ТЕХНОЛОГИЧЕСКИЕ ПРОЦЕССЫ, МАШИНЫ И АППАРАТЫ ДЛЯ ПЕРЕРАБОТКИ ВОДНЫХ БИОРЕСУРСОВ

TECHNOLOGICAL PROCESSES, MACHINES AND APPARATUS FOR PROCESSING AQUATIC BIORESOURCES

Original article
UDK 639.3.043.13
https://doi.org/10.24143/2073-5529-2022-3-66-73
EDN BXBFFP

Scientific substantiation of using fat substitute in semi-finished fish products

Yu. N. Korzhavina, D. L. Alshevsky✉, V. I. Ustich, O. V. Kazimirchenko, M. N. Alshevskaya

Kaliningrad State Technical University,
Kaliningrad, Russia, alshevsky@klgtu.ru✉

Abstract. Fish products play an essential role in ensuring food security as one of the most important components of human nutrition. Irreplaceability and special value of fish is determined by its well-balanced chemical composition. First of all, it is a source of complete protein. Currently, aquaculture is one of the fastest growing areas of bioresources development. Carp is the main object of pond fish farming in the Kaliningrad region. Processing carp with good rheological properties will have a great practical importance in the production of minced fish and its further use in semi-finished products and culinary products. One of the promising areas for the growth of processing technologies is manufacturing products ready for consumption, that is why the development of technology for semi-finished fish products from carp is very promising. Fish wastes processing has also been widely developed and used in the production of various food products. There are presented the results of determining the shelf life of semi-finished fish products (sausages) with and without fat substitute based on the sanitary-microbiological and organoleptic studies using the developed method and a 5-point scale. It has been proposed to replace pork fat by the fat substitute, according to the recipe developed by the authors. The obtained fat substitute based on sodium alginate does not melt during heat treatment and does not create an unpleasant aftertaste. At the same time, its cost is much lower than that of pork. The effect of fat substitute on organoleptic, physico-chemical (MRC) and structural-mechanical parameters (YPV) is shown. The project design documents (TC, TI) have been developed.

Keywords: semi-finished fish products, fat substitute, shelf life, aquaculture, carp

For citation: Korzhavina Yu. N., Alshevsky D. L., Ustich V. I., Kazimirchenko O. V., Alshevskaya M. N. Scientific substantiation of using fat substitute in semi-finished fish products. *Vestnik of Astrakhan State Technical University. Series: Fishing Industry*. 2022;3:66-73. (In Russ.). https://doi.org/10.24143/2073-5529-2022-3-66-73. EDN BXBFFP.

Научная статья

Научное обоснование использования имитационного шпика при производстве рыбных полуфабрикатов

Ю. Н. Коржавина, Д. Л. Альшевский✉, В. И. Устич, О. В. Казимирченко, М. Н. Альшевская

Калининградский государственный технический университет,
Калининград, Россия, alshevsky@klgtu.ru✉

Аннотация. Являясь одним из важнейших компонентов питания человека, рыба играет важную роль в обеспечении продовольственной безопасности. Незаменимость и особая ценность рыбы обусловлена ее хорошо сбалансированным химическим составом. Прежде всего, она – источник полноценного белка. В настоящее время аквакультура – это одно из самых быстро развивающихся направлений освоения биоресурсов. Основным объектом прудового рыбоводства для Калининградской области является карп. Переработка карпа с хорошими реологическими свойствами будет иметь большое практическое значение в производстве рыбного фарша и дальнейшем его использовании при производстве полуфабрикатов и кулинарных изделий. Одним из перспективных направлений развития технологий переработки является разработка продукции, максимально готовой к потреблению, поэтому разработка технологии рыбных полуфабрикатов из карпа является перспективной. Также широкое развитие получила переработка отходов с целью использования их при производстве различных продуктов питания. Представлены результаты определения сроков годности рыбных полуфабрикатов (колбасок) с использованием имитационного шпика и без него на основании санитарно-микробиологических, органолептических исследований по разработанной методике и 5-балльной шкале. Предложена замена свиного шпика на имитационный по разработанной авторами рецептуре. Имитационный шпик на основе альгината натрия не оплавляется при термообработке и не создает неприятное послевкусие, при этом его себестоимость значительно ниже свиного. Показано влияние имитационного шпика на органолептические, физико-химические (ВУС, содержание влаги) и структурно-механические показатели (ПНС) рыбных полуфабрикатов (колбасок). Разработан проект технической документации (ТУ, ТИ).

