Chemical composition of peatland small cranberry (*Vaccinium oxycoccus*) for potential use as functional ingredient

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Abstract

Introduction. The aim of the present study was to determine, for the first time, the small cranberries (*Vaccinium oxycoccus*) chemical composition depending on depending on growing soil.

Materials and methods. The analyses were made on ripe fruits of the plant, harvested from Romania, Suceava county, Coșna commune, in a peat area. The mineral content was determined using a coupled-mass spectrometer (ICP – MS). DPPH method was used for antioxidant activity determination. Folin Ciocalteu method and HPLC analysis were used for polyphenol content determination.

Results and discussion. A value of 84.1% was obtained for fruits' moisture content, close to the values found in other studies. For ash, a relatively low value of 1.38% was obtained that shows a low mineral content, corresponding to the low mineral content of the soil. However, the mineral content of the analyzed fruits is higher than that reported by other studies. For most of the elements there was a positive correlation between mineral content in fruits and soil. A significant amount of calcium was observed in the studied cranberries, close to the average means reported in other studies. Magnesium falls within the limits determined in other studies, and the copper content as well. The contents of manganese, iron and zinc were lower than in other studies. The contents of arsenic, mercury and stibium were below the maximum approved limits and led is under the detection limit. Regarding the antioxidant capacity, the inhibiting percent of free radicals and total content of polyphenols is higher in aqueous extract than in the ethanolic extract and medium content in the studied fruits, in comparison with other reported data: 340.78 mg/100g in aqueous extract and 254.20 mg/100g in ethanolic extract. According to the results obtained by different authors, the total amount of polyphenols is significantly higher in the wild fruits of *Vaccinium oxycoccus*, as compared to grown cultivars.

Regarding to polyphenols, a high content of quercetin, 0.39 mg/100g, and myricetin, 0.23 mg/100g, is noteworthy. In the ethanolic extracts, chlorogenic acid, 0.42 mg/100 g, and p-hydroxybenzoic acid, 0.41 mg/100 g, appear, close to numbers reported in other studies. However, the presence of rosmarinic acid, 0.12 mg/100g, was observed, which has not been reported previously. In the benzene extract, p-coumaric acid appears, 0.27 mg/100 g. Vitamin C present in the peatland small cranberries, 5.98 mg/100g, contributes to its antioxidant activity.

Conclusions. According to results of the present study, the chemical composition of peatland small cranberries from Romania was close to those obtained in studies on cranberries from other geographic regions, and may be considered as fruit with high antioxidant activity.

Introduction

Peatland small cranberry (*Vaccinium oxycoccus*) is a plant from *Vaccinium* genus from *Ericaceae* family, which includes over 450 species from Europe, North America, Central America, Japan and Asia, Central and South-Eastern Africa, Madagascar (Mabberley et al., 1997). Different blueberries species (*Vaccinium myrtillus*, *V. ashei*, *V. angustifolium*, *V. corymbosum)*, cranberries (*V. macrocarpon, V. oxycoccos*), huckleberry (*V. ovatum, V. parvifolium*), lingonberry (*V. vitis-idaea*) are the most known berries of this genus (Jurikova et al., 2018). The most known cranberry, the big cranberry, called American cranberry (*V. macrocarpon*), originates from the eastern and central North America, including Canadian Eastern territory and found in the highlands moors from North East and Great Lakes of United States (Česonienė et al., 2016). Its fruits Its fruits have been used in local medicine from the XVI century or even earlier (Narwojsz et al., 2019).The European relative of the big cranberry less known and studied is small cranberry, *V. oxycoccus*, with a larger geographical distribution.

Regarding the taste, big and small cranberries accumulate components with similar aroma. In total, between 40 and 70 aromatic substances were detected in big and small berries, meanwhile the fruits of the small cranberry have 4 to 5 times higher concentration of these substances than fruits of big one (Česonienė et al., 2016). The antioxidant activity (Ehala et al.,2005; Jurikova et al., 2018), anticancer activities (Masoudi and Saiedi, 2017), anti-obesity (Jurikova et al., 2018; Kowalska et al., 2014; 2015), cardioprotective (Nemzer et al., 2022) effects and urinary tract protection (Canja et al., 2016, Jurikova et al., 2018) of *Vaccinium oxycoccus* has been shown.

