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Determination Some of Macro, Trace and Heavy Elements in Medicinal Fruits and Herb Consumed as a Functional Food in Turkey

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Abstract
In this study was conducted to determine the macro, trace elements and some heavy metal contents growing and cultivated some edible medicinal fruits and herbs in the Eastern Black Sea Region, Turkey. The plant materials included in this study contained macro (N, P, K, Ca, Mg), trace elements (Fe, Zn, Cu, Mn, B) and heavy metals (Al, As, Ba, Cd, Co, Cr, Mo, Ni, Pb, Se) amounts were determined by Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). According to the elemental analyses, it was determined that there were statistically significant differences in mineral and heavy metal contents depending on the plant species, parts and growing conditions. This work may contribute to knowledge of the macro, trace and heavy elements contents of plants which are of some medicinal fruit and herb.

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Türkiye'de Fonksiyonel Gıda Olarak Tüketilen Tıbbi Meyve ve Bitkilerde Bazı Makro, Eser ve Ağır Elementlerin Belirlenmesi

Öz
Bu çalışma Doğu Karadeniz Bölgesinde doğal olarak yetişen ve kültürü yapılan bazı tıbbi özellikli yenilebilir meyve bitkilerin makro, iz ve ağır metal içeriklerinin belirlenmesine yönelik yürütülmüştür. Bu çalışmada yer alan bitki materyallerindeki makro (N, P, K, Ca, Mg), iz (Fe, Zn, Cu, Mn, B) ve ağır metaller (Al, As, Ba, Cd, Co, Cr, Mo, Ni, Pb, Se) İndüktif Olarak Eşleşmiş Plazma-Optik Emüsyon Spektroskopisi (ICP-OES) ile belirlenmiştir. Yapılan elementel analizlerine göre, bitki türü, kısımları ve yetişme koşullarına göre mineral ve ağır metal içeriklerinde istatistiki olarak önemli farklılıklar içerdiği tespit edilmiştir. Bu çalışma bazı tıbbi meyve bitkilerinin makro, iz element ve ağır metal içeriklerinin bilinmesine katkı sağlayabilir.

Anahtar Kelimeler
Ağır metal
Fonksiyonel gıda
İz element
Makro element
Tıbbi bitki

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Introduction

In Turkey, approximately five hundred medicinal and aromatic plant species are consumed for different purposes depending on their chemical content. Medicinal fruits and herb are widely consumed in fresh and processed forms due to their functional food properties nowadays. The mineral composition of medicinal fruit and herbs is an important factor that influences their quality and its purpose of consumption. Ecology, production techniques and genetic characteristics can be considered among the factors affecting the mineral components of medicinal fruits and leaves.

The chemical constituents in plants including protein, carbohydrates, essential/fatty oils, vitamine, macro/microelements, heavy metals and phenolic compounds are responsible for their medicinal and nutritional properties and toxicity. The chemical contents of plants not only meet nutritional needs but also make a significant contribution to healthy living. The nutritional and health roles of minerals as well as their biochemical and pathological significance to humans and animals are well known. The minerals also play an important role in plant metabolism and biosyntheses such as enzymes and hormones. However, unwanted residues and heavy metals in consumed plants may cause the organism to become diseased. Several important macros and (N, P, K, Mg, Ca) and trace minerals (Mn, Zn, Fe, Cu and B) are important part of the plant composition (Kan, 2012). Macro and trace elements contained in plants are an important

source of functional nutrition despite they represent only 4-6% of human body weight. Some macro elements are needed by humans in more than 100 mg day^{-1} and represent 1% of body weight, while trace elements are required in less than quantities of 100 mg day^{-1} and represent only 0.01% of body weight (Imbrea et al., 2016).