Ключевые слова: рыбные полуфабрикаты, имитационный шпик, срок хранения, аквакультура, карп

Для цитирования: *Коржавина Ю. Н., Альшевский Д. Л., Устич В. И., Казимирченко О. В., Альшевская М. Н.* Научное обоснование использования имитационного шпика при производстве рыбных полуфабрикатов // Вестник Астраханского государственного технического университета. Серия: Рыбное хозяйство. 2022. № 3. С. 66–73. https://doi.org/10.24143/2073-5529-2022-3-66-73. EDN BXBFFP.

Introduction

The main objective of aquaculture development is, first of all, sustainable and regular providing the population with fish products that are accessible to people with different income levels, as well as meeting the needs for high quality products. There is a tendency to replace consumption of seafood with aquaculture products. Carp fish provide the largest share of freshwater aquaculture production in the Russian Federation. However, due to the peculiarities of the anatomical structure and a large number of bones, carp is sold mainly in uncut form. Therefore, in order to maximize the use of carp meat, it is proposed to produce minced semi-finished products from it. This will open up new opportunities in the field of rational use of fish raw materials. Carp meat can be separated from the bones using a neopress, which will separate the fish meat from its unclaimed parts. As a result of the neopress, the minced meat is homogeneous, without scales and bones.

One of the promising areas of the fish processing industry is producing semi-finished fish products. Nowadays, the assortment of semi-finished products is constantly changing and growing. The pace of life of a modern person increases the demand for products that require a minimum time spending. Preparation of semi-finished products allows improving the taste of the product and increasing the range of fish products. Semi-finished products prepared for frying are popular with the population since they are most convenient for both picnics and everyday use due to their ease of preparation and relatively low price.

Fat is one of the most popular types of raw materials used in the production of meat products. Fat creates a unique pattern on the cut. The use of fat substitute, which includes a multifunctional mixture of MEATPRO M 750 based on sodium alginate and vegetable oil, will allow to obtain a product of high and stable quality at the output, since it is resistant to heat, which is important when developing products for grilling [1].

The purpose of the present work is to substantiation of the use of fat substitute in the production of semi- finished fish products.

In conformity with the purpose set, the following research tasks have been assigned:

– development of a score scale for quality assessment;

– study of the effect of fat substitute on organoleptic, physico-chemical and structural-mechanical parameters;

– substantiation of the shelf life of semi-finished fish products with fat substitute.

Object and methods of research

The objects of the research were samples of semi-finished fish products with fat substitute and those without fat substitute (control) for grilling. During the experiment, a batch of semi-finished products (grilled fish sausages) has been produced, where the main raw material has been common carp (*Cyprinus carpio*) according to GOST 814-2019 [2] and auxiliary components, such as dietary fiber (Kametsel FS 180) obtained by import, approved for use by the Office of Rospotrebnadzor and flavoring mixture RUTAFISH mixture 6, made according to TR 10.84.12-004-56746846-14. Vegetable (sunflower) oil according to GOST 1129-2013 [3] has been used as a fat-containing component in manufacturing of fat substitute. The fat structure is provided by the addition of MEATPRO M 750 with sodium alginate. To determine the shelf life, samples of semi-finished fish products have been prepared, which, after molding and sedimentation, have been boiled to a temperature of 71 ± 1°C in the center of the product and packed under vacuum.

The expected shelf life is 10 days at 0-2°C. The product has been controlled at the background point, on the 6th, 10th and 13th days according to MG 4.2.2046-06 [4]. The organoleptic characteristics

of semi-finished fish products were evaluated throughout the entire storage period, except for the stock point, according to the developed point scale. The yield point has been determined using a hand-held portable penetrometer according to GOST R 50814-95 [5]. The moisture content and moisture retaining power (MRP) have been established according to GOST 7636-85 [6]. Sanitary and microbiological studies have been carried out using the following methods: the number of mesophilic aerobic and facultative anaerobic microorganisms has been determined according to GOST 10444.15-94 [7], coliform bacteria – according to GOST 31747-2012 [8], *S. aureus* – according to GOST 31746-2012 [9], sulfite-reducing clostridia – according to GOST 29185-2014 [10], Proteus bacteria – according to GOST 28560-90 [11], molds and yeasts – according to GOST 10444.12-2013 [12], *Salmonella bacteria* – according to GOST 31659-2012 (ISO 6579: 2002) [13], *Listeria monocytogenes* – according to GOST 32031-2012 [14].

