THE INFLUENCE OF STORAGE CONDITIONS OF CANDIED FRUITS ENRICHED WITH VITAMIN C BY DIFFERENT METHODS ON ITS CONTENT

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ABSTRACT

The aim of this work was to study the effect of storage conditions of candied fruits enriched with vitamin C on its concentration in that product. The materials were candied fruits (black chokeberry and black currant) enriched with vitamin C by two methods during their production. The final products were stored within 3 months at 8 and 20°C. On the basis of the results it was stated that enrichment method affected the concentration of the vitamin C in fruits measured during storage period at the above conditions.

Keywords: food enrichment, vitamin C, candied fruit

INTRODUCTION

Candied fruits are produced from fresh or frozen fruits, that are properly prepared and saturated with sucrose that also contains potato syrup and possibly food acids. Among different fruits, the most often candied are cherries, currants, black chokeberries, apricots, plums, gooseberry and orange peel. Candied fruits are used in sugar industry where they play role as food additives for cakies or as taste and decorative agents in the production of ice-creams, desserts and coctails **(Szczurek, 1995; Jurczyk,1999).**

Food enrichment is the practice that is more and more often used in food technology and storage in order to avoid the excessive looses of nutritive compounds. This process relies on addition one or more nutritive compounds to the food products so that the final product is rich in deficitive food compounds. Process of food enrichment is mainly used for prevention and correction of vitamin and mineral compound deficits. It is the cheaper and the most effective way of improvement of a food pro-healthly quality, as well as the way of supplementation of the deficient nutritive compounds in a diet **(Krola & Witkowska 2005; Sikorski, 2007)**.

Food concerns try to enrich the food with nutritive compounds and vitamins in order to improve its dietary properties. The new technologies of food enrichment that will assure that the final product will be wholesome not only just after production but also during all the storage period are stillbexpected.

The aim of this work was to study the effect of storage conditions of candied fruits enriched with vitamin C by two methods on its concentration in these fruits.

MATERIAL AND METHODS

The candied fruits: black chokeberry and black currant were produced by PROSPONA Ltd, Fruit and Vegetable Processing in Nowy Sącz. During processing vitamin C was added to the above fruits by two methods. The first method involved 2-stage enrichment process of fruits with vitamin C, while the second one 4-stage process. The total amount of added vitamin C was the same in both methods. The final products were stored in plastic boxes within 3 months at temperature 8 ºC (± 0.5) and 20 ºC (± 0.5).

The content of vitamin C was determined by spectrophotometric method (according to PN-90/A-75101/11), both in raw materials and in final product after 1st, 2nd and 3th months.

In order to assess the significance of differences in content of vitamin C between candied fruits enriched by two methods the one-way analysis of variance and Tukey test (α=0.05) were used. The effect of both enrichment method, and storage time at 8 and 20 °C temperatures on the vitamin C concentration in fruits products were determined using two-way analysis of variance.

RESULTS AND DISCUSSION

The table 1 presents the content of vitamin C in the produced candied fruits. The concentration of vitamin C in fresh black choceberry was in accordance with the data from literature, whereas that in black currant was lower than other data **(Gawęcki & Hryniewiecki, 2007; Skupień & Oszmiański, 2007)**. The lower content of vitamin C in black currant can result from the variety of fruit, as well as losses occured during non-adequate condition of transport of fruit to the company. The methods I and II used to enrich black choceberry with vitamin C caused the increase of the vitamin C concentration to the same level. The opposite effect was stated in the case of black currant, where the method II was more effective in the enrichment process than method I. The black currant enriched with vitamin C by method II contained over 10 % more vitamin C than the black currant enriched by method I.

Table.1 Content of vitamin C in raw material and candied products [mg/100 g of product].

Kind of sample	Material	
	Black chokeberry	Black currant
Raw material	7.5 ± 0.4	81.4 ± 0.4
Candied product enriched by method I	78.9 ± 4.4[a]	268.4 ± 0.3
Candied product enriched method II	85.2 ± 4.0[a]	303.1 ± 3.1

Means followed by the same letters are not significantly different at α = 0.05.

