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THE INFLUENCE OF FREEZING ON THE BIOLOGICAL VALUE OF BERRIES

INFLUENŢA CONGELĂRII ASUPRA VALORII BIOLOGICE A AFINELOR ŞI STRUGURILOR

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The objective of our research was to observe the influence of freezing on the biological value of selected berry samples according to their antiradical activity, content of anthocyans and vitamin C. The content of vitamin C (method by Lásztity and Törley, 1987), anthocyans (method by Fuleki and Francis, 1968) and antiradical activity (method by Brand- Williams et al., 1995 and Sanchéz- Moreno et al., 1998) were analysed both in frozen and fresh berry samples. In general, the avarage contents of vitamin C, anthocyans and values of antiradical activity in the fresh and frozen berry samples are not significantly different. Freezing of fresh plant materials to –18 ˚C is suitable for preservation of their basic biological properties (content of anthocyans, vitamin C and antiradical activity). These plant materials can be used for direct consumption and also to rise the biological value of human nutrition.

Keywords: freezing, anthocyans, vitamin C, antiradical activity, berries.

Introduction

Recently, scientists in the biological and medical field of study are interested in observation of various biological active substances of plant materials in order to improve the quality of human nutrition and to protect the biological value of these plant materials by basic technological storage methods, especially by freezing.

Anthocyans are secondary plant metabolites responsible for the blue, purple, and red colour of many plant tissues. The phenolic structure of anthocyans conveys marked antioxidant activity in model systems via donation of electrons or hydrogen atoms from hydroxyl moieties to free radicals (Ramirez-Tortosa et al., 2001).

Edible berries, a potential source of natural anthocyan antioxidants, have demonstrated a broad spectrum of biomedical functions. These include cardiovascular disorders, advancing age-induced oxidative stress, inflammatory responses, and diverse degenerative diseases. Berry anthocyans also improve neuronal and cognitive brain functions, ocular health as well as protect genomic DNA integrity (Zafra- Stone et al., 2007).

The objective of our research was to observe the influence of freezing on the biological value of selected berriy samples according to their antiradical activity, content of anthocyans and vitamin C.

Materials and Methods

The subjects of our research were various species and variants of berries that are widespread in the area of Hungary: *Vaccinium corymbosum* L. variant Blueray, *Vaccinium corymbosum* L. variant holland, *Vaccinium vitis idea* L. variant Koralle,, *Vaccinum mirtillus* variant Medea,, *Vitis vinifera* L. variants: Hamburgi muskotály, Othello and Saszla. The evaluation of content of anthocyans, vitamin C and antiradical activity were carried out under the supervision of assoc. prof. Maria Gilingerné Pankotai in the laboratory of the University of Semmelweis in Budapest.

A) Evaluation of the content of anthocyans

Principle of evaluation:

Anthocyan pigments were stated after their extraction from solid materials with acidified ethanol or after direct solution of liquid samples with HCl in ethanol by spectrophotometric measurement of absorbantion in absorption maximum (by the method of Fuleki and Francis (1968)).

B) Evaluation of the antiradical activity- DPPH· method

Principle of evaluation:

To evaluate the antiradical activity, a method based on the reaction of antioxidants with a stable radical 2,2- diphenyl- 1- picrylhydrazyle (DPPH·) in methanol solution was used. The absorbance at 515.6 nm was measured at different time intervals using a Shimadzu 1601 UV-VIS spectrophotometer until the reaction reached a plateau. The absorbance of the DPPH· without an antioxidant (control) was measured first. The decrease of absorbance in the course of time at characteristic wavelength is the evidence of reaction of the antioxidants from extracts with DPPH·, which signifies the antiradical activity of extracts (scavenge of DPPH· radicals). The value of antiradical activity is expressed via indicator EC_{50}, which shows the amount of antioxidants that is needed to decrease the concentration of antioxidants by 50 % (the method by Brand- Williams et al. (1995) and Sanchéz- Moreno et al. (1998)).

C) Evaluation of the content of vitamin C

Principle of evaluation:

The reduction property of ascorbic acid is used in this measurement. A basic solution is made from the chopped sample with phosphoric acid, which is filtered. Then Fe (III) ions are added, which are reduced to Fe (II)-ions by ascorbic acid.

Thereinafter dipridyl reagent is added to the Fe (II)-ions, which results a red complex. The content of this complex is measured by spectrophotometer (a method by Lásztity and Törley (1987).

Results and Discussion

Seasonal ripening of the most species of fruits results in the fact that only little part of fruits are consumed in fresh form and the larger part of the fruits must be stored. It follows that nowadays it is a very actual and important effort of nutritionists to discover the most suitable methods for storage of these important plant materials by the most efficient way in order to protect the biological active substances of fruits.

