Ensuring the safety of grain raw materials used in the production of grain products

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Abstract. The article considers the influence of physical methods of disinfection on the complex of microorganisms of grain food raw materials. Various methods of disinfection are considered - chemical, biological and physical, and their influence on the reduction of grain microflora. The classification of the microflora of the grain of cereal crops, the influence of microflora on the quality indicators of vegetable raw materials have been studied. When exposed to microwave energy on the grain, the most optimal modes were identified in terms of temperature, time and heating rate.

1 Introduction

One of the main directions for improving the standard of living and increasing longevity is to provide the population of our country with safe and high-quality food [1]. In this regard, technological measures aimed at improving safety indicators and at the same time maintaining nutritional value, consumer advantages and quality indicators of finished products are of particular relevance to the food industry.

The food industry receives contaminated raw materials, the quality of which deteriorates during storage and a number of technological operations in preparation for processing [2, 3]. The share of food raw materials that do not meet hygienic standards in terms of microbiological indicators is increasing every year.

Grain products are products of daily demand and play a significant role in the nutrition of the population, as they are a source of carbohydrates, fiber, mineral elements and B vitamins [4].

In the system of measures aimed at obtaining environmentally friendly grain products is the preparation of raw materials for use in technological processes [5]. Deterioration of quality contributes to the defeat of grain by microorganisms of a fungal and bacterial nature [6]. Figure 1. shows a summary of the main groups of microorganisms found in cereal grains.

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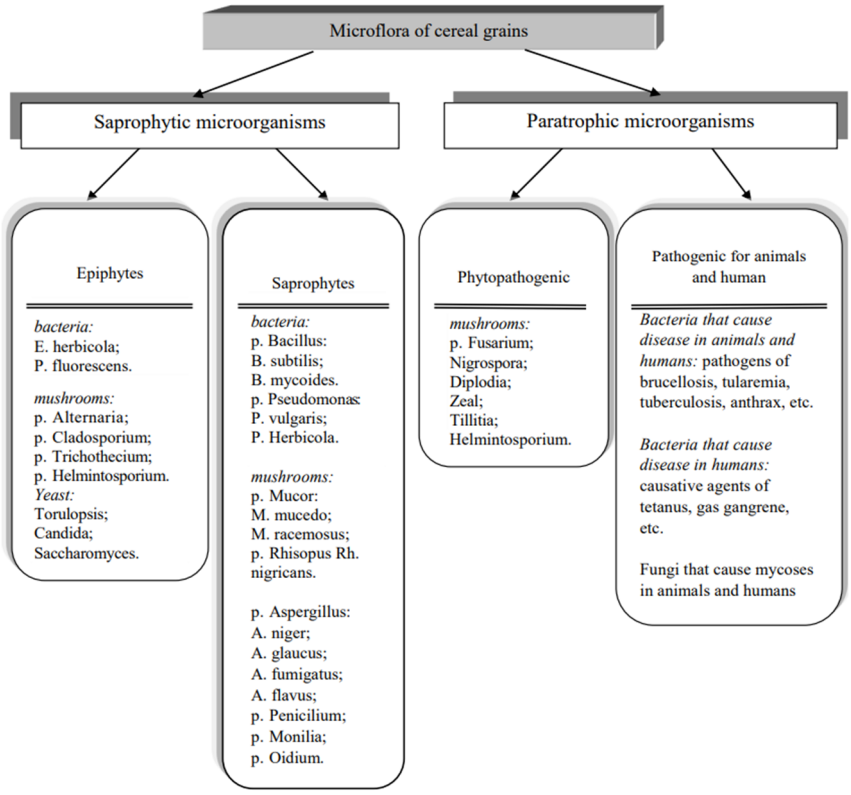

Fig. 1. Classification of the microflora of grain cereal crops.

The impact of microorganisms on the state and properties of grain raw materials can manifest itself in various forms and affect not only organoleptic quality indicators, but also reduce nutritional value, worsen the technological properties of grain (Figure 2).

