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Variation of Minerals Content and Some Bioactive Compound in Some Wild and Cultivated Edible Plants Grown Naturally in Kastamonu Region

Nezahat TURFAN[1]*

ABSTRACT: This study was conducted to evaluate the nutritional and some bioactive compounds like pigment, total phenolic, amino acid, and ascorbic acid of nine species as *Capsella-bursa pastoris* L., *Chenopodium album* L., *Echinophora tenuifolia* L., *Malva sylvestris* L., *Trachystemon orientalis* L., *Tragopon reticulatus* L., and three woody species as *Asparagus acutifolius* L., *Smilax excelsa* L., and *Vitis vinifera* L., which are widely consumed in Kastamonu region. All species were taken from the local market in the second week of May 2019. According to the result, K was the most abundant macro-nutrient ranged from 20 470 to 65 410 mg kg^{-1}, followed by Ca, Mg, and P. The amount of Na, Cl, Mn, Fe, Zn, Cu, Ni, and Co of samples Mn was in the range 100.4-3 280, 759.5-13 930, 77.6-4 298, 8.2-25.3, 9.40-25.4, 307-1 590 and 3.9-11.21 mg kg^{-1}, respectively. In terms of chemical constituents, *T. orientalis*, *V. vinifera*, *M. sylvestris*, and *T. reticulatus* are the richest species with the high level of total chlorophyll, β-carotene, lycopene, phenolics, free amino acid, glycine betaine, ascorbic acid, but *S. excelsa* and *C. album* are two poorest species. As a result, *T. orientalis*, *M. sylvestris*, *V. vinifera*, and *T. retiqulatus* were the richest species in terms of total phenolics, amino acid, chlorophyll, β-carotene, ascorbic acid, but *S. excelsa* and *C. album* were the two poorest species. Considering all data, it can be said that these species were found significantly beneficial in terms of mineral sources have the potential to provide essential nutrients and antioxidant compounds to the consumers.

Keywords: Chemicals, minerals, edible plants, Kastamonu.

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INTRODUCTION

In recent years, there has been a growing interest in the native wild edible plants, which have been consumed for nutritional purposes as well as in medical treatments for many years, but have been forgotten and neglected in the following years due to the development of industrial agriculture (Kaoma and Shackleton, 2015; Jones, 2017). They grow spontaneously in their natural habitat and do not contain any toxic compounds, and many authors have revealed that these sources have severe bioactive compounds as flavons, phenolics, vitamins, pigment, nitrogenous compounds, tannins, certain hormone precursors in addition to protein and energy sources, among others (Kibar and Temel, 2016; Kibar and Kibar, 2017; Ahmed et al., 2020). Wild edible plants as herbal and woody are plants that are neither cultivated nor domesticated but are available from their natural habitat (Kordalı et al. 2021). However, some of them can be cultivated. They are widely consumed in various forms as raw, dried, or pickled for cooking, salads, teas, flavours in soups, cheese, yoghurt, ice cream production, jam, and marmalade (Atalay and Kamalak, 2019). Those plants hold on a significant role in maintaining nutritional balance in diet, especially eliminating obesity problems, preventing cancer, cardiovascular and neurodegenerative diseases (Freeland-Graves et al., 2016; Canlı et al., 2017). Severe people’s interest in the wild and cultivated plant has risen over time because it higher nutritional values, growing naturally, generally available in markets in all seasons, having a low fatty compound with a rich mineral and nutrients that can be consumed in daily diet safely and also being a source of income for the local people in the rural area (Inyang, 2016, Jones, 2017). Besides, these species, which are grown naturally in almost every region, do not have more production costs like other cultivated crops. Nowadays, drought and famine, which are a result of global warming, deprive the opportunities of living in rural areas and inadequate income direct to cheaper but more easily available, safe, and nutritious food sources (Jones, 2017). Studies have shown that such plants are of particular importance to the poorer population with very low income under drought regions (Kaoma and Shackleton, 2015). In terms of wild edible and cultivated species-rich in bioactive constituents and nutrients, the Black Sea Region has significant potential, which is also an important source of income for the local population (Özer and Kibar, 2018). Although there are many studies on nutritional values, antioxidant and antibacterial capacities, mineral levels, and economic importance of wild and cultivated edible species in many regions of Turkey (Özer and Aksoy, 2019; Demir et al., 2020), studies on the nutritional value and mineral content of edible plants of the Kastamonu region are very insufficient. Therefore, it is important to reveal the nutritional status of these plants to emphasize the importance and regain the value they deserve as well as conventional food resources. Besides, further promoting these natural resources y demonstrating their nutritional values and benefits to human health can contribute to the increase of income of low-income families in the Black Sea Regions, especially in Kastamonu. In these scopes, this study was carried out to evaluate the amount of antioxidant compounds and mineral status of *Capsella-bursa pastoris* L., *Chenopodium albüm* L., *Echinophora tenuifolia* L., *Malva sylvestris* L., *Trachystemon orientalis* L., *Tragopon reticulatus* L.), and three woody species (*Asparagus acutifolius* L., *Smilax excelsa* L., and *Vitis vinifera* L. genotypes, which are widely consumed in daily diet as well as medical treatments. This investigating is the first study carried out in the Kastamonu province.

