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Research Article

Improving the Technology of Pre-processing and Freezing Cherries

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Abstract

Today, the demand for fruits and vegetables rich in natural vitamins, micro-and macroelements is increasing. Of great importance is the improvement of the technology of freezing, which, along with natural mono-and disaccharides in fruits, determine the specific taste, preserve organic acids in moderation. In the Food Industry, Scientific Research is being carried out on the preservation of fruits and vegetables on the basis of high-quality and energy-efficient technologies. In this regard, special attention is paid to the development of technologies for storing fruits rich in basic color, vitamins and minerals when freezing in a traditional and shock way. Many scientists have carried out scientific research on the improvement of technologies for freezing and storing fruits and vegetables. Improved technologies have been developed by them to reduce the degree of their oxidation during the period of storage of fruits in freezing chambers after washing and sorting-up to 6-9 months of freezing 10-15°C, the speed and type of cooling agent to the duration of the process, processing of products with citric acid or ascorbic acid in freezing. Solutions to the problem: 1. It has been proven that after shock freezing of selected cherry samples and storage for 6 months, a 2% increase in soluble solids, a 2-fold decrease in the amount of tannins. 2. After processing with 30% sugar syrup and 4% ascorutin, it has been proven that sugar content in shock frozen cherries is maintained in maximum quantities for 10-12 months. 3. The impact of the shock freezing and storage period on the chemical composition of cherries, mono-and disaccharides, ascorbic acid, acidity indicators are determined. 4. The process duration of freezing is reduced, improved technology has been developed, which uses an environmentally friendly cooling agent. Based on the conclusion of the studies carried out, it was experimentally determined that cherries as a suitable variety are the Beech glaze variety. Samples treated with shock-frozen 30% sugar syrup and 4% ascorutin were found to have the property of storing mono-and disaccharide levels within themselves for up to 9 months. Ascorbic acid levels of up to 87% and 74% of sugars were found to be between 62% and 42% during storage periods. As a result of freezing, a change in organoleptic indicators, color, texture in Cherries was analyzed.

Keywords

Fruit, Cherry, Shock Freezing, Cooling Agent, Temperature, Mono and Disaccharides

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1. Introduction

Certain results are being achieved in the modernization of food industry enterprises, expansion of the types and volume of competitive products, development of promising and effective freezing technologies for preserving cherry fruits, which are important sources of biologically active substances grown in Uzbekistan. The development strategy of the new Uzbekistan sets important tasks for "deepening structural changes and consistent development of the processing potential of agricultural products, further strengthening the country's food security, expanding the production of environmentally friendly, high-quality products, and significantly increasing the export potential of the agricultural sector." In this regard, the use of nitrogen freezing devices, the creation of improved continuous processes for increasing the cooling rate by transferring quick (shock) frozen products from the chamber to the apparatus freezing, and the optimization of production technologies with a reduced freezing duration and the use of environmentally friendly cooling agents are of great importance.

1.1. It Has Been Studied by a Number of Scientists

Z. S. Salimov, N. R. Yusupbekov, A. A. Artikov, O. F. Safarov, H. S. Nurmuhamedov, J. M. Kurbanov, H. F. Juraev, K. O. Dodaev, S. G. Zokirov, U. V. Mannonov, B. Shamsutdinov and others conducted scientific research on improving the technologies for freezing and storing fruits and vegetables.

1.2. Study Results

They developed improved technologies for storing agricultural products and fruits in freezers at -10 - 15 oC after washing and sorting, analyzing the effect of the speed and type of cooling agent on the duration of the process, organoleptic indicators of raw materials, and reducing the level of oxidation of products during storage by treating them with sugar syrup, ascorutin solution, citric acid or ascorbic acid during freezing.

2. Research Methods

2.1. Vocabulary of Methods

At the same time, scientific research is being conducted on a comparative analysis of shock freezing and traditional freezing processes of cherry samples, factors affecting storage life, the use of nitrogen freezing devices, and optimization of production technologies with reduced freezing duration and the use of environmentally friendly cooling agents [1].