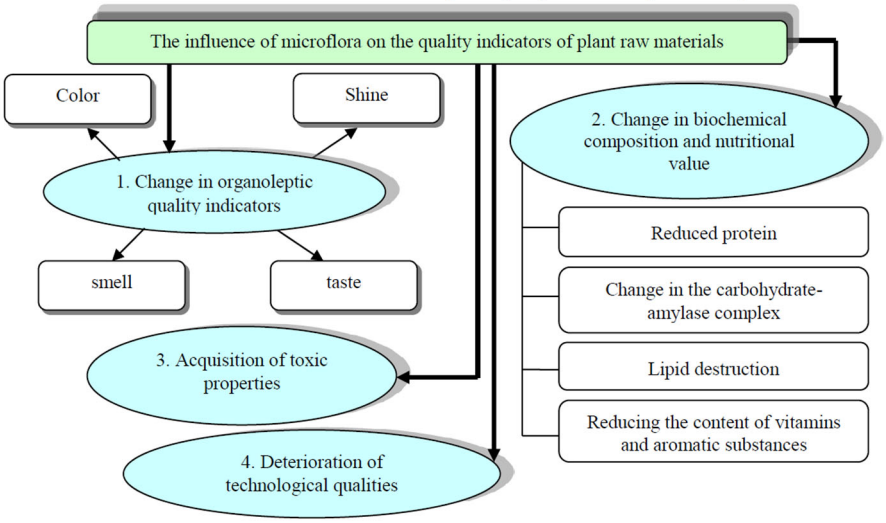

Fig. 2. Influence of microflora on the quality indicators of plant raw materials.

2 Objective

The aim of the work is to ensure the safety of grain raw materials used in the production of grain products.

3 Research materials and methods

When processing plant materials in the technological process, various methods are used that lead to their release from pathogenic microflora [7]. Each of them has a number of advantages and disadvantages. The use of chemicals is unsafe for human health, therefore, strict sanitary control and standards are required for the products of vegetable raw materials processing [8]. The biological method is a progressive method, however, the mechanism of the influence of biological agents is not well understood and requires large economic costs.

An effective way to solve this problem is the use of methods for processing grain products in an electromagnetic field of high and ultrahigh frequency. The results of many years of experiments and industrial tests on decontamination unambiguously confirmed the advantage of this method [9]. In a series of such experiments, the range of microwave exposure regimes was selected, providing the greatest effect while maintaining organoleptic and functional properties. For analysis, the studied grain samples from the final technological stage of production were used.

As a result of the research, the species composition of the microflora of grain raw materials was revealed. During the analysis of the complex of saprotrophic microorganisms of rice grain, its main species composition was established. The most common mushrooms p.p. Penicillium, Aspergillus, Cladosporium, Alternaria, Mucor.

4 Results

Vt = 0.6…0.7°C/s, heating temperature t = 75 …95°C. The mode with the heating temperature t = 35…50°C does not relieve the products from infections, but activates the growth of fungal spore enzymes (Figure 3).

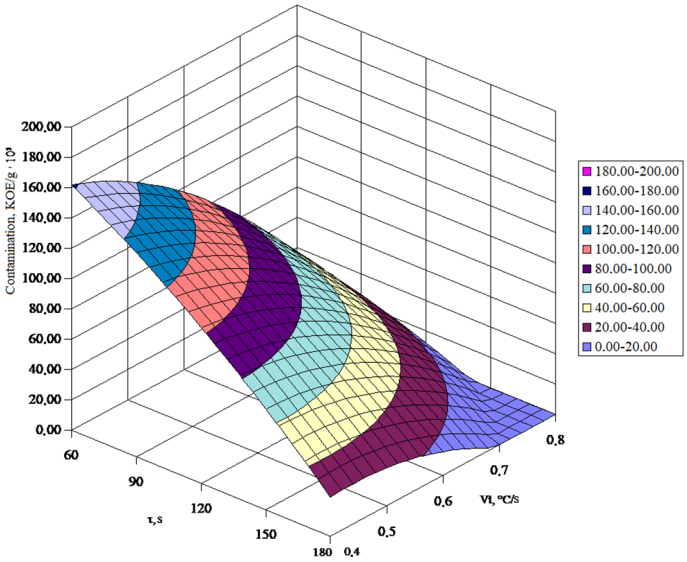

Fig. 3. Dependence of contamination of grain raw materials with pathogens of the genus Alternaria on the parameters of the microwave field.

According to the impact of microwave energy on the development of Alternaria infection, it was noted that the area of effective regimes is within the plane: τ = 144…160 s, heating rate

Among mold fungi (p.p. Aspergillus, Penicillium) effective modes are in the range: heating rate Vt = 0.65…0.68°C/s and treatment time τ = 150…160 s (Figure 4, 5).