MATERIALS AND METHODS

Plant Samples

The nine plant materials; *Vitis vinifera, Malva sylvestris, Trachystemon orientalis* L., *Asparagus acutifolius* L., *Smilax excelsa* L., *Chenopodium album* L., *Echinophora tenuifolia* L., *Tragopon* *reticulatus* and *Capsella bursa-pastoris* L., were obtained from the local market of Kastamonu in the second week of May in 2019 and identified in the laboratory (Table 2).

Table 1. The plants used for the chemical analysis.

Scientific name	Abbreviated names	Family	Turkish name	Locality	Analyzed part	Growing form
Vitis vinifera **L.**	***V. vinif.***	Vitaceae	Asma	İnebolu	Leaf	Cultivated
Malva sylvestris **L.**	***M. sylv.***	Malvaceae	Ebe Gümeci	Daday	Leaf and petiole	Wild
Trachystemon orientalis **L.**	***T. orient.***	Boraginaceae	Kaldırık	İnebolu	Leaf	Wild
Asparagus acutifolius **L.**	***A. acut.***	Asparagaceae	Klemşe, Glemşe, Kuşkonmaz	Taşköprü	Young leaf/stem	Wild
Smilax excelsa **L.**	***S. excelsa***	Liliaceae	Sılcan	İnebolu	Young leaf/stem	Wild
Chenopodium album **L.**	***C. album.***	Chenopodiaceae	Sirken	Center of Kastamonu	Leaf	Wild
Echinophora tenuifolia **L.**	***E, tenuifolia***	Apiaceae	Tarhana Otu, Çörtük	Center of Kastamonu	Leaf /stem	Cultivated/Wild
Tragopon reticulatus **L.**	***T. reticulatus***	Asteraceae	Yemlik	Center of Kastamonu	Leaf	Wild
Capsella bursa-pastoris **L.**	***C. bursa-past.***	Brassicaceae	Çoban Çantası	Daday	Leaf	Wild

The samples were cleaned with deionized water and spread on the blotting paper at room temperature. Then, all samples were placed in an oven at 70 °C for 24 h and were powdered in a laboratory mill. After that, they were put into polyethylene bags and kept in the fridge at 4°C until analysis. All chemical analyses were carried out in triplicate.

Experimental procedure

To determine the chlorophyll content, 0.5 g of a fresh leaf was powdered in liquid nitrogen and extracted by adding 10 ml of 80% acetone in an ice bath (Lichtenthaler, 1987). The mixture was centrifuged for 10 minutes at 3,500 rpm, and triplicate spectrophotometric (Shimadzu UV-260) readings of the supernatants noted were obtained at values of 652 and 450. β-carotene and lycopene contents were measured by using the method of Nagata and Yamashita (1992). 100 mg dry samples were homogenized with 10 ml acetone-hexane (4:6) at once. After filtration, the absorbance of homogenate was recorded at 453, 505, 645, and 663 nm. The amounts of β-carotene and lycopene were estimated by the equations:

$$\beta\text{-Carotene (mg/ml)} = 0.216 \text{ x } A_{663} - 1.22 \text{ x } A_{645} - 0.304 \text{ x } A_{505} + 0.452 \text{ x } A_{453} \quad (1)$$

$$\text{Lycopene (mg/ml)} = -0.0458 \text{x } A_{663} + 0.204 \text{ x } A_{645} + 0.372 \text{ x } A_{505} - 0.0806 \text{ x } A_{453} \quad (2)$$

