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Review Article

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Development of Modes of Thermal Sterilization of Canned Food in Various Types of Consumer Jars

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Abstract

The technique of development of modes of heat treatment of canned food products in various types of consumer containers is considered. The advantages and disadvantages of the types of consumer containers used are described. Consider the wide range of canned food products from various types of raw materials. The characteristics of the final products are given.

Keywords

Mode of heat treatment; Canned products; Consumer packaging; Food raw materials.

Formulation of the Problem. Goal of the Work

In the production of canned food products, the problem of developing the regime parameters of the heat treatment of products is of great importance. Thermal sterilization of food products is the most common and basic way of carrying out the process of heat treatment in the canning industry and, in fact, the main process of canning production, almost completely destroying microorganisms, thus ensuring the preservation of canned food for a long time [1]. In the heat treatment, two factors are the main factor, the temperature and the duration of its action. The higher the sterilization temperature, the less time is spent inactivating microorganisms and enzymes, and vice versa. The duration of the exposure to the temperature necessary to kill microbes at a given sterilization temperature is called "fatal time" and depends on the sterilization temperature, the material and the dimensions of the consumer packaging, the chemical and physical properties of the product, the type and the number of microbes in the product being heat treated [1]. The sterilization regime is established in relation to the average product contamination under normal sanitary conditions of production. On the basis of the duration of warming-up and the dying out of microorganisms established in the laboratory, the sterilization formulas are developed for each type of canned food (taking into account the type, shape and dimensions of the container, the pH of the product), which are used in industrial conditions after their approval in accordance with the established procedure. By the formula of sterilization is meant the conditional recording of data characterizing the temporal and temperature conditions of the process. In the technological instructions for the production of canned food, the sterilization formula is usually written in this form:

$$\frac{A-B-C}{T}\times P$$

Where:

A-duration of temperature rise in the process equipment to its final constant value of temperature T, minutes.

B-duration of the actual heat treatment (at a constant temperature T), minutes.

C-duration of cooling required to bring the water temperature in the process unit to 40 ± 2°C, minutes.

P-pressure in the process apparatus, Pa.

The sterilization mode can be represented graphically. For this purpose, the duration of sterilization (A+B+C) in minutes is plotted along the abscissa axis, and the temperatures in the sterilization apparatus and in the bank with the product (in °C) along the ordinate axis. The heat treatment mode can be represented graphically. For this purpose, the duration of the total heat treatment (A+B+C) is plotted along the abscissa axis in minutes, and along the ordinate axis - the temperatures in the process unit and in the container with the product. Currently, the range of processed fruits and vegetables is extensive and constantly changing. The assortment is improved by increasing the share of quick-frozen fruits and vegetables, natural and snack foods, juices, canned food for children's and dietary food, dried fruits, freeze-dried fruits, potato products. In this regard, the development of the modes of heat treatment - sterilization and pasteurization of canned food is becoming increasingly relevant. In addition, the emergence of new types of consumer packaging, which differ in material and form, also requires the development of new modes of heat treatment of products, which are realized in various designs of technological devices - pasteurizers and sterilizers .

Materials and Methods of the Study

To implement the solution of the research task, a stand was created for studying the thermo physical properties of canned food products in which it is possible to study heating in sterilization equipment of various designs using various heat carriers. As containers for canned food products, glass, metal and polymer cans of various capacities are used [2].Glass containers account for 15% of all packaging materials in the global industry. The release of glass jars and bottles, despite the competition of plastic and metal containers, continues to increase.

Advantages of glass cans are:

1. Excellent sanitary and hygienic properties (from glass to food do not pass toxic substances).
2. Large stocks of raw materials for production - basic raw materials - sand (SiO_2) and cheap. One ton of glass is 6+12 times cheaper than metal.
3. High environmental friendliness, as glass can easily be identified in waste and can be easily recycled
4. Ease of sanitation and disinfection

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5. The presence of high barrier properties and compressive strength
6. Transparency.
7. The disadvantages of glass cans include:
8. Large weight
9. Fragility, loss of production during transportation and storage is 4+5 times more than in metal cans.

Glass jars for canned food have four types of mouth rims:

1. Rolling (type T);
2. Crimp (type II);
3. Threaded (type III);
4. Swaging-crimping (type IV).

The canning industry of the food industry uses glass containers of different capacities - from 0.1 to 3000 cm^3. Metal cans for canned food are made of 2 types: I - prefabricated and II - whole. Prefabricated cans consist of 3 parts: a body with a longitudinal seam and two ends (covers and bottom). One-piece jars consist of two parts: a body with a bottom stamped from a sheet of sheet metal, and a lid. The main materials for the production of metal consumer ta are tin and aluminum. Prefabricated banks (I type) produce round and rectangular. Integral (type II) - round and figured (rectangular, oval and elliptical). There are over 60 varieties of metal cans of different capacities in the range from 50 to 9590 cm^3. The advantages of a metal container are: sufficient mechanical strength, manufacturability. Unlike glass jars, tins are three times lighter, insensitive to temperature changes; there is no danger of getting glass into the product. Disadvantages: metal cans are prone to corrosion, require the consumption of tin and lacquers, which are allowed for contact with food. For the manufacture of containers made of polymeric materials, thermoplastics are used, which, when the temperature is raised significantly, becomes a viscously fluid state.

