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Determination of nutritional value and mineral composition of some wild *Scorzonera* species

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Abstract
Scorzonera species are of important wild edible and medicinal plants in Turkey, especially in Eastern Anatolia. These species have been consumed commonly as raw in salads, cooked as a meal and pickled in Van herby cheese, and medicinal purposes in folkloric medicine. In the present study, nutritional value and mineral compositions of some *Scorzonera* species that wild grown in Van district of Eastern Anatolia in Turkey were determined in the used plant parts. *Scorzoneracana* (C.A.Mey.) Hoffm. var. *jacquiniana* (W.Koch) Chamberlain, *Scorzonera suberosa* K. Koch subsp. *suberosa* and *Scorzonera tomentosa* L. were the investigated species.As nutritional value; dry matter, total ash, % N, crude protein, crude fiber contents and pH were determined.Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, P, Pb, S and Zn were the investigated minerals in the plant samples. According to the results, investigated *Scorzonera* species had different chemical compositions. *S. cana*and *S. suberosa*were richer chemical composition than *S. tomentosa*. In general, *Scorzonera* species that used as wild edible purposes could be useful and safe for human consumption and health.

Keywords: Eastern Anatolia, mineral composition, nutritional value, *Scorzonera* spp., wild vegetable

1. Introduction
Turkey has a great deal of plant genetic resources because of its geographic position. A number of wild plants have been gathered from nature and used for varying purposes as food, herbal tea, wild vegetable, herbal medicine, etc. Turkey is one of the most important medicinal and aromatic plants exporters in the world. Approximately 347 plant species have been collected from nature, used for local consumption an exported to countries as raw material every year [1]. Approximately 40 different plant species have also been gathered from flora and consumed as wild vegetables indifferent regions of Turkey [2].
In Eastern Anatolia of Turkey, having extreme climatic and topographic conditions, crop production is limited and uses of natural resources for life are optimum. In these conditions people in the region often turn to what have been variously designated as spontaneous wild plants or scarcity foods to supplement their normal diets [3]. Local people of the East Anatolia region have a long history of traditional uses of plants, which was gained through many difficult and painful experiments. This experience can be seen in the use of plants as food, fodder, spices, traditional medicine, ornamentals, and hand-crafts. A number of wild edible plant species have been collected from nature and consumed locally in different seasons in the region, but their nutritive values have not been determined in detail.
Wild edible plants are cheaper food sources having a number of nutrients and provide minerals, vitamins and essential fatty acids and enhanced colour and distinguished taste in diets [4, 5]. Previous studies on wild edible plants in Turkey describe the consumption and mineral compositions of some edible parts of wild plants as vegetable [6-8]. However, these literatures provide limited information on mineral and nutrient content of many wild plants. Nevertheless, this information is also valuable for several reasons, not least in ascertaining the nutrient contents which may be used to supplement the nutritional value of the normal diet. This information is also useful for environmentalists involved in the design of conservation, propagation and sustainable uses of nutritionally valuable wild plant resources [3].
Nowadays, customs on daily diets have changed and plants have a big portion in daily diets for good health. Extensive agricultural practices such as chemical fertilizers, pesticides, hormones, etc., in traditional crop systems, organic crops have a special interest in the last decades. With a distinguished aroma and natural habit, wild edible plants have regained their importance in

diets. According to last scientific reports, wild edible plants are good source for useful mineral compositions and nutritional values than cultivated crops [3, 9]. Thus, the importance and consumption of wild edible plants especially wild vegetables have gradually increase in diets. Thus, the aim of this study was to determine the nutritive value of three mostly collected and consumed wild plants species of *Scorzonera* genus in Van province in the Eastern Anatolia region of Turkey. The results were compared to previous scientific works.

