COMPARISON OF ANTIOXIDANT PARAMETERS IN THREE DIFFERENT PARTS OF THE BERRIES OF SOME SEA BUCKTHORN GENOTYPES

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Abstract

In the last few decades, the cultivation and consumption of sea buckthorn (*Hippophae rhamnoides* L.) is increasing with the extending prevalence of health-conscious nutrition. For that reason, investigation of antioxidant value and finding differences between varieties are especially current research topic.

The aim of this study was to determine the antioxidant status of the different parts of the sea buckthorn berry (skin + flesh, juice, peel) by TPC and FRAP analysis in the case of six genotypes.

Based on our results, the polyphenol content of the skin of the berries of the cultivars the 'Leikora', 'Mara' and 'Habego' was significantly higher. The highest FRAP value was for the berries of 'Mara', followed by R-01 and Askola, while the lowest value was represented by the 'Clara'. The FRAP value of the berry skin was significantly higher for the 'Leikora' and 'Habego'.

Introduction

Sea buckthorn (*Hippophae rhamnoides* L.) is an important plant with a worldwide attention for the key attributes medicinal and nutritional potential [1].

The scientific evidences of the important elements and bioactive substances of the *Hippophae rhamnoides* L. is vast and continues to increase exponentially [2]. An essential source of bioactive substances such antioxidants, vitamins, fatty acids, amino acids, and minerals is found in this plant.

Human medicine comes along with health nutrition. Therefore, being rich in antioxidant properties, high vitamin C content and valuable vegetable oil content makes Sea buckthorn plant with high interest for studying [3].

Sea buckthorn is a multi-purpose plant, all parts of the berries are processed into food or dietary supplements. However, the amount of biologically active substances differs in the parts of the berry [4, 5].

In order to produce a product with an optimal composition, we need to know the valuable substances of the different parts of the berry.

The aim of this study is to determine the antioxidant content on the different parts of Sea buckthorn berries (skin + flesh, juice, skin), which was done by conducting TPC and FRAP analysis.

Experimental

Plant material

Berries of the SB cultivars (Ascola, Clara, Leikora, Mara, Habego) and one Hungarian canditate (R-01) were collected from the ecologically farmed plantation of Superberry Plus Kft. in Rákóczifalva (N. 47 °11'87", E.H. 20° 21'97). The research material were harvested manually from early August to October, when the berries began to soften and had orange colouring that is characteristic for the cultivar.
Following the fruit harvest, samples (3 kg cultivar^{-1}) were delivered to the laboratory, there the berries were separated to three part (skin with flesh, juice and skin). After than it were homogenised in a blender and stored in freezer at -28°C until analysis.

Spectrophotometric methods

1. Sample preparation for the spectrophotometric measurements. After thawing, the frozen fruit pulp was centrifuged with a Hettich EBA 21 (Hettich Instruments, Massachusetts, USA) laboratory centrifuge at 15,000 rpm for 5 minutes and polyphenol content and FRAP were determined from the diluted supernatant as needed on a Hitachi U2800A UV-VIS spectrophotometer (Chiyoda, Tokyo, Japan).

2. Total phenolic content. The total polyphenol content (TPC) was measured photometrically with Folin-Ciocalteu reagents at λ=765 nm. The calibration curve was made from gallic acid using the method of Singleton and Rossi [6]. Three parallel measurements were conducted for each sample.

3. FRAP assay. The ferric reducing antioxidant power (FRAP) assay was carried out according to [7]. The FRAP assay is based on the reduction of the Fe^{3+}-2,4,6-tripyridyl-S-triazine [3682-35-7] complex to the ferrous form (Fe^{2+}) and the intensity of the reaction is monitored by measuring the change of absorption at 593 nm. The final results were expressed as micrograms of Ascorbic Acid equivalents (AA) per liter of pulp (mM AA L^{-1}). Five parallel measurements were conducted for each sample.

Statistical analysis

For the statistical analysis of data, SPSS program was used. Statistical analysis was made by nonparametric methods, Kruskal-Wallis test and Mann-Whitney test. In that case, if on the base of a Kruskal-Wallis test based on rank numbers, there was a significant difference between samples at 95% significance level, differences between groups were examined by pair comparisons (Mann-Whitney probe).

Results and discussion

Several previous studies reported that the berries of SB varieties has a strong antioxidant effect and there is considerable variance among the cultivars [8, 9, 10]., but the antioxidant content of the different parts of the berries (skin + flesh, juice, peel) has not been investigated before. In this study, the antioxidant state of different part of berries of the investigated SB cultivars and one Hungarian candidate was characterized by total polyphenol content (TPC) and water-soluble antioxidant capacity (FRAP).

Contents of TPC in three different part of berries of sea buckthorn genotypes are displayed in Table 1. Among the investigated cultivars showed the skin +flesh part of the berries of 'Leikora' (1241.6 mg L^{-1}) the lowest TPC value, while the R-01 candidate had the highest polyphenol content for all three berry parts (2646.51-3063.47 mg L^{-1}).

Based on our results, the polyphenol content of the skin of the berries of the cultivars the 'Leikora', 'Mara' and 'Habego' was significantly higher, while in the case of 'Ascola', 'Clara' and R-01 there was no significant difference in the berries of the three in different parts (Fig.1).

The polyphenol content in the skin of the berry of 'Leikora' is significantly lower than the value measured in the skin of 'Mara', 'Habego' and R-01 (Table 3).

In present study, the TPC contents of the analyzed cultivars were similar or higher than the published value of 1.75 mg GAE kg^{-1} fw in berries of Indian Summer cultivar from Canada [9]. However, some Indian populations were measured extremly high TPC content (from 964 to 10.704 mg GAE 100 g^{-1}) by Korekar et al. [10].

