Bioactive Content of Sea Buckthorn (*Hippophae rhamnoides* L.) Berries from Turkey

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Summary

In Northeast part in Turkey, wild grown fruits are abundant and they are widely collected and consumed by rural peoples. In this study, the fruits of seven sea buckthorn genotypes from Northeast in Turkey were sampled and analyzed for their total phenolic content, vitamin C, total anthocyanins and antioxidant capacity. Total phenolic, vitamin C and total anthocyanin content varied from 213 to 262 mg GAE/100g FW; 28-85 mg/100 g and 3-21 mg/L among genotypes. Antioxidant capacity analyses (in DPPH and β-carotene method) showed that all samples had a high antioxidant (average 94.23% in β-Carotene and 31.23% in DPPH) capacity.

Key words

wild grown fruits, antioxidant capacity, total phenolic content, vitamin C

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Introduction

The sea-buckthorns (*Hippophae* L.) are deciduous shrubs in the genus *Hippophae*, belonging to the family *Elaeagnaceae*. The genus include seven species and among them the common sea-buckthorn (*Hippophae rhamnoides* L.) is by far the most widespread of the species in the genus, with the ranges of its eight subspecies extending from the Atlantic coasts of Europe right across to northwestern China (Bartish et al., 2002). It is one of the important natural resources of the mountainous regions of China and Russia (Li and Schroeder, 1996). The genus found in a wide area of Europe and Asia typically occurs in dry, sandy areas, but demand full sunlight for good growth and do not tolerate shady conditions near larger trees (Li, 2002). It has an extensive root system and vigorous suckers and so it has been used in soil conservation schemes, especially on sandy soils (Li, 2002). Aside from erosion control, the plant is primarily valued for its golden-orange fruits. The fruit is a very rich source of vitamins and minerals, especially in vitamins A, C and E, flavanoids and other bioactive compounds (Guliyeva et al., 2004; Sabir et al., 2005; Tiitinen et al., 2005).

Several studies on phytochemical compounds of sea buckthorn berries have been published (Tiitinen et al., 2005; Gao et al., 2000; Sabir et al., 2005). However a few reports have dealt with of sea buckthorn in Turkey. The aim of this study was to determine genotypic variation on bioactive content of sea buckthorn berries from Turkey.

Material and methods

Sea buckthorn berries were harvested in 2009 from the selected seven genotypes grown in Ispir and Pazaryolu districts in Northeast part of Turkey. The fruits were harvested at commercial maturity stage according to change of color and size. Approximately 200 g of berries per genotype were used for analysis. The harvested berries were quickly brought to laboratory in cold chain and were prepared immediately for analysis. The Vitamin C (AOAC, 1984), total anthocyanin (Wrolstad, 1976), antioxidant capacity with β-carotene bleaching method (Kaur and Kapoor, 2002) and DPPH scavenging activity (Brand-Williams et al., 1995) and the amount of total phenolics (Gulcin et al., 2002) were determined. The experiment consisted of a completely randomized design with four replications. Variance analysis (ANOVA) was used and means were separated by Duncan multiple range test.

Results and discussion

The results for total phenolic content, vitamin C, total anthocyanins and antioxidant capacity of berries from seven sea buckthorn genotypes are given in Table 1. The differences in all searched parameters among genotypes were statistically significant ($p<0.05$, Table 1).

The content of vitamin C varied from 28 (Genotype 6) to 85 mg/100 g FW (Genotype 3), respectively (Table 1). Previous studies showed that sea buckthorn berries are high in vitamin C, but that genetic background is the most important factor determining the vitamin C content, and the degree of ripeness affects it more than other factors such as climatic conditions (Tang and Tigerstedt, 2001). It has been reported a typical variation of 2–500 mg/100 g of vitamin C content in sea buckthorn berries (Gao et al., 2000; Sabir et al., 2005; Tiitinen et al., 2005).

The total anthocyanin content of sea buckthorn berries ranged from 3 to 21 mg/L in berry juice and the differences among genotypes (Table 1). The highest amount of anthocyanin was observed in Genotype 4, while the lowest was in Genotype 6. The anthocyanin content of different sea buckthorn genotypes (*H. rhamnoides*) has previously been reported to be between 0.5-25 mg/l (Sabir et al., 2005) that is in accordance with our results.

A statistical significant difference ($p<0.05$) was found among the samples in both antioxidant capacity determination methods (β Carotene and DPPH). All samples revealed a very high antioxidant capacity nearly to reach 100% in β Carotene method (Table 1).