The measurement of total phenolic content was carried out according to the Folin Ciocalteu method Ciocalteu colourimetric method (Singleton et al., 1965), using a UV-Vis spectrophotometer. The amount of total phenolic compounds was given as mg of gallic acid equivalents (mg GAE/ g DW). The amount of total free amino acid of species was carried out by the method of Moore and Stein (1948) using the ninhydrin method. For glycine betaine estimation, the method of Grieve and Grattan (1983) was used. 500 mg dry samples were put into a 20 ml test tube containing 5 ml of a toluene-water mixture (0.05% toluene) and mechanically shaken at 25°C for 24 h. All samples were filtrated and 0.5 ml of it was mixed with 1 ml of 2 N HCl. Then 0.1 ml of potassium tri-iodide solution (containing 7.5 g Iodine and 10 g potassium iodide in 100 ml of 1 N HCl) was added and the test tubes were shaken in an ice-cold water bath for 90 min. 10 mL of 1,2 dichloroethane (chilled at -10° C) was added and 2 ml of ice-cooled water was transferred into the tube. After waiting for 2-3 minutes to form two separated layers, upper aqueous phases were discarded and the optical density of the organic layers was used for determining the absorbance values at 365 nm. The amount of glycine betaine (GB) of samples was determined by using the standard curve plotted by using different concentrations of GB. The amount of Vitamin C was determined by the method of Klein and Perry (1982). 2000 mg samples were homogenated with 20 ml distilled water in the volumetric flask. After that, all samples were kept for 10 minutes in a shaker and the samples were mixed thoroughly. Then, these mixtures were titrated with a 2,6 dichloro phenol indophenol solution. Ascorbic acid of samples was estimated with ascorbic acid standards (0.1 mg/100 ml), and the ascorbic acid level expressed in mg vitamin C /100g of the dry weight of samples. The leaf samples of nine edible species were also analyzed for macro (Ca, Mg, P, K, and S) and micro (Na, Mn, Fe, Si, Al, and Zn) nutrient concentrations using SPECTRO brand XEPOS model XRF instrument at Central Research Laboratory at Kastamonu University. An analysis of variance (ANOVA) was applied for analyzing the differences in the chemical composition of the samples using the SPSS program ver. 11.0 for Windows. Following the results of ANOVAs, Tukey's honest significance difference (HSD) test ($\alpha = 0.05$) was used for testing differences between group means.

RESULTS AND DISCUSSION

Variation Of Bioactive Compounds İn The Nine Examined Species

Various amounts of different chlorophylls, carotenoids, β-carotene, lycopene, and total phenolic have been reported previously in wild edible and cultivated species (Şener et al., 2017, Kibar, 2018; Kordali et al., 2021). They have the potential to scavenge toxic molecules as ROS, MDA, ketones, and nitrite derivatives with antioxidant properties, which occur normally in metabolism, but their concentrations reach toxic levels that result in cell damage under disease or stress conditions (Rajalakshmi and Banu, 2015; Sarker and Oba, 2020). The amount of β-carotene ranged from 21.1-410.76 mg 100g^{-1}, with the maximum content found in *T. orientalis* (410.76 mg 100g^{-1}), followed by *T. reticultaus* (370.83 mg 100g^{-1}) and *E. tenuifolia* (317.49 mg 100g^{-1}). The amount of lycopene of nine genotypes varied between 16.17 to 150.22 mg 100g^{-1} (*C. bursa-pastoris-M. sylvestris*). The values measured in the nine edible species (chlorophyll, carotenoid, β-carotene, lycopene, and total phenolic) are in agreement with the literature. For example, Ahmed et al. (2020) studied with thirteen medicine plants to determine the biochemical and bioactive potential. Results revealed that the amount of total chlorophyll ranged from 161.30 to 800.11 µg g^{-}1, a total carotenoid from 8.64 to 38.63µg g^{-1}, lycopene from 1.33 to 9.26 µg g^{-1}, and phenolic ranged from 43975to 63025 µg g^{-1}, respectively, similarly this study results. Znidarcic et al. (2011) showed that the concentration of total chlorophyll varied between 200.44-359.62 mg 100g^{-1}, total carotenoid between 3.94-8.24 mg 100g^{-1}, β-carotene between 3.94-7.96 mg 100g^{-1}, respectively, in five leafy vegetables. In terms of total carotenoid and β-carotene content, our results were higher than those five species but lower than chlorophyll levels. Sarker and Oba (2019) examined the amount of pigments and phytochemicals in the leaves of six weedy Amaranthus varieties.

