FOOD SAFETY AND HACCP SYSTEM IN THE APPLE JAM PRODUCTION

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ABSTRACT

Jam production technologies applied for processing of fruit raw materials can have critical control points affecting the quality of a final product. The given article contains the analysis of technological processes used at the production of apple jam with pumpkin and Jerusalem artichoke syrup taking into account the principles of the HACCP system. Apple and pumpkin are natural antioxidants and have a high nutritional value and useful properties from medicine point of view. In this regard, it is important to preserve all the benefits of these fruits during manufacturing jam. The technological processes were analyzed step by step, and their critical control points were determined. The most important production stages are reception and sorting, cleaning and sterilization. To avoid negative factors, the monitoring, control and corrective action systems are proposed based on the HACCP/ISO 22000:2018 food safety management system.

Key words: food safety, HACCP, apple jam, antioxidant, hazard, risk, prerequisite.

INTRODUCTION

Food safety is the concept that food does not harm for the consumer, if prepared and / or eaten according to the appropriate use [1]. In this regard, in order to support the stated concept and rules of harmless production, the safety of the power management system is important. Investment in food safety management systems is a key prerequisite for a reliable and stable supply of safe food and the growth of international trade [2, 3].

HACCP (Hazard Analysis and Critical Control Points) is a simple and logical control system based on the concept of preventing problems by identifying hazards, establishing critical control points and developing measures to monitor, prevent and correct them [4]. It should be developed taking into account seven basic principles [5]:

1. Analysis of potential hazards;
2. Identification of critical control points (CCP).
3. Determination of critical limits for CCP.
4. Creation of a monitoring system to control CCP.
5. Installation of corrective actions.
6. Correction of verification procedures.
7. Establish guidelines for record keeping and documentation.

When processing fruit raw materials, the technology for the production of jam can set critical control points that will affect the safety of the final product.

The technological process for the production of jam consists of: receiving and sorting the initial products, cleaning, washing, grinding and mixing, filling, packaging, sterilization, storage. There is a potential risk of detecting hazards at every stage of jam production.

The HACCP system should take into account all categories of potential risk: biological, chemical and physical hazards [6].

Biological risks include risks arising from the action of living organisms, including yeast (osmophilic yeast), microorganisms (pathogens), protozoa, parasites, etc., their toxins and waste products.

Chemical risks can be divided according to the source of origin into the following three groups:

1. Accidentally swallowed chemicals;

a) Agricultural chemicals: pesticides, herbicides, plant growth regulators, etc.

b) Chemicals used in enterprises: cleaning agents, detergents and disinfectants, lubricating oils, etc.

c) Infections from the external environment: lead, arsenic, cadmium, mercury, etc.

2. Natural risk factors for metabolic products of plants, animals or microbes, such as like aflatoxins.

3. Chemicals that are deliberately added to food, such as preservatives, acids, food additives, substances that facilitate processing, etc.

Physical risks are associated with the presence of any physical material that is not present in a natural product or food product that can cause illness or harm to a person who has consumed the food (glass, metal, plastic, etc.) [5].

MATERIALS AND METHODS

The following ingredients were used to make the jam: apple, pumpkin and Jerusalem artichoke. Organoleptic and physico-chemical properties were analyzed in accordance with GOST 31712-2012 (Jams. General specifications (Reissue)) [6].

The apple tree is a genus of deciduous trees and shrubs of the Rosaceae family. Apple fiber, although less than most other fruits, stimulates intestinal motility, which may lower the risk of cancer. Fiber may also be beneficial in preventing heart disease, losing weight, and lowering cholesterol levels.

The content of phytoncides makes apples a good physiological antiseptic, and also contains malic, tartaric, citric and other organic acids, antioxidants (preventing oxidative processes), sugar (glucose, sucrose and others), vitamins C, A, B1, carotene, tanning and pectin substances, microelements (iron, copper), macroelements (potassium, calcium, magnesium and others), essential oil, macro- and microelements, tannins.

