

# The possibility of using lactic additives and sonochemical technology in the production of preserves

Vera Demchenko<sup>1</sup>, Irina Asfondiarova<sup>2,\*</sup>, Nina Katkova<sup>2</sup>, Marina Ivanova<sup>2</sup>, Elena Belokurova<sup>2</sup>

<sup>1</sup>ITMO University, 9, Lomonosova street, 191002, Saint-Petersburg, Russia

<sup>2</sup>Peter the Great St. Petersburg Polytechnic University, 29, Polytechnicheskaya, 195251, Saint-Petersburg, Russia

**Abstract.** The priority in improving the existing methods of processing fish is salting with the use of food additives with different functional orientations. The aim of the study was the development of preserves with the introduction of lactate-containing additives and using sonochemical technologies; examination of the quality of the products obtained according to organoleptic and microbiological safety indicators. The article proposes a resource-saving technology for the production of fish products with prolonged shelf life due to the use of a complex food additive consisting of lactic, acetic, propionic acids and their salts in different proportions with subsequent ultrasonic treatment using the ultrasonic generator of the Wave series model UZTA-0 2/22-OM. There was established the optimal mode of using the ultrasonic processing power of 75 W / m<sup>2</sup> in the manufacture of fish preserves from herring. Organoleptic and microbiological quality indicators were studied during storage of preserved products with the addition of additives and ultrasonic treatment compared to the control. Organoleptic assessment was carried out on a five-point scale, microbiological indicators were studied by standard methods. The Dilactin Forte Plus dietary supplement in the composition of preserves in the amount of 3% and in combination with the use of sonochemical technologies makes it possible to obtain a safe high-quality fish product. Manufactured preserves at a storage temperature of  $0 \pm 2$  °C can maintain their high quality for 5 months.

## 1 Introduction

Consumers give more and more preference to food products, including fish, with fewer synthetic additives, but with increased safety, quality and shelf life [1,2].

The successful development of fish and seafood processing has become impossible without taking into account the relations between producers and consumers in an emerging market of fish products. A significant decline in production in the absence of a centralized

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\* Corresponding author: [ririna25@mail.ru](mailto:ririna25@mail.ru)

distribution of finished products and the presence of fierce competition between manufacturers necessitated the search for effective ways to develop production.

In addition, enterprises existing in an unstable economic environment should increase the measure of diversity and abandon old models of functioning in combination with stable organizational values and the use of information and digital technologies [3,4,5]. At the same time, the technologies used for the production of products suggest an increase in their quality [6].

One of the main factors is to increase the competitiveness of product manufacturers by improving its quality and reducing production costs. The solution to this problem contributes to the results of studies achieved in recent years by scientists. The authors suggest using food additives and various methods of processing products [7, 8, 9].

Therefore, the development and improvement of fish processing technology in order to improve its quality and shelf life is an urgent area.

Fish and fish products are particularly perishable products. Traditionally, salting was used to preserve fish and occupied a leading place among the methods of processing it. The use of salt to protect the fish product from spoilage is based on its ability to reduce the activity of enzymes and “extract” water from microorganisms, creating “physiological dryness”.

Also, to suppress the development of unwanted microorganisms, their formation of toxins and increase the shelf life of food products, food additives called preservatives are added. Preservatives cannot compensate for the poor quality of raw materials and violation of the rules of industrial hygiene.

The use of substances with a preservative effect (sodium chloride, acetic and lactic acids, etc.) has long been well known. Usually they are used in the amount of several percent or tens of percent, often achieving certain organoleptic properties, and preserving the effect, considering it as a side effect [10].

It is known that lactic acid bacteria ferment fish, meat and milk and turn them into food products with an extended shelf life; also help digest food and create a healthy environment in the intestines. The economic and social importance of these relatively simple and small bacteria is enormous [11, 12].

Recently, interest has also increased in salts of lactic acid - sodium, calcium, iron, ammonium, potassium and magnesium lactates. The increasing interest in these additives can be explained by their versatility. Lactates act as regulators of acidity and humidity, antimicrobial agents, synergists of antioxidants and fillers.

