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Preliminary research on the proximate composition of blackberry fruits (*Rubus fructicosus*)

Ariana B.Velciov[1], A-I. Birtea[1], Sofia G. Popescu[1]*, A. Nicolae[1], Simelda E. Zippenfening[1], Monica Gabriela Dinu[2], Nicoleta G. Hădărugă[1]

[1]Banat's University of Agricultural Sciences and Veterinary Medicine "King Michael I of Romania" from Timisoara, Faculty of Food Engineering, 300645-Timisoara, Romania, CaleaAradului 119, Romania, Phone: +40-256-277327; Fax: +40-256-277261

[1] Viilor Economic College, 38th Viilor Street, 050151, Bucharest, Romania*

Abstract

This study aims to determine the proximal composition of local blackberries variety (*Rubus fruticosus*), marketed in different agri-food markets in Timisoara (Romania) and highly appreciated due to its flavor and taste, but also for the outstanding nutritional and curative qualities.These fruits are consumed by the local population either as a fresh fruit or in the form of jams, syrups or pastry, etc. The high content of antioxidants, minerals, vitamins, carbohydrates (especially simple sugars) suggests that these fruits could be considered as functional foods.

The blackberry fruits have been analyzed for their proximal composition: fruit weight, dry matter, total mineral content (ash), total soluble substances (TSS), and titratable acidity through recommended standard procedures.

The preliminary results show that the analyzed fruits had weight (6.01 g – 7.23 g), dry matter (11.24 - 12.63%), total minerals (0.34 – 0.44%), total soluble solids (11.6-12.7 °Brix), pH (3.1–3.5), total treatable acidity (0.9– 1.2 % citric acid) and TSS/TTA Ratio (9.66 – 14.11).

Keywords: blackberry, physico-chemical properties, proximate composition

1.Introduction

Blackberries, fruits of the Rubus fruticosus L. shrub, are famous for their nutritional, medicinal and cosmetic value [1]. Blackberries were among the fruits with the highest content of antioxidants, including resveratrol. They also contain significant amounts of vitamins and minerals, trace elements and substances with anti-inflammatory, anti-bacterial, anti-aging and anti-cancer role. The main bioactive substances found in blackberries include vitamins C and E and complex B (B_1, B_2, B_3, B_5), vitamin B_6, resveratrol, folic acid, minerals (Fe, Mg, Ca, K, Cu, Mn, Na, P, Se), tannins, high quality sugars, proteins and very few vegetable oils [2]. Nutritional profile of berry fruit shows that 100 g blackberries are containing: 88.15 g water, 0.39 g ash, 0.49g fat, 1.39 g protein, 9.61g carbohydrates, 5.3 g dietary fiber, 25 µg folates, 0.030 mg pyridoxine, 0.646 mg niancin, 0.276 mg pantothenic acid, 0.020 IU thiamin, 21 mg vitamin C, 214 IU Vitamin A, 19.8 µg Vitamin K, 1.17 mg Vitamin E, 162 mg K, 29 mg Ca, 1 mg Na, 20 mg Mg, 165 mg Cu, 0.62 mg Fe, 0.53 mg Zn, 0.646 mg Mn, 0.4 µg Se, 118 µg lutein-zeaxanthin, 0.014g total saturated fatty acids, 0.047 g total monosaturated fatty acids [3].

All the data presented above support the assertion that blackberries can be considered functional foods. Due to the supply of vitamins, active substances and minerals, these fruits are important in human therapy: they are used as a remedy for the prevention of colon and stomach cancer, helps regulate intestinal transit, helps the nervous system to function well, strengthens the bones, detoxifies the liver, strengthen the immune system, protect the eyes, prevent anemia, soothe the wounds of the neck, have healing effect and are good for diabetics, etc. [4,5].

Corresponding address: sofia.pintilie@gmail.com

The beneficial effects of the blackberries consumption are due to the reduced calories, lower energy density and low fat content, increased vitamin content, essential mineral elements, fiber and simple sugars, as well as the presence of numerous bioactive constituents [6,7,8]. Specialized literature data in this field are presenting the physico-chemical characteristics of different varieties of blackberries and how they are determined. We mention in this regard the studies developed by Yilmaz *et al.* [9], Mayara Schulz *et al.* [7], Shivraj Hariram Nile and Se Won Park [8], Keservani *et al.* [1], Muhammad Zia-Ul-Haq *et al.* [6], Elisabeta Elena Tănase *et al.* [10] and Ilkay Tosun *et al.* [11], who showed that fruit weight, titratable acidity, pH and total soluble solids contents varies widely, depending on the variety of fruit cultivation techniques and climatic conditions during harvest, etc. Accidentally, in case of inappropriate cultivation and processing conditions, these fresh or processed fruits can be contaminated with various harmful compounds: heavy metals, pesticides, etc. [12]. Therefore, it is important and necessary to perform the physico-chemical analysis of these fruits both for the evaluation of the nutritional contribution, as well as for the determination of the degree of contamination with various harmful compounds with toxicogenic potential, as well as harmful by-products resulting from their oxidation.

The purpose of the work is to determine the physico-chemical parameters for native blackberries marketed in different agri-food markets in Timisoara: weight of fruit, content of soluble substances (TSS), titratable acidity (ripening index), total solids content (dry matter) and mineral substances (ash).

2.Materials and methods

2.1.Materials

In order to carry out the experiment, samples of blackberries marketed in 3 markets from Timisoara (Provider 1-3) were taken, for each agry-food market the 500 g fruits were taken, of which 9 samples were prepared for analysis (3 samples from each provider); each sample consisted of 50 fruits. The fruits were analyzed during the optimum ripening period- August 2019, being kept until analysis, in the refrigerator at 4 ^{0}C.

