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Characterization of bioactive compounds in whole dry and atomized blueberries

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Abstract

The purpose of this research study is to determine the influence of the atomization and drying processes of blueberries (*Vaccinium myrtillus L.*) on two classes of bio-active compounds, vitamin C and anthocyanins.

Vitamin C was determined titrimetrically and the amount of anthocyanins was determined spectrophotometrically.

Regarding the vitamin C content, there is a decrease in atomized blueberries (40.82mg / 100g) compared to the blueberries fruit (48.93mg / 100g), and in the case of anthocyanin content there are significant differences, the atomized blueberries having a lower content (48.93mg / 100g) compared to the blueberries fruit (126.8mg / 100g).

Because there is significant difference between the samples analyzed in terms of vitamin C content and anthocyanins, it results that the atomization process influences the content of bioactive compounds quantitatively. By atomization the total surface of the oxygen in the air increases, increasing the risk of oxidation of anthocyanins.

Keywords: blueberries, anthocyanins, vitamin C, spectrophotometer

1. Introduction

Blueberries are one of the most consumed fruits in the world because of the properties they have [1].

Blueberries for many years have been traded in North America, but nowadays blueberries are grown throughout the world [2]. From many research it follows that blueberries has a higher antioxidant capacity than some fruits such as plums, raspberries, strawberries and blueberries. Blueberries have been reported to be beneficial in maintaining memory function, inhibiting the growth of cancer cells, preventing gastrointestinal disorders [4].

They are the most well-known berries in the markets, sold fresh, frozen, and processed for various food applications. Blueberries are known for bioactive compounds, including phenolic acids, tannins, flavonoids, and anthocyanins that help individually or synergistically against cardiovascular disease, diabetes, inflammation, obesity, and other chronic diseases [3]. The content, structure and antioxidant activity are important in the nutritional field and are of interest to the food industry and the pharmaceutical industry [5]. Anthocyans include a large group of water-soluble pigments, part of the flavonoid class.

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These give the colors red, blue, purple and black to more fruits, vegetables and flowers. There is an increasing interest in anthocyans such as natural food colorants, but also as pharmaceuticals due to therapeutic effects [6].

The purpose of the research is to determine the influence of the preservation on the active compounds in blueberries.

2. Materials and Methods

The blueberries (*Vaccinium myrtillus L.*) were harvested from 15 July to 15 August in the Apuseni Mountains, Horea, Alba County.

To achievement the dietetic and functional product have been used dried and ground blueberries. The blueberries were pressed and the pulp dried. The drying it was made in rooms equipped with fans and dehumidifiers in trays on a single layer, at room temperature for a maximum of 2 to 3 weeks.

2.1. Determination of anthocyanins pigments

The anthocyanins pigments were extracted from whole blueberries and atomized blueberries in methanolic acid according to the method described by *Abdel-Aal et al. (2002*) [7] and *Sconta* (2012) [8]. The total anthocyanins content was determined by the differential pH method. Changing pH results in reversible change in color of monomeric anthocyanins. The results are expressed as the equivalent of cyanidin-3-glucoside.

Two dilutions were prepared from each sample, the first in potassium chloride buffer (0.025 M, pH 1.0), and the second in sodium acetate buffer (0.4 M, pH 4.5) and with HCl was made adjusted pH. Samples were left at room temperature for 15 minutes for balancing.

Absorbance readings for both dilutions were made at 520 nm and 700 nm respectively with the Jasco V-530 double UV-VIS spectrophotometer.

For the determination of anthocyanin pigments, it was used the calculation formula in mg of cyanidine-3-glucoside equivalents:

$$TA = \frac{A \times MW \times DF \times 1000}{\varepsilon \times L}$$

Where: A = (A520 nm - A700 nm) pH 1.0 - (A520 nm - A700 nm) pH 4.5; MW (molecular weight) = 449.2 g / mol for cyanidin-3-glucosides (cyd-3-glu); DF = dilution factor; 1000 = conversion factor from g to mg; ε = 26,900 molar extinction coefficient, in L x mol-1 x cm-1 for cyn-3glu; L = optical path length (1cm) (*AOAC, 2005).*

2.2.Determination of vitamin C

Based on the reducing property of ascorbic acid, the chemical methods of vitamin C by oxidation convert to dehydroascorbic acid the method proposed by *Stanila (2013*) [9].

Until the blue coloration in the presence of potassium iodide and starch, the vitamin C acid extract is titrated with potassium iodate.