The small cranberries (*Vaccinium oxycoccus*) were gathered on peatlands from the North of Carpathian Mountains. The aim of the present study was to determine the small cranberries (*V. oxycoccus*) chemical composition, particularly the content of moisture, ash, trace elements, nitrites, polyphenols, and vitamin C, as well as their antioxidant activity, and to compare the present paperwork results with the those from other studies on cranberries grown on different areas.

Materials and methods

Materials

Plants harvested in Romania, Suceava County, Coşna commune were used from a peatland area, situated at 47.375188 latitude and 25.166790 longitude, stereo GPS coordinates 70 x = 652942,481, y = 512680,436, approximately 860 altitude (Figure 1, 2).

Ripe berries used for the study were harvested during September – October. Soil samples were taken from the same area to determine ash and minerals contents.

Determination of moisture content

The moisture content was determined by weighing berries sample, dried in oven till the mass remained constant. The moisture content was calculated by the following formula:

$$C, \% = (m_S - m_{DS}) \cdot 100 / m_S,$$

were m_S is sample mass before drying, g; m_{DS} is sample mass after drying, g.

Figure 1. Harvest area of *Vaccinium oxycoccus.*

Figure 2. *Vaccinium oxycoccus* flowers

Figure 3. *Vaccinium oxycoccus* - ripe cranberries

Determination of ash

To determine ash content, fruit and soil samples were calcinated at 800 ºC using a Nabertherm LE 2/11/R6 Muffle Furnace (Arvinte et al., 2019). The ash percentage was calculated by the following formula:

$$C, \% = m_{CS} \cdot 100 / m_s$$

where m_S is sample mass before calcination, g; m_{CS} is sample mass after calcination, g.

Determination of mineral content

The mineral content was determined by using ICP – MS Agilent Technologies 7500 series spectrometer; the samples were digested with concentrated nitric acid and hydrochloric acid (Arvinte et al., 2019). The metal concentration (C) was expressed in mg/100 g of sample and was calculated by formula:

$$C = a \cdot V/m,$$

where a is standard concentration, mg/L; V is a volume of the acid that dissolves the sample, L; m is mineralized sample mass, g.

The mineral content was determined in *Vaccinium oxycoccus* fruits and in soil, taken from the area where the fruits were harvested.

Determination of nitrite content

The determination of nitrite content in small cranberries was made using Griess method (Neacsu and Chirigiu, 2006). In slightly acidic medium (acetic acid) the nitric acid (nitrite) mixed with sulfanilic acid and α-naphthylamine form a red nitric acid. The intensity of pink color of the nitric compound formed as a diazotizing reaction between sulfanilic acid and nitrites from deproteinized watery extract and the subsequent coupling with α-naphthylamine was measured. Also, the substance absorbance was measured at 520 nm wavelength versus a blank.

Determination of the antioxidant capacity

The determination of the antioxidant capacity was made through DPPH (2-diphenyl-1-picrilhidrazil), which is one of the most stable nitrogen alkyls and commercially available, with a maximum absorption UV-VIS at 517 nm. DPPH methanol solution has a maximum absorption at 517 nm wavelength, due to the unpaired electron. In the presence of an antioxidant, the electron pairs, resulting the simple form of DPPH-H, discolored, and the absorption disappears. The result of the decolorating is directly proportional with the number of the captured electrons, so inversely proportional with the absorbance. Determinations were made for watery extract: 5 g sample in 200 mL of water were boiled for 30 minutes and alcoholic extract: 1 g sample in 50 mL of ethanol, obtained on an ultrasound tub, at 40 ºC and 25 KHz frequency from the plant berries. 5 mL of extract were mixed with 2.5 mL solution DPPH, $6 \cdot 10^{-5}$ M. Absorbance was determined on a fiber optic spectrophotometer from Ocean Optics, 5 min read time.

The inhibit percent of the free radicals, by comparison with DPPH was calculated with the formula:

$$I\% = A_0 – A_p/A_0 \text{ x}100,$$

where A_0 is standard substance absorbance and A_P is analyzed sample absorbance (Paduret at al., 2016).

Determination of the total polyphenol content

The determination of the total content of polyphenols was made through Folin-Ciocâlteu method, on the same extracts of 5 g samples in 200 mL water. Polyphenols are substances with antioxidant specificity. They are aromatic chemical compounds with more hydroxyl groups inserted on aromatic ring. Due to this structure, they can be oxidized by Folin Ciocâlteu reagent (Fc), with the formation of blue coloration with maximum of absorption at 700 nm. Folin – Ciocâlteu indicator is specific only to the phenol compounds with reducing properties. The calibration curve was made using gallic acid solution (Su et al., 2007). The sample for analyses was made from 2 mL extract, 1 mL Folin Ciocâlteu reagent and 8 mL of 7.5% Na_2CO_3 solution, mixed for 5 minutes, left to still for 30 minutes in the dark and the reading of the sample absorbance was done at 750 nm (Sripakdee et al., 2015).