2.2. Methods

The weight determination of the blackberry fruits was made by weighing them on the analytical balance [7,9]. The average weight of the berries represents the arithmetic average calculated from 25 weighings; the weight of the blackberry were measured with the whole fruit.

The dry matter content was obtained by drying the samples in the oven at 105^0 C [7]. Basically, 10 g blended and homogenized fruits weighed on the analytical balance were dried in the oven at 105^0 C, for 12 hours, until constant weight of fruits. The dry matter content, expressed as a percentage, was determined using the relation:

$$DM\ (\%) = \frac{m_2}{m_1} \cdot 100$$

where: m_1 - the mass of fresh sample (g) și m_2 - mass of dry sample (g).

Total mineral content **(**ash) was measured gravimetrically by incinerating the samples at 525 ± 25 °C to constant weight [2]. In order to determine total mineral content we used samples of already dried blackberries.

The total mineral content was calculated using the relation:

$$Ash\ (\%) = \frac{m_2}{m_1} \cdot 100$$

where: m_1 - the mass of fresh sample (g); m_2 - mass of the residue after calcination (g);

Total titratable acidity (TTA) was determined with potentiometer Consort C 932, taking 10 g of pure fruit extract plus 10g of distilled water to obtain a 1:1 solution [7], at pH=8.2. Blackberry juice was obtained by blending the blackberries, followed by centrifugation, in the Universal 32-R HETTIC - ZENTRIFUGEN centrifuge for a time (at 9000 rpm / min, for 5 minutes).

The computer showed the pH and the volume of reagent required for titration in millimeters, so that the percentage of acidity was calculated by the following formula:

$$Acidity\ (\%) = \frac{V * N * C}{W} * 100$$

where: V - NaOH used volume (mL); N - NaOH normality (0.1 N); C – citric acid constant (0.007 g/mEq); W: sample weight (g) [13].

For TSS determination, a HI 96804 refractometer (Inverted Sugar) was used with one pure extract juice of blackberry as sample and the results were expressed in Brix degrees [7].

The pH measurements were made directly from blackberry juice, by using Electochemical Analiser Consort C-932 calibrated with pH 4 and 7 buffers [9]. TSS/TAc Ratio on the basis of ripening index (RI) was calculated from the measured data SSC/TA [14].

All measurements were carried out in triplicate, and presented as mean ± SD. The correlation and linear regression analyses were performed using Microsoft Office Excel 2003.

3.Results and discussions

Experimental results obtained after the determination of some physico-chemical and proximate composition for blackberry fruits: fruit weight, dry matter, ash, TSS, TTA, pH and TSS/TTA are shown in Tables 1 and 2.

The determined parameters are important for assessing the quality of the blackberries.

The weight of the fruits ranged between 6.01 g to 7.23 g. These values are comparable to those obtained by Milošević et al., when analyzing the blackberries from cultivars, so we can consider that analysed fruits come from cultivated species. The obtained values places blackberries within the preferences of both consumers and processors, because excessive or too little weight has a direct effect on the acceptance of blackberries.

The values presented in Table 1 regarding the dry matter content, lead to the idea that they are specific to the milder climatic conditions in the summer of 2019. Comparing the values obtained with those in the literature [9,11, 14,15], no noticeable differences are observed.

The ash content shows that the analyzed fruits are rich in minerals, characteristic for this kind of fruit.

Table 1. Proximate composition of analyzed blackberries

Specificare	Weight, (g)	Dry matter (%)	Total minerals (ash), %
Provider 1	7.23±0.62	11.24±0.35	0.34±0.03
Provider 2	6.46±0.35	12.63±0.42	0.44±0.05
Provider 3	6.01±0.47	12.41±0.44	0.38±0.04

Table 2. Physico-chemical characteristics of analyzed blackberries

Specificare	Total soluble solids (TSS), °Brix	Total titratable acidity (TTA), % citric acid	pH	TSS/TTA
Provider 1	11.6±0.43	1.2±0.03	3.1±0.03	9.66±0.63
Provider 2	12.7±0.53	0.9±0.05	3.5±0.04	14.11±0.52
Provider 3	12.3±0.36	1.0±0.04	3.4±0.03	12.3±0.43

TSS are describing the level of sugar and are characteristic values of the fruits .

The values obtained from the determination of pH and TTA are between 3.1-3.4, respectively 0.9 and 1.2 and are characteristic of ripening fruits that are describing the acidity and sweetness of blackberry fruits.

The TSS is a better indicator of blackberry maturity appreciation and also very important in establishing their provenance.

The proximal composition of blackberry fruits could be influenced by the species, genotype, age, environment conditions, ripeness of the fruit, storage and processing methods.

Titratable acidity, a very important quality attribute, is responsable for influencing berry taste. Data presented in Table 2 indicated that TTA significantly varied between 0.9 to 1.2 % citric acid. These values are characteristic of the 2019 climatic conditions (high temperatures and low rainfall).

The ones presented above are also confirmed by the RI values (9.66 - 14.11). RI plays an important role for apreciation the nutritional value, customer acceptance and optimum harvesting period.

Conclusions

According to our findings, we can also conclude that the blackberry fruits were harvested in optimal ripening period. Finally, it can be concluded that the analyzed blackberries are favorably appreciated in terms of appearance, taste and aroma and are recommended for consumption either as such - in fresh form, or in various food preparations.

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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