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NUTRITIONAL CHARACTERIZATION OF ORGANIC SEABUCKTHORN POMACE

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Abstract

Seabuckthorn is recognized worldwide as a valuable berry with real benefits in human health. It is being analysed in detail for its introduction as a functional ingredient in various sectors of the food industry. The most popular industrial product of sea buckthorn fruit is sea buckthorn juice, but significant amount of pomace results after fruit processing as waste. The purpose of this paper is to characterize fresh, dried, and ground sea buckthorn pomace (as powder) that could be further used as functional ingredients. In terms of nutritional characterization, antioxidant activity, total phenolic content and ascorbic acid content were determined. The results show that sea buckthorn pomace presents important nutritional value and can be further processed and used as a functional ingredient in various industrial applications.

***Key words**: sea buckthorn, functional ingredient, pomace, sea buckthorn powder.*

INTRODUCTION

Seabuckthorn (*Hippuphae rhamnoides* L.) is a world-renowned plant for both its high content of compounds (over 100 types), and for its ease of adaptation to climate and soil types (Gâtlan & Gutt, 2021), belonging to *Eleagnaceae* family (Mihova & Ivanova, 2020). Seabuckthorn is a thorny deciduous plant widely grown in Eurasian countries (Sharma & Kalkal, 2018), which is important from both economic and ecological point of view, being a low-demanding, wind-pollinated, and winter hardy tree (Kumar et al., 2021a). Sea buckthorn is a multipurpose plant with many uses starting from the control of soil erosion to use as horse fodder, a food component, and also in tea, drugs and cosmetics. Different parts of this plant are considered a good source of bioactive substances (Kant et al., 2012) and used in traditional medicine for a long time (Sne et al., 2013; Zhao et al., 2017; Wei et al., 2019; Luntraru et al., 2022). Seabuckthorn presents long lanceolate leaves, having characteristic silver hairs on the underside. It blooms between late April until early May, producing a great number of small green and brown flowers that grow together, forming clusters. In time, round yellow / orange berries are formed. The ripening season is in the fall, in September. Each fruit contains a small, elongated, grooved stone covering an oily seed (Fu et al., 2014; Bartish et al., 2002; Korekar et al., 2013). Approximately 150 species, subspecies and varieties of seabuckthorn have been identified; they differ in shrub habitat, appearance of berries and their value in use (Ciesarova et al., 2020). The development of research and interest in this plant led to the taking of seabuckthorn from the spontaneous flora and introduction into crops. With easy adaptability and good profitability, the industrialization of fruit was of great interest. Seabuckthorn berries are attractive due to their nutritional properties, being scientifically recognized for their content in vitamin C, carotenoids, flavonoids, sterols and tocopherols (Maheshwari et al., 2011; Olaru & Popa, 2019; Ciesarova et al., 2020). They are known in traditional medicine for anti-inflammatory properties, antitoxic effect, positive effect on hair and skin regeneration and condition (Tkacz et al., 2019). Different parts of the plant vary in composition of antioxidants, which has shown a positive biological, physiological, and medicinal effect of seabuckthorn. The medicinal properties of seabuckthorn were reported in various research studies, properties such as antimicrobial, antioxidative, hepatoprotective, anti-carcinogenic, antiulcerogenic, antihypertensive, radioprotective, anti-inflammatory and

immunomodulatory, which can be attributed to the content of various bioactive compounds which cand be found in different parts of the plant, like leaves, berries and seeds (Sharma & Kalkal, 2018).
Generally, the scientific interest concentrates on the ascorbic acid content of berries, juice, and leaves (Chandra et al., 2018); phytosterols, such as cycloartenol, campesterol (Zheng et al., 2017); citrostadienol, sitosterol (Hao et al., 2019); carotenoids, among which lycopene, lutein, zeaxanthin, α-carotene, β-carotene, γ-carotene can be found (Tudor et al., 2020; Pop et al., 2015); tocopherols (Bittová et al., 2014); flavonoids, isorhamnetin, and quercetin (Guo et al., 2017), or polyphenolic compounds, such as gallic acid in leaves and berries, and lower amounts of caffeic acid, p-coumaric acid, and ferulic acid (Bittová et al., 2014). Also, seabuckthorn pomace valorization is of great interest nowadays, due to the presence of different valuable compounds with heath promoting properties (Sharma et al., 2022; Hussain et al., 2021). Studying the nutritional aspects of sea buckthorn by-products could lead to new opportunities for obtaining nutraceuticals and natural functional food at low prices. Effective valorisation of agri-food industrial wastes/by-products targets to contribute to an enhanced economy and also to minimize the negative impact on the environment, with positive effect on ensuring food security (Bhat, 2021; Kumar et al., 2021b). Therefore, the aim of this study was to characterize the waste from seabuckthorn juice processing taking into study three organic seabuckthorn varieties.

