NTNU

Sustainable Energy in Food Production

MSTU

GUIDES FOR INTERACTIVE LABORATORY EMPLOYMENT

«DEVELOPMENT OF CANNED FOOD STERILIZATION REGIMES. DETERMINING THE ACTUAL MORTALITY AND PARAMETERS OF THE ENERGY SAVING MODE»

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1. Goal: To study the methods of determining the effect of sterilizing on cans using traditional and innovative equipment.

2. Subgoal:

1. Prepare natural canned fish for sterilization.

2. Carry out sterilization for a given regime using Ellab (Denmark) wireless sensors.

3. Extract instrumental data (temperature at the cans center, sterilizing effect).

4. Determine the organoleptic characteristics of canned fish and draw a conclusion about the impact of sterilization mode.

3. Equipment and materials

Vertical autoclave H2-ITA-602; beading machine № 3 (6, 2) with lids; sterilization process control system; wireless Ellab sensors with installation kit and software; Personal Computer; cutting boards; scales with an accuracy up to 1 g.

4. Theory in brief

Sterilized canned fish is a fish product in a sealed airtight metal (less polymer) containers which is subjected to sterilization (usually at temperatures not lower than 100°C).

Natural canned fish is a canned fish (fish liver, fish roe, fish milt) generally this products don`t have preliminary heat treatment, cans do not consist sauces and extra fills. The composition of natural preserves contains only fish, salt and spices. Another group of sterilized canned fish is "fish natural with oil", which is differ with a classical one in a small amount of oil.

Receiving of raw materials is carried out in accordance with current standards. You can use either chilled and frozen fish as a raw material in the coastal factories. Raw materials can be stored at industrial premises in accordance to the terms of shelf life (with long-term storage - more than 6 months from the date of catch – frozen raw material for the canning industry is not recommended).

Frozen raw materials are subjected to defrosting (in air, irrigation water, steam under vacuum, microwave energy, currents with industrial and increased frequency) until block decays and temperature inside the fish will gain at least 2°C below zero. If unfreezing is not conducted in water, product has to be washed.

Cutting of fish for canning depends on it`s size. Small fish doesn`t subjected for cutting or only behead; medium size and large fish carve on the carcass (special cutting) or fillets.

After cutting it is required to wash the product and remove residual blood, entrails and squama.

The process of portioning is about cutting a cleaned fish into small pieces which is suitable to the height of banks. Small fish is not required to be cut. Portioned pieces of fish (or a whole small fish) should be gently packed in pre-washed and pasteurized bank. If the canning line is mechanized, it is usually combined with the pre-packaging line. It is necessary to control the weight of the semifinished product in the pot.

Salt and spices bring in accordance with technological instructions and in accordance with requirements of salinity standards of the fish. As a rule, the bank number 3 should contain 4 grams of salt, as well as 2 items of black (scented) pepper. Such method of introducing the salt is most preferred from precision standpoint of metering, simplicity and mechanization, but can lead to the formation of "salt burn" - protein denaturation and sealing mass on the surface of the fish exposed to salt. The solution could be a separate tuzluchny salt liquid for fish, but it complicates the entire technology process.

Exshaustation is a vacuum creating process in the tin. Vacuum is needed to prevent oxidative processes in cans, it prevents the development of aerobic microorganisms (for example genus Bacillus). Ekshaustation can be carried out mechanically (in a vacuum seamers) or by using heat method.

Pressurization is a process of capping banks which are prepared and marked (according to GOST 11771) lids. It is necessary to form a high-grade double-seaming line.

After pressurization, tins are carefully washed to remove residual contaminants, especially with a fatty nature: such contamination during sterilization may form on the surface of the tin a dark spots of fatty acids salts.

Sterilisation is usually carried out in a horizontal or vertical autoclaves. Tins are placed in baskets (or carts), and then into autoclave.

