Assessment of the quality of canned cod liver

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Abstract. The task of this work is to analyze the quality indicators of canned food called *Cod liver in Murmansk style*. To achieve this goal, methods of organoleptic and physicochemical analysis were applied. In the course of the study we studied the change in the quality of canned food made from the liver of raw Atlantic cod (*Gadus morhua*, Linnaeus, 1758), which was caught in the fall-winter period. For this purpose, the actual content of fats, proteins, carbohydrates, vitamins A and B2, the acid number and the calculation of the product energy value were determined.

1 Introduction

Currently, the quality, functional properties and safety of food products determine the consumer's choice and the success of promoting products in the sales markets [1-3]. Enterprises are interested in maintaining the high competitiveness of their products. Particular attention is paid to the control of technological parameters of the product manufacturing process that directly affect its safety. At food enterprises, product quality control, along with production technology and ecology, is given increased attention. The state also controls these processes using technical regulation, paying attention to the development and updating of the regulatory framework.

One of the key sectors of the Murmansk region economy is the processing of aquatic biological resources. In recent years, the level of fish processing and conservation in this region exceeds the Russian average. Figure 1 shows the dynamics of processing and conservation of aquatic biological resources in the Murmansk region compared to the average level in the Russian Federation.

An important aspect of the use of food products in water bodies is the production of sterilized canned food in metal cans. Figure 2 shows the dynamics of production of canned food and preserves in the Murmansk region for the period from 2017 to 2021 [4]. It is noted that the production of these products in the Murmansk region is dominated by natural canned foods. It is interesting to note that the share of canned cod liver is 90-98% of the total volume of natural canned products. This product is in stable demand not only in the Murmansk region, but also in many other regions of Russia.

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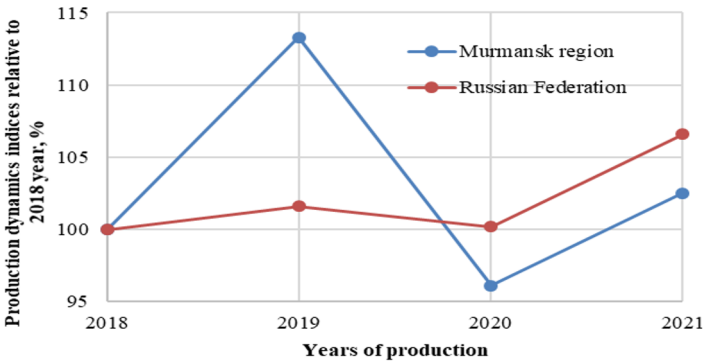

Fig. 1. The dynamics of processing and conservation of aquatic biological resources in the Murmansk region [14].

Cod liver canned food is rightfully one of the Murmansk region brands. For several decades, the demand for them has been constantly growing, despite the fact that they are produced in large quantities both at sea and at onshore enterprises. Based on literary sources, it can be concluded that the consumer market for canned cod liver products covers the European part of Russia [1, 5-10]. Cod liver is a traditional food product not only in Russia, but also in Norway, Germany, Iceland, Denmark, Poland and other countries [11-12]. Cod liver products have a high nutritional and biological value and have a beneficial effect on human health [13-14]. Cod liver is a source of polyunsaturated fatty acids ω-3 (ω-3 PUFA) vitamins A, B_1, B_2, D, E, PP. [6, 13-14]. It is worth noting that cod liver can accumulate toxic substances in itself that can harm human health. Canned cod liver produced in Russia, Denmark and Germany was tested for arsenic content. It was found that the content of arsenic in the finished products of various brands ranged from 2.6 to 5.5 mg/kg [11, 15]. The permissible level of arsenic for fish products is 5 mg/kg [16]. Other researchers note that fish contains high natural level of arsenic, only 10% of which is inorganic compounds with toxic properties. It is also reported that the content of heavy metals in cod liver has not exceeded the permissible levels [14]. In a study of the content of persistent organic pollutants and metals in the Northeast Arctic cod of the Barents Sea, it was found that the normalized level of dioxins in the fish liver was exceeded in 166 cases out of 784 selected individuals. The highest concentrations of dioxins were found in samples from the eastern part of the Barents Sea [17]. Mercury concentrations were well below the maximum allowable level. Arsenic concentrations varied greatly from 0.3 to 170 mg/kg wet weight [11]. These results of cod liver safety indicators lead to the need for periodic environmental monitoring of the Barents Sea. Another significant problem of canned cod liver is the presence of nematode larvae of the Anisakidae family in the liver. The negative effect of somatic antigens of the dead anisakidae cuticle on the human body, appearing in the form of severe allergic reactions, has been established. Anisakidae allergens are quite heat-resistant and are practically not destroyed by heat treatment [12]. In this regard, the production of canned cod liver needs the technologies allowing the complete removal of nematode larvae from raw materials. As an objective indicator of the quality of canned cod liver, it is proposed to use the value of the acid number, the maximum permissible level of the indicator is 4.0 mg KOH/g. The organoleptic evaluation of product quality correlated with the value of the acid number [2, 18].