Results and discussion

Moisture retaining power is one of the most important indicators of semi-finished products, which are further subjected to additional processing before use. As a result of heat treatment, part of the moisture and fat is separated, which can be expressed as weight loss or purge. Such organoleptic indicators as juiciness, tenderness and losses during heat treatment depend on the MRP. The values of water-holding capacity of samples of semi-finished fish products during storage are shown in Fig. 1.

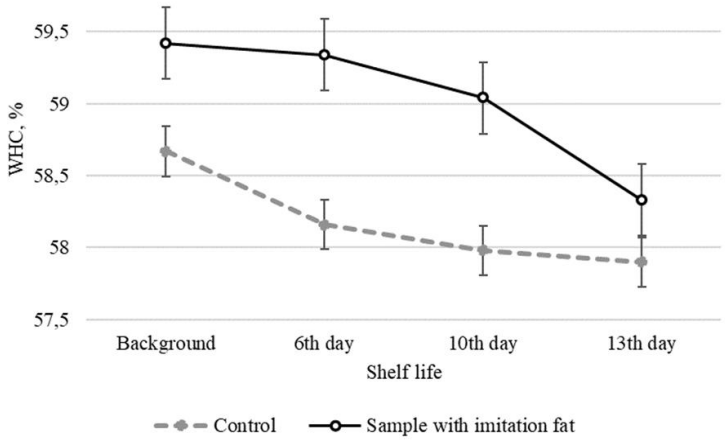

Fig. 1. Dynamic pattern of MRP: WHC – water holding capacity

It can be seen from Fig. 1 that the value of the MRP decreases over time. Samples of semi-finished fish products, which contain fat substitute, have higher water-holding capacity than control ones. This is due to the fact that fat substitute contains sodium alginate, which binds water well, and an increase in the water-holding capacity of the sample is probably associated with this.

As an objective indicator of consistency, the yield point value (YPV) is used, which has been calculated according to GOST R 50814-95. This indicator can be used to assess the quality of minced meat and finished products. Measurements were taken on an optical projection scale in degrees of penetration, where the degree of penetration is 0.1 mm. The results are presented in Fig. 2.

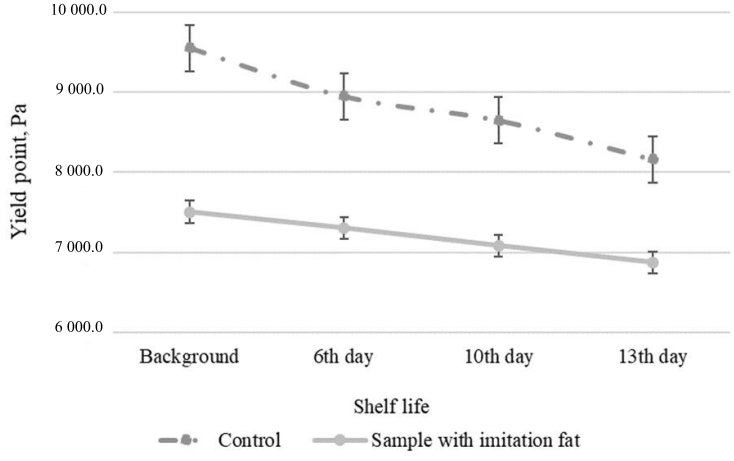

Fig. 2. Dynamic pattern of the yield point, Pa

From the data presented in Fig. 2, it can be seen that over time, the YPV decreases. This is due not only to a decrease in MRP, but also to an increase in exposure time. A sample with the addition of fat substitute is less susceptible to the YPV changes compared to the control one.

To assess the quality of samples of semi-finished fish products, a technique [15] has been used and a 5-point scale has been developed. The main principle of quality assessment is to highlight the features that characterize non-standard products. Deviations of semi-finished fish products that may result from the addition of fat substitute have been identified.

Points have been set in the following order: 5 – full compliance with the requirements; 4 – single minor inconsistencies; 3 – numerous minor inconsistencies; 2 – significant inconsistencies; 1 – gross inconsistencies; 0 – not subject to evaluation. Samples with a score below 3 (inclusive) were not standard and should not be implemented. For identified inconsistencies, points have been reduced taking into account severity of the defect, options for reducing the score are given in Table 1.

