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RESEARCHES CONCERNING THE BEHAVIOUR AND QUALITATIVE CHANGES OF FROZEN RASPBERRY FRESH FRUITS

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Abstract

Raspberry fruits are well-suited for preservation by freezing in the sugar-free version. During the freezing and defrosting operations, a number of changes in the physico-chemical and organoleptic characteristics occur, mainly due to the loss of cellular juice and the degradation of some components, especially of vitamin C.

Key words: raspberry, freezing, soluble dry substance, total titratable acidity, organoleptic properties, vitamin C.

INTRODUCTION

Raspberry fruits are well-suited to freezing preservation. Being a species that retains its pigmentation during the freezing process, it can freeze as such without sugar.

The conditioning of this species is minimized due to the fragility of these fruits: very thin epidermis and very succulent polydrupes. For the fruits intended for immediate consumption after thawing, due to these characteristics, it is recommended to harvest directly in the freezing packaging and the raspberries should not be washed before freezing. Packaging in which harvesting and freezing takes place shall be of small capacity. This reduces the number of manipulations and the risk of affecting the structure of the fruit. For the same reasons, it is also recommended that the freezing operation be carried out on the day of harvesting, the raspberries being excessively perishable.

Immediately after harvesting, the fruit packs are refrigerated at -0,5 ... -1^{0}C and a relative humidity of 90 - 95% (I.F. Radu, 1985).

The freezing process begins with the refrigeration being carried out at the above parameters, followed by freezing itself, which consists in forming ice crystals and lowering the temperature of the product below the freezing point of the juice to the temperature at which the product is subsequently to be stored .

During the process of freezing, as well as during defrosting, important changes of physico-chemical and organoleptic nature occur.

In domestic freezers, freezing takes place at slow speeds, with slow freezing. In this case, ice crystals are formed from the juice of cellular vacuoles to the outside of the cell (which is cooler). Water passes through cell membranes, through diffusion, into intercellular spaces where ice crystals are formed, so the juice becomes more concentrated and the freezing point decreases. Large ice crystals are formed, which exert pressure on the permeable cell membranes, and after thawing, the juice drips to their surface. At the same time, colloidal substances undergo physico-chemical changes and diminish the absorption capacity of the lost water, which leads to a lax structural structuring of the products (A. Ardelean, 2013).

Physical changes observed after thawing are: the structo-texture becomes more lax the weight loss due to cell juice leakage observed on the bottom of the packs (I. Potec, et al., 1983, 1985, D. Beceanu, 2003, Gh. Mihalca, 1980).

The structo-texture of the defrosted fruit is altered because freezing creates ice crystals in intercellular spaces that affect cell membranes and can cause cell dissociation and loss of cellular juice during defrosting (Ioancea L. et al., 1988, Marca Gh. 1987).

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 reduced flavor and taste loss due to cellular juice leakage.

Research on the vitamin C content revealed that vitamin losses were lost by freezing, but water losses were much lower compared to other processing methods (Inoue K. et al., 1998, Neamţu G. et al., 1993, 1997, Cornelia Purcarea, 2005, 2008, Carmen Hura, 2006).

MATERIAL AND METHOD

The research was carried out in 2018 within the Faculty of Environmental Protection, Oradea.

Rubin raspberry variety was used in the studies.

The raw material comes from field crops and is harvested at technological maturity in the first decade of July.

The research has been carried out on fresh and frozen raspberries at certain time intervals.

The frozen finished product is intended for fresh consumption or for making various pastries.

The phases of the technological flow are: harvesting and sorting, packaging preparation, quantitative and qualitative reception, refrigeration, freezing.

Simultaneously with the harvesting operation, sorting and calibration were performed. Raspberries are harvested according to two qualities: extra and quality I. The extra quality fruits are 15 mm in size and the quality I is of minimum 12 cm.

Packaging was carried out in 200g capacity cassettes.

Refrigeration was performed at a temperature of -0.5 ... 1 ℃.

Freezing was done in a domestic freezer at -18 ℃, at which temperature it was stored for two or four months respectively.

Defrosting was performed at ambient temperature.

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.

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.

The vitamin C content was determined by iodometric methods. Thus, out of the average sample, 15 g of analysed product are weighed with the analytical balance which is pestled with 2 g of quartz and and 10 ml of metaphosphoric acid, until a homogenous paste is formed. The mix is passed through a calibrated flask of 50 ml and is brought to the sign with metaphosphoric acid. Then, the next step is the filtration of the mix, out of which 10 ml are used for further analyses. Furthermore, two titrations are performed.

The titration of the standard solution of ascorbic acid: 10 ml of ascorbic acid, 20 ml of distilled water, 2 drops of acid hydrochloric acid 1M, 15 drops of starch solution 1% are put into an Erlenmeyer glass. The mix is titrated with iodine solution until the change of colour to aubergine-bleu (V).