Apple fruits accumulate dry matter - 10.5 - 19.2%, sugar - 6.4 - 14.9%, pectin substances - 0.88 - 1.43%. Due to the presence of water-soluble pectin and gelling properties, apples are used in cooking, in the preparation of jelly, marmalade, confiture, jam, yoghurt and soft drinks [7].

RESULTS AND DISCUSSION

The presented work provides an analysis of probable hazards in the production of apple jam. All stages of production were analyzed as sources of hazards: receiving and sorting of raw materials, cleaning, washing, grinding and mixing, filling, packaging, sterilization, storage location. The summarized results are presented in Table 1.

Table 1 - Analysis of hazards in the production of apple jam.

Name ofoperation	Process parameters	Considered factors	Controlled hazards	Preventive action	Responsible person
1.Reception and sorting of apples, pumpkins and Jerusalem artichoke	Apples and pumpkins should be fresh or frozen, ripe enough, clean, free of foreign odor, no stems, no damage or disease. Jerusalem artichoke must be clean, no mechanical damage, no damage by pests and diseases, no peduncles	Microbiological	a) bacteria of the *Escherichia coli* group b) pathogenic microorganisms	Control at the reception	Head of Laboratory
		Chemical	a) pesticides b) herbicides c) plant growth regulators	Input control	Head of Laboratory
		Physical	a) glass b) metal c) plastic	Control at the reception	Head of Laboratory
2. Cleaning	The remains of unsuitable parts of raw materials	Microbiological	Bacteria, viruses, yeasts, moulds and viruses	Cleaning process control	Foreman
3. Washing	Removal of mechanical impurities, detergent residues, microorganisms and pesticides	Physical	If the fruit washing process is not followed, foreign substances may remain	Control of washing process	Foreman
4. Grinding	Metal objects, personal belongings of staff	Physical	If the grinding process is not followed, foreign objects or particles may get into the finished product	Control grinding processes	Foreman
5. Mixing and cooking	Foreign objects, personal belongings of staff	Physical	If the mixing and cooking processes are not followed, foreign objects or particles may enter the finished product.	Control mixing and cooking processes	Foreman

Table 1 continuation

6. Filling	Contaminated packaging	Microbiol ogical	Sterilization	Control of the filling process into the packaging, the creation of aseptic conditions	Foreman
7. Packing	Presence of foreign objects	Physical	If the packing process is disregard, foreign objects or particles can input into the finished product (rubber from the cover, glass, plastic).	Control of the packing process	Foreman
8. Sterilization	Incorrect compliance of the sterilization process	Microbiol ogical	*Escherichia coli* bacteria	Creating aseptic conditions	Foreman
		Physical	Impurities Metal parts of equipment	Use of metal detector	
9. Storage	Package integrity	Microbiol ogical	Temperature,ºC Duration, h	Control of temperatur e-time variation	Foreman

The technological scheme for obtaining apple jam with the determination of possible CCP (critical control points) is shown in Fig. 1.