Medicinal and aromatic plants are generally used in three forms: (i) fresh/dried leaves; (ii) dried ripe seeds (fruits), and (iii) extract (Ayran et al., 2017). A lot of space for fresh and riped seeds /fruits such as blueberry, fox grape, elderberry, and cherry laurel are consumed as functional beverages and food. In addition, fresh/dried leaves such as thyme and tarragon are used as a spice to add flavor to foods. Anatolian sage (*Salvia fruticosa*) and Lemon verbena (*Lippia citriodora*) balm leaves are also widely used for medicinal tea and similar purposes.

The purpose of this study was to determine macro and trace elements, and heavy metal contents of medicinal fruit and herb samples obtained both from cultivated areas and natural sources in the eastern black sea region of Turkey.

Material and Method

Plant materials

The samples of medicinal fruit and herbs provided from the cultivation and natural flora in the Eastern Black Sea region of Turkey are given below. Among the medicinal fruits and plants, only blueberries are collected from nature and the other plants are cultivated plants. While fruits and leaves were analyzed in all other samples, these parts of the plant were analyzed since the most consumed parts of grapes are the fruit and pulp at the same time, in this research, it was aimed to compare grapefruits and their pulp with fruits to determine whether they have important content in terms of mineral components. The plant samples for elemental analyses were kept at +4°C.

Elderberry [(*Sambucus nigra*) – fruit Cultivation)]; Blueberry [(*Vaccinium arctostaphylos*) – fruit and leaf (Natural flora)]; [Fox grape (*Vitis labrusca*) - pulp (Cultivation)]; Cherry laurel (*Laurocerasus officinalis*) - fruit(Cultivation)]; [Blueberry (*Vaccinium corymbosum*) – fruit (Cultivation)]; [Anatolian sage (*Salvia fruticosa*) - leaf (Cultivation)]; [Tarragon (*Artemisia dracunculus*) - leaf(Cultivation)]; Lemon verbana (*Lippia citriodora*) – leaf (Cultivation)]; [Highland thyme (*Thymus nummularius*) leaf (Cultivation)].

The analyses of mineral compositions in the samples of medicinal fruit and herb

For elemental analysis, the elemental contents of fruits and herbs 0.2 g were weighed and placed into a plastic liner tube. 5 ml of HNO_3 and 2 ml of H_2O_2 were added to each tube. Once fragmented the material was transferred to a 50 ml plastic tube, and ultra-distilled water was added until a volume of 20 ml was obtained. Samples (phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), iron (Fe), zinc (Zn), Mn, copper (Cu), bor (B), aluminum (Al), arsenic (As), barium(Ba), cadmium (Cd), cobalt (Co), chromium (Cr), molybdenum (Mo), nickel (Ni), lead (Pb) and selenium (Se) were determined by ICP-OES (Inductively Coupled Plasma Optical Emission Spectrometry). The raw results were multiplied by the coefficient determined for each sample and thus the amount of elements in the sample was determined in mg kg^{-1}.

The analyses of macro, trace and heavy metal contents samples of medicinal fruit and herb

Approximately 0.2 g of the dried and ground plant samples were weighed and placed in tin containers and nitrogen contents were determined according to the Dumas Combustion Method given in (LECO/ TRUESEC MİCRO) AACC Method 46-30 in a LECO C/N analyzer operating with helium, oxygen and dry air heated at 950 °C (AACC, 2000).

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Statistical analysis

The statistical analyzes in the study were performed using the JMP 7 statistical program. The significance of treatment effects was tested through analysis of variance and Student's t method was used to compare mean values (Jones and Sall, 2011).

Results and Discussion

Macro elementel contents of medicinal fruit and herb

According to the data obtained in this study, statistically significant differences ($p<0.01$) were obtained in terms of macro elements content in medicinal fruits and herbs (Table 1). Research results have shown that the highest (N) content was obtained from tarragon leaves (2.91%), followed by Anatolian sage leaves (2.66%) and lemon verbena leaves (2.12%). It is observed that the nitrogen/protein content of plants consumed as leaves is higher than that of fruits.