Table 1

5-point scale of organoleptic quality assessment

Appearance					***a***				
5 – straight or slightly curved loaves, without damage to the shell, slips, spots, sagging minced fish									
Irregular shaped products	4	3	2	–	Presence of bacon or minced fish on the surface of the shell	4	3	2	–
A product with dirty surface	–	3	2	–	Slimming of the shell	–	–	–	0
Shell breaks	–	3	2	–	–	–	–	–	–
Sectional view					***b***				
5 – Minced fish is evenly mixed, without voids; in the presence of fat - it does not separate from the minced fish and is well connected with muscle tissue									
Minced fish is not well mixed	4	3	2	–	Fat in separated from minced fish	4	3	2	–
Presence of foreign matter	–	3	2	–	Fat is unevenly distributed	4	3	2	–
Indistinct cut pattern	4	3	2	–	–	–	–	–	–
Presence of voids in minced fish	4	3	2	–	–	–	–	–	–
Color					***c***				
5 – uniformly colored muscle tissue from gray to light pink; in the presence of fat – the color of the fat is white or with a pinky shade									
Heterogeneous color	4	3	2	–	Insufficiently expressed color	4	3	–	–
Overly bright color	4	3	2	–	–	–	–	–	–
The color is not typical for this type of product	4	3	2	–	–	–	–	–	–
Taste and smell					***d***				
5 – characteristic of this type of product, with the aroma of spices, without foreign taste and smell, the taste is moderately salty									
Predominance of the taste of individual components in minced fish	4	3	2	–	Prevalence of the smell of: – spices – other components	4	3	–	–
Taste of oxidized fat	–	–	2	1	No strong smell of: – species – other components	4	3	–	–
Foreign flavor not characteristic of this product	–	–	2	1	Acrid taste of smoke	–	–	2	1
The taste of individual components in minced fish is not pronounced	4	3	–	–	Putrid smell	–	–	–	0
Smell of mold or yeast	–	–	–	0	–	–	–	–	–
Consistency					***e***				
5 – dense									
Too dense consistency	4	3	2	–	Rubber-like	4	3	2	–
Soft, mealy	4	3	2	–	Crumbly	4	3	2	–
Spreadable	4	3	2	–	–	–	–	–	–

The overall score is calculated by the formula

$$\text{Overall score} = \frac{a+b+c+d+e}{5}.$$

Fish semi-finished products tasting assessment results are shown in the Fig. 3.