The result is expressed as Fc indicator, achieved by calculus formula:

$$Fc = A_{750} \cdot d \cdot 100$$

where A_{750} is absorbance read at a 750 nm; d is sample dilution.

Identification and determination of the polyphenol content

Samples of 10 g of berries stepped into 100 mL of solvent (ethanol, ether and benzene) were analyzed. Phenolic extracts were analyzed using a liquid chromatography High Performance System (Shimadzu, Kyoto, Japan) equipped with liquid chromatograph LC-20 AD, auto sampler SIL-20A, column oven CTO-20AC and a detector with diode array SPD-M-20A. The separation was made on a Phenomenex Kinetex® 2,6 µm Bifenil 150 × 4,6 mm, column with 0,5 mL/min flow, and temperature controlled at 25°C. The sample injection volume was of 10 mL. A solvent system consisting of 0.1% acetic acid in water (A solvent) and acetonitrile (B solvent) was used with the following gradient: starting with 100% A and installing a gradient to obtain 5% B at 6.66 min, 40% B at 66.6 min and 80% B at 74 min, according to the method previously described with some modifications (Palacios et al., 2011). Solvent flow was of 1 mL/min. Phenol compounds were identified based on standard materials retention times and the quantification was made through chromatogram recording absorbance as oppose to external standards, at 280 nm for gallic acid, protocatechuic acid, vanillic acid, p-hydroxibenzoic acid and 320 nm for chlorogenic acid, caffeic acid, p-coumaric acid, rosmarinic acid, myricetin, quercetin, luteolin and kaempferol. All the standard calibration curves showed high linearity levels.

The analysis was done through infrared spectroscopy with Fourier transform (FT-IR) using a Nicolet i-20 spectrophotometer (ThermoScientific, SUA). The spectra were recorded in transmission mode using ATR system in the wave number rage of 4000–400 cm^{-1} at 4 cm^{-1} resolution. SpectraGryph–spectroscopy software was used to display spectra. The samples (peatland cranberries extract in ethanol, ether and benzene) were placed on the ATR crystal and the spectra were recorded in triplicates.

Determination of vitamin C content

The samples were obtained through mixing 5 g grounded berries with 12 mL acid solution (10% perchloric acid and 1% o-phosphoric), completed with mono-potassium phosphate 0.02 mol/L. The samples were analyzed with HPLC Agilent Zorbax Extend- C18 columns, 5 µm particle size, I.D. × L 150 cm × 4.6 mm, flow rate was 1.0 mL/min.

Results and discussion

Chemical composition of cranberries

The moisture content of peatland cranberries was 84.1% (Table 1). This explains the fact that these plants grow only in swamp areas, with high humidity, as compared with blueberries (*Vaccinium myrtillus*) and lingonberries (*Vaccinium vitis-idea*), which grow in swamps along with peatland small cranberries, but also on alpine meadows and even in alpine forests. The results corroborate with other studies (Table 2), which identified moisture content from 84.2% up to 92% for small cranberries, the highest moisture content was detected in berries collected in spring, after the snow has melted (Česonienė et al., 2016).

Table 1

Content of moisture and ash in peatland small cranberries and the soil they grow on

Sample	Ash (%)	Moisture (%)
Peatland small cranberries berries	1.38 ±0.09[b]	84.08±6.41[a]
Peatland soil 1	12.53±0.90[a]	70.10±5.39[b]
Peatland soil 2	12.51±0.99[a]	71.28±2.02[b]

For difference assessment was performed Student t-test. Values followed by a,b are statistically different at 95% confidence level.

Table 2

Comparison of the moisture and ash content in cranberries with those available in the literature

Source	Content, %	
	Moisture	Minerals
Our result	84.1	1.38
Česonienė et al. (2016)	84.2–92.0	0.20–0.28

One can remark a strong correlation between the low minerals content in small cranberries and that of soil. However, the mineral content of small cranberries is much higher than the figures obtained in other studies (0.20–0.28%) (Česonienė et al., 2016).