According to our analyses, the concentration of P ranged from 195.53 [Blueberry (*Vaccinium corymbosum*) fruit] to 553.60 mg kg^{-1} Lemon verbena (*Lippia citriodora*) leaf]. The levels of K are 620.16 [Blueberry (*Vaccinium arctostaphylos*) fruit and leaf] -4156.10 mg kg^{-1} [Lemon verbena (*Lippia citriodora*) leaf] as shown in Table 1. The level of Ca is 0.75 [Blueberry (*Vaccinium corymbosum*) fruit] -284.07 mg kg^{-1} [Lemon verbana (*Lippia citriodora*) leaf] in our study. The levels of Mg in our study ranged from 8.59 [Blueberry (*Vaccinium corymbosum*) fruit] to 136.75 mg kg^{-1}ppm [Anatolian sage (*Salvia fruticosa*) leaf].

In a study conducted on blueberries (*Vaccinium corymbosum*), the highest macro elements detected were Mg, P, Ca, Na and K (104.72 mg kg^{-1}; 156.24 mg kg^{-1}; 646.79 mg kg^{-1}; 320.32 mg kg^{-1}, respectively and 1416.78 mg kg^{-1}) (Medvecký et al., 2014). In our study, the levels of these macro elements were found to be low in blueberry fruit (*Vaccinium corymbosum*) (Table 1-2). Özer and Aksoy, (2019) reported that mineral analyzes were carried out on *Trachystemon orientalis* with very high amounts of K (388.38- 579.14 mg kg^{-1}) to P (33.97 - 54.09 mg kg^{-1}), Ca (15.94 - 43.24 mg kg^{-1}), Mg (10.80 - 43, 24 mg kg^{-1}) contents were determined. These research results are lower than our research results, except for the Ca and Mg contents of blueberry (*Vaccinium corymbosum*) fruits (Table 1).

In another study, the highest Ca, Fe, K, Mg and S levels were respectively, it has been detected in *Thymus vulgaris, Lavandula officinalis* L., *Anethum graveolens* L., *Ocimum basilicum* plants (Özcan, 2004). In our study results of macro element contents of medicinal fruit and herb differences when compared to other studies. These differences may be due to growth/cultivation conditions, genetic, ecology factors, and other procedures (Kan et al., 2005).

Table 1. Macro element contents of medicinal fruit and herb.

Plant samples	N	P	K	Ca	Mg
	------(%) -----		---------- (mg kg^{-1}) ----------		
1	0.88±0.14 G	**547.65±0.26 A**	2582. 78±169.69 E	46.03±0.42 E	70.07±0.53 C
2	0.84±0.11 G	238.28±1.39 E	620.16±1.78 F	20.10±0.77 F	22.19±0.33 E
3	1.14±0.12 D	245.30±6.79 DE	885.25±6.10 F	6.59 G±0.10 H	14.22±0.21 F
4	1.32±0.06 E	331.10±1.36 C	778.54±14.59 F	43.67±0.10 E	20.99±0.31 E
5	0.49±0.05 H	284.54±7.28 D	3359.35±57.29 CD	19.26±1.16 FG	21.93±1.29 E
6	0.39± 0.04 I	195.53±6.08 F	674.17±15.33 F	0.75±0.04 H	8.59±0.18 F
7	2.66±0.02 B	406.16±1.34 B	3135.95±10.46 D	238.07±8.98 B	**136.75±0.14 A**
8	**2.91±0.03 A**	366.24±6.20 BC	3856.94±229.57 AB	154.19±11.49 C	58.39±3.69 D
9	2.12±0.04 C	**553.60±17.21 A**	**4156.10±100.06 A**	**284.07±1.37 A**	120.55±2.64 B
10	1.86± 0.12 D	258.07±27.20 DE	3686.38±36.00 BC	95.91±0.39 D	71.07±0.72 C
11	2.12±0.10 C	241.48±9.14 DE	620.16±4.89 F	14.30±0.57 FG	22.29±1.08 E

A,B; $p<0.01$, **ab**; $p<0.05$.