According to results, total chlorophyll ranged from 413.61 to 445.22 µg/g, carotenoid from 68.52 to 92.87 mg 100g^{-1}, β-carotene from 64.22 46.76 mg100g^{-1}, total phenolic 24.98 to 46.72µg g^{-1}, respectively, which the investigated constituents were in agreement with the values obtained from the nine studied species, except the amount of total carotenoid. Vivek et al. (2013) reported that total chlorophyll levels in leaf samples of some edible species were ranging between 0.394 mg/g to 1.850 mg/g, and also the total chlorophyll content of woody species, *Barringtonia acutangula* was 1.235 mg g^{-1}. Demir et al. (2020) showed that the amount of carotenoids were in the range of 7.75 mg 100g^{-1} (*S. excelsa*), 13.14 mg 100g^{-1}(*T. orientalis*) and 19.02 mg 100g^{-1}(*C. bursa-pastoris*), but β-carotene levels varied between 102.1 µg 100g^{-1} (*C. bursa-pastoris*), 153.17µg g^{-1}(*S. excelsa*) and 200.69, similar to the results of this study.

Ascorbic acid, known as vitamin C, is a water-soluble vitamin, which is very important for human health with its high antioxidant capacity which has an important role in maintaining a healthy life, but it cannot be produced by human metabolism and they have to be taken from food sources by the diet (Booker et al., 2013; Shukla et al., 2014). As seen in Table 2, the richest level was found in *T. orientalis* (97.34 mg) followed by *T. reticulatus* (97.04 mg), but the poorest level in *C. album* (25.78 mg) and *M.*

sylvestris (32.54 mg), respectively. It was also detected in *S. excelsa* (74.39 mg), *A. acutifolius* (73.18 mg), and *V. vinifera* (66.00 mg).

Table 2.The amount of total phenolic, chlorophyll, carotenoid, β-carotene, lycopene total free amino acid, glycine, and ascorbic acid in the nine species.

Species	*Total Chlorophyll mg 100g^{-1}	Total Carotenoid mg 100g^{-1}	β-carotene mg 100g^{-1}	Lycopene mg 100g^{-1}	Total phenolic mg g^{-1}	Ascorbic acid mg g^{-1}	Free amino acid mg g^{-1}	Glycine betaine mg g^{-1}
V. vinif.	90.57±0.0014f	121.74±0.006a	278.45±0.009d	104.47±0.003d	20.85±0.16g	66.00±0.008e	134.74±0.140	52.60±0.015d
M. sylv.	92.11g±0.0110g	358.87±0.009b	288.42±0.005e	150.22±0.001f	3.65±0.17a	32.54±0.007b	113.52±0.00e8	60.38±0.023f
T. orient.	93.78±0.0009h	364. 34.00±0.013b	410.76±0.012h	125.39±0.003e	4.74±0.13b	97.34±0.004g	101.30±0.00d6	49.97±0.005c
A. acut.	51.79±0.0012b	1002.72±0.017c	21.11±0.001a	40.95±0.001b	7.35±0.16c	73.18±0.005f	128.68±0.004	56.34±0.049e
S. excelsa	63.95±0.0006c	1130.95±0.018d	166.83±0.001c	84.23±0.001c	17.44±0.28f	74.39±0.002f	93.98±0.010c	47.79±0.006c
C. album.	86.55±0.0036f	920.67±0.021c	161.40±0.003b	80.60±0.002c	14.83±0.06e	25.78±0.003a	62.43±0.018a	27.58±0.015a
E, tenuifolia	81.78±0.0004d	356.65±0.011b	317.49±0.003f	106.58±0.002d	4.81±0.13b	37.12±0.003c	113.69±0.01e0	52.86±0.007d
T. reticulatus	82.68±0.0006e	1326.52±0.009e	370.83±0.039g	121.96±0.012e	13.35±0.18e	97.04±0.003g	95.71±0.010c	43.72±0.041b
C. bursa-past.	28.61±0.0006a	918.07±0.011c	284.19±0.006e	16.17±0.001a	11.79±0.09d	52.99±0.001d	87.72±0.019	51.68±0.005d
F	3186.011	96710.817	7271.382	6240.586	1474.247	2725.911	2164.584	1549.762
Sig.	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

* Means indicated with different letters within the same column are significantly different ($P < 0.05$).