Materials and Methods

Plant material and preparation of plants for analysis

Mineral compositions and some nutritional properties of three *Scorzonera* species wild grown in Van Lake district located in Eastern Anatolia in Turkey were analyzed in the present study. The plants were collected from Van Lake district in 2010 and botanical identifications were done according to Flora of Turkey [10] by Dr. Fevzi Özgökçe at Yuzuncu Yil University Biology Department. Some information of the species is given in Table 1

Table 1: Some traits of three wild edible plants from Van Lake district

Plants' Scientific Name	Family	Local Name	Used Parts	Use	Locality	Col. No.
Scorzoneracana (C.A.Mey.) Hoffm. var. *jacquiniana* (W.Koch) Chamberlain	Asteraceae	Tekesakalı, karakok, yemlik	Aboveground	Meal, roasted, food	L1	F 9355
Scorzonerasuberosa K. Kochsubsp. *suberosa*	Asteraceae	Sıpınk	Rhizome, Root	Food, salad	L2	F 10083
ScorzoneratomentosaL.	Asteraceae	Kanok, dağsakızı	Root latex	For sterility Gum	L3	F 12250
L1: B9 Van: Gevaş, north slopes of Alacabük Mountain, east of the Altınsaç church, steppe, 2900 m.						
L2: B9 Bitlis: Tatvan, northeast slopes of Alacabük Mountain, Karaayvaztepe - İnköyü path, steppe, 1800m						
L3: B9 Bitlis: Tatvan, northwest slopes of Alacabük Mountain, ridges of Zerzemin, steppe, 2700m						

Before chemical analysis plants were cleaned from foreign materials, separated used parts and washed with deionized water, dried at room temperature, ground, packaged in plastic bags and kept for analysis in the laboratory.

Dry matter and total ash determination

The materials were dried at 105 ºC for 24 hours in oven to determine the dry matter content of the samples. Electric Muffle Furnace set at 550 ºC was used for determination of total ash content (inorganic matter) [11].

Total nitrogen determination and crude protein calculation

Kjeldahl apparatus and method were used to find of total nitrogen content of the samples [12]. After total nitrogen content determination, crude protein contents were calculated by the formula.

1. $$\% Nitrogen = \frac{(v1-v2)x0.014}{m} x100$$

2. $$\% Protein = \% Nitrogen \times F$$

pH determination and Total crude fibre determination

pH values were determined by pH-meter in the plant samples according to the AOAC method 981.12 [13]. Crude fiber analyses were accomplished by AOAC method 962.09 [14].

Total Mineral determination

Mineral compositions of the sampled were made as follows: dried plant samples were ashed in a furnace by nitric (AR) and hydrochloric acid [15]. Afterwards, distilled water (50 ml) was added to samples in a volumetric flask. All the analyses were repeated in three times and standard materials were used for chemical analyses. Atomic Absorption Spectrometry was used for determination of mineral contents. The data obtained from chemical analyses, mean values were calculated and are given in the table with their standard deviations.

Results and Discussion

Because of distinguished climate and topographic conditions Eastern Anatolia of Turkey is housing a number of plant species of which are endemic. Inhabitants in the region have sued wild plants in their daily life, especially wild food sources. Nevertheless, their nutritive values and hazardous chemicals have not been studied in details. Thus, in the present work, some nutritional and mineral composition traits of three *Scorzonera* species that mostly used as vegetable were investigated and their some properties are given in Table 1. The values of dry matter, total ash, N, crude protein, pH and crude fiber contents are showninTable2 and mineral compositions in Table 3. The values are given as mean ± SD.

The minimum and maximum values of dry matter, total ash, N, crude protein, pH and crude fiber of these samples were found 17.16 – 21.24%, 7.33 – 13.67%, 1.06 –1.64%, 6.63 – 10.05%, 6.00 – 6.75% and 43.14 – 48.98%, respectively. Özcan, *et al*. [16] stated that the dry matter, crude protein, crude fiber and crude ash contents of some edible wild plants consumed in Mersin province in Turkey were established between 13 – 17%, 1.2 – 2.6%, 4.2 – 9.5% and 8.2 – 15.6%, respectively. Coşkun, *et al*. [17] reported the dry matter, ash, protein and crude fiber content of *P. ferulacea* grown in Şırnak, Turkey as 90.48%, 5.05%, 6.10%, respectively.