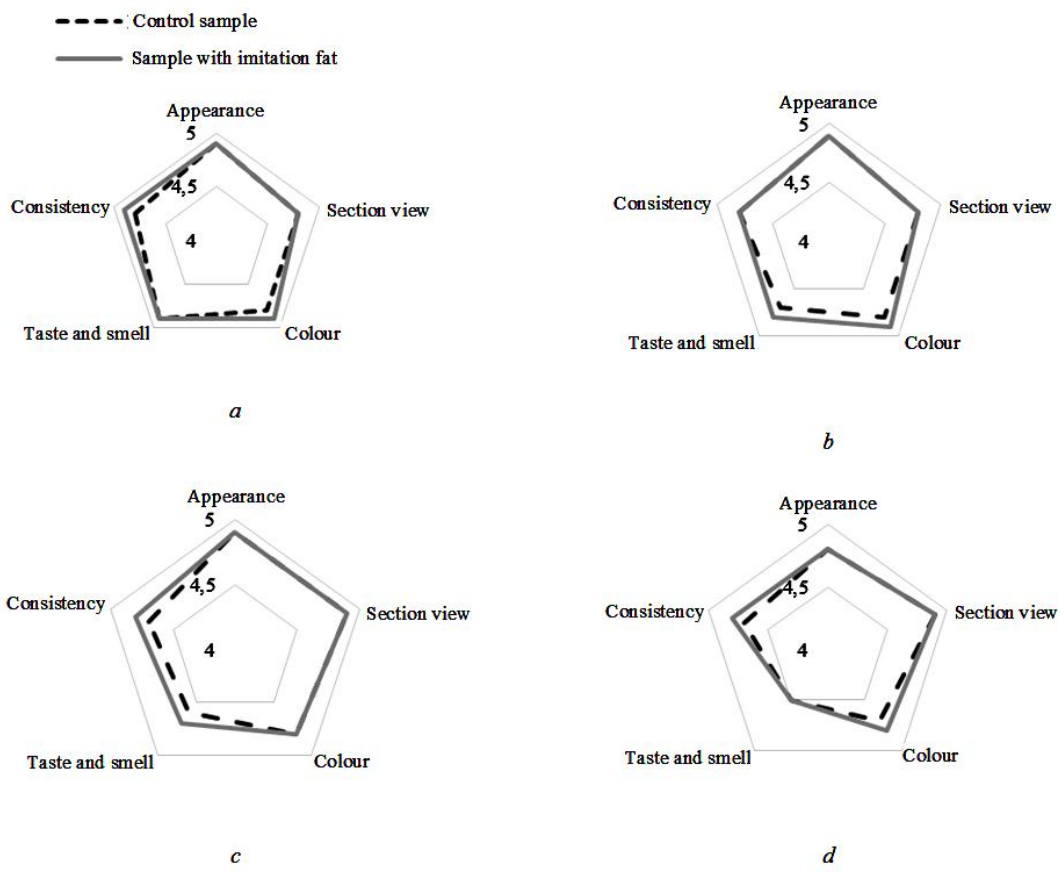

Fig. 3. Organoleptic evaluation of samples of semi-finished fish products in storage:
a – background; *b* – 6th day; *c* – 10th day; *d* –13th day

As can be seen from Fig. 3, both samples have got high marks. The presence of fat substitute did not cause negative assessments among the tasters, on the contrary, the sample with fat substitute turned out to be juicier and attractive.

To determine the compliance of semi-finished fish products with microbiological safety indicators, the regulatory parameters provided for by TR TI 021/2011 and TR EAEU have been used [16, 17]. Microbiological tests have been carried out during the entire period of storage of samples, taking into account the reserve ratio.

During the entire period of storage, sanitary indicative bacteria of the intestinal group (coliforms), opportunistic (*Staphylococcus aureus*, *Proteus bacteria*) and pathogenic bacteria (*Salmonella*, *Listeria monocytogenes bacteria*) have not been detected in the control sample and in the sample with fat substitute, which confirms their sanitary security.

The dynamic pattern of QMAFAnM indicator in the samples of semi-finished fish products during storage is shown in Table 2.

Table 2

Change of QMAFAnM indictor in samples of semi-finished fish products

Control day	Regulatory value, CFU/g	Control sample, CFU/g	Sample with fat substitute, КОЕ/г
Background	$1 \cdot 10^5$	Less than 10	
6th day		Less than 10	
10th day		Less than 10	
13th day		$3{,}5 \cdot 10^2$	$5{,}9 \cdot 10^3$

During the entire storage period, both for the control sample and for the sample with fat substitute, pathogenic microorganisms (*Salmonella*, *L. monocytogenes bacteria*) have not been detected. *Coliforms*, *S. aureus*, *Proteus* bacteria have not also been detected in all samples of the product.

The results presented in Table 2 show that the prototypes during storage have microbial contamination lower than the standard value. After 10 days of stor-

age, growth of microflora has been observed. The microflora of the samples is represented mainly by *Bacillus bacteria*, which formed large membranous colonies on fish-peptone agar.

No significant difference has been found in the microbial contamination of the control sample and the sample with fat substitute, which shows the possibility of its use. Based on the data obtained, the shelf life of semi-finished fish products has been established, which is 10 days at temperatures from 0 to 2°C.

Conclusions

1. Influence of the fat substitute on the indicators of MRP and YPV has been studied. It has been shown that addition of fat substitute increases MRP and reduces YPV, which indicates a juicier consistency and fewer losses during heat treatment.

2. A 5-point scale for organoleptic quality assessment has been developed. The study of changes in organoleptic indicators bears evidence of a good storage capacity without signs of spoilage within the prescribed period. Study of changes in organoleptic parameters indicates the storage capacity of fish semi-finished products without signs of spoilage at a stated time.

3. Shelf life of semi-finished fish products has been established, which is 10 days at a temperature from 0 to 2°C.

References

1. Naumov V. A., Korzhavina Iu. N., Shibeko A. G. Singaev V. I., Al'shevskii D. L. Regressionnaia model' plotnosti imitatsionnogo shpika [Regression model for density of imitation fat]. *Izvestiia Kaliningradskogo gosudarstvennogo tekhnicheskogo universiteta*, 2018, no. 49, pp. 145-154.

