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RESEARCH ON THE QUALITY CHANGE APPEARED IN SPINACH DURING ITS PROCESSING BY FREEZING

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Abstract

The processing of spinach by freezing represents a winter preservation option, having in view that it is an extremely perishable species that cannot be preserved in a fresh state more than two days. During the processing operations, a series of organoleptic and physical-chemical changes take place, fact that determines a decrease in the nutritive value.

The decrease in volume of the processed vegetal material allows the saving of the storage space. The chemical changes refer to the decrease of the content in vitamin C, especially in the case of the minced spinach, and to the decrease of the pH of the cell juice. The changes in colour, taste and consistency are highlighted from an organoleptic point of view.

Key words: spinach, freezing, blanching, mincing, weight, soluble dry substance, pH, vitamin C.

INTRODUCTION

Spinach is well suited to the processing by freezing, being consumed in off season under the form of puree.

The changes in quality that appear in the frozen spinach are those that refer to the aspect and chemical composition of the leaves.

The research performed in this respect highlights the appearance of some light colour spots, with spongy aspect (freezing burnt), as an effect of the advanced dehydration or the usage of some imperfectly closed packages. The freezing burnt has the effect of weight loss (D. Beceanu, 2003, Potec și colab., 1983, 1985)..

The changes in colour and taste are also present, being correlated with the period of preservation (Banu C., 1992, Ioancea L.și colab., 1988). The change of colour in the spinach leaves from intense green to olive, brown-green is due to the transformation of chlorophyll into pheophytin, being in direct correlation with the storage temperature and its fluctuation during the storage process. The changes in taste appear due to the enzymatic activity (Neamțu G. și colab. 1993, 1997). To prevent these unwanted phenomena, the spinach is blanched in advance. The blanching operation must be carefully performed, strictly complying with the time and water/steam temperature. Blanching contributes significantly to the decrease of the microbial load (Ardelean Alina, 2009, 2013, 2015, Marca Gh., 1987).

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Blanching, especially the steam blanching, is performed with the purpose of diminishing the vitamin loss (I.F. Radu, 1967, 1985, Gherghi A., 1995, 1998).

The studies performed by Hohl show a 57% vitamin C loss in the case of spinach puree after a storage period of 12 months (Gh. Mihalca, 1980).

Vitamin C is hydro-soluble and has an essential role in the normal functioning of organism, being involved in the metabolism of glucides, lipids, amino-acids. It also stimulates and inhibits some enzymatic systems from the chain of cell oxidation (Inoue K.și colab., 1998). The studies performed upon the vegetal products, including the spinach, highlight its presence in important quantities. The daily ratio intake is of 25-30 mg of vitamin C. The lack of vitamin C from organism leads to the appearance of scurvy (Cornelia Purcărea, 2005, 2008, Carmen Hura, 2006).

The performed research highlighted significant losses of vitamin C in the case of the minced frozen spinach in comparison with the whole leaves spinach.

MATERIAL AND METHOD

The researches has been made in 2016 at Faculty of Environmental Protection Oradea.

Matador spinach variety was used in the research, after it was obtained in the autumn field crop.

The changes in colour, taste and vitamin C content, pH, soluble dry substance, as well as the weight losses in the case of the fresh samples but also after its freezing and storage for two months have been studied.

The spinach was harvested at its technological maturity. The freezing took place on the same day when harvesting, according to the technological flow: quantitative and qualitative reception, sorting, washing, water blanching, water drainage, cooling, mincing (for the minced option), preparation of packages, packaging, freezing, storage and delivery.

The weight was determined by the analytical balance. Thus, fresh samples of 100g were taken, dried at the environmental temperature, which were submitted to the processing by freezing.

The frozen samples were weighed immediately after they were taken out from the freezer, by using the following working technique: the packages have been wiped by ice and snow with a towel, after which the samples were weighed without opening the package (gross weight). The packages were then opened and the content (sample, ice) was emptied into a bowl. The empty package was wiped by water and ice remainings and they were left to dry at the environmental temperature, after which they were weighed again. The net weight of the sample was calculated making the difference between the gross weight and the weight of the empty package.