2.2. Characteristics of the Cherry Variety

The changes that occur in plant tissues during the freezing process and storage of cherry fruits were evaluated, taking into account the biological characteristics of the variety, technological parameters and the duration of the studied processes.

2.3. Mono and Disaccharides

As is known, soluble carbohydrates are of great importance in plant metabolism and human nutrition. The composition of soluble carbohydrates (mono- and disaccharides) is the main component of fresh and frozen fruit supply.

2.4. Fruit Freezing Period

Changes in these cell components are one of the criteria determining the suitability of fruits for freezing and long-term storage. When fruits are frozen, sugars play the role of natural cryoprotectants, accumulating, they help reduce the freezing point of tissue fluid [2, 3].

3. Results

3.1. Vitamins in Cherry Varieties

Soluble carbohydrates in cherry fruits are represented by monosaccharides (glucose and fructose) and disaccharides (sucrose) (Table 1).

Table 1. Mass fraction of mono- and disaccharides in cherry varieties.

№	Name of the species	Glucose,%	Fructose,%	Sucrose,%
1	May	2,70	2,65	0,15
2	Bull's eye	3,74	3,04	0,42
3	Ox heart	2,90	2,75	0,44

Monosaccharides are represented by glucose and fructose in approximately equal proportions. The amount of MCs varies depending on the variety (Bull's Eye variety) [4-6].

According to the data (Table 2), the content of soluble carbohydrates, which is expressed in the amount of mono- and disaccharides in fresh cherries, is significantly dependent on the variety and varies. In addition, all studied varieties are characterized by a low content of disaccharides, which varies from 0.15 to 0.6.

3.2. The Amount of Mono and Disaccharides in Cherry Varieties

After the rapid (shock) freezing process, the amount of monosaccharides in the fruits of all studied varieties increases. The maximum amount of saccharides (%) was found in the fruits of the following varieties: Ox heart –7.2; May –7.0; Bull's Eye –7.4. The increase in monosaccharides, as is known, occurs due to the hydrolysis of disaccharides (sucrose) under the influence of the sucrase enzyme, in addition, in cherry fruits, in order to reduce cryodamage, a protective mechanism is activated to accumulate sugars during freezing [7, 8].

3.3. The Effect of Temperature

The dynamics of the composition of MS and DS is caused by two processes occurring simultaneously: the content of MS increases due to the decrease in the content of DS, which participates in biochemical processes, especially when the temperature zone exceeds 0...-5°C, and the speed increases.

During storage, the content of disaccharides and monosaccharides in fruits of all varieties decreases (Table 2).

3.4. Advantages of Pre-processing

The decrease in the content of monosaccharides depends on the biological characteristics of the variety. Thus, the content of soluble carbohydrates in fruits ranges from 90.1% (Ox heart) to 98.8% (Bull's eye) [9].

Table 2. *Changes in monosaccharides (MS), disaccharides (DS) in frozen cherry samples processed in 30% sugar syrup.*

Name of the variety	Amount of sugar,%											
	New fruits		After freezing		month							
					3		6		9		12	
	MS	DS	MS	DS	MS	DS	MS	DS	MS	DS	MS	DS
May	5,6	0,26	5,8	0,25	5,5	0,17	5,4	0,09	6,3	0,06	5,2	0,04
Bull's eye	6,3	0,22	7,0	0,21	6,6	0,18	6,4	0,09	6,3	0,04	6,2	0,04
Ox heart	6,0	0,42	6,9	0,38	6,5	0,26	6,2	0,18	6,1	0,07	5,9	0,02

During long-term storage (12 months), the content of sugars in the fruit decreases to 0.10...1.0%, depending on the variety.

According to the data in Table 2, the change in soluble carbohydrates during freezing also depends on their content in fresh fruits [15].

4. Discussion

Thus, for varieties with a high initial content of soluble carbohydrates (6.44...7.57%), the differences in the preservation of this indicator for cherry fruits (0.8...2.9%) are less significant than for varieties with a low initial content of soluble carbohydrates (less than 6.44%), for which the above differences are 2.8...5.3%, depending on the variety. Apparently, this is due to the cryoprotective effect of sugars. The content of sugars stored in the fruits of all cherry varieties for 12 months is lower than in freshly picked fruits and averages 1.8% [13, 14].