MATERIALS AND METHODS

Experimental design

Three varieties of organic seabuckthorn were analysed in this study, namely Mara, Clara and Sorana. The seabuchthorn pomace was analysed from a nutritional point of view in different stages of processing: fresh (Clara_Fresh, Mara_Fresh, Sorana_Fresh), dried (Clara_Dried, Mara_Dried, Sorana_Dried) and in the form of powder (Clara_Powder, Mara_Powder, Sorana_Powder). Organic seabuckthorn fruits were processed into juice and the remaining pomace was further used in this research. The drying process was conducted at 50°C for 12h resulting dried pomace, and the powder was obtained by dried pomace grinding (Figure 1). All analysis were performed within Food Biotechnology Laboratory of the Faculty of Biotechnologies, USAMV Bucharest.

Figure 1. Aspect of the three varieties of organic seabuckthorn in different stages of processing

Antioxidant activity

The effect of antioxidant activity on 1,1-dipheny l-2- picrylhydrazyl (DPPH) was estimated according to the procedure described by Villaño et al. (2007), with some modification presented further. Briefly, 10 g of sample was macerated in 50 ml ethanol (75%) for 48 h in the dark, at room temperature. For each measurement, 0.05 ml filtered extract solution was added to 1.95 ml DPPH ethanolic solution and thoroughly homogenized, and incubated in dark at room temperature for 30 min. Sample absorbance was measured at 515. Results were expressed as quercetin equivalents (QE) per 100g D.W.

Ascorbic acid content

The content of ascorbic acid was determined by extracting 10 g of sample in 100 ml of 2% oxalic acid. The extract was filtered and 2 ml from the extract solution, 1 ml oxalic acid 2%, 5 ml buffer solution, 2 ml indophenol (2, 6-Dichlorophenol Indophenol) and 20 ml xylene, were placed in a centrifuge tube and centrifuged for 20 min at 5°C and 9000 rpm. The absorbance of the samples was measured 500 nm and the results were expressed as mg ascorbic acid / 100g D.W.

Total polyphenolic content

Total content of polyphenols (TP) was determined using the Folin-Ciocalteu method. Briefly, for each measurement, 1.58 ml distilled water, 20 µl filtered extract solution (10 g of fruit macerated in 50 ml ethanol (75%) for 48 h in the dark at room temperature), and 100 µl Folin-Ciocalteu reagent were mixed and then 300 µl Na_2CO_3 (20%) was added. The solutions were mixed and stored in the dark at room temperature for 2 hours. Sample absorbance was measured at 765 nm. Total polyphenol concentration was expressed as mg/L Gallic acid equivalents (GAE) per 100g D.W.

Statistical analysis

All determination was performed in duplicate. The obtained data was statistically analysed using Microsoft Excel 2017. In all tests, it was considered the significance level of $p < 0.05$.

RESULTS AND DISCUSSIONS

Antioxidant activity

Figure 2 presents the results obtained for the antioxidant activity of the tested samples. Fresh seabuckthorn samples presented the highest antioxidant activity (1436.33-2567.55 QE/ 100 g D.W.), while for the dried pomace and seabuckthorn powder lower values were obtained, most probably due to the heating during drying process.

