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RESEARCH ON THE BEHAVIOR AND QUALITATIVE CHANGES OF FROZEN APPLES

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Abstract

Apples can freeze as such. During the freezing and thawing operations, a series of changes of the physico-chemical and organoleptic characteristics take place, which are mainly due to the color and structure-texture changes and the degradation of some components, especially of vitamin C.

Key words: apples, freezing, color change, structure-texture, organoleptic properties, vitamin C.

INTRODUCTION

Frozen apples are an appreciated assortment, being used in confectionery or compote preparation.

The freezing can be done in two variants: in the form of slices or rounds as such or in sugar syrup.

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

For cold resistant varieties (Golden Delicious, Red Delicious, Starkrimson, Renet Baumann, etc.) the refrigeration is carried out at 0 ... +1^{o}C (A. Ardelean, 2019).

A series of physico-chemical and organoleptic changes occur during freezing and storage.

The dehydration of frozen products is among the physico-chemical modifications, especially if the packaging is not efficiently enough. It must be impermeable to water vapor and sealed. Also, water losses occur during storage, especially for products stored in bulk or in permeable packaging for water vapor.

At the same time, the freezing modality influences the percentage of water lost from fruits. Studies have shown that by the method of rapid freezing, fruits lose less water compared to the slow freezing process (Gherghi A., 1998).

A consequence of the dehydration phenomenon is the weight loss of the frozen products.

Another negative effect of freezing is the modification of the texture by the loss of the consistency of the fruits, a phenomenon due to the losses of cellular liquid upon defrosting, as a result of the damage of the cell membranes, especially in the slow freezing variant. Also, the scalding operation performed for the purpose of enzymatic inactivation, causes changes in the structure of pectic substances in the cell membranes, affecting the consistency of the products (I. F. Radu, 1985, I. F. Radu, A. Gherghi, 1967).

Due to these changes, the structure-texture becomes looser, and weight loss due to water evaporation and cell juice leakage is observed on the bottom of the packages (I. Potec, et al, 1983, 1985, D. Beceanu, A. Chira, 2003, Gh. Mihalca, 1980).

Among the important chemical changes that take place 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 effect of the scalding operation, the degradation of some components and the losses of cell juice.

Research on the content of vitamin C has revealed that by freezing losses of vitamins occur, which are soluble in water, but the losses are much lower compared to other processing processes (Inoue K. et al., 1998, Neamțu G. et al., 1993, 1997). These vitamin losses are due to their solubility in scalding water and degradation during freezing.

MATERIAL AND METHOD

The research was carried out in 2019, at the Faculty of Environmental Protection Oradea.

The Golden Delicious apple variety, which is a winter variety, was used in the studies. Harvesting took place in mid-October.

The fruits have a light, crispy flesh, with a succulent, slightly acidic sweet taste and a specific aroma.

The research was carried out on fresh and frozen fruits for two months.

The operations of the freezing technological flow are the following: harvesting, storage, quantitative and qualitative reception, conditioning operations (sorting, washing, sorting, cleaning, dividing), antioxidant treatment, packaging, freezing, storage, delivery.

The cleaning consists in extracting the seed core, followed by the split into slices (8-12 pieces).

To strengthen the structure, the fruit slices were immersed in a solution of sodium chloride and calcium chloride 1%.

Antioxidant treatments are performed to avoid the phenomena of browning (oxidation), by scalding.

The scalding was done by immersion in water for 1-2 minutes.

The frozen fruit was packaged in 200g casseroles.

Freezing was performed in the freezer.

Storage is performed for all frozen products at – 18^0C. The storage time depends on the freezing method used: 3-5 months for the frozen apples as such.

The main chemical indicators analyzed for both fresh and frozen samples refer to soluble dry matter content, total titratable acidity and vitamin C content. For frozen samples the determinations were performed after thawing and appropriate preparation of the samples.

The soluble dry substance was determined refractometrically directly in the field with the Zeiss portable refractometer for the fresh products, so that the optimum harvest time was established based on this value (A. Ardelean, 2009).

The total titratable acidity was determined as follows: fresh products were milled, filtered and titrated with sodium hydroxide solution with the known factor, in the presence of phenophthalein as a color indicator (A. Ardelean, 2015).