Empirical equations describing the dependence of mono- and disaccharide content in cherry fruits of the researched varieties on the storage period were created [10].

Changes in the composition of monosaccharides and disaccharides in cherry fruits of different varieties during storage.

Along with mono- and disaccharides, organic acids are the most important quality indicators in cherries, as they determine the sour taste of the fruit, and their accumulation during storage indicates increased oxidation processes. Organic acids are of particular interest because they determine the specific taste of the fruit, and their overall composition depends on the varietal characteristics [11, 12].

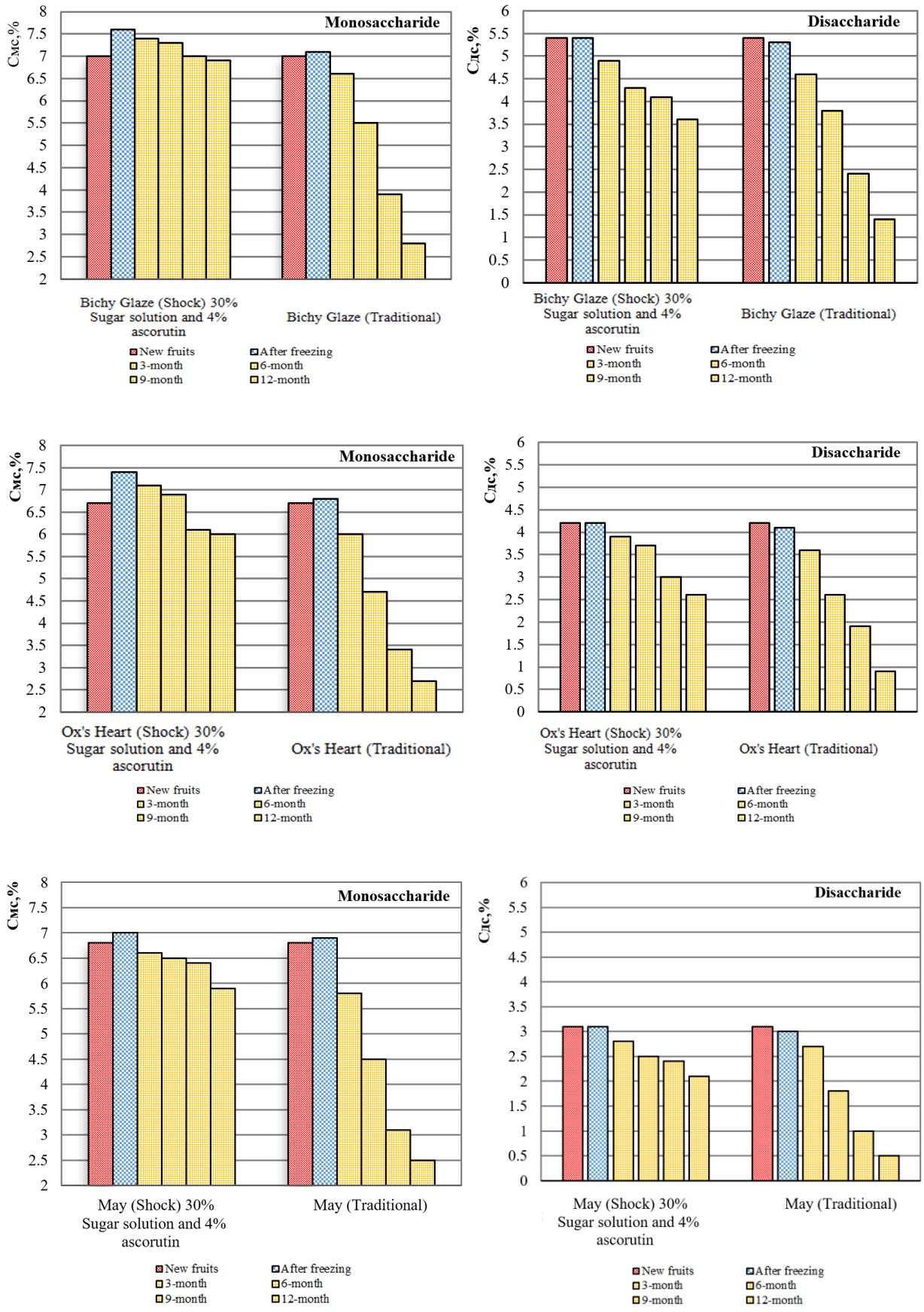

Figure 1. *Changes in the composition of monosaccharides and disaccharides in cherry fruits of different varieties during storage.*