With a precision of 0.001 g on the analytical balance (Shimadzu Corporation), 10 g of blueberries were weighed, which in a mortar was triturated with about 10 ml of 2% HCl solution and 2.5 g of quartz sand for 10 minutes.

Pass quantitatively into a 50 ml volumetric flask, make up to volume with 2% HCl, then filter through a filter. Pipette 10 ml of the filtrate into a 100 ml Erlenmeyer flask, add 30 ml of distilled water, 5 ml of KI, 5 ml of HCl and 1.5 ml of starch. Titrate with a solution of potassium iodate to the blue color, this must persist for 30 seconds.

Calculation of the result:

$$\text{Vitamin C mg\%} = \frac{N * 5 * 0{,}325 * 100}{M}$$

where:
N - number of ml used for titration
m - grams of material taken in the analysis

2.3. Statistical analysis

The ANOVA analysis of variance was used to compare the mean values, using the SPSS 19.0 statistical analysis (IBM, Armonk, New York, USA) and a Turkey HSD test with a confidence interval of 95% or 99%. Differences were considered to be significant at $p < 0.05$.

Values are expressed as mean of two replicates. Significant differences are denoted by asterisks: *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; $p \geq 0.05$, non-significant.

3. Results and Discussions

For anthocyanin analysis p = 0.000, and for vitamin C p = 0.001, as can be seen in Table 1 is significant difference between samples.

At the vitamin C content, there is a decrease in the atomized blueberries (40.82mg / 100g) compared to the blueberries fruit (48.93mg / 100g), and in the case of anthocyanin content there are significant differences, the atomized blueberries having a lower content (48.93mg / 100g) compared to the blueberries fruit (126.8mg / 100g).

Table 1. Statistical results of bio-active compounds in two types of pre-processed blueberries

Sample	Vitamin C (mg/100g)	Total anthocyans (mg/100g)
A_t (atomized blueberries)	40.82±0.27	81.54±0.82
A_{fr} (whole blueberries)	48.93±0.26	126.8±0.35

Quantitative data obtained in the case of anthocyanin content are comparable to those quoted in the literature 182 ± 9 mg / 100 g [10]; 101.88 ± 2.36 mg / 100 g - 195.01 ± 2.65 mg / 100 g [5], this being in the fresh state, therefore there are no major quantitative differences with the results of the present study in which the blueberries were dried 126.8 ± 0.35 mg / 100g. With regard to the blueberries atomized in the present study 81.54 ± 0.82 mg / 100g, there is a slight difference compared to the literature mentioned above.

As can be seen in another specialty study, the amount of anthocyanins of different varieties of fresh blueberries, Elliot 163.40 ± 16.4; Bluecrop 160.76 ± 13.9 mg / 100g; Duke 100.58 ± 13.5 mg / 100g; Wild 1 300.02 ± 27.9 mg / 100g; Wild 2 252.23 ± 18 mg / 100g; (Sconta, 2012) were compared with 126.8 ± 0.35 mg / 100g dried cranberries in the present study, resulting in insignificant differences.

A study on frozen blueberries containing 1.94 ± 0.03 mg / g anthocyanins [11] shows that the amount of anthocyanins is higher in the case of atomized and dried blueberries 81.54 ± 0.82 in the present study, the drying process is more effective in keeping bioactive compounds, for example anthocyanins. There are no major meanings for dried blueberries (126.8 ± 0.35) in the present study compared with fresh blueberries175.9 ± 2.4 mg / g [11] from the literature.

Following the literature, one can notice that Vaccinium uliginosum, another species of blueberries, contains vitamin C 26.20 mg / 100 g, which is fresh [12], this value is lower compared to the present study, blueberries dried fruit (48.93 ± 0.26), atomized blueberries (40.82 ± 0.27). However, the differences may be due to several factors, the seasons, the country of origin (soil, climate and cultivation techniques), harvesting, post-harvesting and analytical methods for the quantification of vitamin C.

Conclusions

Following statistical analysis, it can be seen that atomized blueberries (40.82mg / 100g) have a lower amount of vitamin C compared to fruit blueberries (48.93mg / 100g). Also, in the case of anthocyanin content, there are significant differences, the atomized blueberries having a lower content (48.93mg / 100g) compared to fruit blueberries (126.8mg / 100g). Between the two samples there are significant differences in vitamin C and anthocyanin content, it results that the atomization process influences quantitatively the content of bioactive compounds,by atomization the total surface of the oxygen in the air increases, increasing the risk of oxidation of anthocyanins.

Compliance with Ethics Requirements. Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards.

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