DPPH scavenging capacity of fruit extracts is shown in Table 1. Significant differences in scavenging activity were found among fruits of seven sea buckthorn genotypes. DPPH scavenging capacity of Genotype 3 (35.62%) was the highest while the lowest was in Genotype 2 (26.84%) (Table 1). A highly significant ($P<0.05$) correlation ($r=0.85$) was found between DPPH scavenging capacity and β Carotene. It has previously been reported that extracts of *H. rhamnoides* had strong antioxidant capacity (Gao et al., 2000) that supports our findings.

Table 1. Bioactive content of sea buckthorn genotypes

Genotypes	Total phenolic content (mgGAE/100gFW)	Vitamin C (mg/100 g FW)	Total anthocyanin (mg/L)	Antioxidant capacity (%)	
				DPPH β-carotene	EC_{50} (µg extract/ml)
1	244ab	34d	10b	28.10ab	95.15ab
2	213c	67bc	16ab	26.84b	91.10b
3	262a	85a	19a	35.62a	97.36a
4	238b	75b	21a	27.40ab	94.42ab
5	230bc	70bc	20a	30.12ab	96.40ab
6	222bc	28d	3c	27.30ab	94.00ab
7	220bc	62c	18ab	27.00ab	95.80ab
BHA					89.40c

Values in the same column with different lower-case letters are significantly different at $P<0.05$ according to Duncan's multiple range test.; BHA - butylated

A high genotypic variation in terms of total phenolic content was observed among genotypes (213-262 mg GAE/100 g FW). Genotype 3 had the highest total phenolic content (262 mg GAE/100 g FW) (Table 1).

As a conclusion of this study, sea buckthorn fruits have important bioactive compounds. The great difference among genotypes in terms of physicochemical profile also shows their potential use for further breeding studies.

References

AOAC (1984). Officials methods of analysis (14th edition). VA, USA: Association of Official Analytical Chemist, Arlington.

Bartish J.V., Jeppson N., Nybom H., Swenson U. (2002). Phylogeny of *Hippophae* (Elaeagnaceae) inferred from parsimony analysis of chloroplast DNA and morphology. Syst Botany 27(1):41–54.

Brand-Williams W., Cuvelier M.E., Berset C., Use of a free radical method to evaluate antioxidant activity. LWT 28:25-30

Gao X., Ohlander M., Jeppsson N., Bjork L., Trajkovski V. (2000). Changes in antioxidant effects and their relationship to phytonutrients in fruits of sea buckthorn (*Hippophae rhamnoides* L.) during maturation. J Agric Food Chem 48:1485-1490.

Gulcin I., Oktay M., Kufrevioglu I., Aslan A. (2002). Determination of antioxidant activity of lichen *Cetraria islandica* (L) Ach. J. Ethnopharmacol. 79, 325-329.

Guliyeva, V.B., Gul, M., Yildirim, A., 2004. *Hippophae rhamnoides* L.: chromatographic methods to determine chemical composition, use in traditional medicine and pharmacological effects. J Chrom B, 812:291–307.

Kaur C., Kapoor H.C. (2002). Anti-oxidant activity and total phenolic content of some Asian vegetables. Int J Food Sci Tech 37:153-161.

Li T.S.C., Schroeder W.R. (1996). Sea buckthorn (*Hippophae rhamnoides*): A multipurpose plant, Hort. Tech 6(4):370-378.

Li T.S.C. (2002). "Product development of sea buckthorn". In Janick J, Whipkey A. *Trends in new crops and new uses*. Alexandria, VA: ASHS Press. http://www.hort.purdue.edu/newcrop/ncnu02/v5-393.html.

Sabir S.M., Maqsood H., Ahmed S.D., Shah A.H., Khan M.Q. (2005). Chemical and nutritional constituents of sea buckthorn (*Hippophae rhamnoides* ssp. *turkestanica*) berries from pakistan. Ital J Food Sci 17:455-462.

Tang X., Tigerstedt P.M.A. (2001). Variation of physical and chemical characters within an elite sea buckthorn (*Hippophae rhamnoides* L) breeding population. Sci Hort 88:203-214.

Tiitinen K.M., Hakala M.A., Kallio H.P. (2005). Quality components of sea buckthorn (*Hippophae rhamnoides*) varieties. J Agric Food Chem 53:1692-1699.

Wrolstad R.E. (1976). Color and pigment analyses in fruit products. Oregon St. Univ. Agric. Exp. Stn. Bulletin 624:1-13.

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