The polyphenol content of SBT cultivars is affected by both their genetic background and by the growing and climatic conditions [11, 12, 13].

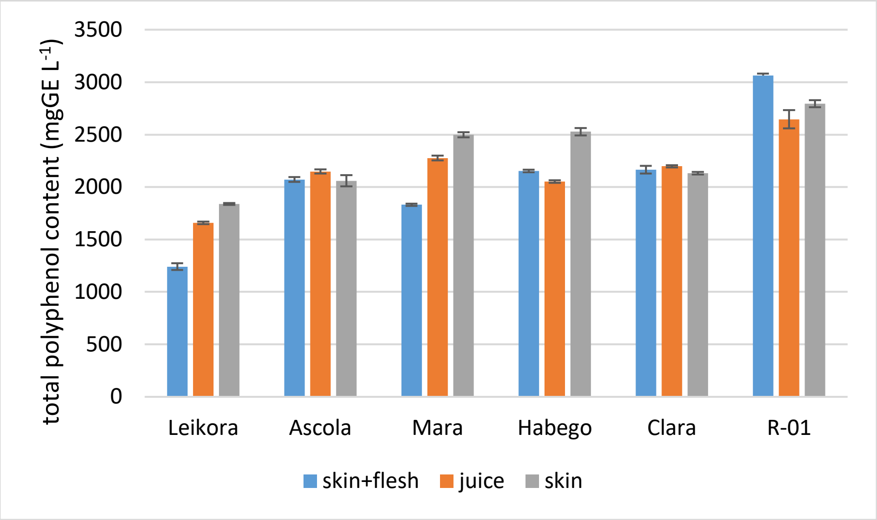

Figure 1. Total polyphenol content in three different parts of the investigated sea buckthorn genotypes (mgGE L^{-1}) (average ± standard deviation).

Based on our results, we can conclude that the berries of the investigated genotypes have a high water-soluble antioxidant capacity (6.87 – 17.7 mMAA L^{-1}). The highest FRAP value was for the berries of 'Mara', followed by R-01 and 'Askola', while the lowest value was represented by the 'Clara'. The FRAP value of the berry skin was significantly higher for the ‘Leikora’ and ‘Habego’ (Fig. 2), while in the case of the other examined cultivars there was no significant difference in the 3 different parts of the berry (Table 1).
The berry skin of 'Clara' had a statistically verifiable higher FRAP value compared to the other tested genotypes, while the FRAP value of the berry peel of 'Leikora' was significantly lower than the value measured in the berry skin of 'Mara' and R-01.

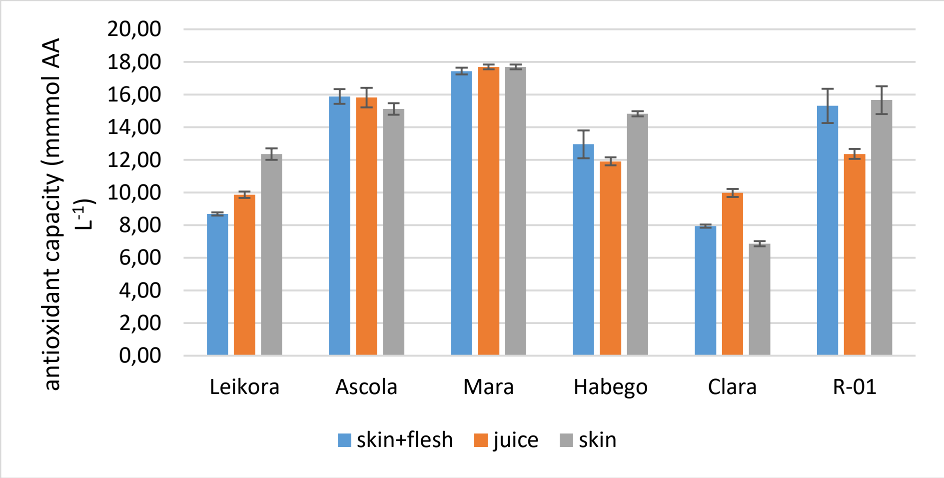

Figure 2. Antioxidant capacity (FRAP) in three different parts of the investigated sea buckthorn genotypes (mM AA L^{-1}) (average± standard deviation)

Table 1

	TPC					FRAP				
	Ascola	**Mara**	**Habego**	**Clara**	**R-01**	**Ascola**	**Mara**	**Habego**	**Clara**	**R-01**
			skin+flesh					**skin+flesh**		
Leikora	ns	ns	*	*	*	*	*	ns	ns	*
Ascola		ns	ns	ns	ns		ns	ns	*	ns
Mara			ns	ns	*			*	*	ns
Habego				ns	ns				*	ns
Clara					ns					*
			juice					**juice**		
Leikora	ns	*	ns	*	*	*	*	ns	ns	*
Ascola		ns	ns	ns	*		ns	ns	*	ns
Mara			*	ns	ns			*	*	ns
Habego				ns	*				ns	ns
Clara					ns					*
			skin					**skin**		
Leikora	ns	*	*	ns	*	ns	*	ns	ns	*
Ascola		ns	ns	ns	*		*	ns	*	ns
Mara			ns	ns	ns			*	*	ns
Habego				ns	ns				*	ns
Clara					*					*

Conclusion

Based on our results, we determined that the investigated sea buckthorn varieties are suitable for the production of products or dietary supplements containing biologically valuable active substances with functional properties. ‘Askola’ and ‘Mara’ varieties are mainly recommended for the production of juice. The peel, in the case of most varieties, has a higher active ingredient content. The peel (e.g. dried) can be used as an additional active ingredient in foods, especially the ‘Mara’, ‘Habego’ varieties and the R-1 variety candidate.

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