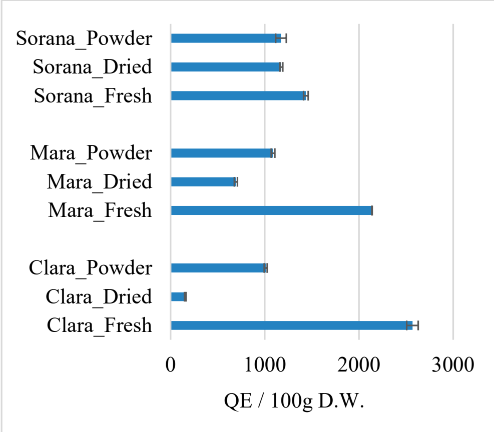

Figure 2. Antioxidant activity of tested samples

Therefore, for Sorana variety, the values obtained for antioxidant activity were similar for both dried pomace (1175.75 QE/100 g D.W.) and for the powder sample (1171.83 QE/100 g D.W.). Mara variety sample presented an antioxidant activity of 693.39 QE/100 g D.W. for dried pomace and 1087.55 QE/100 g D.W. for the powder sample. Significant difference between the values for this parameter was observed in case of Clara variety, where for the dried pomace a value of 155.18 QE / 100g D.W. was obtained, while for the powder sample the value was of 1009.95 QE/100 g D.W. The results obtained regarding the antioxidant activity of the tested samples showed similar values between varieties, especially in the case of powder samples (1009.95-1171.83 QE/100 g D.W.).

Ascorbic acid content

As shown in Figure 3, the highest amount of ascorbic acid was determined in fresh seabuckthorn pomace samples (28.43-48.34 mg /100 g D.W.), the values decreasing after drying processing for Mara and Sorana varieties, but being close for both dried pomace and seabuckthorn powder.

Clara variety maintained similar values for all tested variants, namely 25.49 mg/100 g D.W. for the dried pomace, 27.49 mg/100 g D.W. for the powder sample and 28.43 mg/100 g D.W. for the fresh pomace sample. Regarding this parameter, the values obtained for dried pomace and powder samples were similar for all three studied organic seabuckthorn varieties.

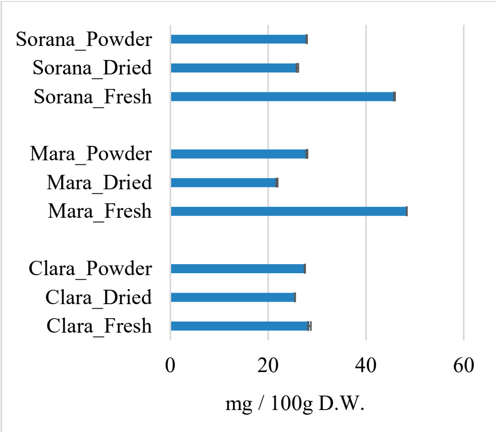

Figure 3. Ascorbic acid content of tested samples

Total polyphenolic content

Regarding the total polyphenolic content of three varieties (Figure 4), the highest values were obtained for the pomace samples processed into powder (2418.18-3019.80 mg GAE/100 g D.W.), most probably due to the high content of polyphenols present in seabuckthorn seeds.

For the fresh pomace, similar results were obtained, the polyphenolic content values being of 432.98 mg GAE/100 g D.W. for Mara variety, 508.80 mg GAE/100 g D.W. for Clara variety and 613.41 mg GAE/ 100 g D.W. for Sorana variety.

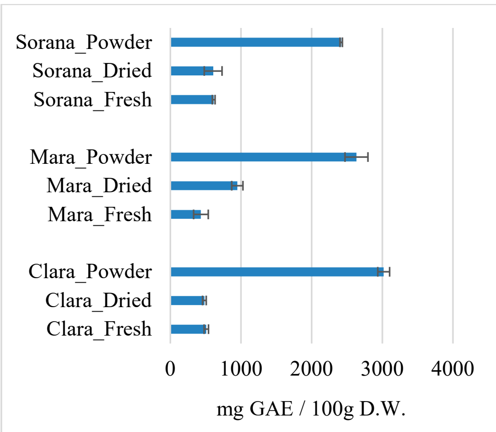

Figure 4. Total polyphenolic content of tested samples

Same trend was observed in case of dried pomace, for which values of 481.56 mg GAE/100 g D.W. (Clara variety), 605.84 mg GAE/100g D.W. (Sorana variety) and 947.89 mg GAE/100 g D.W. (Mara variety) were obtained.

CONCLUSIONS

The aim of this study was to characterize organic seabuckthorn pomace from a nutritional point of view, before and after processing.

The results showed all samples presented antioxidant activity both in both fresh form and after drying (dried pomace and powder), their values being slightly influenced by the drying process, but not significant.

Ascorbic acid was also determined in the studied seabuckthorn pomace.

Polyphenolic content was higher in powder samples, most probably due to the presence of grinded seeds.

The results of this study shows that seabuckthorn waste represents valuable by-products that can be further processed and used in various industrial application, such as food industry, phytochemicals extraction, pharma-ceuticals and cosmetics.

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