Analysis of the microflora of dried grape fruit products

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Abstract. The article presents an analysis of the microflora of dried grapes with a description of the factors of influence. A technological method of processing dried grapes using ultrasonic action on plant raw materials is described. The fruits of dried grapes were investigated using different methods of preparation - preliminary hydration of the fruits within 24 hours at a temperature of 20 ± 2 °C. The indicators of microbiological safety of the products obtained from dried grapes were investigated. An analysis of the risk situation associated with the safety performance of ultrasonic treatment using the Fault Tree Analysis (FTA) method is presented. Situations that can lead to the occurrence of events in the production of products from dried grapes using technology based on the principles of ultrasonic exposure are analyzed.

1. Introduction
Dry vegetable raw materials are products ready for use for food purposes, also raw materials for further processing for food purposes. The usefulness of dried fruit products is determined by the energy and biological value. These raw materials are a strong chemical regulator of the digestion process, influencing the biochemical processes of digestion and metabolism [1].

Dried grapes are fruits imported to Siberia mainly from Central Asia, a high-calorie product, for example, 100 g of the product is enough to restore the body’s energy needs. Some types of dried grapes, in particular the variety "kishmish", are used to treat neuropsychiatric diseases, to normalize the digestive processes of the body. Antioxidants contained in fruits contribute to the sorption of pathogenic bacteria, an increased fiber content activates intestinal motility, etc. [2].

The natural microflora of dried grapes depends on many factors (figure 1).

For the analysis, fruits were selected taking into account the minimization of microbiological safety factors - "sanitary drying conditions", "sterility of packaging", "transportation conditions" and "storage conditions". As a separate stage of the technological process, "drying" is a preservation method, as a reliable way to preserve the biological value, taste and epidemiological safety of food for a long period of storage (subject to the technological standards of other accompanying production stages). In addition, dried products can reduce the seasonality of fruits and vegetables, contribute to their suitability for transport logistics, and make it possible to use them in the nutrition of the population where these products are not grown.
Microflora of dried grapes species diversity of soil microbiota grape variety weather conditions of the collection sterilization of the package transportation conditions sanitary conditions of drying

- reducing the seasonality of fruit consumption;
- preservation of biological value; preservation of taste properties;
- increasing the parameters of transport logistics.

**Figure 1.** Factors of influence on the microflora of dried grapes.

Drying is used to destroy a specific microflora that causes spoilage with the suppression of redox processes. But the dried product does not always correspond to the declared microbiological safety of its use, therefore the relevance of the study lies in the study of the microbiota of dried grapes (raisins) supplied for sale and its disinfection using ultrasonic exposure.

2. Materials and methods
The purpose is to study the influence of ultrasonic exposure when processing dried grapes according to GOST 6882-88 corresponds to the type - "colored raisins".

**Figure 2.** Installation for ultrasonic treatment.

According to the traditional technology for producing compotes, it included the main technological stages based on high-temperature and long-term exposure to temperature of raw materials to maximize the extraction of extractives from dried raw materials. The resulting product can be assessed visually by organoleptic characteristics - saturation "color", "aroma", "consistency", which depend on the raw material and processing. The duration of the technological process of heating the dried product leads to the transition of water-soluble substances, however, to the destruction of biologically active ingredients. Therefore, the use of other methods of processing plant raw materials is proposed. In the experimental experiments, a setup was used, which includes: a control device (1, 2), an ultrasonic generator of the
type "Volna" series apparatus UZTA-0.4 / 22-OM [5,6] (3), a container (4), Measuring equipment: pH-meter (5), thermometer (6), stopwatch (7).

Application of this scheme for processing plant raw materials when obtaining extracted products without destroying the structure of plant raw materials.

For the experiment, we used dried grape fruits in a dry and hydrated form (within 24 hours); preparation for processing on the UZTA device included the use of water in an amount of 700 ml per 100 g. raw materials. The finished product, according to GOST 28322, looked like a "compote".

The obtained experimental samples were processed in glass containers with a nominal value of 1000 ml at a power of 100 W/cm² for a duration of 30±2 minutes, indicating the temperature change.

Figure 3. Technological scheme for obtaining products from dried grapes.

The study of safety indicators according to the technological scheme was carried out at the stage of "storage". Sampling was carried out and research was carried out according to standardized methods:

- KMAFAanM, CFU/g - determination of the number of mesophilic aerobic and facultatively anaerobic microorganisms (GOST 10444.15-94 Food products. Methods for determining the amount of mesophilic aerobic and facultative anaerobic microorganisms);
- Salmonella - determination was carried out according to GOST 31659-2012 (GOST 10444.15-94 Food products. Methods for determining the amount of mesophilic aerobic and facultative anaerobic microorganisms);
- BGKP - coliform bacteria (GOST 31747-2012 Food products. Methods for detecting and determining the amount of coliform bacteria (coliform bacteria));
- E. coli - to confirm the belonging of microorganisms grown on Kessler's medium to E. coli, they were subcultured onto the surface of Endo agar medium (GOST 30726-2001 Food products. Methods for detecting and determining the number of bacteria of the species Escherichia coli);
- Moldy fungi and yeast (GOST 10444.12-2013 Microbiology of food and animal feed. Methods for detecting and counting the amount of yeast and mold).

One of the quality management methods, the Fault Tree Analysis (FTA) method, was used to characterize possible microbiological losses. Using the quality management method - Fault Tree Analysis (FTA), presents a risk analysis at all stages of the life cycle of design and production of...
products from dried grapes. The most common and effective method of risk analysis is Fault Tree Analysis (FTA).