The main task of sterilization is to destroy all vegetative microorganisms. All pathogens and dangerous microorganisms should be also destroyed. From cryptogamous pathogenic micro-organisms, the most dangerous is Clostridium Botulinum, the assured destruction of it achieved when the product is heated at 121.1 ° C (250 ° F) for about 2.5 - 3 minutes (in the least-heated spot). Thus, all the cans should be provided with a comparable sterility. Usually the one 'oversized' can is picked up , for destruction of more heat-resistant spores. However, excessable sterilization will lead to the digestion of the contents of cans: the texture of product will be unsatisfactory, nutritional and biological values will be low, and the content of canned food may 'stick' to the can's inner surface.

Thus, it is necessary to provide, on the one hand, a guaranteed level of sterility, and on another – not exceed it significantly, i.e., not digest food. But keep in mind that there are a variety of cans, autoclaves (sterilizers), different methods of sterilization. Directly because of this the definition of 'sterilizing effect' was established.

Sterilizing effect (the actual lethality F, LT_Z) is the length of an imaginary process that takes place at a constant base temperature (T_B=121,1 °C), which is equivalent to the action on the microorganisms in the actual sterilization process (in an unsteady temperature field).
To recalculate the actual process taking place at some conditionally constant temperature T_C, it is necessary to use the formula (1):

$$LT_Z = \frac{U}{10^{\frac{T_B - T_C}{z}}} \qquad (1)$$

where

LT$_Z$ is the actual sterilizing effect (actual lethality) of the process, min.;
U – duration of the process, min;
z - constant of thermostability of microorganisms, which is characterizing in how many degrees it is necessary to increase the temperature for decreasing the duration of sterilization in 10 times. Mostly for canned fish z=10.

In practice, the sterilization process is always in an unstable temperatures: the contents of the can must be warmed, then it should be cooled. Thus, the formula (1) can't be directly applied. However, you can split the sterilization process in many stages, each of them - with the temperature that can be considered conditionally constant, equal to the arithmetic mean between the initial and final temperatures at the stage. When using Ellab equipment (designed to measure the temperature of the center of cans), calculation of the sterilizing effect is performed in automatic mode by numerical integration. After sterilizing effect for these products in the can in the autoclave will be calculated (and will not be below the standard), it is submitted for approval; in the future, in such conditions it is possible to carry out sterilization on the production, without continuous temperature control in the cans.
The actual sterilizing effect usually should be established as close as possible to the normative (but not below it). Normative sterilizing effect is determined by termal death of microorganisms. It can be obtained by the mathematic and microbiological methods.

The sterilization process in the autoclave is in accordance with the established regime (at the stage of defining a sterilizing effect on the proposed regime) by one of the following ways:

1.Steam sterilisation with air pressure water cooling;

2.Sterilization by hot water steam, the water pressure and cooling water;

3.Steam sterilisation without counter-pressure with cooling water.

After sterilization and cooling, the cans are removed from the baskets, washed, dried or wiped, then labeled (if there are no lithographed cans) and sent for maturation. Theoretically, immediately after the sterilization of canned, food is suitable for eating, but its organoleptic characteristics are not the best. It's notable that only after a certain time (for ordinary canned goods - from 10 to 14 days) canned product acquires the required organoleptic properties. It happens due primarily to the redistribution of components.

In parallel with the maturation, canned food is setted under microbiological analysis. Then all the cans are went under examination for any visible can defects.

5. Progress

Sterilization of canned food is on the proposed regime, observing possible deviations and their absolute value (tolerance ±1 degree). At the end of sterilization of canned food recovered; cans without the sensor direct to the maturation and him to cool him out, and banks with sensors opened and organoleptically evaluated, with paying special attention to signs of excessive sterilization of canned food, or lack thereof. Sensors are then removed and connected to computer for displaying heat patterns.

The output is carried out by comparing the actual mortality with the target value given in the process instructions.

The content of the report may look like this:

1. Job title
2. Goals and subgoals
3. Technological scheme of production
4. Organoleptic evaluation.
6. Thermal simulation and calculation of the sterilizing effect
7. Conclusion