Soil samples were taken from two distinct areas, as peat soil is heterogeneous. Regarding the ash content, the highest values were found in the soil, not in the fruit. The difference were not significant at $p<0.05\%$. On the other hand, the moisture content was lower in the soil, differences being not significant at 95%

Most of the mineral elements found in the soil are also found in the cranberries fruit, but in smaller amounts (Table 3). There is an important calcium quantity in the studied peatland small cranberries, 11.04 mg/100 g, close to the average 13.0 mg/100 g related to other studies and significantly higher than the average calcium quantity from *Vaccinium macrocarpon*, 7.8 mg/100 g (Česonienė et al., 2016). Also, magnesium with 5.19 mg/100 g is situated between established limits by other studies, 2.9–9.1 mg/100 g. Manganese content of 0.05 mg/100 g is lower as opposed to other results 0.9–4.00 mg/100 g, although the manganese content in the soil is relatively high. Iron quantity of 0.23 mg/100 g is significantly lower than the one reported, 0.11-0.42 mg/100g (Česonienė et al., 2016), but the majority is represented by iron divalent ion. Zinc quantity of 0.03 mg/100 g has lower values than in other determinations, 0.1 – 0,19 mg/100 g, as the coppery quantity of 0.10 mg/100 g fits in other determinations limits, reaching the higher limit, 0.04 – 0.19 mg/100 g, and it is higher than in *Vaccinium macrocarpon*, 0.04 – 0.06 mg/100 g (Česonienė et al., 2016). Arsenic, mercury and antimony are below the approved limits and lead is under detection limits (Amariei et al., 2017). The difference in elements composition was significant (at 95% confidence level) for all the samples studied.

Table 3

Content of metals, mg/100 g, in peatland small cranberries and the soil they grow on

Cranberries		Soil 1	Soil 2	Cranberries		Soil 1	Soil 2
Li	0.09 ±0.0002^{a}	0.02 ±0.0009^{b}	0.006 ±0.0000^{c}	Zn	0.03 ±0.0007^{c}	0.02 ±0.0009^{b}	0.04 ±0.0002^{a}
Na	7.13 ±0.22^{s}	1.60 ±0.10^{c}	1.93 ±1.004^{b}	Mo	2.95 ±0.12^{c}	87.88 ±0.04^{a}	86.59 ±4.20^{b}
Mg	5.19 ±0.14^{a}	1.89 ±0.11^{b}	1.37 ±0.09^{c}	In	0.02 ±0.0009^{c}	0.05 ±0.002^{b}	0.05 ±0.002^{a}
Al	0.80 ±0.04^{c}	14.43 ±0.50^{b}	4.57 ±0.20^{a}	Sb	3.72 ±0.12^{c}	19.32 ±0.38^{a}	16.72 ±0.35^{b}
Ca	11.04 ±0.42^{c}	109.53 ±2.30^{a}	99.90 ±2.04^{b}	Cs	0.22 ±0.011^{c}	5.3673 ±0.1672^{b}	5.7141 ±0.3974^{a}
Ti	2.45 ±0.10^{c}	44.90 ±3.28^{b}	45.89 ±2.56^{a}	Ba	0.20 ±0.009^{c}	1.69 ±0.10^{b}	1.77 ±0.10^{a}
V	0.01 ±0.001^{c}	1.66 ±0.10^{a}	1.42 ±0.10^{b}	Pt	0 ±0.0000	undetectable	undetectable
Cr	1.09 ±0.1^{c}	11.71 ±0.53^{b}	12.10 ±0.68^{a}	Au	0 ±0.0000	undetectable	undetectable
Mn	0.05 ±0.003^{c}	17.11 ±0.77^{b}	17.59 ±0.77^{a}	Hg	0.30 ±0.01^{a}	0.01 ±0.0001^{b}	0.01 ±0.0007^{c}
FeII	0.22 ±0.001^{c}	0.52 ±0.02^{a}	0.48 ±0.01^{b}	Tl	0.80 ±0.03^{a}	0.03 ±0.0002^{b}	0.03 ±0.0009^{c}
Fe III	0.006 ±0.0005^{c}	0.06 ±0.002^{a}	0.04 ±0.004^{b}	Pb	0 ±0.0000	undetectable	undetectable
Cu	0.10 ±0.009^{c}	0.19 ±0.008^{b}	0.39 ±0.002^{a}				

Superscript letters (a,b and c) refer to the comparison of the same element between the different samples; results followed by superscript letters are significantly different ($p < 0.05\%$) according to Turkey's post hoc test.

