during refrigerated storage

Indicators	Shelf life, hours	Control	Sample №1	Sample №2	Sample №3	Permis-sible level
MAFAnM, CFU/g	0	$(2,3\pm0,11)\times 10^2$	$(3,3\pm0,14)\times 10^2$	$(5,1\pm0,13)\times 10^2$	$(3,1\pm0,13)\times 10^2$	no more $2\cdot10^5$
	24	$(3,0\pm0,13)\times 10^3$	$(3,8\pm0,10)\times 10^3$	$(7,6\pm0,13)\times 10^3$	$(2,8\pm0,13)\times 10^3$	
	48	$(3,6\pm0,14)\times 10^4$	$(4,4\pm0,20)\times 10^3$	$(5,3\pm0,13)\times 10^4$	$(3,3\pm0,13)\times 10^4$	
	60	$(5,6\pm0,15)\times 10^4$	$(5,3\pm0,13)\times 10^4$	$(8\pm0,15)\times 10^4$	$(6\pm0,15)\times 10^4$	
	72	$(7,5\pm0,16)\times 10^4$	$(6,9\pm0,15)\times 10^4$	$(9,8\pm0,17)\times 10^4$	$(7,7\pm0,17)\times 10^4$	
Escherichia coli, in 0.1 g	0-72	not detected				not allowed
S. aureus, in 0.1 g	0-72	not detected				not allowed
Salmonella, in 25 g	0-72	not detected				not allowed
L. monocyte-genes, in 25 g	0-72	not detected				not allowed
Proteus, in 0.1 g	0-72	not detected				not allowed

The results of research show that at the initial stage of storage, sample №2 is characterized by a higher degree of microbiological contamination compared to other samples, due to the addition of vegetable raw materials to the product. When storing mousses for 24 hours, the number of microorganisms increases in all samples. In sample №3 the amount of mesophilic aerobic and facultative anaerobic

microorganisms (MAFAnM) is less than in other samples, due to the bactericidal properties of garlic. As of 72 hours of mousse storage, MAFAnM values are acceptable for product suitability, but close to the limit.

Bacteria of the Escherichia coli group, Staphylococcus aureus and Proteus were not detected in 0.1 g of test samples.

Pathogenic microorganisms, including Salmonella and L. monocytogenes, were absent in 25 g in all mousse samples.

Therefore, based on microbiological and organoleptic parameters, the allowable shelf life at a temperature of 0 to + 5◦C for mousses is not more than 72 hours.

Conclusions. Based on the results of theoretical and experimental research, the recipe and technology of shrimp-based mousses with the addition of animal (milk cream, cream cheese) and vegetable raw materials (olive oil, apples, avocados) have been improved.

Based on the techno-chemical characteristics of shrimp, the feasibility of their use in the technology of mousse culinary products from hydrobionts was confirmed.

The technological scheme of mousse production has been developed, which includes preliminary preparation of raw materials, fine grinding of the mixture and packing of the finished product.

A study of organoleptic, physicochemical, quality indicators and chemical composition of finished products. Based on the research results, the compliance of the indicators with the requirements of the standard has been established. According to organoleptic indicators, the highest score was obtained by sample №2. The salt content in the test samples and control corresponds to the norm - 1.5-2.5%. All samples have the appropriate mousse consistency, and the value of the shear limit stress of the control sample (254.0 Pa) exceeds this indicator of the experimental samples (196.0−206.3 Pa), which indicates a denser control structure compared to the developed samples. High values of water activity index (0.967-0.989) confirm that shrimp mousses are perishable products.

Analysis of the results of research on the chemical composition shows that the experimental samples of mousse are characterized by high nutritional value due to the

significant protein content.

The shelf life is set to 72 hours when refrigerated at a temperature of -6…-4°C from the moment of manufacture.

Therefore, improving the technology for producing shrimp mousses with the addition of animal and plant components allows for a product with high taste properties, nutritional value, as well as high quality and safety during the established shelf life.