The vitamin C content is determined by iodometric method. Thus, 15 g of product to be assessed are weighed with the analytical balance from the intermediate sample which is grinded with 2 g of quartz sand and 10 ml of metaphosphoric acid until a homegenous paste is obtained. The mixture is passed through a calibrated flask of 50 ml and is brought to the sign with metaphosphoric acid. Then, the mixture is filtered and 10 ml are furtherly assessed. Two titration are further made.

The titration of the standard solution of ascorbic acid: in an Erlenmeyer glass, 10 ml of ascorbic acid, 20 ml of distilled water, two drops of hydrochloric acid solution 1M, 15 drops of amidon solution 1% are put together. They are all titrated with iodine solution until the change of colour into lavender blue.

The titration of the sample under study: the working technique is the one previously presented with the observation that the standard solution of ascorbic acid is replaced with 10 ml of sample to be filtered. Titration is also performed with iodine solution until the change of colour into lavender blue (C. Purcărea, 2005, 2008, C. Hura, 2006).

The organoleptic properties of fresh and frozen fruits were determined by sensory methods. Thus, the appearance of the fruits in terms of pigmentation and texture, but also taste and aroma were analyzed.

RESULTS AND DISSCUSIONS

Immediately after harvesting, analysis samples were performed, and the results present the average of the determinations.

The physical-chemical properties analyzed in fresh apples are presented in Table no. 1.

Table no. 1

The main indicators analyzed in fresh apples

Sample no.	1	2	3	4	5	6	7	8	9	10	Samples average
Weight (g)	200	200	200	200	200	200	200	200	200	200	200
S.D.M. (%)	17	17,5	18	17,5	18	18,5	17,5	18	18,5	17,5	17,8
Total titratable acidity (malic acid)g/%	3,2	3,2	3,0	3,2	3,1	3,5	3,0	3,5	3,5	3,2	3,2
Vit. C (mg/ 100g)	5.9	5,8	6,0	5,8	5,9	6,0	5,5	5,9	5,7	5,5	5,8

The physico-chemical properties analyzed for frozen apples stored for two months are presented in table 2.

Table no. 2

The main indicators analyzed for frozen apples stored for two months

Nr. probă	1	2	3	4	5	6	7	8	9	10	Samples average
S.D.M. (%)	15,5	15,0	16,0	15,0	16,5	16,0	15,5	16,0	16,0	15	15,65
Total titratable acidity (malic acid)g/%	2,9	3,0	2,7	2,8	2,9	3,1	2,6	3,0	3,1	2,8	2,89
Vit. C (mg/ 100g)	5,3	5,2	5,5	5,8	5,0	5,0	5,0	5,1	5,0	4,9	5,18

From the analysis of the obtained results, a decrease in the value of the total titrable acidity and of the vitamin C content is observed. The change in the total titrable acidity is due to the loss of a quantity of water by

freezing and as a result the concentration of the cellular juice takes place, which also caused the decrease in the soluble dry matter content.

The decrease in vitamin C content is due both to the losses recorded during the water scalding operation, as it is a water soluble vitamin, and due to its degradation during the freezing operation and during storage.

From the point of view of the weight of the samples, the decreases recorded are due to the losses of cell juice after the thawing operation. By the slow freezing carried out in the domestic freezers, non-uniform ice crystals are formed as an intra- and intercellular size, which, at the time of thawing, damages the thin epidermis of the split into slices.

From the sensory point of view, there was a decrease of the organoleptic characteristics, respectively taste and aroma, the changes being more noticeable in the samples deposited for four months. As for the texture, it has become looser for thawed products as a result of cell juice losses. The pigmentation has been preserved, the thawed fruits have an intense coloring similar to the fresh products.

CONCLUSIONS

From the analysis of the results obtained regarding the quality changes in the frozen and stored apple samples, the following conclusions can be drawn:

1. The soluble dry matter content (s.u.s.) slightly decreased for the samples stored for two months;

3. The total titrable acidity, expressed in malic acid, also decreased during the storage period.

4. Vitamin C content is reduced, primarily due to the scalding operation and due to chemical degradation during freezing and thawing.

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

6. Apples are very suitable for preservation by freezing in the sugar-free version, considering the behavior of this species during the technological flow.

7. It is also recommended to use rigid casserole packages to preserve the integrity of apple slices.

8. The defrosting of the fruits is carried out at room temperature, so that the losses of cell juice are minimal.

9. It is recommended to continue research on freezing apples and other methods.

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