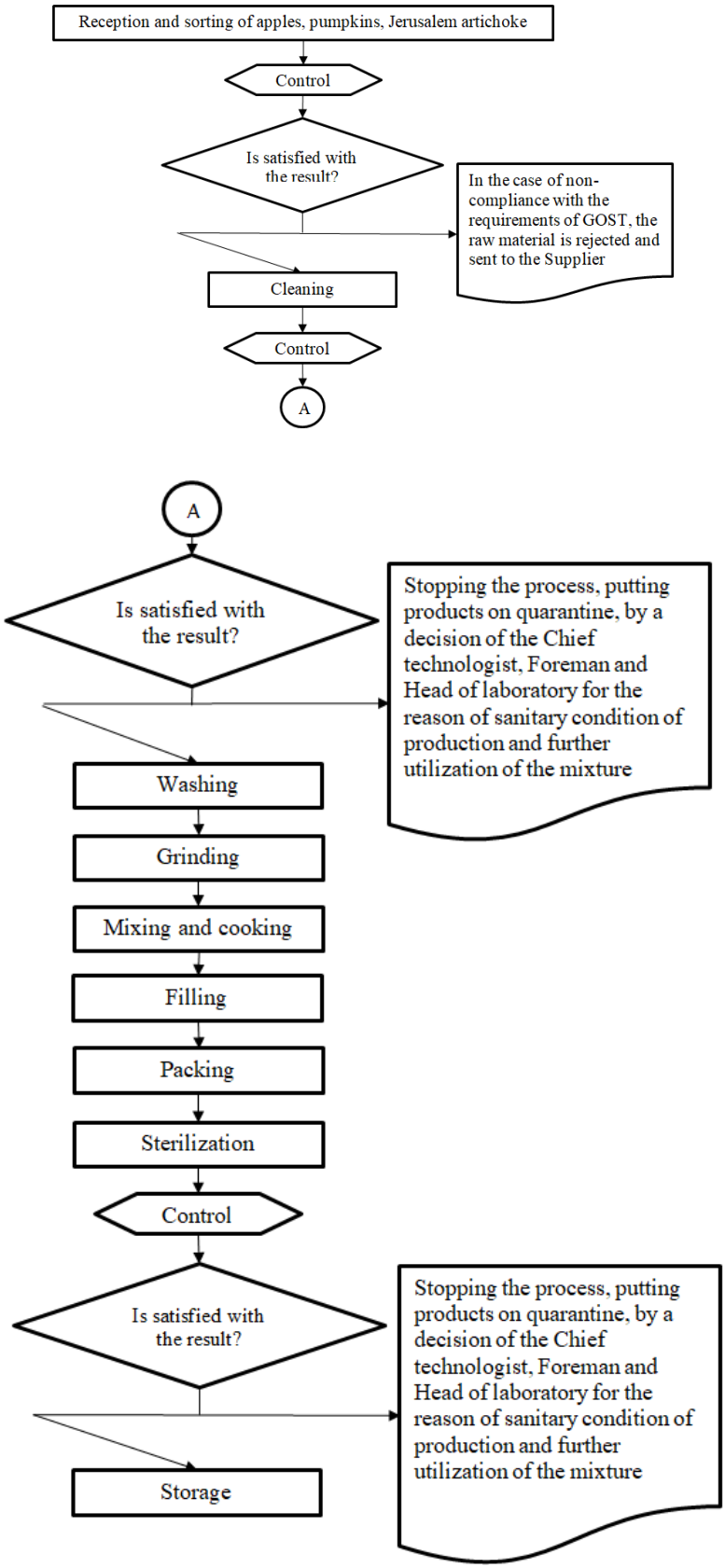

Fig. 1. Technological scheme of apple jam production and CCPs

Analyzing Fig. 1, three high-risk CCPs can be identified: reception and sorting, cleaning and sterilization. These production steps and proposed control actions are presented in Table 2.

Table 2 - Preconditions for the risk assessment and control actions of the CCP in the production of apple jam

Prerequisite	Risk	Control actions	Degree of risk
CCP 1	Reception and sorting of apples, pumpkins, Jerusalem	Apples and pumpkin should be fresh or frozen, ripe enough, clean, free of foreign odor, no stems, no damage or disease. Jerusalem artichoke must be clean, no mechanical damage, no damage by pests and diseases, no peduncles. More thorough visual inspection and laboratory analysis of products.	High
CCP 2	Cleaning	Compliance strictly with the parameters of cleaning, identifying rotten, mismatching products, cleaning of foreign objects	High
CCP 3	Sterilization	Control of sterilization parameters	High

CONCLUSION

Thus, the analysis of the most possible hazards in the production of apple jam was carried out, taking into account the possible prerequisites for CCP (critical control points): biological, chemical and physical risks. Hazards and critical control points are identified, the important stages of production are: reception and sorting, cleaning and sterilization. As an operational check, visual inspection and laboratory analysis of all products is required. A monitoring system is also required to control the CCP and corrective actions. In order to avoid negative factors, monitoring, control and corrective action systems based on the HACCP / MS ISO 22000: 2018 Food Safety Management System.

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