Our results show that the content of vitamin C, anthocyans and the value of antiradical activity remain almost the same after freezing of selected species of berries (*Vaccinium corymbosum* L. variant Blueray, *Vaccinium corymbosum* L. variant holland, *Vaccinium vitis idea* L. variant Koralle*,, Vaccinum mirtillus* variant Medea*,, Vitis vinifera* L. variants: Hamburgi muskotály, Othello and Saszla).

As the following tables show (Table 1, 2, 3) the avarage content of vitamin C, anthocyans and value of antiradical activity in the fresh and frozen berry samples are not significantly different ($p>0,05$). It is interesting, that in case of *Vaccinum mirtillus* variant Medea it was found a very high significant difference between the avarage content of vitamin C in fresh and frozen samples ($p<0,001$).

Table 1

The avarage content of vitamin C in selected species of berries in fresh and frozen samples

SAMPLES	The avarege content of vitamin C, mg/100g in fresh samples	The avarege content of vitamin C, mg/100g, in frozen samples	P value	Statistical significance
***Vaccinium corymbosum* L. variant Blueray**	10.00 ± 1.00	9.86 ± 0.57	1	-
***Vaccinium corymbosum* L. variant holland**	10.00 ± 0.995	10.02 ± 0.85	1	-
***Vaccinium vitis idea* L. variant Koralle**	47.4 ± 1.06	45.8 ± 1.56	1	-
***Vaccinum mirtillus* variant Medea**	76.65 ± 1.10	73.8 ± 3.86	0.00011	+++
***Vitis vinifera* L. variant Hamburgi muskotály**	28.75 ± 0.61	24.6 ± 1.62	1	-
***Vitis vinifera* L. variant Othello**	12.79 ± 0.86	10.8 ± 0.86	1	-
***Vitis vinifera* L. variant Saszla**	25.77 ± 1.14	24.4 ± 0.82	1	-

+++ very high statistical significance

Table 2

The avarage content of anthocyans in selected species of berries in fresh and frozen samples

SAMPLES	The avarege content of anthocyans, g/kg in fresh samples	The avarege content of anthocyans, g/kg, in frozen samples	P value	Statistical significance
***Vaccinium corymbosum* L. variant Blueray**	4.231 ± 0.117	4.204 ± 0.096	1	-
***Vaccinium corymbosum* L. variant holland**	1.433 ± 0.087	1.440 ± 0.132	1	-
***Vaccinium vitis idea* L. variant Koralle**	1.262 ± 0.090	1.250 ± 0.211	1	-
***Vaccinum mirtillus* variant Medea**	0.826 ± 0.094	0.798 ± 0.160	1	-
***Vitis vinifera* L. variant Hamburgi muskotály**	0.902 ± 0.062	0.900 ± 0.19	1	-
***Vitis vinifera* L. variant Othello**	1.644 ± 0.076	1.620 ± 0.062	1	-
***Vitis vinifera* L. variant Saszla**	0.440 ± 0.070	0.453 ± 0.981	1	-

Table 3

The avarage value of antiradical activity in selected species of berries in fresh and frozen samples

Samples	EC_{50}, g in fresh samples	EC_{50}, g in frozen samples	P value	Statistical significance
***Vaccinium corymbosum* L. variant Blueray**	0.0972 ± 0,0168	0.0977 ± 0.0878	1	-
***Vaccinium corymbosum* L. variant holland**	0.0995 ± 0.0139	0.0999 ± 0.0109	1	-
***Vaccinium vitis idea* L. variant Koralle**	0.0974 ± 0.0041	0.0975 ± 0.008	1	-
***Vaccinum mirtillus* variant Medea**	0.0995 ± 0.0101	0.0998 ± 0.0137	1	-
***Vitis vinifera* L. variant Hamburgi muskotály**	0.0995 ± 0.0101	0.0994 ± 0.0167	1	-
***Vitis vinifera* L. variant Othello**	0.1026 ± 0.0091	0.1028 ± 0.0331	1	-
***Vitis vinifera* L. variant Saszla**	0.0959 ± 0.0067	0.0960 ± 0.001	1	-

By comparison of the vitamin C and anthocyans content and the value of the antiradical activity in selected species of berries it is evident that freezing of these samples does not cause significant changes in the biological value of these fruits. This important finding is a strong argument for the eligibility of freezing as an effective storage method, which do not cause significant loss of the biological active substances and do not decrease the biological value of these fruits. A very similar fact was also confirmed by studies of Ayala- Zavala et al. (2004). They have proved that the low temperature of the storage influence positivly the quality of fruits and it also decreases the risk of putrefaction caused by fungi.

Conclusions

Freezing of berry species by the temperature of –18 ˚C can protect their biological value, especially their content of vitamin C, anthocyans and value of antiradical activity. These findings can be utilisied as one of the suitable technological methods by plant materials storage as well as for industrial purposes and also commenly in households. These plant materials can also be used for direct consumption and also to rise the biological value of human nutrition.

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