The titration of the analysed sample: the working technique is the one presented previously with the specification that the standard solution of ascorbic acid is replaced with 10 ml sample to be filtered. The titration is performed with iodine until the change of colour to aubergine-blue (V_1).

Vit. C mg/ 100 g product = $10 \times V_1 \times 5 / V \times m \times 100$

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 physico-chemical properties analyzed for fresh raspberries are presented in Table no. 1.

Table no. 1

Main indicators analyzed at fresh raspberries

Sample no.	1	2	3	4	5	6	7	8	9	10	Average of samples
Weight (g)	200	200	200	200	200	200	200	200	200	200	200
S.D.M. (%)	10.5	11.0	10.0	11.0	10.5	10.0	10.5	11.0	11.5	11.0	10.7
Total titratable acidity (malic acid g/%)	1.9	1.85	1.95	1.87	1.9	1.93	1.91	1.83	1.8	1.83	1.87
Vit. C (mg/ 100g)	22.9	23.1	22.0	23.8	24.0	23.2	23.7	23.7	23.8	23.4	23.36

The physico-chemical properties analyzed for raspberries two months after freezing are shown in Table 2.

Table no. 2

Main indicators analyzed for frozen raspberries, stored for two months

Sample no.	1	2	3	4	5	6	7	8	9	10	Average of samples
S.D.M. (%)	10.0	10.5	9.7	10.7	9.9	9.6	10.1	10.6	11.2	10.7	10.3
Total titratable acidity (malic acid g/%)	1.39	1.33	1.42	1.35	1.5	1.5	1.39	1.3	1.3	1.3	1.37
Vit.C (mg/ 100g)	14.9	15.0	14.2	15.8	16.3	15.3	15.7	15.6	15.8	15.1	15.37

The physico-chemical properties analyzed on raspberries four months after freezing are shown in Table 3.

Table no. 3

Main indicators analyzed for frozen raspberries, stored for four months

Sample no.	1	2	3	4	5	6	7	8	9	10	Average of samples
Weight (g)	195	193	195	197	195	192	193	196	196	194	194.6
S.D.M. (%)	9.5	10.0	9.3	10.1	9.5	9.6	9.6	10.2	10.5	10.7	9.9
Total titratable acidity (malic acid g/%)	1.01	0.96	1.04	0.96	1.00	1.02	1.00	0.94	0.96	0.95	0.98
Vit. C (mg/ 100g)	10.0	10.3	9.2	10.6	10.9	10.0	10.6	10.5	10.5	10.1	10.27

The analysis of the obtained results shows a progressive decrease of the chemical indicators analyzed for the frozen products as the storage period increases. Thus, the soluble dry substance decreased to 0.4% two months after storage and 0.8% after four months of storage. Total titratable acidity of the finished product reached 0.98g%.

From the point of view of the weight of the samples, the decreases recorded are due to the loss of cellular juice after the thawing operation. By slow freezing in household freezers, non-uniform intra-and intercellular ice crystals are formed, which, when defrosted, damage the thin epidermis of raspberries.

From a sensorial point of view, there was a decrease in organoleptic characteristics, namely taste and aroma, the changes being more noticeable in the samples stored for four months. As far as structure-texture is concerned, it has become more lean on thawed products as a result of cellular juice leakage. Pigmentation has been preserved, thawed fruits have an intense coloring similar to fresh products.

CONCLUSIONS

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

1. Weight loss due to cellular juice leakage during the thawing operation.

2. Soluble dry matter content (S.D.M.) shall be reduced for samples stored as a prolongation of the storage period.

3. The total titratable acidity, expressed in malic acid, also decreased over the storage period.

4. The vitamin C content is reduced primarily due to cellular juice loss and due to chemical degradation during freezing and thawing.

5. As for the organoleptic properties, some modifications are observed: the raspberry polydrupes structo-texture becomes more lax, a phenomenon which is more intense in the case of slow freezing as a result of the cell membrane perforation and epidermis during freezing and defrosting operations . Taste and aroma are losing intensity compared to fresh fruits, the phenomenon being more pronounced than those stored for four months. This is due to the loss of water that drives some of the dissolved substances responsible for these properties. Pigmentation does not change compared to fresh products, which is why fruits of this species can be frozen without sugar.

6. Raspberry fruits are well suited to freezing preservation in the sugar-free version. Due to the peculiarities of the fruits (very fine epidermis, rich in excessively perishable cellular juice) it is recommended to carry out the harvesting operations at the optimal harvesting time, without overcoming the technological maturity stage, the over-harvested fruits exhibiting a very fragile structure - with imminent possibilities of alteration.

7. It is also recommended to use rigid casserole -type packaging and reduce handling for the same reasons.

8. Defrosting the fruit is done at ambient temperature so that the cellular juice losses are minimal.

9. Further research on the freezing of raspberries and other methods is recommended.

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