2. GOST 814-2019. *Ryba okhlazhdennaia. Tekhnicheskie usloviia: natsional'nyi standart Rossiiskoi Federatsii* [GOST 814-2019. Chilled fish. Specifications: national standard of the Russian Federation]. Moscow, Standartinform, 2019. 16 p.

3. GOST 1129-2013. *Maslo podsolnechnoe. Tekhnicheskie usloviia: natsional'nyi standart Rossiiskoi Federatsii* [GOST 1129-2013. Sunflower oil. Specifications: national standard of the Russian Federation]. Moscow, Standartinform, 2019. 15 p.

4. MUK 4.2.2046-06. *Metody vyiavleniia i opredeleniia paragemoliticheskikh vibrionov v rybe, nerybnykh ob"ektakh promysla, produktakh, vyrabatyvaemykh iz nikh, vode poverkhnostnykh vodoemov i drugikh ob"ektakh* [MUK 4.2.2046-06. Methods for the detection and determination of parahemolytic vibrios in fish, non-fish fishery objects, products produced from them, surface water and other objects]. Moscow, Standartinform, 2006. 28 p.

5. GOST R 50814-95. *Miasoprodukty. Metody opredeleniia penetratsii konusom i igol'chatym indentorom: natsional'nyi standart Rossiiskoi Federatsii* [GOST R 50814-95. Meat products. Methods for determining penetration by a cone and a needle indenter: national standard of the Russian Federation]. Moscow, Standartinform, 2010. 6 p.

6. GOST 7636-85. *Ryba, morskie mlekopitaiushchie, morskie bespozvonochnye i produkty ikh pererabotki. Metody analiza: natsional'nyi standart Rossiiskoi Federatsii* [GOST 7636-85. Fish, sea mammals, sea invertebrates and processed products. Analysis methods: national standard of the Russian Federation]. Moscow, Standartinform, 2010. 86 p.

7. GOST 10444.15-94. *Produkty pishchevye. Metody opredeleniia kolichestva mezofil'nykh aerobnykh i fakul'tativno-anaerobnykh mikroorganizmov: natsional'nyi standart Rossiiskoi Federatsii* [GOST 10444.15-94. Food products. Methods for determining the number of mesophilic aerobic and facultative anaerobic microorganisms: national standard of the Russian Federation]. Moscow, Standartinform, 2010. 4 p.

8. GOST 31747-2012. *Produkty pishchevye. Metody vyiavleniia i opredeleniia kolichestva bakterii gruppy kishechnykh palochek (koliformnykh bakterii): natsional'nyi standart Rossiiskoi Federatsii* [GOST 31747-2012. Food products. Methods for detecting and determining the number of bacteria of the Escherichia coli group (coliform bacteria): national standard of the Russian Federation]. Moscow, Standartinform, 2013. 15 p.

9. GOST 31746-2012 (ISO 6888-1:1999, ISO 6888-2:1999, ISO 6888-3:2003). *Produkty pishchevye. Metody vyiavleniia i opredeleniia kolichestva koagulazopolozhitel'nykh stafilokokkov i Staphylococcus aureus: natsional'nyi standart Rossiiskoi Federatsii* [GOST 31746-2012 (ISO 6888-1:1999, ISO 6888-2:1999, ISO 6888-3:2003). Food products. Methods for detection and quantification of coagulase-positive staphylococci and Staphylococcus aureus: national standard of the Russian Federation]. Moscow, Standartinform, 2013. 22 p.

10. GOST 29185-2014 (ISO 15213:2003). *Mikrobiologiia pishchevykh produktov i kormov dlia zhivotnykh. Metody vyiavleniia i podscheta sul'fitredutsiruiushchikh bakterii, rastushchikh v anaerobnykh usloviiakh (s Popravkoi): natsional'nyi standart Rossiiskoi Federatsii* [GOST 29185-2014 (ISO 15213:2003). Microbiology of food products and animal feed. Methods for detection and enumeration of sulfite-reducing bacteria growing under anaerobic conditions (Amended): national standard of the Russian Federation]. Moscow, Standartinform, 2015. 11 p.