The FTA method is a systematic method with the flexibility to account for the potential risks of processes and heterogeneous food systems. The principle of the method is used in systems that include several interdependent subsystems, as well as for hazard identification and risk assessment, the frequency of defects or risk situations. The principle of FTA construction, as a graphical system for building a "fault tree", is a deductive (top-down) analysis method aimed at identifying the cause or its combinations that contribute to the accumulation of the risk of defects. Graphical representation of the "fault tree" in accordance with the rules of GOST R 51901-2002.

3. Research results
The principle of extracting extractive substances that make up the flavor-aromatic bouquet of compotes is aimed at extracting the target components of the plant cell from the solid state into the aqueous fraction. The porous structure inside the plant cell is capable of passing water molecules and transferring water-soluble substances to the interface of fractions. This technological process visually represents the saturation of the aqueous fraction with coloring pigments of plant raw materials and swelling of the components of the dry mixture, which leads to deformation and destruction of plant materials.

Technological processing of dried grapes according to figure 3 is characterized by ultrasonic action on the combined system (fruit of dried grapes: water fraction) with increasing temperature. The results are shown in figure 4.

![Figure 4. Temperature change during processing of dried grapes.](image)

where: t₁, °C - when processing non-hydrated dried dark grapes; t₂, °C - when processing hydrated dried grapes.

The mechanical factor (exposure to ultrasound) causes the occurrence of variable acoustic pressure - wave-like propagating sections of compression and rarefaction. Part of the energy of ultrasonic vibrations is absorbed, which is accompanied by heat generation. Under the influence of low-intensity ultrasound (0.05-0.6 W/cm²), intramolecular bonds in the protein structures of cells change, enzymatic activity is activated, the permeability of cell membranes changes, biologically active substances are released, tissue respiration increases. At a higher intensity, the destruction of the protein structures of cells occurs, which leads to the death of cells, including microorganisms.

The results of dried grapes soaked for 24 hours showed that during soaking, the preserved and acquired microflora was activated. It was revealed that the number of mesophilic aerobic and facultatively anaerobic microorganisms was exceeded by two orders of magnitude, an order of magnitude of bacteria of the E. coli group (BCGC), the presence of a conditionally pathogenic species
E. coli, pathogenic microorganisms of the genus Salmonella, an excess of microorganisms of spoilage "Mold fungi" in 6 times (table 1).

Table 1. Microbiota of dried grapes before and after processing on a device with the principle of ultrasonic exposure.

| Sample | KMAFAnM | BCGC | Salmonella | E.coli | Mold fungi | Yeast |
|--------|---------|------|------------|--------|------------|-------|
| №1    | 6.31×10⁶ | + | + | Salmonella | 12.5×10² | 1.2×10² |
| №2    | 5.0×10³  | + | - | Salmonella | 8.5×10²  | n/a     |
| №3    | n/a      | - | - | n/a      | 2.5×10²  | n/a     |

Requirements of SanPiN 2.3.2.1078-01 clause 1.6.2.2

TR CU 021/2011 "On food safety"

Where: sample No. 1 - hydrated dried grapes (1: 7) (duration 24 hours); sample No. 2 - hydrated dried grapes (1: 7) (duration 24 hours) + UZTA 100 W / cm³ 30 min; sample No. 3 - non-hydrated dried grapes (1: 7) + UZTA 100 W / cm³ 30 min; n / f - not found; n / a - not allowed

Under the influence of ultrasound, a significant decrease in the QMAFAnM indicator by three orders of magnitude was observed from 6.31 × 10⁶ to 5.0 × 10³ colony-forming units per gram of product, a decrease in the indicator of E.coli bacteria by one order of magnitude, the death of E. coli bacteria, a 5-fold decrease in the number of molds, death of yeast.

The study of unhydrated but sonicated dried grapes showed the most effective way of disinfection. Previously identified types of opportunistic and pathogenic microorganisms were not detected, spoilage microorganisms were within the normal range, and the sanitary-indicative group (KMAFAnM, BGKP) of microorganisms showed the sterility of the sample under study.

Risk situations related to safety indicators when processing dark raisins

Figure 5. The risk situation in the manufacture of products from grapes dried fruit. Where: t° - temperature, °C, P-processing power W/cm³, W-humidity, %, * - no solution found.
Fault Tree Analysis (FTA) as a system is represented by logical Fault Tree analysis with a top-down approach, focusing on the impact of hazards to risk. The graphic display visually identifies negative factors and control points. Using this method, a “fault tree” is constructed with a detailed consideration of the main technological stages. Analyzed situations that can lead to the emergence of risks that led to a decrease in commodity indicators. Like any production process, the processing of plant materials using physical methods of exposure is accompanied by risky situations. When analyzing risks in the process of processing plant raw materials, a list of preliminary stages of the occurrence of possible risks is formed, the factors and causes of their occurrence, possible solutions are analyzed. The stage should form the input data for the direct implementation of the sub-processes of risk occurrence.

For the analysis, a risk situation associated with safety indicators in the process of technological processing was selected. Situations that can lead to the occurrence of events that lead to a decrease in the commodity characteristics and consumer preferences of the finished product are analyzed. Most often, risky events occur due to the fault of personnel who do not comply with the requirements of technological instructions and/or other regulatory documents, as a result of a violation and/or malfunction of the equipment. It should be noted that it is necessary to model the recipe at all stages of the technological cycle of raw materials processing, including the modes of preparation, storage and processing, both of the raw material and the finished product.

4. Conclusion
As a result of the study of safety indicators of products from dried grape fruits, the parameters of processing and pre-preparation of fruits were summarized. Changes in the temperature of products in the process of changing the parameters of technological processing of plant materials using ultrasound are presented.

Application of the Fault Tree Analysis (FTA) method identified the main reasons for the occurrence of risk situations when processing dried grapes.

References
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