These results are similar to some previous studies. The mean vitamin C concentrations recorded are similar to the works of Narzary et al. (2015) reported for twelve wild edible plants (11.39 to 79.06 mg/100g). In another study, Guzelsoy et al. (2017) reported that some wild edible plants collected from three different biogeographic of Turkey are rich in vitamin C, ranging from 2.0 to 129.4 mg 100g^{-1}. Prasad and Chandra (2018) also reported similar values of ascorbic acid in some wild edible medicinal herbs as *P. hirta* (108.40 mg 100g^{-1}), *E. thymifolia* (88.48 mg 100g^{-1}), and *P. indica* (77.49 mg 100g^{-1}). According to the results, the daily vitamin C requirement of an adult person can be provided by consuming both the T. *orientalis* and *T. reticulatus*. It has been proven by clinical investigations that the current RDA for ascorbic acid is recommended to be 100-120 mg day^{-1}, and also the daily vitamin C requirement of men is 90 mg, While that of women is 75 mg (Camarena and Wang, 2016). As seen in the literatüre, the results of pigment, phenolic, and ascorbic acid did not agree with some studies due to the heterogeneity of recorded values. For example, Andarwulana et al. (2012) found that the amount of total phenolic acids 0.04 to 2.53 mg 100g^{-1}, β-carotene from 0.01 to 2.25 mg 100g^{-1}, a total carotenoid from 0.36 to 13.96 mg 100g^{-1}, and ascorbic acid from 12.03 to 494.43 mg 100g^{-1}, respectively, in the medicinal species as *Anacardium occidentale, Sauropus androgynous*, and *Moringa pterygosperma*. The recorded values of the total carotenoid (34.00-1326 mg 100g^{-1}) and ascorbic acid (25.78-97.34 mg 100g^{-1}) contents are similar to our study, but the phenolic acids (3.65-20.85 mg 100g^{-1}) and β-carotene (21-410 mg 100g^{-1}) concentrations are generally lower. Yadav et al. (2013) showed that the amount of ascorbic acid was the highest with amaranth and Chenopod cultivars by 59.0-69.4 mg 100g^{-1}, with spinach by 51-60.6 mg 100g^{-1}, and the content of carotenoids was the maximum with amaranth (59.00-69.4 mg 100g^{-1}). In addition, total polyphenols ranged from 234-750.47 mg 100g^{-1}, 225.73 to 397.00 mg 100g^{-1} in spinach, 941.57 to 1133.73 mg 100g^{-1}, 202.47 mg 100g^{-1} g in lettuce, respectively. According to their values, the total carotenoids are much lower than the values of this study, but the amount of total polyphenol is lower. However, total polyphenol content is consistent with our data. Zdravković et al. (2014) investigated the amount of some bioactive chemicals in lettuce. According to results they recorded, the β-carotene ranged from 1.97 to 4.35 mg 100g^{-1}, lycopene from1.32 to 2.22 mg 100g^{-1}, ascorbic acid from 7.3 to 10.9 mg 100g^{-1}, which are much lower than the results we achieved, however, the amount of total phenolic (70.56 to 78.98 mg 100g^{-1}) is much higher than the value recorded for the studied in this study. In another study, it has been indicated that the amount of chlorophyll, carotenoid, carotene are lower than that of *Allium porrum*, *Amaranthus spin*osis, *Apium graveolens*, *Caralluma edulis*, *Chenopodium album*, *Urtica dioica* (Shad et al., 2016), of the weedy Amaranthus genotypes (Sarker and Oba, 2019).

Nitrogenous compounds are considered as markers of protein levels in plants because they are the building blocks of proteins, which are important nitrogenous sources for human nutrition and health (Molla et al., 2014; Demir et al., 2020). Also, they have many functions including skeletal muscle, atrophic conditions, sarcopenia, and cancer (Dioguardi, 2011; Kim et al., 2014). In the studied samples, the highest free amino acid level was recorded for *V. vinifera* (134.74 mg 100g^{-1}), followed by *A. acutifolius*, *E. tenuifolia* and *M. sylvestris* (128.68 mg 100g^{-1}, 113.69 mg 100g^{-1}, and 113.52 mg 100g^{-1}, respectively). Glycinebetaine levels ranged between 27.58 mg 100g^{-1} (*C. album*) and 60.38 mg 100g^{-1} (*M. sylvestris*) (Table 2). Total free amino acid levels of samples coincided with that obtained by Kim et al. (2014), Inyang (2016), who also determined that green leafy vegetables and many herbal leaves contained high-level free amino acids such as glycine, arginine, glutamate, aspartate, leucine, proline and others. Similarly, in a study carried out by Moran-Palacio et al. (2014), some medicinal species used in traditional medicine were found to be very rich in amino acids. Prasad and Chandra (2018) showed that the total essential amino acid levels were ranging between 35.58 mg 100g^{-1} and 145.82 mg 100g^{-1}, and the amount of total amino acid content of *Pavetta indica* was 58.80 mg 100g^{-1}*, E. thymifolia* 123.92 mg g^{-1}, and *P. hirta* 225.73 mg 100g^{-1}.