Salty foods, depending on the features of their preparation, are very diverse - from salty to spicy, pickled and delicate delicacies. Therefore, their range, especially fish preserves, is constantly expanding and improving.

Some species of fish, especially herring, are able to ripen in the process of salting, acquiring specific pleasant aroma, taste and texture characteristic only of them.

One of the alternative methods of fish processing is ultrasound technology, which can pasteurize and preserve food products by inactivating many enzymes and microorganisms at moderate temperature conditions, which can improve the quality of food products and guarantee the stability and safety of food products [13].

The aim of the study was the development of preserves with the introduction of a comprehensive food supplement and the use of sonochemical technologies; assessment of the quality of the products by organoleptic and microbiological safety indicators.

## 2 Methods

To improve the quality, optimize the pH, reduce the technological process, increase the shelf life and microbiological stability of fish preserves, we used food additives developed in the laboratory of VNIIPD (a branch of the Federal State Budget Scientific Institution “Gorbatov

Federal Scientific Center for Food Systems” RAS) and consisting of milk , acetic and propionic acids and their salts: Dilactin Forte (DF) and Dilactin Forte Plus (DFP) (table 1) [14, 15]

**Table 1.** Characteristics of additives.

Characteristic of integrated samples food additives	Dilactin forte			Dilactin Forte Plus		
	1	2	3	4	5	6
	Lactic acid Acetic acid Sodium lactate Water			Lactic acid Acetic acid Propionic acid Sodium lactate Water		
Active acidity, units pH	5.25	5.60	5.76	5.21	5.54	5.85
Titrateable acidity, deg.	98.5	46.1	39.9	87.9	49.0	30.3
Density, g / cm <sup>3</sup>	1.282	1.288	1.288	1.282	1.288	1.290

The Wave series model UZTA-0.2 / 22-OM model was chosen as an ultrasonic transducer, which has advantages in comparison with other devices: small dimensions, reduced power consumption, ease of operation (Figure 1).



**Fig. 1.** Ultrasonic device the series «Volna-M».

The objects of study: control - without additives and ultrasonic treatment, sample 1 - preserves + DF, sample 2 - preserves + DFP, sample 3 - preserves + DF + ultrasound and sample 4 - preserves + DFP + ultrasound.

The technology for the production of preserves consisted of the following operations: defrosting of fish raw materials at a temperature of + 18 ° C to (-2 ± 1) ° C; washing; cold brine salting (with a mass fraction of table salt of 10%) at a temperature of -1 ... -3 ° C with the addition of lactate-containing additives in an amount of 70% of the mass fraction of additives; interruption of salting process.

It is known that the interrupted salting process allows you to get salty products of any salinity.

After salting the herring, ultrasonic processing (US) was performed with a radiation power of 75 W / m<sup>2</sup> in brine for 1 minute in order to reduce the time of salting and improve the salting out of the fish fillet (the salting is better and more uniform). Next, the salted herring fillet was cut into 2 cm pieces and placed in polymer cans with a capacity of 200 g.

As a fill, we used vegetable sunflower oil with the addition of the studied additives — DF and DFP in the amount of 30% of the mass fraction of the added additives. To speed up the mixing and distribution of food additives throughout the volume of the can and additional pasteurization of the product, the filling was also treated with ultrasound of the same power as brine, but until the temperature reaches 30 ° C in the filling, to prevent protein denaturation in herring fillet meat.

Corked jars were stored at a temperature of  $0 \pm 2$  ° C for 1 to 5 months.

Organoleptic evaluation was carried out on a five-point scale, according to which the appearance, color, taste, aroma and texture were determined.

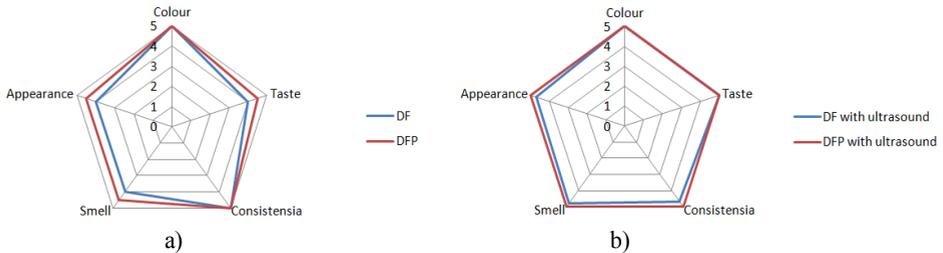
Microbial safety (QMAFAnM) was determined by standard methods.