In recent years, the most popular canned food has become *Cod liver in Murmansk style*, which is characterized by a pleasant uniform spreadable consistency, characterized by the

absence of released fat. These products can be used in the form of sandwiches, salads, as well as in various samples of culinary products.

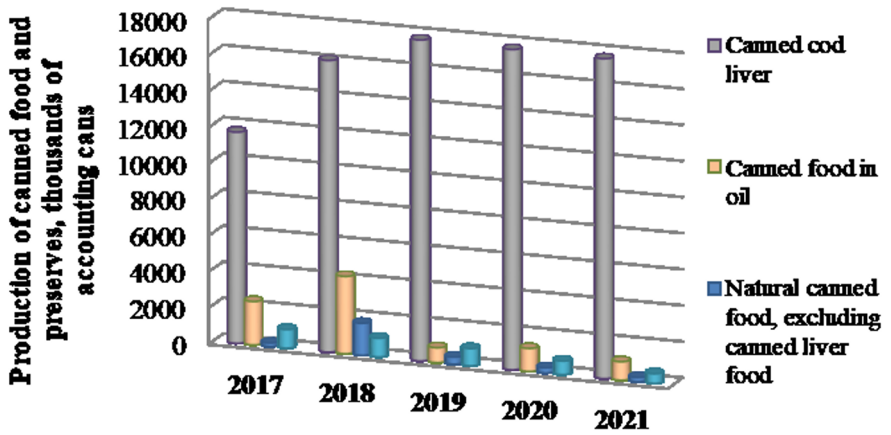

Fig. 2. The dynamics of processing and conservation of aquatic biological resources in the Murmansk region [14].

2 Materials and methods

The purpose of the study is to assess the quality of industrial samples of canned *Cod liver in Murmansk style*.

Research objectives are:

- To carry out an organoleptic evaluation of finished products.
- To determine the acid number of canned food, the content of vitamins A, B2.
- To determine the content of protein, fat, mass fraction of table salt.
- To compare the quality indicators of canned food in the autumn-winter fishing season.

The objects of the study were samples of canned food *Cod liver in Murmansk style* in a metal round collection jar No. 3, manufactured at sea (autumn-winter fishing season), in the amount of 72 pieces.

Industrial sterility was determined according to State Standard 30425-97 [19].

The tightness of canned food was determined according to State Standard 8756.18-2017 [20].

The work uses chemical and biochemical methods of analysis accepted in scientific research. The mass fraction of water, fat, protein substances, sodium chloride of raw materials and products was determined by standardized methods according to State Standard 7636-85 [21]:

- The mass fraction of nitrogenous substances in fish was determined using an automatic nitrogen / protein analyzer "Pro-Nitro A" according to the Kjeldahl method: the method is based on the Kjeldahl sample mineralization, the distillation of ammonia into a sulfuric acid solution, followed by titration of the sample under study.
- Mass fraction of water - by drying method at a temperature of 100-105°C.
- Mass fraction of sodium chloride - by argentometric method based on the interaction of sodium chloride with silver nitrate followed by titration.

- The mass fraction of fat was determined on the apparatus "Det-gras N" according to the Soxhlet method, based on the extraction of fat with an organic solvent from a dry sample and the determination of its mass by weighing.
- The acid number was determined by titration with a potassium hydroxide solution of fatty acids present in a sample of the test substance dissolved in diethyl ether (HOST R 50457-92) [22].
- Vitamin A was determined by a method based on its interaction with antimony trichloride with the formation of a colored complex according to the method M-04-10-2007 [23]. vitamin B2 - by the fluorimetric method using a fluid analyzer "Fluorat-02" according to the method M 04-56-2009 [24].

3 Results

To verify compliance of the selected product samples with the standards of GOST R 56418-2015 [25], quality testing of canned cod liver *Cod liver in Murmansk style* packed in can No. 3 with net weight of 230 g, produced at sea, was carried out. The research included industrial sterility test, microbiological, organoleptic and chemical analysis.

According to the results of the industrial sterility test, the following data were obtained:

- The packaging has no damage, there are no defects on the inner and outer surfaces of the cans.
- The appearance of the examined cans of canned food *Cod liver in Murmansk style* after thermostatization at 37 °C for 5 days meets the requirements of standards, there are no defects.
- Packing tightness: there is no leakage of cans.
- pH of the canned product is 6,9.
- Residual microflora was not detected in all samples of canned food.

