

CHEMICAL PROPERTIES AND NUTRITIONAL RELEVANCE OF ROMANIAN EDIBLE FOREST FRUITS

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Abstract

A diet rich in fruits and vegetables has long been associated with a reduced risk of degenerative disorders, including cardiovascular diseases and certain types of cancer. Recent research has increasingly focused on the biochemical variability of phenolic compounds and antioxidants naturally present in fruits and vegetables. This variability is influenced by species diversity, applied cultivation or processing technologies, and environmental conditions.

Wild forest fruits are valuable sources of antioxidants and polyphenols, exhibiting multiple biological activities such as antioxidant, anticancer, and anti-inflammatory effects.

The present study aimed to assess the chemical and nutritional parameters of wild raspberry (*Rubus idaeus*) and blackberry (*Rubus discolor*) genotypes collected from native populations in unpolluted areas of Romania.

Keywords: Rubus, forest fruit, blackberry, raspberry, chemical properties,

Introduction

Romania ranks among the richest European countries in plant diversity, owing to its geographical position in South-Eastern Europe and its distinctive ecological, climatic, and geomorphological conditions. Numerous wild-growing species of the genus *Rubus* can also be found in vineyards, large orchards, hedgerows, pastures, as well as in abandoned meadows and other ruderal habitats [1, 2].

Berry fruits are small, fleshy fruits widely consumed both fresh and in processed forms. This category includes red raspberry (*Rubus idaeus*), blackberry (*Rubus spp.*), black raspberry (*Rubus occidentalis*), blueberry (*Vaccinium corymbosum*), and strawberry (*Fragaria × ananassa*). Berries are an excellent source of natural antioxidants and bioactive phenolic compounds, including flavonoids, stilbenes, phenolic acids, and tannins [3], which, individually or in synergy, may contribute to the prevention of cardiovascular disease, cancer, inflammation, obesity, diabetes, and other chronic disorders [1,4,5].

Raspberry (*Rubus idaeus* L.) and blackberry (*Rubus fruticosus* L.) are berry fruits valued for their nutritional content and bioactive properties [6,7]. The fruits are rich in phenolic compounds, flavonoids, and anthocyanins, which provide antioxidant and anti-inflammatory properties, as well as in vitamin C, fiber, and minerals [8, 9].

This paper aims to provide a synthesis of the chemical and nutritional composition of raspberries and blackberries, while also presenting the analytical methods used to determine

these parameters. The main objective is to highlight the potential of these fruits as a source of nutrients, with applications in nutrition and the food industry.

Experimental

In this study all reagents were of analytical grade and were purchased from Merck (Germany), Sigma–Aldrich (Germany) and Fluka.

The sweet berry fruits were collected randomly from the Sibiu county in summer of 2024. The fruits were collected from the forests of Mounts Cindrel area.

The following basic nutritional parameters of harvested fruits were determined: dry matter (total and soluble), moisture, and macronutrients composition (fat, proteins, ash and carbohydrates). Fruit weight has been measured by using a digital balance with a sensitivity of 0.001 g. The moisture of samples has been determined by Sartorius thermobalance. Total solid content can be determined from moisture content as below:

$$\text{Total solids / Dry matter} = 100 - \% \text{ Moisture}$$

Ash content was determined by placing 5-10 g of fruit sample in a crucible in an oven and heating at 500 ± 15 °C.

Total soluble solid contents (TSS) were determined by extracting and mixing one drop of juice from each fruit into a digital refractometer (Model KRÜSS) at 22 °C.

Twenty fruits from each clone (10 fruit per brambles) of each species were used for analysis.

The fruits were examined through standard procedures, for their nutritional chemical composition (fat, proteins, ash and carbohydrates) [10, 11].

Average fruit weight (g) was measured by using a digital balance with a sensitivity of 0.001 g. For moisture content determination, fruit samples were accurately weighed and kept by drying at 103 ± 2 °C until they reached constant weight [11].

The crude protein content ($\text{Nx}6.25$) found in the samples was estimated by the macro-Kjeldahl method. The crude fats were determined by extraction with petroleum ether from a known weight of dried and chopped/grinded fruit, using a Soxhlet extractor. Total carbohydrates were calculated by difference.

Results and discussion

The results of the nutritional characterization of raspberry (*Rubus idaeus*) and blackberry (*Rubus discolor*) fruits are shown in Table 1.