Comparison of the mineral content, mg/100 g, in peatland small cranberries with mineral content of the soil on which these berries grow is shown in Table 4.

Table 4

Comparison of the mineral content in peatland small cranberries, mg/100 g, with those available in the literature

Minerals content	Our results, mg/100 g	Results available in the literature, mg/100 g	Reference
Na	7.13	2.00	Nemzer et al., 2022
Ca	11.04	8.00–13.00	Česonienė et al., 2016
Mg	5.19	2.9–9.1	
Fe	0.022	0.11–0.42	
Mn	0.048	0.90–4.00	
Cu	0.101	0.04–0.10	
Zn	0.019	0.10–0.19	

Determination of the antioxidant capacity and the total polyphenol content.

Antioxidant capacity and the polyphenol contents in peatland small cranberries are shown in Table 5.

Table 5

Antioxidant capacity and polyphenol content for the aqueous and ethanolic extract

Parameter	Aqueous extract	Alcoholic extract
Antioxidant capacity, I%	60.40±2.00[a]	24.90±1.70[b]
Polyphenol content, mg/100g	340.78±2.33[a]	254.20±2.69[b]

It could be observed that the free radicals inhibition percentage was higher in aqueous extract. Wild cranberries antioxidant properties were compared with the grown cultivars, and a significantly higher antioxidant activity in wild cranberries was noticed (Borowska et al., 2009). Likewise, cranberries had a higher antioxidant potential than lingonberry, the adjacent plant from the peatland (Brown et al., 2012). One can observe that watery extract is richer in polyphenols than the alcoholic extract, the difference was significant $p<0.05\%$.

By comparison (Table 6), other studies presented a polyphenol total content of 226.5 mg/100 g of fresh weigh (Narwojsz et al., 2019). Other authors determined a polyphenol total content, which varies from 288.5 to 456.3 mg/100 g (Borowska et al., 2009), up to 705 mg/100 g (Denev et al., 2013). One can notice a medium content in the studied berries. According to the results obtained by different authors, polyphenol total content is significantly higher in wild cranberries as opposed to grown varieties, 100.4 – 154.8 mg/100 g (Borowska et al., 2009)

Identification of polyphenols and determination of their content

Polyphenol content in extracts in ethanol, ether and benzene is shown in Table 7.

Table 6

Comparison of the antioxidant activity and total polyphenol contents in peatland small cranberries with those available in the literature

Parameter	Extract		Results available in the literature
	alcoholic	water	
Antioxidant capacity, I%	24.9	60.2	87-96% (Kähkönen et al., 1999, 2001) 59-64% (Wang et al., 2000) 69.6% (Vattem et al., 2005)
Total polyphenols, mg/100 g	254.20	340.78	705 (Denev et al., 2013) 288.5-456.3 (Borowska et al., 2009) 226.5 (Narwojsz et al. 2019) 347-389 (Česonienė et al., 2009)

Table 7

Content of polyphenols in peatland small cranberries

Polyphenolic compounds	Polyphenols content, mg/100 g product		
λ=280 nm	**in ethanol**	**in ether**	**in benzene**
Gallic acid	0±0.000[c]	0±0.000[c]	0±0.000[c]
Protocatechuic acid	0±0.000[c]	0±0.000[c]	0±0.000[c]
4-hydroxybenzoic acid	0.41±0.02[a]	0±0.000[c]	0±0.000[c]
Vanillic acid	0±0.000[c]	0±0.000[c]	0±0.000[c]
λ=320 nm			
Caffeic acid	0±0.000[c]	0±0.000[c]	0±0.000[c]
Chlorogenic acid	0.42±0.02[a]	0±0.000[c]	0.01±0.01[b]
P-coumaric acid	0±0.000[c]	0±0.000[c]	0.27±0.001[a]
Rosmarinic acid	0.12±0.09[a]	0±0.000[c]	0±0.000[c]
Myricetin	0.23±0.01[a]	0±0.000[c]	0±0.000[c]
Luteolin	0±0.000[c]	0±0.000[c]	0±0.000[c]
Quercitin	0.39±0.01[a]	0±0.000[c]	0±0.000[c]
Kaempferol	0.07±0.003[a]	0±0.000[c]	0±0.000[c]
Total	**1.630**	**0.000**	**0.371**

When followed by different superscript letters (a, b, c), the values are statistically different at 95% confidence level.