11. GOST 28560-90. *Produkty pishchevye. Metod vyiavleniia bakterii rodov Proteus, Morganella, Providencia: natsional'nyi standart Rossiiskoi Federatsii* [GOST 28560-90. Food products. Method for detection of bacteria of the genera Proteus, Morganella, Providencia: national standard of the Russian Federation]. Moscow, Standartinform, 2010. 6 p.

12. GOST 10444.12-2013. *Mikrobiologiia pishchevykh produktov i kormov dlia zhivotnykh. Metody vyiavleniia i podscheta kolichestva drozhzhei i plesnevykh gribov: natsional'nyi standart Rossiiskoi Federatsii* [GOST 10444.12-2013. Microbiology of food products and animal feed. Methods for detecting and counting the number of yeasts and molds: the national standard of the Russian Federation]. Moscow, Standartinform, 2014. 9 p.

13. GOST 31659-2012 (ISO 6579:2002). *Produkty pishchevye. Metod vyiavleniia bakterii roda Salmonella: natsional'nyi standart Rossiiskoi Federatsii* [GOST 31659-2012 (ISO 6579:2002). Food products. Method for detection of bacteria of the genus Salmonella: national standard of the Russian Federation]. Moscow, Standartinform, 2014. 19 p.

14. GOST 32031-2012. *Produkty pishchevye. Metody vyiavleniia bakterii Listeria monocytogenes: natsional'nyi standart Rossiiskoi Federatsii* [GOST 32031-2012. Food

products. Methods of detecting Listeria monocytogenes bacteria: national standard of the Russian Federation]. Moscow, Standartinform, 2010. 25 p.

15. TR TS 021/2011. *Tekhnicheskii reglament Tamozhennogo soiuza «O bezopasnosti pishchevoi produktsii»* [TR CU 021/2011. Technical Regulations of the Customs Union "On food safety"]. Available at: http://www.eurasiancommission.org/ru/act/texnreg/deptexreg/tr/Pages/PischevayaProd.aspx (accessed: 21.05.2022).

16. TR EAES 040/2016. *Tekhnicheskii reglament Evraziiskogo ekonomicheskogo soiuza «O bezopasnosti ryby i rybnoi produktsii»* [TR EAEU 040/2016. Technical Regulations of the Eurasian Economic Union "On safety of fish and fish products"]. Available at: http://www.eurasiancommission.org/ru/act/texnreg/deptexreg/tr/Pages/TR_EEU_040_2016.aspx (accessed: 21.05.2022).

Список источников

1. *Наумов В. А., Коржавина Ю. Н., Шибеко А. Г. Сингаев В. И., Альшевский Д. Л.* Регрессионная модель плотности имитационного шпика // Изв. Калинингр. гос. техн. ун-та. 2018. № 49. С. 145–154.

2. *ГОСТ 814-2019.* Рыба охлажденная. Технические условия: национальный стандарт Российской Федерации. М.: Стандартинформ, 2019. 16 с.

3. *ГОСТ 1129-2013.* Масло подсолнечное. Технические условия: национальный стандарт Российской Федерации. М.: Стандартинформ, 2019. 15 с.

4. *МУК 4.2.2046-06*. Методы выявления и определения парагемолитических вибрионов в рыбе, нерыбных объектах промысла, продуктах, вырабатываемых из них, воде поверхностных водоемов и других объектах. М.: Роспотребнадзор, 2006. 28 с.

5. *ГОСТ Р 50814-95*. Мясопродукты. Методы определения пенетрации конусом и игольчатым индентором: национальный стандарт Российской Федерации. М.: Стандартинформ, 2010. 6 с.

6. *ГОСТ 7636-85.* Рыба, морские млекопитающие, морские беспозвоночные и продукты их переработки. Методы анализа: национальный стандарт Российской Федерации. М.: Стандартинформ, 2010. 86 с.

7. *ГОСТ 10444.15-94.* Продукты пищевые. Методы определения количества мезофильных аэробных и факультативно-анаэробных микроорганизмов: национальный стандарт Российской Федерации. М.: Стандартинформ, 2010. 4 с.

8. *ГОСТ 31747-2012.* Продукты пищевые. Методы выявления и определения количества бактерий группы кишечных палочек (колиформных бактерий): национальный стандарт Российской Федерации. М.: Стандартинформ, 2013. 15 с.