Table 2: Mean values of chemical composition values of three wild edible plants

Parameters	***Scorzoneracana*** (C.A. Mey.) Hoffm. var. *jacquiniana* (W.Koch) Chamberlain			***Scorzonera suberosa*** K. Koch subsp. *suberosa*			***Scorzonera tomentosa* L.**		
Dry matter (%)	20.10	±	1.360	17.16	±	2.120	21.24	±	1.360
Total ash (%)	13.00	±	1.000	13.67	±	0.570	7.33	±	1.160
N (%)	1.14	±	0.050	1.06	±	0.040	1.64	±	0.080
Crude protein (%)	7.07	±	0.290	6.63	±	0.270	10.05	±	0.210
pH	6.29	±	0.060	6.75	±	0.100	6.00	±	0.210
Crude Fibre (%)	44.60	±	1.650	48.98	±	2.090	43.14	±	0.890

The results come from our samples' analyses found to be higher than the previously reported findings in the literature. In conclusion, these differences among the species could be explained of different plant species, environmental and growing conditions. Studied plant species had good nutritive values when compared to other reports.

Chemical analysis results showed that *S.cana* had the highest values for Na, K, Ca, P, S and Fe concentrations, *S.suberosa* had the highest values for totalash, pH, crude fiber, Mg, Mn, Cu and Zn. It could be said that *S.tomentosa* was the poorest among the analyzed plant species (Tables2, 3).

Sodium and potassium have a role in ionic balance of the human body and maintain tissue excitability. Because of its solubility, sodiumhas an important role in the metabolite transportation. Potassium is of importance as a diuretic. Sodium content ranged from 0.50 g kg^{-1} (*S. tomentosa*) to 0.69 g kg^{-1} (*S. cana*). Guil Guerrero, *et al*. [18], who evaluated the mineral content of eight edible wild plants used by the first European farmers growing in southeast Spain, also reported that *Crithmummaritimum* had the highest Na (2.9g kg^{-1}) content and the *Cardariadraba* lowest (0.5g kg^{-1}).*S. cana* had the highest K content (26.06 g kg^{-1}) and *S. suberosa* (21.52 g kg^{-1}) and *S. tomentosa* (15.11 g kg^{-1}) were the lowest (Table 2). It has been reported that potassium concentration appeared to vary as a function of absolute age of leaf and environmental conditions [19].

In humans, magnesium is required in the plasma and extracellular fluid, where it helps maintain osmotic equilibrium. Lack of Mg is associated with abnormal irritability of muscle and convulsions and excess Mg with depression of the central nervous system [20]. In this study *S. suberosa* had the highest Mg content (6.80 g kg^{-1}) and *S. tomentosa* (3.17 g kg^{-1}) was the lowest (Table 3). The Mg levels for medicinal and edible plants were reported between 0.57 and 2.25 g kg^{-1} [20-22].

Calcium is essential for healthy bones, teeth, and blood [23]. The health of the muscles and nerves depends on calcium. The calcium content in various tree plant samples varies from 17.38 g kg^{-1} in *S. tomentosa* to 27.69 g kg^{-1} in *S. cana*. Calcium levels of *Urticaurens* (8.3 g kg^{-1}) and *Capparis spinosa* (0.27 g kg^{-1}) from western Anatolia, Turkey has been reported by Turan [3].

According to average data, *S.cana* (3.80-4.65 g kg^{-1}) had the highest P and S content among the analyzed plant species and *S.suberosa* (2.97 g kg^{-1} P), *S.tomentosa* (1.74 g kg^{-1} S) the lowest. Insomestudies, phosphorus contents varied from 34.92 to 69.13 g kg^{-1}[24]; sulphur concentrations were reported in the range of 12.34 – 108.01 g kg^{-1} [24-26].

Mineral analysis of three wild plant samples showed that Mn content ranged from 35.73 to 172.6 mg kg^{-1}, Fe from 207.40 to 321.5 mg kg^{-1}, Cu from 25.42 to 38.51 mg kg^{-1}, Zn from23.14to 62.18 mgkg^{-1}. The highest Mn, Cu and Zn content were obtained in *S.suberosa.S. cana* had the highest Fe content (321.5 g kg^{-1}) and *S. suberosa* (207.40 mg kg^{-1}) were the lowest (Table 3). Turan [3] reported that the highest contents of Fe and Mn obtained in the wild plants were 488 and 127 mg kg^{-1} in *Urticaurens,* respectively. The highest contents of Zn (229 mg kg^{-1}) and Cu (117 mg kg^{-1}) were observed in *Malvaneglecta* respectively. Plant materials with high concentrations of the above-mentioned micronutrient elements will definitely play an important role in maintenance of human health when taken at recommended levels [27].