### 3 Results and its discussion

The resulting preserves were subjected to organoleptic and microbiological analysis during storage.

Figure 2 shows the results of organoleptic evaluation of samples with food additives with ultrasound and without treatment.

According to fig. 2, the samples of preserves 3 and 4 with the introduction of additives DFP and DF in the amount of 3% and using ultrasound had maximum scores at the beginning of storage; samples 1 and 2 had a good quality level.

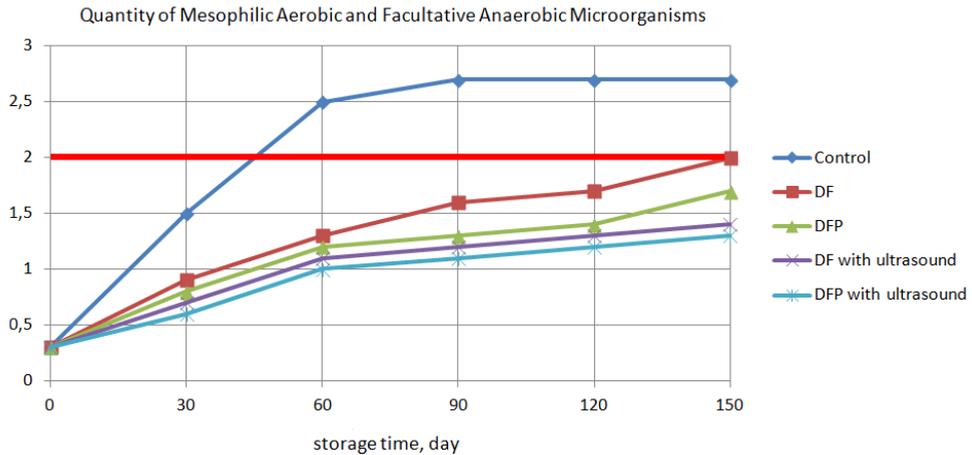


**Fig. 2.** Organoleptic profile of salted herring fillet preserves: a) when you make Dilantin Forte, Forte Plus Dilantin; b) making Dilantin Forte, Forte Plus Dilantin using ultrasound.

At the end of the storage period, it was established that samples 1–2 had signs of spoilage after opening the packaging, and samples 3–4, treated with ultrasound, did not have unacceptable defects, with the exception of sticking pieces of fish in some samples in the last days of storage of preserves.

The data of microbiological analysis of preserves from herring fillet during storage are presented in figure 3.

According to fig. 3, on day 35 QMAFAnM exceeds the permissible norm in the control sample. In the sample with the introduction of Dilactin Forte, QMAFAnM exceeds the permissible norm already by 143 days. In the sample with Dilactin Forte Plus and ultrasonic treatment during the entire experiment, no excess of the permissible norm of the total microbial number was found.



**Fig. 3.** Kinetics of growth of sanitary-indicative microorganisms when storing fish preserves from herring fillets with the addition of 3% DF both DFP and ultrasound use.

## 4 Conclusions

Based on the obtained experimental studies, the effective use of a lactate-containing additive in the amount of 3% with ultrasonic treatment for the production of preserves is justified. Ultrasound, destroying and homogenizing the surface of tissues, facilitates the penetration of preservative substances into them. Ultrasound also contributes to the disinfection of fish by exposure to acoustic vibrations of ultrasonic frequency. The mechanism of action of ultrasound is due to a combination of mechanical, thermal and physico-chemical factors that can damage the cell membranes of metacercariae, which leads to their death.

Thus, a technology is proposed for the production of fish preserves, which provides for a combination of ultrasonic treatment with a power of  $75 \text{ W} / \text{m}^2$  and the use of a comprehensive food additive Dilactin Forte Plus, which provides improved quality and safety and prolongs the shelf life of the target products.

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