These results confirm the industrial sterility of canned food *Cod liver in Murmansk style*.

Organoleptic evaluation revealed that the samples of canned *Cod liver in Murmansk style* in can No. 3 have a pleasant taste and odor characteristic of this type of canned food. The product is a homogeneous finely ground mass without impurities, the fat is transparent. The color of the liver mass is creamy, the fat that stands out is light yellow. The height of the liver mass is equal to or 4-5 mm less than the internal height of the jar. Nematode larvae are not found. The process of production of canned *Cod liver in Murmansk style* includes mechanical processing of raw liver on special equipment, which removes large vessels, films and together with them nematode larvae.

The results of the physical and chemical studies of canned food *Cod liver in Murmansk style* for the autumn-winter fishing season are presented in Table 1. The protein content in canned food is on average (4.63 ± 0.08) %, fat - (70.78 ± 0.87) %, vitamin *A* - 0,95 mg / 100 g, vitamin B_2 - 0.19 mg / 100 g, acid number of fat - (0.79 ± 0.11) mg KOH/1 g of fat. There are no carbohydrates. The calorie content of 100 g of products ranges from 648 to 662 kcal and averages 655 kcal.

Table 1. Main characteristics of the quality of canned food “Cod liver “in Murmansk style” (compiled by the authors).

Content		Vitamins content, mg/100g		Acid number, mg KOH/1 g fat	Energy value, kcal / 100 g	Mass fraction of sodium chloride,%
Protein,%	Fat, %	*A*	B_2			
4.63±0.08	70.78±0.87	0.95	0.19	0.79±0.11	655.25±7.15	1.5±0.05

The relative error in the protein content in canned food *Cod liver in Murmansk style* for the autumn-winter fishing season was 1.72 %, fat - 1.23 %. The fat and protein content in canned food of the autumn-winter fishing season remained practically unchanged. The acid number did not exceed 0.9 mg KOH / 1 g fat. This value is about four times lower than the maximum permissible indicator. The acid number correlated with the organoleptic characteristics of canned food, which were at a sufficiently high level, corresponding to previously obtained data [2, 18]. Based on the data presented in Table 1, it can be concluded that the quality indicators of canned food made from cod liver in the autumn-winter fishing season are almost identical, and, therefore, the month of fish catch does not significantly affect the canned food quality.

As a result of the study of cans Cod liver "in Murmansk style in a metal round collection jar No. 3, it was found that all the samples tested in terms of tightness meet the requirements of State Standart 8756.18-2017 [20].

4 Discussion

The results of the physical and chemical studies of canned food *Cod liver in Murmansk style* for the autumn-winter fishing season: the protein content in canned food is on average 4.6%, fat - 70.8%, vitamin A – 0.95 mg / 100 g, vitamin B2 - 0.19 mg / 100 g. There are no carbohydrates. The calorie content of 100 g of products ranges from 649 to 659 kcal and averages 655 kcal. The fat and protein content in canned food of the autumn-winter fishing season remained practically unchanged. The acid number did not exceed 0.9 mg KOH / 1 g fat. This value is about four times lower than the maximum permissible indicator. The acid number correlated with the organoleptic characteristics of canned food, which were at a sufficiently high level, corresponding to previously obtained data [2, 18]. The quality indicators of canned food in the autumn-winter fishing season are almost identical, and, therefore, the month of fishing does not have a significant impact on the quality of canned food [2]. No nematode larvae of the Anisakidae family, which are a potential source of severe allergic reactions [12], were found in canned *Cod liver in Murmansk style*.

Consequently, based on the results of microbiological, physico-chemical and organoleptic studies, it can be concluded that canned *Cod liver in Murmansk style* have a high nutritional and energy value, and their quality meets the requirements of GOST R 56418-2015 [10]. The quality indicators of canned food made from cod liver of the autumn-winter fishing season are almost identical, and, therefore, the month of fish catch does not significantly affect the quality of the produced canned food.

5 Conclusion

Mechanical processing of raw liver at a technological plant allows removing nematode larvae, increasing the safety and quality of canned food. The acid number of canned *Cod liver in Murmansk* style correlates with the organoleptic characteristics of canned food.

The quality indicators of canned food made from cod liver of the autumn-winter fishing season are almost identical, and, therefore, the month of fish catch does not significantly affect the quality of the produced canned food. All the studied samples of canned food *Cod liver in Murmansk style* were proved to meet the requirements of tightness, organoleptic and physicochemical indicators meet the regulatory and technical documentation requirements. In further studies, it is planned to study the quality of canned food of spring-summer fishing, when changes in the chemical composition of the liver are observed.

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