One can see that the ethanolic extract is much richer in polyphenols than the ether and benzene extracts, excepting the P-coumaric acid, which appears in benzene extract (Table 8). It is obvious the p-hydroxibenzoic acid presence, as it appears in other research studies, its quantity value being very close to that found in large cranberry (*Vaccinium macrocarpon*) (Zuo et al., 2002). Likewise, one can observe the presence of the chlorogenic acid, p-coumaric acid (Jurikova et al., 2018, Zuo et al., 2002) as other researchers report, but also the rosmarinic acid which was not identified in other studies. All the difference found were not significant at 95% confidence level.

Table 8
Comparison of the polyphenols and vitamin C content, mg/100 g, in small cranberries with those available in the literature

Polyphenol compound	Our results, mg/100 g	Results available in literature, mg/100 g	Reference
4-hydroxybenzoic acid	0.41	N/A*	N/A
Caffeic acid	0	0.7–1.4	Jurikova et al., 2018, Zuo et al., 2002
Chlorogenic acid	0.42	61.0–96.3	
P-coumaric acid	0.27	2.0–78	Jurikova et al., 2018, Zuo et al., 2002
		2.02	Ehala et al., 2005
Rosmarinic acid	0.12	N/A	N/A
Myricetin	0.23	8.4–11.2	Chen et al., 2001
Quercetin	0.39	0.52–15.4	Chen et al., 2001, Ehala et al.2005
Kaempferol	0.07	N/A	N/A
Vitamin C	5.98	15.3–30	Česonienė et al., 2016
		14	Nemzer et al., 2022
		18	Canja et al. 2016

Note: *N/A, not available.

As other authors show, the major flavonoids which appear in cranberries are quercetin and myricetin (Chen et al., 2001). The high content of quercetin, 5.15 mg/100 g of frozen weight, was reported (Ehala et al., 2005). Although the content found in the studied cranberries was lower, 0.39 mg/100 g, it is nevertheless a significant quantity. This substance contributes mainly in the antioxidant activity of the fruit. As for the quercetin content, the peatland cranberries are in the third place among the berries that contain this polyphenol, after elder and blueberries, and among vegetables only French and red onion have more quercetin than peatland cranberries (Kiviranta et al., 1988). There are multiple studies regarding this bitter-taste flavonoid, which has unique biological properties than can improve mental and physical performance and can reduce infection hazards. Quercetin stands out through anti-carcinogenic, anti-inflammatory, antiviral, antioxidant and psycho-stimulant activities and also through the capacity of lipid per-oxidation inhibition, platelet aggregation and mitochondrial biogenesis simulation (Li et al., 2016; MLcek et al., 2016). Quercetin may play an important role in treating several degenerative diseases (Palle et al., 2017; Pandey et al., 2012; Suganthy et al., 2016) without side effects or insignificant side effects. It was shown that quercetin and other flavonoids prevent the formation of atherosclerotic plaque, aggregation platelets (antithrombin effects) and favors the cardiovascular smooth muscles relaxation (Formica and Regelson, 1995). The quercetin antivirals' properties were investigated and proved on a large number of studies (Noor et al., 2021). As for myricetin content, cranberries are among the richest berries in this element (USDA, 2011). From the structural point of view, myricetin is similar to quercetin and it might have many of the latest functions (Ross et al., 2002). Studies show that myricetin has a therapeutic effect on many diseases (Song et al., 2021).

Vitamin C content

Vitamin C content in the studied berries (Table 8) was 5.98 mg/100 g, lower than the reported quantity in other studies, 15.3–30 mg/100 g (Česonienė et al., 2016), although the obtained results of vitamin C quantities in cranberries are quite different (Jurikova et al., 2018; Tikuma et al., 2014). It was shown that too ripened berries have a much lower vitamin C content, average 1.03 mg/100 g (Jurikova et al., 2018; Viskelis et al., 2009). Likewise, during storage a part of ascorbic acid transforms into its active biologic isomer, dehyidroascorbic acid. Vitamin C content is positively correlated with antioxidant activity of these berries (Jurikova et al., 2018).

Conclusion

The obtained results show the antioxidant potential of peatland small cranberries and their possible usage in maintaining health, ageing and oxidative stress diminishing. It is known that quercetin and other polyphenols identified in peatland small cranberry have antioxidant, anti-inflammatory, vasodilatory, antithrombotic, antihypertensive, anticancer and probiotic properties (Lu et al., 2017), and this allows to recommend these cranberries for consumption as functional food.

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