TECHNOLOGY OF APPLE COMPOTE PRODUCTION FOR BABY FOOD WITH A HIGH CONTENT OF NATURAL INGREDIENTS

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Abstract. The most promising direction of improving food technologies for baby food is the use of new technical solutions that ensure maximum preservation of natural ingredients contained in the initial plant raw materials in the finished product. To do this, instead of the traditional process of blanching in water, microwave blanching is proposed directly in glass jars in microwave EMF (ultrahigh frequency electromagnetic field) with a frequency of 2400 MHz for 1.5 minutes, after which syrup is poured at a temperature level of 98°C, prepared with the addition of infusion extracted from secondary products, followed by sealing of cans and sterilization according to a new gentle sterilization regime with a preliminary increase in the temperature level of the semi-finished product by processing it in microwave EMF before sealing cans, for 1.5 min.

1. Introduction

The issues of healthy nutrition of children with a wide use of products with high nutritional and biological value are the most important tasks of state policy. At the same time, the most promising direction of improving the technologies of food products for baby food is the search for such technical and technological solutions, the use of which ensures the maximum preservation of natural ingredients contained in the initial plant raw materials in the finished product.

It is this approach, when improving the technologies of canned products, that can ensure a high content of natural ingredients and increase the nutritional value of finished products, due to the maximum preservation of biologically active substances in their natural form in it, which also provides a significant improvement in organoleptic indicators.

In the production of apple compote for baby food, more than 35% of the raw materials used are secondary products (waste): seed nest, skin, etc. [1], which also contain a sufficient amount of biologically active substances.

In addition, the imperfection of some technological processes, mainly thermal, such as blanching and sterilization, also leads to a significant decrease in the level of biologically active components in canned apple compote [2-14].

2. Research methods

The study was carried out on an experimental installation providing mechanical pressing of the test jar in the carrier; the temperature of the product was determined using chromel-copel thermocouples installed in the central and peripheral regions of the glass jar, the signals from which were transmitted to the potentiometer KSP-4.
3. Results and discussion

Losses of biologically active components during blanching can amount to more than 20% of their initial content, and these losses occur both due to thermal exposure and due to their leaching into the process fluid in which the blanching process is carried out.

Our studies conducted in relation to vitamin C, as the most thermolabile and water-soluble, these losses amount to 2.7 mg% during blanching and 5.2 mg% during sterilization. And as a result, in the finished product, out of the total vitamin C content in apples, which is 11.0 mg %, 3.1 mg % remains in the finished compote.

We have conducted research both on improving the processes of blanching and thermal sterilization, and, if possible, using secondary products (waste) obtained during cutting and peeling apples for syrup preparation.

At the same time, to intensify the output of solids from secondary products, they are subjected to microwave treatment for 1.0-1.5 minutes, after which they are crushed and extracted in water at a temperature of 60 0C for 10 -15 minutes.

As for the technological process of blanching the prepared raw materials, we propose to carry it out directly in glass jars after laying them, placing the jars in a microwave EMF with a frequency of 2400 MHz for 1.0-1.5 minutes, after which the syrup is poured at a temperature level of 980C, prepared with the addition of infusion extracted from secondary products, followed by sealing the jars and sterilization according to gentle regimes with a preliminary increase in the temperature level of the semi-finished product by processing it in a microwave EMF before sealing the jar, for 1.5 minutes.

The use of microwave EMF for blanching and heating the semi-finished product before sealing helps to achieve the initial temperature level of the semi-finished product before sterilization to 90-920C, while according to traditional technology, the temperature level of the semi-finished product is 45-480C.

Dynamics of changes in the temperature level and suppression of the vital activity of microorganisms during sterilization of apple compote for baby food in a 0.2-liter glass jar using two-stage microwave heating of fruits and fruits filled with syrup in a glass jar according to a new mode of multilevel high-temperature sterilization with air-water evaporative cooling during container rotation 92-(10/110)-(7/25(6,0) -8/20(6,0) )-0,1 shown in Figure 1, where: 92 is the initial temperature of the product, 0C; 10, 7 and 8 – respectively, the duration of heating in a dimethyl sulfoxide solution with a temperature of 1100C, cooling with air and humidified airflow with temperatures of 25 and 200C and a speed of 6.0 m / s; 0.1 - the rotation frequency of cans during heat treatment, s-1.

![Figure 1. Dynamics of changes in the temperature level (1,3) and suppression of the vital activity of microorganisms (3,4) in the wall (1,3) and central (2,4) regions of a 0.2-liter glass jar during sterilization of apple compote with two-stage microwave treatment in a glass jar and high-temperature sterilization with air-water evaporative cooling during rotation of the jar.](image-url)
Figure 2 shows a block diagram of an improved technology for the production of compote from apples using secondary resources and gentle heat treatment.

The duration of the multi-level high-temperature sterilization regime is 25 minutes, which is 33 minutes less than the traditional sterilization regime, and in addition, evaluating the graphic images of the dynamics of temperature levels and the destruction of microorganisms shown in the figure and ensuring the industrial sterility of finished products, the components for compotes 150-200
conventional minutes [15] and for this mode are respectively equal to 174.6 and 151.2 conventional minutes, which confirm that the coefficient of uneven heat treatment for this mode is 1.1, which suggests that during heat treatment according to the proposed regime, the wall and middle layers of the product receive sufficient to ensure industrial sterility and a more uniform thermal effect [15].