Table 1. Characterization of raspberry (c) and blackberry (*Rubus discolor*) genotypes fruits in macronutrients

Species		Glucid	Lipids	Protein	Ash
		(g/100g FW)	(g/100g FW)	(g/100g FW)	(g/100g FW)
<i>Rubus discolor</i>	MBb	13.94 ± 0.89	0.48 ± 0.11	1.19 ± 0.23	0.4 ± 0.12
<i>Rubus idaeus</i>	ZRb	12.07 ± 0.59	0.59 ± 0.13	1.32 ± 0.3	0.37 ± 0.11

ZRb: raspberry genotypes and (*Rubus idaeus*) MBb: blackberry (*Rubus discolor*) genotypes, FW- fresh weight

The most abundant macronutrients found in berry fruits were carbohydrates, followed by proteins. The glucid (carbohydrate) content ranged from 10 % to 15.5%; *Rubus idaeus* has an average content of 12.07, while *Rubus discolor* shows an average content of 13.5.

Rubus idaeus (ZRb-raspberry variety) has an average content of 12.07%, while *Rubus discolor* (MBb –blackberry variety) shows an average content of 13.94%. The total lipids contents of the berry species were low. The lower fat content was found in *Rubus discolor*. The protein content ranged from 0.76 % (blackberry) to 1.5 % (raspberry). *Raspberry* has an average

content proteins of 1.32 %, while blackberry shows an average protein content of 119%. The data obtained in this study are comparable to those in the literature [13, 14]

The physical–chemical characteristics of blackberry and raspberry fruits: fruit weight, moisture, total soluble solids (TSS) and total dry weight (TDW) contents of berry species are given in table 2.

Table 2. Fruit moisture, TDW (total dry weight), weight and TSS (total soluble solids) contents of berry species

Species		Fruit weight (g)	TSS (%)	TDW (%)	Moisture (g/100g FW)
<i>Rubus discolor</i>	MBb	2.31 ± 0.5	12.5 ± 0.78	19.96 ± 2.77	80.04 ± 2.77
<i>Rubus idaeus</i>	ZRb	2.54 ± 0.56	10.6 ± 0.67	22.3 ± 2.43	77.7 ± 2.43

ZRb: raspberry (*Rubus idaeus*) genotypes and MBb: blackberry (*Rubus discolor*) genotypes, TSS: total soluble solids; TDW: total dry matter content weight; FW- fresh weight

The fruit weight of berry species ranged between 1.04 g and 3.3 g, with *Rubus discolor* having the biggest fruit. For the analyzed wild berries, the average weight was 2.31 g for wild blackberries and 2.54 g for wild raspberries. The obtained data are consistent with those reported in the literature [14]. Fruit weight is dependent on the species and the soil. The tested blackberries had a lower weight compared to the tested raspberries, the blackberry dimensions being smaller than those of raspberry fruits.

The average moisture contents of berry fruit species were of 77.7 g/100g raspberry up to 80.04 g/100g blackberry. The results obtained are in close agreement with previously reported data [12, 13, 14].

TSS average values were of 10.6 % (*Rubus idaeus*) to 12.5 % (*Rubus discolor*). With respect to total soluble solids (TSS). The data obtained in this study are comparable to those in the literature [13, 14]. According to these results, raspberry and blackberry fruits may be recommended for fresh fruit production, since they have attractive fruit, and also may be recommended for processing, due to higher TSS and TDW contents.

Conclusion

In the present study, physicochemical investigations have been undertaken in order to reveal the chemical composition, nutritional values of the two *Rubus* species in Romania.

In terms of the physicochemical characteristics of two berry species grown in Romania, inter-species variability was generally greater than intra-species difference. The inter-species differences were found in the fruit weight, and macronutrients content. The *Rubus idaeus* and *Rubus discolor* cultivars showed good characteristics for fresh-eating, since it has attractive fruit, and also may be suitable for processing.

The present indications lead us to the conclusion that this fruit is a potential candidate for bioactivity study as well as functional fruit development.

The results indicate that the studied berry fruits are a valuable horticultural product, based on their rich and beneficial nutrient composition and may be useful in a balanced diet. In addition, this study brings numerous arguments towards the standardization of these fruits as potential healthy foods and their use in food and pharmaceutical industries. For these fruits, determinations of antioxidant content and other bioactive compounds were also carried out; however, these results are not included in the present paper and will be reported in subsequent studies.

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