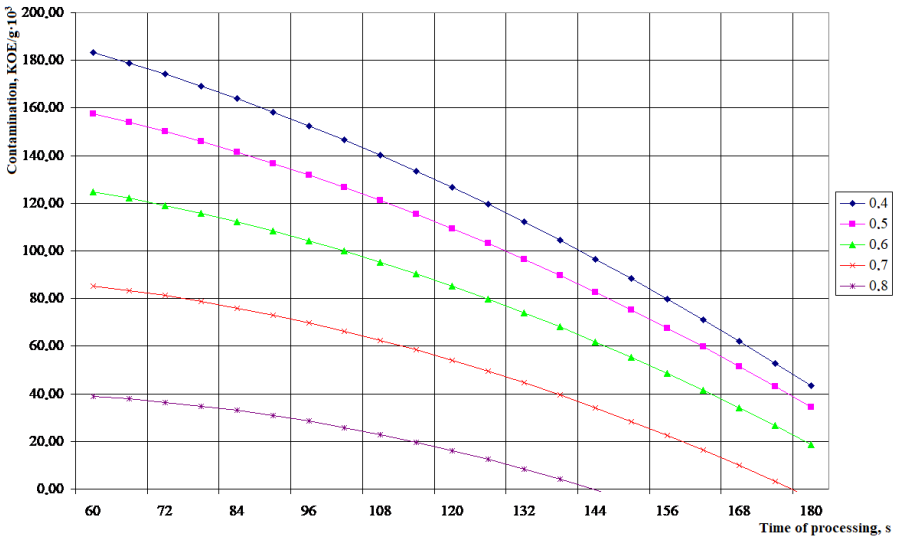

Fig. 4. Dependence of contamination of grain raw materials with pathogens of the genus Alternaria on the parameters of the microwave field.

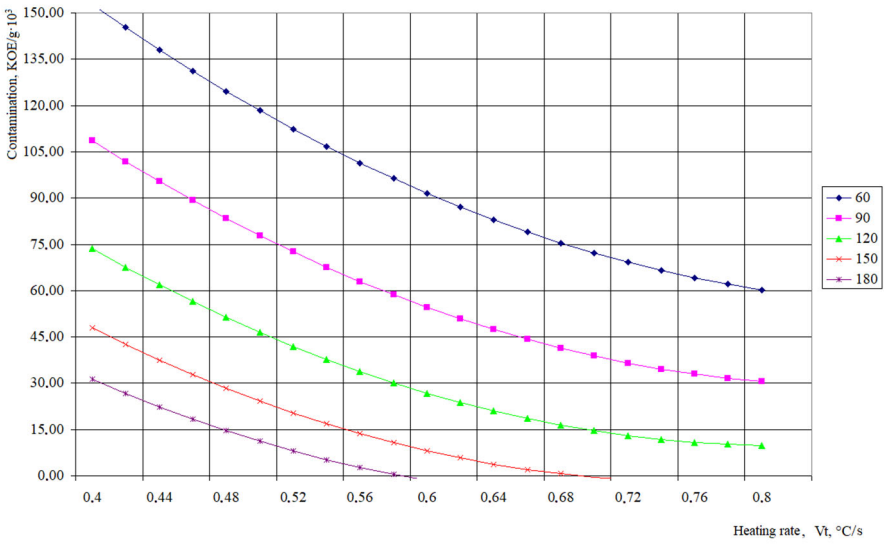

Fig. 5. Dependence of infection with pathogens of the genus Penicillium on the parameters of the microwave field.

Since penicillosis is an internal infection, it is almost impossible to release the product with existing processing methods. In addition, fungal spores of this genus are thermally tolerant and can withstand temperatures above 170°C. The effective mode area is in the range

of values: processing time t = 120…170 s, heating rate Vt = 0.56…0.68°C/s. Destructive modes for fungi are: τ = 180 s, heating rate Vt = 0.6…0.8°C/s. At τ = 120 s, the heating rate is Vt = 0.6°C/s, the number of fungi is reduced to the level of safe limits, and at τ = 60…120 s, the heating rate is Vt = 0.4...0.6°C/ with observed activation of the growth of fungal infection.

An effective way to solve this problem is the use of methods for processing grain products in an electromagnetic field of high and ultrahigh frequency. The results of many years of experiments and industrial tests on decontamination unambiguously confirmed the advantage of this method [9]. In a series of such experiments, the range of microwave exposure regimes was selected, providing the greatest effect while maintaining organoleptic and functional properties. For analysis, the studied grain samples from the final technological stage of production were used.

5 Conclusion

The most environmentally friendly are thermal methods of disinfection. When using electromagnetic fields of microwave frequencies, it is possible:

- disinfection without the use of chemical reagents;
- preservation of nutritional value of products of processing of vegetable raw materials;
- improvement of consumer properties of finished products.

As a result of the studies, using the developed methodology for the disinfection of plant materials and products of its processing with microwave energy, a complete disinfecting effect on pathogens of the Alternaria complex, storage molds and spore-forming bacteria was observed.

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