The proposed technology provides sugar savings of up to 10 kg per 1 tube of products and an increase in the nutritional value of products in terms of the content of biologically active components in the finished product.

Table 1 presents the results of studies on the content of some biologically active components of apple compote made using different technologies.

**Table 1.** The content of biological components in apple compote made using different technologies

| Name of indicators | Technologies of production |  |
|--------------------|---------------------------|---|
|                    | traditional | advanced |  |
| Mineral substances, mg per 100 g. |  |
| sodium             | 20.0        | 25.0      |  |
| potassium          | 258.0       | 275.0     |  |
| calcium            | 12.0        | 15.0      |  |
| magnesium          | 7.0         | 8.5       |  |
| phosphorus         | 9.0         | 11.0      |  |
| iron               | 1.8         | 2.2       |  |
| Vitamin C, mg/%    | 3.1         | 5.2       |  |

The analysis of the results shown in the table confirms that the proposed technology provides a significant increase in the nutritional value of products, which is especially important in the production of canned products for baby food.

4. Conclusion

The conducted studies confirm the effectiveness of using new technical solutions in the production of canned apple compote for baby food, based on the use of secondary resources obtained during cutting and cleaning of fruits for cooking syrup, microwave blanching of fruits in glass jars and new high-temperature sterilization modes with a preliminary increase in the temperature level of the semi-finished product before sterilization.

The results of studies on the evaluation of the nutritional value of the finished product confirm the high content of biologically active components in it.

**References**

1. Collection of technological instructions for the production of canned food. Vol. 2. M.: Pishcheprom, 1977. 355 p.
2. Akhmedov, M., Demirova, A., Piniaskin, V., Rakhmanova R.A. // New technological and technical solutions in dietary pear compote production(2020) E3S Web of Conferences, 161.
3. Akhmtedov, M., Demirova, A., Abdulkhalikov Z Daudova T. Daudova L An enhanced technology of pear compote production through direct blanching with syrup in glass jars and a device for its implementation(2020) E3S Web of Conferences, 161.
4. Aleshkevich Y.S., Barbashov A.V., Zaporozhskii A.A., Zolotokopova S.V., Kasyanov G.I., Silinskaya S.M. System analysis and safety of the process to obtain co 2 - extracts from plants // In the collection: IOP Conference Series: Earth and Environmental Science. International Conference on Production and Processing of Agricultural Raw Materials. 2021. P. 042018.
5. Babarin V. P. Sterilization of canned food. St. Petersburg: GIORD, 2006. 312 p.
6. Gadzhieva A.M., Rabadanov G.A., Sultanov Yu.M., Kasyanov G.I., Magomedova M.M., Magomedova Z.M. Assessment of the nutritional value of southern dogwood oil // In the collection:
IOP Conference Series: Earth and Environmental Science. International Conference on Production and Processing of Agricultural Raw Materials. 2021. p. 042020.

7. Demirova A.F., Akhmedov M.E., Abdulkhalikov Z.A., Daudova T.H., Rakhmanova M.M. In apple puree technologi for dietetic nutrition. // In the collection: E3S Web of Conferences. Cep/«International Scientific and Practical Conference «Development of the Agro-Industrial Complex in the Context of Robotization and Digitalization of Digitalization of Production in Russia and Abroad», DAIC 2020» 2020.C.3005

8. Zaporozhskaya S.P., Kasyanov G.I., Kosenko O.V., Jum T.A., Ksenz M.V., Kucherova S.I. Technology and commodity characteristics of extracts and oil cake for food enrichment. // In the collection: IOP Conference Series: Earth and Environmental Science. International Conference on Production and Processing of Agricultural Raw Materials. 2021. p. 042017.

9. Inochkina E.V., Kaminir O.N., Kasyanov G.I., Medvedev A.M., Mishkevich E.Yu., Safonova O.N. Planning an experimental technology of expanded snacks. // In the collection: IOP Conference Series: Earth and Environmental Science. International Conference on Production and Processing of Agricultural Raw Materials. 2021. S. 072014.

10. Isrigova T.A., Salmanov M. Mukailov M. D., Ashurbekova T. N., U. A. Selimova. Chemical-technological assessment of wild berries for healthy food production. In 2016, the Research Journal of Pharmaceutical, Biological and Chemical Sciences "nbltenmbdgbhgljenfdm".

11. Ismailov T.A., Demirova A.F., Akhmedov M.E., Akhmedova M.M. Apparatus for high-temperature thermal sterilization of canned products. RF Patent No. 2604919. 12/20/2016, Byul. No. 35.

12. Kasyanov G.I., Demirova A.F., Akhmedov M.E. Innovative technology of sterilization of fruit and vegetable raw materials. // Reports of the Russian Academy of Agricultural Sciences, No. 6, 2014. - pp. 57-59.

13. Mukailov M.D., N.A. Ulchibekova., Isrigova T.A., Akhmedov M.E., Selimova U.A. // Functional foods produced from strawberries. - 2020 International Journal of Advanced Science and Technology.

14. Renard, C. M. G. C., Maingonnat, J. F. (2012). Thermal processing of fruits and fruit juices. In D. W. Sun (Ed.), Thermal Food Processing: New Technologies and Quality Issues (second ed., pp. 413–440): Taylor & Francis.

15. Flaumenbaum B. L. Tanchev S. S. Grishin M. A. Fundamentals of food sterilization. M.: Agropromizdat, 1986. 264 p.