RESEARCH ON THE EFFECT OF PRESERVATION BY FREEZING ON THE QUALITY INDICATORS OF FRUITS

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RESEARCH ARTICLE

Abstract

Fruits are very well suited for preservation by freezing. During the freezing and thawing operations, a series of changes occur in the physico-chemical and organoleptic characteristics, which are mainly due to changes in color, structure-texture, and the degradation of some components, especially vitamin C.

Keywords: fruits, quality indicators, freezing

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INTRODUCTION

Frozen fruits represent a popular assortment used in pastry, for preparing compotes, and alcoholic and non-alcoholic beverages.

Freezing can be done in two variants: in divided form for large fruits or whole for small fruits. Fruit freezing can be done as is or in sugar syrup.

For freezing, varieties with light-colored pulp, sweet-sour taste, aromatic, with firm, dense pulp, resistant to browning, having reached technological maturity are suitable.

The freezing point is a characteristic of the species, variety, and degree of maturation, being determined by the concentration of the cell sap. Thus, in the physiological maturity phase, the cell sap concentration is maximal, which determines a lower freezing point value.

The freezing point at technological maturity for peaches is -1.45°C, yellow melon -1.6°C, cherries -4.05°C, and for sour cherries -2.2°C. (A. Ardelean, 2009, 2015).

During freezing and storage, a series of physico-chemical and organoleptic changes occur.

Physical changes are evident through the dehydration of frozen products, especially if the packaging is not efficient enough. It must be impermeable to water vapor and hermetically sealed. Also, water losses occur during storage, especially for products stored in bulk or in packaging permeable to water vapor. A consequence of the dehydration phenomenon is the weight loss of frozen products (I.F. Radu, 1985, I.F. Radu, Gherghi A., 1967, Gherghi A., 1995, 1998).

Another negative effect of freezing is the change in texture by losing the consistency of the fruits, a phenomenon due to the loss of cellular liquid during thawing, as a result of damage to the cell membranes. Due to these changes, the structure-texture becomes looser, and weight losses due to water evaporation and cell sap leakage are observed at the bottom of the packaging (Potec, I. et al, 1983, 1985, Beceanu D, Chira A., 2003, Gh. Mihalca, 1980).

At the same time, the freezing method influences the percentage of water lost by the fruits. Studies have shown that with the rapid freezing method, fruits lose a smaller amount of water compared to the slow freezing process.

Among the important chemical changes that occur during the technological flow are: soluble dry matter content, total acidity, and vitamin C losses.

Organoleptic changes refer to diminished losses of aroma and taste due to the degradation of some components and the loss of cell sap.

Research on vitamin C content has revealed that freezing causes vitamin losses,

as they are water-soluble, but the losses are much smaller compared to other processing methods (Inoue K. et al., 1998, Neamţu G. et al., 1993, 1997, Cornelia Purcărea, 2005, 2008, Carmen Hura, 2006). These vitamin losses in fruits are also due to degradation during freezing.

MATERIAL AND METHODS

Research was conducted in the year 2025, at the Faculty of Environmental Protection Oradea.

In the studies, local fruit varieties purchased from the local agri-food market were used.

The research was carried out on fresh fruits as well as those frozen for three months.

The operations of the technological freezing flow are as follows: harvesting, temporary storage by refrigeration, quantitative and qualitative reception, conditioning operations (sorting, washing, cleaning, dividing), packaging, freezing, storage, delivery.

Harvesting was done at technological maturity, which corresponds to consumption maturity.

Temporary storage was carried out for 3 hours by refrigeration at a temperature of 7°C.

Sorting was done immediately after the washing operation, so that only specimens with a uniform degree of maturity and health were retained for preservation.

Cleaning consists of removing the pits (peaches, cherries, sour cherries), the seeds (yellow melon), followed by dividing into slices (peaches and yellow melon).

In the studies carried out, the conditioning operations were done quickly, so antioxidant treatment was not necessary, which allows highlighting the quality changes and the behavior of the fruits during preservation by freezing without being influenced by other treatments.

The packaging of frozen fruits was done in 250g containers.

Slow freezing was carried out in a domestic freezer.

Storage was done at a temperature of – 18°C for three months.

Soluble dry matter was determined refractometrically with a portable refractometer for fresh and frozen products.

Total titratable acidity was determined as follows: for fresh products, they were crushed, filtered, and titrated with sodium hydroxide solution with a known factor, in the presence of phenolphthalein as a color indicator.

The vitamin C content was determined by the iodometric method.

RESULTS AND DISCUSSIONS

The frozen fruit samples were thawed at ambient temperature.

Several samples were analyzed from each species, so the results refer to the average of the samples.

The main quality indicators of the fruits refer to soluble dry matter, total titratable acidity, and vitamin C. Also, textural changes and sensory properties of fresh and frozen fruits were evaluated.