Table 3: Mean values of mineral compositions of three wild edible plants

Minerals	***Scorzoneracana*** (C.A. Mey.) Hoffm. var. *jacquiniana* (W.Koch) Chamberlain			***Scorzonera suberosa*** K. Koch subsp. *suberosa*			***Scorzonera tomentosa*** **L.**		
Na (g kg^{-1})	0.69	±	0.020	0.57	±	0.080	0.50	±	0.040
Mg (g kg^{-1})	5.46	±	0.110	6.80	±	0.140	3.17	±	0.180
K (g kg^{-1})	26.06	±	0.050	21.52	±	0.680	15.11	±	0.590
Ca (g kg^{-1})	27.69	±	0.650	21.81	±	0.560	17.38	±	1.090
P (g kg^{-1})	3.80	±	0.100	2.97	±	0.060	1.74	±	0.090
S (g kg^{-1})	4.65	±	0.180	1.50	±	0.360	2.74	±	0.090
Mn (mg kg^{-1})	120.20	±	5.010	172.60	±	4.500	35.73	±	1.860
Fe (mg kg^{-1})	321.50	±	6.770	207.40	±	0.980	222.56	±	0.800
Cu (mg kg^{-1})	25.42	±	1.150	38.51	±	0.450	28.48	±	1.270
Zn (mg kg^{-1})	44.21	±	0.570	62.18	±	1.500	23.14	±	0.080
Cr (mg kg^{-1})	0.53	±	0.020	0.32	±	0.070	0.69	±	0.070
Cd (mg kg^{-1})	0.04	±	0.002	0.06	±	0.007	0.10	±	0.015
Co (mg kg^{-1})	0.88	±	0.090	0.33	±	0.510	0.34	±	0.045
Pb (mg kg^{-1})	0.19	±	0.100	0.49	±	0.100	0.04	±	0.020

Na, K, Mg, Ca, Mn, Cu, and Zn are important for humans and livestock health and optimal intakes of these elements can reduce individual risk factors for health problems such as cardiovascular disease [28]. Mayer and Vyklicky [29] stated that these elements play a significant role in neurochemical transmission and also serve as constituents of biological molecules as a cofactor for various enzymes and in a variety of different metabolic processes. As potential antioxidants Fe, Zn, and Mn are involved in strengthening the immune system [30].

S. tomentosa had the highest Cr and Cd content (0.69 and0.10 mg kg^{-1}), *S. cana* had the highest Co concentration (0.88 mg kg^{-1}), and *S. suberosa* had the highest Pb concentration (0.49 mg kg^{-1}). Results of Cr, Cd, Co and Pb contents of this study are higher than those reported by Akgunlu [24]. Kızıl [22] reported that *T. spicata* contained Cr from 0.699 to 2.488mg kg^{-1}, Cd from 0.162 to 0.417mg kg^{-1}, Pb from 1.486 to 6.994mg kg^{-1}.

The mineral and heavy metal concentrations found herein might not be on par with some of the previous study on edible plants [31-33]. The differences among the species and previous works might come from various growth conditions, genetic factors, geographical variations in the level of soil fertility, efficiency of mineral uptake, and the analytical procedures employed [16].

Conclusion

In the present study, three different *Scorzonera* species which are mostly collected and consumed as wild vegetable in Eastern part of Turkey were analyzed their nutritional value and mineral compositions. According to chemical analyses and comparison to previous studies, it is concluded that *Scorzonera* species investigated are good source of nutrition and minerals as wild edible plants. Moreover, it could be said that hazardous heavy metal concentrations had low values thatareunder WHO limits.

Considering increasing interest on wild edible vegetables, scientific studies on these plant groups have a special importance.

In conclusion, *Scorzonera* species has a good nutritive value and desirable mineral composition and could be evaluated as novel foods in daily diets. It is important that their natural populations should be conserved and sustainable uses of them must be developed.

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