Evaluation of the Quality of Canned Seafood with Added Spice-oil Extract

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Abstract
The influence of spice (cinnamon, allspice, black pepper)-oil extract on canned seafood quality was studied. During the processing of canned seafood, the substitution of spice-oil extract for vegetable oil (refined sunflower, corn, soybean and olive oil) resulted in a decrease in the heat resistance of spore microorganisms, making it possible to reduce the duration of sterilization for canned food to 5-10 min at 115°C. This reduction in the sterilization duration of canned seafood with spice-oil extract inhibited residual microflora in the product, thus reducing the deleterious effect of heating on the main food compounds while preserving protein digestibility.

Key words: Spice-oil extract, Canned foods, Heat resistance, Sterilization, Digestibility, Fatty acids

Introduction
Microbiological safety is a fundamental property to be considered in the creation and development of technology for food processing and preservation. Some techniques used to ensure microbiological safety, including the addition of preservatives, increases in acidity, and high-temperature processing, result in the destruction, inactivation or growth stabilization of microorganisms. However, such measures often lead to reductions in food quality.

For food preservation, canning, a technology that relies on high-temperature processing or sterilization, provides a reliable means of securing microbiological safety. In most countries, including Russia, the sterilization of fish and non-fish food products is conducted to kill spoiling and pathogenic organisms (Giprorybflot, 1996; Shul'gina, 1995). As a quality test organism, highly heat-resistant spores of Clostridium sporogenes-25 (C. sporogenes-25) are targeted.

Although the sterilization process secures microbiological safety, it results in the loss of native properties of products and has some undesirable effects, including the accumulation of products of nutrient destruction, the formation of high-molecular-weight nitrogen compounds, and reductions in food digestibility and assimilation (Shvydkaya and Blinov, 2008; Shulgin, 2006; Shulgin et al., 2006). A well-known method of reducing the heat resistance of spore microorganisms in canned seafood and decreasing the requisite rigidity of sterilization modes is through the creation of an acidic environment in the canned product (Mazokhina-Porshnyakova et al., 1977), which is barely acceptable for fish and non-fish goods canned...
in oil. This method allows for effective sterilization without an excessive thermal load on canned food, thus guaranteeing the commercial sterility of food products. The aim of this work was to investigate the influence of spice-oil extract on the heat resistance of microorganisms in canned seafood, the modes of product sterilization, and the quality of the product.

Materials and Methods

Preparation of canned food

The preparation of semi-finished canned seafood products was carried out in accordance with “The technological instructions for preparing canned seafood from non-fish objects” (Giprorybflot, 1989). The following ingredients were used in canning: frozen sea cucumber, frozen octopus, frozen surf clam, frozen squid, frozen whelk, frozen sea scallop, frozen mussels, refined sunflower corn, soybean and olive oils, edible salt, powdered black pepper, powdered allspice and milled cinnamon. Spice-oil extract was prepared as follows: milled spices (cinnamon, allspice, black pepper) and vegetable oils were mixed, heated and incubated at 80°C for 24-36 h. The mixture was cooled and the sediment and spice-oil were separated (Lazhentseva et al., 2011). The cut and washed seafood meat was placed on grids in a smoking room. The flue-curing mode was employed for 20 min at 23-25°C until the seafood attained the mellow flavor and light aroma of smoked seafood meat. The prepared seafood was batched by size and packed in 90-g glass jars. Twenty cubic centimeters of spice-oil extract or vegetable oil were poured into the experimental and control jars of canned seafood, respectively. The spice-oil extract was a clear flavored oil with a brownish tinge and pleasant cinnamon smell, from which microorganisms were absent (Lazhentseva et al., 2011). After filling, the jars were rolled using a vacuum, and the patterns of their heating during the sterilization process in water at a counter pressure of 0.18 MPa at 115°C, was calculated graphically. The experiment was repeated three times for each extract. The arithmetic mean of the results from three experiments was used. The value of the normative sterilizing effect (Fn in conditional min) was calculated using formula (1):

\[ F_n = D_{121°C} \times (\lg B/b + x) \]  

where \( D_{121°C} \) is the heating time in min required to reduce the amount of Cl. sporogenes-25 spores by a factor of 10; B is the initial number of microbial spores in one gram of product before heating at 121.1°C; b is the finite amount number of microbial spores surviving after heating; \( \lg B/b \) is the logarithm of the surviving spores, taken with the opposite sign; and x is a correction to take into account deviation in the number of surviving cells after the heating of spores from the log scale of death. The thermo-physical characteristics of the canned food content and the factual sterilizing effect (\( F_t \)) were assessed using STF-9004 (manufactured by ELLAB, Denmark). The calculation of de facto lethality in sterilization modes was performed according to the manual of Flaumenbaum (1986). The factual lethality (F) of the sterilization mode is the stationary equivalent of the concrete non-stationary mode, expressed in conventional 121.1-degree min, which allows for the quantification of the microbiological efficiency of any sterilization mode. The value of \( F_t \) was calculated using formula (2):

\[ F_t = I_e \times [K_1 + K_2 + ... + K_n] \]  

where \( I_e \) is the time interval between temperature measurements in the can center and \( K_i \) is the value of the conversion coefficient at the moment of measurement.

Digestibility

The factual digestibility of canned seafood was determined using the biotesting method recommended by Shulgin et al. (2006).