The soluble dry matter was determined refractometrically.

The pH was determined by the pH-meter.

The vitamin C content was determined by iodometric methods both for the fresh and frozen sample. Thus, out of the average sample, 15 g of analysed product are weighed by the analytical balance which is pestled with 2 g of quartz sand 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 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-blue (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 aspect, colour and taste are analysed organoleptically for both the fresh and frozen samples.

RESULTS AND DISSCUSIONS

The results regarding the physical-chemical changes in the fresh samples of spinach are presented in table 1.

Table no. 1

Main physical-chemical features in the fresh spinach samples

Sample no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Average of samples**
Weight (g)	100	100	100	100	100	100	100	100	100	100	100
S.U.S. (%)	1	1	1	1	1	1	1	1	1	1	1
pH	6.45	6.45	6.45	6.45	6.45	6.45	6.45	6.45	6.45	6.45	6.45
Vit. C (mg/100g)	65	63	65	68	67	65	68	66	64	65	65.6

The physical-chemical changes in the whole and minced spinach leaves after freezing are presented in tables 2 and 3.

Table no. 2

Main physical-chemical features in the frozen spinach samples under the form of whole leaves

Sample no.	1	2	3	4	5	6	7	8	9	10	Average of samples
Weight (g)	62	59	63	62	60	61	62	63	60	63	61.5
S.U.S. (%)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
pH	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Vit. C (mg/100g)	26	25	26	27	26	26	28	26	26	26	26.2

Table no.3

Main physical-chemical features in the frozen minced spinach samples

Sample no.	1	2	3	4	5	6	7	8	9	10	Average of samples
Weight (g)	58	57	57	55	58	56	57	60	57	58	57.3
S.U.S. (%)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
pH	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Vit. C (mg/100g)	19	18	18	19	19	17	19	18	17	18	18.2

The analysis of the achieved results for frozen spinach samples indicates a decrease of the parameter values under study, some of them with positive effects. With respect to this, it can be mentioned the decrease of weight and implicitly of the volume of the processed products, fact that allows the saving of the occupied space during the freezing chain.

As regards the analysis of the chemical parameters, a decrease of their value is noticed, especially as regards the content in vitamin C for the minced processed option.

CONCLUSIONS

The following conclusions can be drawn from the analysis of the achieved results on the quality changes in the frozen samples of whole leaves spinach or minced spinach:

1. By blanching and freezing, some weight losses are observed of about 61,5% in the option processed under the form of whole leaves and with 57,3% for the option processed under the form of minced spinach.

These weight losses are due to the dehydration of the frozen product that losses water from the leaf tissue, water that is replaced by the oxygen from the environment, so that browning processes of the tissues take place. To prevent this problem, the blanching operation is performed before freezing.

2. The content in soluble dry substance (s.u.s.) is reduced with 0.5%, insignificant changes for spinach.

3. The change of the pH is due to the concentration of the cell juice, the last one becoming more acid for both processed options..

4. The content in vitamin C is reduced both for the option processed under the form of whole leaves but especially for the option processed under the form of minced spinach. This decrease of the content in vitamin C is due to the blanching operation, the vitamin C being a hydro-soluble vitamin that is lost in the blanching water. A chemical degradation also takes place during blanching and freezing.

5. As regards the aspect of the processed leaves, they changed their colour from dark green to olive green during blanching, due to the transformation of the chlorophyll into pheophytin. This change in colour became more obvious during the freezing process. The taste has changed altogether with the blanching and freezing operations, the taste of fresh cabbage being lost. The consistency of the leaves has changed, becoming softer but smoother.

6. Spinach is a species that is very suitable to be frozen. The blanching operation is absolutely compulsory due to its positive effects upon the spinach: inactivates the oxidative enzymes contributing to the preservation of the organoleptic characteristics (taste, colour); softening of the structo-texture that determines the decrease of the vegetal product volume; better preservation of the vitamin C content during freezing; decrease of the number of micro-organism on the product. The cooling operation is compulsory after blanching because the excessive softening of the leaf tissues is avoided and the water surplus on the leaves is removed.

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