The quality indicators were determined for fresh fruits (Table 1) and those frozen for three months (Table 2).

Table 1

Chemical quality indicators of fresh fruits

No.	Sample	Soluble dry matter % (sample average)	Total titratable acidity (sample average)	VIT. C % (sample average)
1	Peaches	9.2	0.36	4.3
2	Yellow Melon	8.2	0.16	8.0
3	Cherries	20.5	0.19	16.2

4	Sour cherries	16.9	0.28	17.1

Table 2

Chemical quality indicators of fruits frozen for 3 months

No.	Sample	Soluble dry matter % (sample average)	Total titratable acidity (sample average)	VIT. C % (sample average)
1	Peaches	7.9	0.29	3.9
2	Yellow Melon	8.0	0.12	7.2
3	Cherries	18	0.17	15.4
4	Sour cherries	15.1	0.12	16.5

Fruits are products with a high water content, are rich in fiber, and represent an important source of vitamins and mineral salts.

The study of the chemical quality indicators of fresh fruits highlighted the highest content of soluble dry matter in cherries and sour cherries (20.5% and 16.9%, respectively). Yellow melon has the lowest content of soluble dry matter (8.2%), being the species with the highest water content.

In terms of acid content, yellow melon has a higher acidity compared to the other species studied.

The highest vitamin C content was found in sour cherries and cherries (17.1% and 16.2%, respectively), and the lowest in peaches 4.3%.

The physical quality indicators studied refer to the textural changes of the fruits. It should be mentioned that species with a firm structure and texture, which are preferable for this preservation method, were preserved.

The sensory properties were highlighted by organoleptic analyses. Thus, peach fruits have light-colored pulp, slightly crunchy, of suitable juiciness, with a sweet, slightly acidic taste and specific aroma. Yellow melon fruits had golden-yellow pulp, juicy and very aromatic. Sour cherries are large (5-8 g), dark red, and juicy. The pulp is consistent, with a pleasant sweet-sour taste. Cherries are large, dark red, with firm and juicy pulp, having a sweet, slightly sour taste.

For products preserved and stored for three months, the following changes are noted. The soluble dry matter content reduced the most in cherries by 2.5%, and for the other species, the decreases are smaller. The total titratable acidity content increased, the preserved fruits being slightly more acidic than the fresh ones.

The decrease in vitamin C content is due to the chemical degradation suffered during freezing, storage, and thawing.

Regarding the textural changes that occurred in fruits preserved by slow freezing, they refer to a slight reduction in firmness, as a result of losing a certain part of the water from their composition.

From a sensory point of view, a decrease in organoleptic characteristics, namely taste and aroma, was noted in cherries and sour cherries. The aroma and taste were best preserved in yellow melon and peaches, properties that were more pronounced in the fresh fruits as well. The pigmentation was preserved; the thawed fruits show an intense coloration similar to the fresh products.

CONCLUSIONS

From the analysis of the results obtained regarding the quality changes in the fruit samples preserved by freezing, the following conclusions can be drawn:

1. The soluble dry matter (s.d.m.) content decreases for samples stored for a period of three months.
2. The total titratable acidity,

expressed as malic acid, also increased during the storage period.

3. The vitamin C content decreases, primarily due to cell sap losses and because chemical degradation occurs during freezing and thawing.

4. Regarding the organoleptic properties, some changes are observed: the structure-texture of the fruits becomes looser, a phenomenon that is more intense in the case of slow freezing, as a result of the cracking of cell membranes and the epidermis during the freezing and thawing operations, respectively. The taste and aroma lose their intensity compared to fresh fruits. This aspect is due to water losses, which also carry away some of the dissolved substances responsible for these properties. The pigmentation does not show changes compared to fresh products, which is why the fruits of these species can be frozen without sugar.

5. The vitamin C content decreased slightly in all frozen fruits due to the chemical degradation suffered during freezing, storage, and thawing.

6. The fruits of the analyzed species are very well suited for preservation by freezing in the sugar-free variant. Due to the peculiarities of the fruits (thin epidermis, rich in cell sap, perishable), it is recommended to carry out harvesting operations at the optimal harvesting time, without exceeding the technological maturity phase. Overripe fruits have a more fragile structure-texture, with imminent possibilities of alteration.

7. From the analysis of the results obtained regarding the main quality indicators of fresh and frozen fruits, it was concluded that the preservation method by freezing has minimal effects on these indicators, compared to other processing and preservation methods, the products retaining their nutritional and organoleptic values close to the initial values of the fresh products.

8. Also, the use of rigid packaging such as containers and the reduction of handling operations are recommended for the same reasons.

9. Thawing of fruits is done at ambient temperature so that cell sap losses are minimal.

10. It is recommended to continue research on fruit freezing by other methods as well.

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