5. Conclusion

The chemical and technological indicators characterizing the suitability of various varieties of cherries for freezing and long-term storage were theoretically substantiated and experimentally determined.

Differences in the content of nutritional and biologically active substances, organoleptic indicators were identified between 3 varieties of freshly picked cherries.

Varieties characterized by a high content of mono- and disaccharides, ascorbic acid, organic acids, as well as high indicators of organoleptic assessment were identified.

In all studied varieties of cherries, regardless of the freezing conditions in air and liquid media, it was shown that the content of organic acids, monosaccharides increases and the content of disaccharides decreases.

The process of shock freezing of cherry samples, treatment of fruits with 30% sugar syrup and 4% ascorutin was tested at the production plant and its effectiveness was determined.

6. Recommendations

Due to the high freezing rate, the period of activity of the bacteriological environment decreases. Different types of bacteria have their own temperature zones of vital activity. With slow freezing, they can leave traces of their vital activity, but shock freezing does not allow them to develop.

Abbreviations

MS	Monosaccharides
DS	Disaccharides

Author Contributions

Mirolim Aripov: Methodology, Data Curation, Formal Analysis, Writing – original draft, Writing – review & editing

Sherzodbek Berdiev: Conceptualization, Formal Analysis, Methodology, Supervision

Axror Ziyoyev: Conceptualization, Formal Analysis, Methodology, Supervision

Asliddin Shokirov: Formal Analysis, Methodology, Supervision

Sherzod Mamatov: Formal Analysis, Methodology, Supervision

Data Availability Statement

The data is available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

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Biography

Mirolim Aripov is an associate professor of the Department of Biotechnology of the Tashkent Institute of Chemical Technology. Having completed his bachelor's degree in 2011, he was accepted to study for a master's degree in the specialty of Food Technology (Fat Processing Technology) at the Faculty of "Food Products Technology" of the Tashkent Institute of Chemical Technology and, having completed the master's degree in 2013, in March 2023 he defended his dissertation for the degree of Doctor of Philosophy in Technical Sciences on the topic "Improvement of the technology of freezing cherries" and received the scientific degree of Doctor of Philosophy in Technical Sciences on May 5, 2023. technical committees at international conferences.

Sherzodbek Berdiev — Assistant Professor of the Department of Technological Processes and Devices Design of the Tashkent Institute of Chemical Technology After completing his bachelor's degree in 2019, he was admitted to the master's degree program in Chemical Technology Processes and Devices (for the production of inorganic and organic substances) at the Faculty of Chemical Engineering of the Tashkent Institute of Chemical Technology, and after completing his master's degree in 2021, in September 2025 he defended his dissertation for the degree of Doctor of Philosophy in Technical Sciences on the topic "Obtaining and practical application of permutite for the treatment of industrial wastewater and irrigation water", and on October 31, 2025 he received the degree of Doctor of Philosophy in Technical Sciences.

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Sherzod Mamatov is the Deputy Director of Webster University in Tashkent. He graduated from the bachelor's degree in 2008 and the master's degree in 2010. In 2010, he was accepted to the Food Safety Department of the Tashkent Institute of Chemical Technology for postgraduate study. In 2014, he was accepted to the Internship Research Institute of the Tashkent Institute of Chemical Technology and in July 2015, he successfully defended his doctoral thesis on the topic "Improvement of drying technology of agricultural products". Since August 2020, he has been working as the 1st Deputy Director of Webster University in Tashkent. He has published more than 120 scientific works and 4 students have received the degree of Doctor of Philosophy in technical sciences. In recent years, he has participated in many international scientific cooperation projects.