9. *ГОСТ 31746-2012* (ISO 6888-1:1999, ISO 6888-2:1999, ISO 6888-3:2003). Продукты пищевые. Методы выявления и определения количества коагулазоположительных стафилококков и *Staphylococcus aureus*: национальный стандарт Российской Федерации. М.: Стандартинформ, 2013. 22 с.

10. *ГОСТ 29185-2014* (ISO 15213:2003). Микробиология пищевых продуктов и кормов для животных. Методы выявления и подсчета сульфитредуцирующих бактерий, растущих в анаэробных условиях (с Поправкой): национальный стандарт Российской Федерации. М.: Стандартинформ, 2015. 11 с.

11. *ГОСТ 28560-90.* Продукты пищевые. Метод выявления бактерий родов Proteus, Morganella, Providencia: национальный стандарт Российской Федерации. М.: Стандартинформ, 2010. 6 с.

12. *ГОСТ 10444.12-2013.* Микробиология пищевых продуктов и кормов для животных. Методы выявления и подсчета количества дрожжей и плесневых грибов: национальный стандарт Российской Федерации. М.: Стандартинформ, 2014. 9 с.

13. *ГОСТ 31659-2012* (ISO 6579:2002). Продукты пищевые. Метод выявления бактерий рода *Salmonella*: национальный стандарт Российской Федерации. М.: Стандартинформ, 2014. 19 с.

14. *ГОСТ 32031-2012.* Продукты пищевые. Методы выявления бактерий *Listeria monocytogenes*: национальный стандарт Российской Федерации. М.: Стандартинформ, 2010. 25 с.

15. *ТР ТС 021/2011*. Технический регламент Таможенного союза «О безопасности пищевой продукции». URL: http://www.eurasiancommission.org/ru/act/texnreg/deptexreg/tr/Pages/PischevayaProd.aspx (дата обращения: 21.05.2022).

16. *ТР ЕАЭС 040/2016*. Технический регламент Евразийского экономического союза «О безопасности рыбы и рыбной продукции». URL: http://www.eurasiancommission.org/ru/act/texnreg/deptexreg/tr/Pages/TR_EEU_040_2016.aspx (дата обращения: 21.05.2022).

The article is submitted 24.05.2022; approved after reviewing 19.08.2022; accepted for publication 19.09.2022
Статья поступила в редакцию 24.05.2022; одобрена после рецензирования 19.08.2022; принята к публикации 19.09.2022

Information about the authors / Информация об авторах

Yuliya N. Korzhavina – Postgraduate Student of the Department of Food Technology; Kaliningrad State Technical University; yuliya.korzhavina@klgtu.ru

Dmitry L. Alsheyevsky – Candidate of Technical Sciences, Assistant Professor; Assistant Professor of the Department of Food Technology; Kaliningrad State Technical University; alshevsky@klgtu.ru

Юлия Николаевна Коржавина – аспирант кафедры технологии продуктов питания; Калининградский государственный технический университет; yuliya.korzhavina@klgtu.ru

Дмитрий Леонидович Альшевский – кандидат технических наук, доцент; доцент кафедры технологии продуктов питания; Калининградский государственный технический университет; alshevsky@klgtu.ru

Vladimir I. Ustich – Candidate of Technical Sciences, Assistant Professor; Vice Rector of Academic Affairs; Kaliningrad State Technical University; ustich@klgtu.ru

Oksana V. Kazimirchenko – Candidate of Biology, Assistant Professor; Assistant Professor of the Department of Aquatic Bioresources and Aquaculture; Kaliningrad State Technical University; oksana.kazimirchenko@klgtu.ru

Marina N. Alshevskaya – Candidate of Technical Sciences, Assistant Professor; Assistant Professor of the Department of Food Technology; Kaliningrad State Technical University; marina.alshevskaya@klgtu.ru

Владимир Иванович Устич – кандидат технических наук, доцент; проректор по учебной работе; Калининградский государственный технический университет; ustich@klgtu.ru

Оксана Владимировна Казимирченко – кандидат биологических наук, доцент; доцент кафедры водных биоресурсов и аквакультуры; Калининградский государственный технический университет; oksana.kazimirchenko@klgtu.ru

Марина Николаевна Альшевская – кандидат технических наук, доцент; доцент кафедры технологии продуктов питания; Калининградский государственный технический университет; marina.alshevskaya@klgtu.ru