Elemental status of the tested plant samples

The mineral status of 9 samples of edible species used as a flavour enhancer in salads, soups, yoghurt, and cheese, as well as cooked in the Kastamonu Region were measured and the values noted are shown in Table 3. Thirteen elements as major and trace were determined in all samples. Elements are inorganic materials that are necessary for maintaining normal lifestyles. They provide significant contributions in reducing the effects of health problems such as obesity, diabetes, and high blood pressure (Carvalho et al., 2016; FAO, 2016). The major-minerals are required in amounts greater than 100 mg dl^{-1} and the trace-minerals are required in amounts less than 100 mg/dl (Miller and Welch, 2013; Okut, 2019). In this study, the values recorded for K, Ca, Mg, P, S, Na and Cl were 20470-65410 mg kg^{-1}, 2681 to 32630 mg kg^{-1}, 1004 to 10200 mg kg^{-1}, 2262 to 10410 mg kg^{-1}, 3339 to 9727 mg kg^{-1}, 100.4 to 11110 mg kg^{-1} and 759.5 to 13930 mg kg^{-1}, respectively (Table 3). K, Ca, Mg, P, and S levels of species in this study were determined higher than those of other nutrients. The highest content of (mg kg^{-1}) K (65410) and Mg (759.5) was recorded in *C. album*, highest P and S in *A. acutifolius* (10410-9727), highest Ca in *C. bursa-pastoris* (32630), highest Na in *T. reticulatus* (3280) the lowest Ca and Mg (2681-1004) in *A. acutifolius*, the lowest Na and Cl in *C. album* (100.4-13930), respectively (Table 3).

Table 3. The amount of essential elements of nine species (mg kg^{-1}).

Species	**Major**					**Trace**	
	K	Ca	**Mg**	**P**	**S**	**Na**	**Cl**
V. vinif.	20470±30	18220±20	3105±32	4724±6	4787±5	100.8±0.00	759.5±1.2
M. sylv.	43070±40	30810±30	4693±39	5909±7	7007±6	100.9±0.00	2253±2
T. orient.	29720±30	32630±30	5000±39	5286±6	4833±5	100.5±0.00	5035±4
A. acut.	53260±50	16870±20	10200±50	4020±6	4088±4	381.6±16.0	6884±5
S. excelsa	44010±40	2681±12	1004±28	10410±10	9727±8	100.5±0.00	9648±7
C. album.	41210±40	5543±15	1201±21	6894±7	4447±4	100.6±0.00	970.5±1.3
E, tenuifolia	65410±50	16990±30	11780±50	3782±5	3944±4	100.4±0.00	3401±3
T. reticulatus	51620±40	18970±30	3569±42	4717±6	8645±7	11110.0±320	10940±10
C. bursa-past.	22520±30	27880±30	9838±57	2262±5	3339±4	3280.0±290	13930±10

On the other hand, the lowest values of (mg kg^{-1}) K and Cl was found in *V. vinifera* (20470-759.5), lowest Ca and Mg in *A. acutifolius* (2861-1004), lowest Na in *C.album* (100.4), and lowest P and S in *T.reticultaus*, respectively (Table 3). Major K, Ca, Mg, P, S, and trace elements as Na and Cl are presented in the human body, which is necessary for many metabolic functions (Roe et al., 2013; Celep et al., 2017; Topdas and Sengul, 2021). For example, Ca is present in the structures of bones, teeth, and muscles, K, Na, and Mg have an important role in the regulation of blood pressures (FAO, 2010; Stone et al., 2016). The results for the macroelement are supported by the studies of Guzelsoy et al. (2017), Özer and Aksoy (2019), Kibar (2020), who demonstrated that the elements with the highest level in plants are K, Ca, Mg, Na, P, and S in terms of essential nutrients. Similarly, Volpe et al. (2015) revealed that K was the most abundant element ranging between 26350 and 60235 (S. asper samples). And also, they found that Ca level ranged from 3417 mg kg^{-1} to 8589 mg kg^{-1}and Mg from 1550 to 7701 mg kg^{-1} in the studied species, respectively. Kibar and Kibar (2017) investigated to reveal some nutritional status of *Malva neglecta*, *Polygonum cognatum*, and *Trachystemon orientalis*, used as food in the Middle Black Sea Region of Turkey. Results showed that K content varied between 12.19 and 1867.47 mg 100g^{-1}, P between 56.89-195.86 mg 100g^{-1}, Ca between 282.96-688.32 mg 100g^{-1}, and Mg between 112.54-165.7 mg 100g^{-1}, respectively. Özer and Aksoy (2019) showed that K concentration ranged from 3883.8 to 5791.4 mg 100g^{-1}; P from 339.7 to 540.9 mg 100g^{-1}; Ca from 159.4 to 432.4 mg 100g^{-1}; Mg from 108 to 76.4 mg 100g^{-1}, respectively in some edible herbal species, which lower than those of this study results. Satter et al. (2015) revealed that the amount of Ca ranged from 279.16 to 909.13 mg 100g^{-1}, K from 858.39 to 20055.26 mg 100g^{-1}, and Mg from 57.18 to 35.21 mg 100g^{-1}, respectively, in some wild vegetables used in Bangladesh, similar to this study. Olujobi (2015) measured lower amounts of K (445.89-1159.93 mg kg^{-1}), Ca (70.23-480.27 mg kg^{-1}), and Mg (15.69-20.73 mg kg^{-1}) in the leaf samples of five native trees consumed as food. Values for macronutrients of this study are within the limits of values given in the literature (Table 3). According to literature, major and trace mineral requirements vary with age, sex, physiological conditions as well as characteristics of the living area, however, the recommended daily dose for some major elements are found in the human cell more than 0.01%, include K, Na, P, S, Mg, Ca and Cl has been as 4700, 1500, 700, 1000, 310-420, 1000-1200, 2300 mg (Smolin and Grosvenor, 2010; Freeland-Graves et al., 2016).