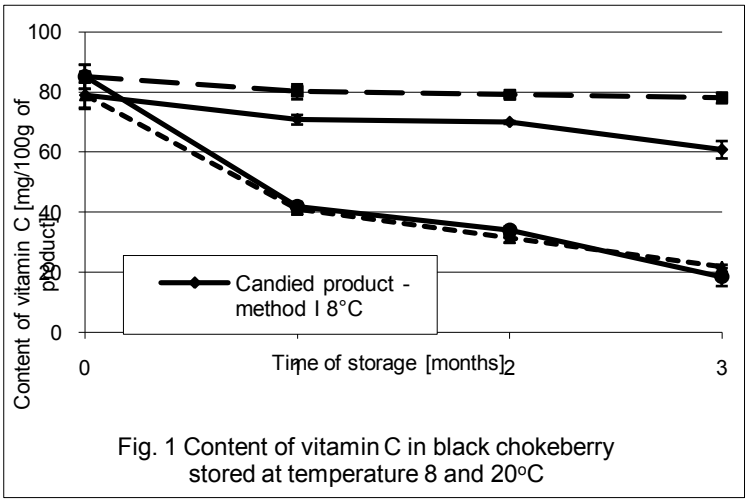

Fig. 1 Content of vitamin C in black chokeberry stored at temperature 8 and 20°C

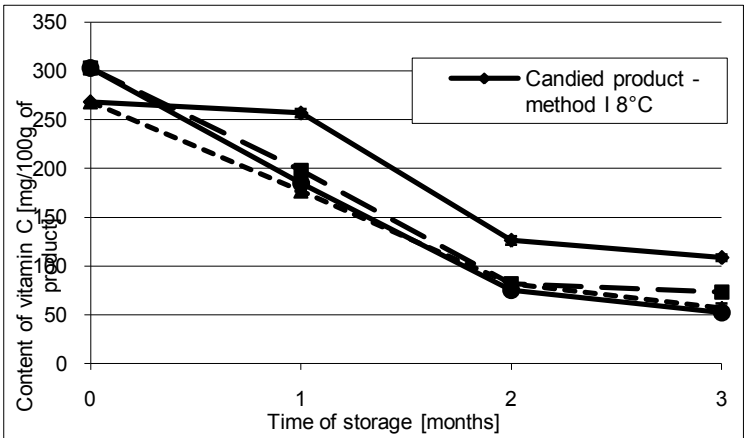

Fig. 2 Content of vitamin C in black currant stored at temperature 8 and 20°C

Figure 1 presents the results of determination of vitamin C content in enriched black chokeberry stored at 8 and 20° C within 3 months.The longer was the storage time the lower was vitamin C content in the black chokeberry. The losses of vitamin C in the black chokeberry fruits stored at cold temperature were lower than these for fruits stored at room temperature, and it is in accordance with the literature data **(Kabasakalis et al., 2000)**. Two-way analysis of variance showed that the storage time in both temperatures 8 °C ($F_{calc.}$ = 22.77; F_{test} = 3.24) and 20 °C ($F_{calc.}$ = 646.48; F_{test} = 3.24) affected the content of vitamin C in the candied black chokeberries enriched with that vitamin by both methods. Enrichment method affected the vitamin C content in the candied black chokeberry stored only in temperature 8 °C ($F_{calc.}$ = 93.94; F_{test} = 4.49). As for whole storage period, the candied chokeberries enriched with vitamin C by method II contained more vitamin C in comparison with method I. Storage losses of vitamin C (at temperature 8 °C) in the candied black chokeberry enriched by method I amounted to over 8% after 3-months-storage period, whereas these determined in the candied fruits enriched by method II amounted to 20 % (calculated in relation to the vitamin C content of the beginning of storage period).

Figure 1 presents the results of determination of vitamin C content in enriched black currant stored at 8 and 20 ° C within 3 months. Similary to the black chokeberries, vitamin C content in the black currants enriched with vitamin C by both methods was gradually decreasing with storage time and it depended on storage temperature. Two-way analysis of variance showed that storage time affected vitamin C content in fruits stored at both temperatures (8 °C – $F_{calc.}$ = 4685.60; 20 °C – $F_{calc.}$ = 7549.68; F_{test} 3.24). Moreover, the results of statistic analysis showed that kind of enrichment method affected losses of vitamin C in fruits stored at both temperatures (8 °C – $F_{calc.}$ = 347.15; 20 °C – $F_{calc.}$ = 42.06; F_{test} 4.49). In the case of enrichment method I, the storage losses of vitamin C in the black currant were greater than these stated for method II, regardless of storage temperature. It can be concluded that the storage stability of vitamin C added to black currants by method I was higher than that of method II.

CONCLUSION

On the basis of the results it was stated that the concentrations of vitamin C in black chokeberries enriched by two different methods were similar. In contrast, the content of vitamin C in the candied black currant enriched by method II was higher than that of fruits enriched by method I. Storing the of analyzed products at the temperature 8 °C resulted in better vitamin C stability in comparision with storing at temperature 20 °C. The black chokeberries enriched with vitamin C by method II and stored at temperature of 8 °C exhibited better vitamin C stability comparing with these enriched by method I. Stability of vitamin C determined in candied black currants enriched by method I was greater than that found in the case of candied product enriched by method II, regardless of the storage temperature.

REFERENCE

GAWĘCKI, J., HRYNIEWSKI, L. 2007. Żywienie człowieka. Podstawy nauki o żywieniu. PWN Warszawa 2007.

JARCZYK, A. 1999. Kandyzowanie owoców i warzyw. In *Przemysł Spożywczy*, 1999, 4**,** 19-20.

KABASAKALIS, V., SIOPIDOU, D., MOSHATOU, E. Ascorbic acid content of commercial fruit juices and its rate of loss upon storage. In *Food Chemistry*, 2000, 70, 325-328.

KROLA L., WITKOWSKA, M. 2005. Kinetyka degradacji witaminy C w warzywach kapustnych przechowywanych w kontrolowanej atmosferze. In *Przemysł fermentacyjny i owocowo – warzywny*, 2005, 12, 30-32.

POLSKA NORMA PN-90/A-75101/11 Przetwory owocowe i warzywne. Przygotowanie próbek i metody badań fizykochemicznych. Oznaczanie zawartości witaminy C.

SIKORSKI, Z. E (red). 2007. Chemia żywności. Składniki żywności. Tom I, WNT, Warszawa 2007.

SKUPIEŃ, K. i OSZMIAŃSKI J. 2007. The effect of mineral fertilization on nutritive value and biological activity of chokeberry fruit, Agricultural and Food In *Science*, 2007, 1, 46-55

SZCZUREK, G. 1995. Owoce kandyzowane – ich wyrób, przygotowanie i zastosowanie w technologiach ciastkarskich i cukierniczych. In *Przegląd Piekarski i Cukierniczy*, 1995, 4, 22-23.

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