Properties of polymers important for canning.

1. Mechanical (puncture and tear resistance).
2. Protective (barrier) - permeability for oxygen, water vapor, aromatic substances, fat permeability, light transmission.
3. Thermo physical-heat resistance, frost resistance.
4. Technological - the ability to heat-seal, to glue, to print.
5. Sanitary and hygienic properties of the polymer containers are associated with.

The problem of migration of toxic substances through the container wall, in basic with low molecular weight substances in the polymer, among which:

1. In cellophane - its glycerin and petroleum jelly, they are harmless.
2. In polyvinyl chloride - synthetic esters, they are toxic.
3. Fillers - give useful properties or reduce the cost of the product.
4. Resistance to mechanical damage.
5. Ensuring the quality and integrity of products.
6. Simple recycling of recyclable materials and environmental safety.
7. Not exposed to the risk of a tare battle.
8. Has a small specific weight of tare to the weight of the product.
9. Occupies a small volume before and after use.
10. Easy to store and transport.
11. Can have a different original shape.
12. Possibility of installation on the packaging of the dispenser.
13. Ability to manufacture from a material that does not penetrate the sun's rays, moisture and odors.
14. It is possible to heat the packaged product in a microwave oven.

Plastic containers are available in various capacities (from 20 to 3000 cm^3), and the products packed into it require final heat treatment - pasteurization or sterilization. Differences in the structure of consumer packaging materials used in the canning industry, as well as differences in the thermo physical properties of these materials, require an individual approach when justifying the regime parameters in each case, depending on the type and size of the used packaging and the type of canned products. Foods that were examined included: pates, drinks, natural products, marinades, sauces - made from various types of raw materials. Meat, fish, dairy, vegetable food raw materials were used. Temperature measurement at the least heated point of the product volume in the bank during heat treatment and in the volume of technological equipment was carried out using an analog-digital system [3]. The system ensures the calculation and indication of the lethality of the sterilization process, evaluated with three pairwise combinations of the basal temperature and the microbiological parameter Z, characteristic for a particular type of microorganism. Indication of the lethality of the sterilization process allows to calculate the actual value of "lethal time" and compare it with the normative value for a particular type of microbes that develop in a specific food product. Thus, it becomes possible to create a database of heat treatment regimens for a wide range of canned food products.

Conclusions

As a result of the research, specific heat treatment regimens for a wide range of canned food products in various types of consumer containers were developed. The modes are implemented on the technological equipment of various companies and heat schemes. Based on the microbiological approaches outlined previously, the final cooking regimes for food canned products of a wide range were developed. The list of original products is 0given in the table. Heat treatment is possible both in various designs of sterilization and pasteurization equipment of intermittent and continuous operation, and in conditions of aseptic preservation, in which the consumer container and the preserved product are processed separately and are already connected in a sterile state. For orientation, the Table 1 shows the type of test microorganisms to which the required lethality of the developed heat treatment regime and its actual values are calculated, as well as the basic physical-chemical characteristics of the canned food product-the pH value. The data given in the table make it possible to speak about the reliability of the developed modes of heat treatment of canned food products. Modes have been tested in production conditions and are used by canning enterprises to produce finished products.

Table 1: List of canned food products for which heat treatment regimens have been developed.

Name of canned products	pH	Test-microorganisms	lethal time normal (Z, T), conditional minutes	Lethal time factual (Z, T), conditional minutes
Crab meat natural	Not is limited	*Cl. Sporogenes*	4,7 (90, 121, 10 °C)	5,3
Pate of mushroom with garlic	Not is limited	*Cl. Sporogenes*	6,0 (100, 121, 10 °C)	7,15
Pickled pepper, grilled	3,7	*Cl.Botulinum*	1,9 (10, 121, 1°C)	2,1
Beverage Cranberry juice Cranberry-apple cranberry juice	3,8	*Bys. nivea*	200 (8, 80 °C)	240
Bull fried in tomato juice	5,3	*Cl. Sporogenes*	3,5 (9, 121, 1 °C)	4,2
Black Sea sprat in tomato sauce	5,6	*Cl. Sporogenes*	4,9 (13, 121, 1 °C)	5,8
Adjika Adjika "Sharp" Adjika "Ukrainian" Adjika "Special" Adjika "Spark" Adjika "Southern" Adjika "Home" Adjika "With eggplants" Adjika "With sweet pepper" Adjika "With chili pepper" Adjika "Veres"	4.0	Cl. *Butyricum*	150 (150, 8°C)	165
Ketchup "Dneprovsky" Ketchup "Tavrida" Ketchup "Veres" Ketchup Tomato Ketchup "Gentle" Ketchup "Chernigov" Ketchup "Satsebeli" Cossack sauce Sauce "Ukraine"	3,8	Cl. *Butyricum*	150 (150, 80 °C)	165

The above approach to the development of heat treatment regimens for canned food products is applicable to medicinal products, since they have a structure similar to food products and are packaged in various types of consumer containers [4].

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