On the other hand, Fe, Co, Cr, Cu, I, Mn, Zn, Mo, Se, and Ni concentrations of human body cells are needed in only small levels as less than 0.01% (Celep et al., 2017). All of them are mandatory minerals since they exhibited a wide range of biological functions such as being components of enzymatic and redox systems, connective tissue, and nerve activation, maintaining immune system activities (Miller and Welch, 2013; Freeland-Graves et al. 2016). In terms of trace elements, Fe concentration varied from 77.6 to 4298 mg kg^{-1}, Mn from 34.9 to 243.1 mg kg^{-1}, Zn from 26.3 to 87.6 mg kg^{-1}, Ni from 8.2 to 25.3 mg kg^{-1}, Se from 0.06 to 0.4 mg kg^{-1} and Co from 3.9 to 11.2 mg kg^{-1}, respectively (Table 4). The element with the highest level among the examined species was Fe, which varies between 77.6 to 4298 mg kg^{-1} and the lowest ion was Se ranging between 0.06 to 0.49 mg kg^{-1} (Table 4). According to data, *S. excelsa* was rich in Cu and Se (25.4-0.49 mg kg^{-1}), *V. vinifera* rich in Mn (243 mg kg^{-1}), A. acutifolius rich in Zn (87.6 mg kg^{-1}), *T. reticlatus* rich in Fe and Co (4298-11.2 mg kg^{-1}) (Table 4). Tunçtürk et al. (2014) found a similar result that the macronutrient contents of *Malva sylvestris Falcaria vulgaris* and *Chenopodium botrys* were 580.53 mg kg^{-1} for Fe, 79.54 mg kg^{-1} for Mn, 43.14 mg kg^{-1} for Zn. However, Zn was observed to be ranging between 1.02 (*T. occidentalis*) and 3.69 mg 100g^{-1} (*Psychotria* sp), but Mn from 0.56 mg 100g^{-1} to 1.430 mg 100g^{-1}, both of them are lower than our results. Similar to this study, trace minerals as Na, Fe, Zn, Mn, Ni, Cu, and Co concentrations were higher than those of other micronutrients in some edible plants, ranging from 201 to 15896, 3676 to 13290, 18.0 to 52.0, 21.2 to 86.5, 1.32 to 6.30 ($\mu g\ g^{-1}$), respectively (Targan et al. 2018). Moreover, the Se level of all samples was found to be low (0.08-0.25 $\mu g\ g^{-1}$), like the values we recorded (0.06-0.49 mg kg^{-1}). Also, Şimşek et al. (2017) analyzed four edible wild species to assess macro, trace, and toxic elements.

Table 4. The amount of micronutrients in the nine species (mg kg^{-1}).

Species	Fe	Mn	Zn	Ni	Cu	Se	Co
V. vinif.	261.5±1.5	243.1±0.9	39.5±0.30	10.6±0.3	20.8±0.24	0.46±0	8.3±1.4
M. sylv.	259.2±1.4	54.0±0.5	30.2±0.29	8.2±0.3	9.4±0.13	0.06±0	8.4±1.2
T. orient.	2629.0±5	125.9±0.7	44.3±0.30	25.3±0.4	13.0±0.13	0.47±0	10.1±1.5
A. acut.	220.7±1.3	77.3±0.5	27.6±0.25	8.4±0.3	20.4±0.23	0.20±0.1	7.7±1.2
S. excelsa	113.7±0.9	34.9±0.3	87.6±0.40	12.5±0.3	22.4±0.23	0.46±0	4.2±0.9
C. album.	77.6±0.7	54.4±0.4	72.3±0.40	10.6±0.3	25.4±0.24	0.49±0	9.4±1.4
E, tenuifolia	78.2±0.7	111.0±0.6	26.3±0.28	8.7±0.3	10.9±0.11	0.47±0	3.9±0.8
T. reticulatus	189.7±1.2	71.3±0.5	31.9±0.30	8.7±0.3	12.8±0.13	0.48±0	5.6±1.0
C. bursa-past.	4298.0±6	230.0±0.9	28.7±024	23.9±0.4	11.3±0.11	0.30±0.1	11.2±1.5

Their results indicated that the amounts of (mg kg^{-1}) Fe (160.5), Mn (18.21), Zn (12.47), Cu (9.98), Ni (6.11), Co (0.50), and Se (0.076) were higher than in other consumed species. As seen in the literature, Se content is lower generally lower than other micronutrients. Similarly, Płaczek and Patorczyk-Pytlik, (2020) reported that some species with low Se accumulation capacity contained less than 25 mg g^{-1} Se, named non-accumulators. It has been reported that the Se level is generally lower in vegetables (Oklo et al., 2017). Pehlivan et al. (2013) reported that *C. bursa pastoris* had the following minerals; Fe 44.36 mg kg^{-1}, Mn 4.5 mg kg^{-1}, Zn 5.48 mg kg^{-1}, Co 0.15 mg kg^{-1}, Cu 0.7 mg kg^{-1}, and Na 2.90 mg kg^{-1} in the consumable sections, very lower than our results. According to WHO, trace element deficiencies are a more common problem, and more than 2billion human population in the world today suffer from micronutrient deficiencies primarily I, Fe, and Zn (Theodore and Tulchinsky, 2010). The recorded recommended levels for Fe, Zn, Ni, Cu, Cr in daily nutrition was 1-3 g, 10-15 mg, 150 µg and 13-60 mg, 13-61 mg, respectively, which are influenced by food taken (Abbaspour et al., 2014; Chen et al., 2018). These differences of measured bioactive compounds of nine studied plants may be due to genotype, the different ability to produce the secondary metabolites as well location differences (Janu et al., 2014; Kibar and Kibar, 2017). As seen in the literature, the most abundant element was K following Ca, Mg, P as macro-nutrients, but Na, Fe, and Zn are the most abundant elements in edible leafy species in terms of micronutrients. The highest macro-nutrient was also determined as K in our study. Depending on the mineral values of the nine species studied, *V. vinifera* was rich in Mn; *C. bursa-pastoris* in Ca; *A. acutifolius* in P, S, and Zn; *S. excelsa* in Cu; *C. album* in K and Mg; *E. tenuifolia* in Na and *T. reticulatus* in Cl, Si, and Fe (Table 3, Table 4). In this study, it was thought that genetic factors, growing variations, geographical differences, and analytical errors during the experiment may be effective in the differences observed in the studied species.

CONCLUSION

The present study exhibited that all the nine examined species have adequate levels of some bioactive compounds and minerals necessary for medicinal activity and benefits, and they are within the permissible range in terms of pigments, nitrogenous compounds, phenolic, and nutrient elements in this study. Based on bioactive compounds, *T. orientalis, V.s vinifera, M. sylvestris,* and *T. reticulatus* are the richest species with the high level of total chlorophyll, β-carotene, lycopene, phenolics, free amino acid, glycine betaine, ascorbic acid, but *S. excelsa* and *C. album* are two poorest species. Considering the element profile of the genotypes, it has been observed that the mineral values are quite heterogeneous. However, the highest K and Mg were recorded in *E. tenuifolia*, P, S, and Zn in *S. excelsa*, Fe in Capsella bursa-pastoris, Mn in *V. vinifera*, and Ca in *T. orientalis*, respectively. When all data are considered, it can be said that these species are rich in some bioactive compounds and *minerals* higher and can be consumed in the diet for combating mineral deficiencies and strengthening body health.

Conflict of Interest

As an author, I declare that there is no conflict of interest in the planning, execution and writing of the article.

Author's Contributions

As the author, the planning, execution and writing of the articles was carried out by me.

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