1: Elderberry (*Sambucus nigra*) fruit; 2: Blueberry (*Vaccinium arctostaphylos*) fruit; 3: Fox grape (*Vitis labrusca*) fruit; 4: Fox grape (*Vitis labrusca*) pulp; 5: Cherry laurel (*Laurocerasus officinalis*) fruit; 6: Blueberry (*Vaccinium corymbosum*) fruit; 7: Anatolian sage (*Salvia fruticosa*) leaf; 8: Tarragon (*Artemisia dracunculus*) leaf: 9: Lemon verbana (*Lippia citriodora*) leaf; 10: Highland thyme (*Thymus nummularius*) leaf; 11: Blueberry (*Vaccinium arctostaphylos*) leaf.

Wild-collected fruits of the *Vaccinium arctostaphylos* species and when the fruits of the cultivated *Vaccinium corymbosum* species were compared in terms of macro element content; *Vaccinium arctostaphylos* fruit collected from nature had higher N (0.84%), Ca and Mg content; It was observed that P and K contents were close to each other (Table 1). On the other hand, when we compare fox fruit (*Vitis labrusca*) and its pulp in terms of macro element content, as seen in Table 1, the N, P, K and Mg contents are close to each other, and the Ca content is higher in the pulp.

Trace elementel contents of medicinal fruit and herb

In this study; the level of Fe ranged from between 0.001 [Blueberry (*Vaccinium arctostaphylos*) fruit] -5.65 mg kg^{-1}ppm[Lemon verbana (*Lippia citriodora*) leaf]. From other trace elements, Zn concentrations were 0.90 mg kg^{-1} [tarragon (*Artemisia dracunculus*) leaf] -2.85 mg kg^{-1} [fox grape (*Vitis labrusca*) pulp]. According to our analysis, the highest copper (cu) level was obtained from highland thyme (*Thymus nummularius*) leaf (5.62 mg kg^{-1}) while the lowest was obtained from blueberry (*Vaccinium corymbosum*) fruit (0.73 mg kg^{-1}). Mn level ranged from between 0.001 mg kg^{-1} [fox grape (*Vitis labrusca*) pulp] -5.19 mg kg^{-1} [blueberry (*Vaccinium arctostaphylos*) leaf]. As seen in Table 2, the highest boron (B) level was obtained from cherry laurel (*Laurocerasus officinalis*) fruit (5.63 mg kg^{-1}), while the lowest was obtained from blueberry (*Vaccinium corymbosum*) fruit (0.74 mg kg^{-1}).

The highest content of trace elements (Fe 156.60 mg kg^{-1}, Mn 8.68 mg kg^{-1}, Zn 1.081 mg kg^{-1} , Cu 0.507 mg kg^{-1}) was detected from Blueberry (*Vaccinium corymbosum*) fruit (Medvecký et al., 2014).

Table 2. The trace element contents of medicinal fruit and herb.

Plant samples	Fe	Zn	Cu	Mn	B
	---------- (mg kg^{-1}) ----------				
1	0.82±0.003 D	1.55±0.005 F	1.01±0.05 E	0.80±0.012 D	3.15±0.014 D
2	0.001±0.001 E	1.62±0.003 F	2.13±0.04 D	4.61±0.283 AB	1.62±0.01 F
3	0.93±0.008 D	2.55±0.151 B	1.13±0.01 E	0.85±0.051 D	3.01±0.02 D
4	0.95±0.013 D	**2.85±0.039 A**	2.51±0.03 D	0.001±0.001 E	1.95±0.03 E
5	0.79±0.002 D	1.85±0.001 DE	1.21±0.09 E	0.84±0.043 D	**5.63±0.04 A**
6	0.74±0.001 DE	2.24±0.001 C	0.73±0.01 E	0.75±0.003 D	0.74±0.01 G
7	3.63±0.064 C	0.93±0.003 G	3.32±0.11 C	0.89±0.028 D	3.53±0.11 C
8	4.55±0.586 B	0.90±0.008 G	4.91±0.36 B	2.10±0.065 C	5.27±0.07 B
9	**5.65± 0.091A**	1.87±0.036 DE	5.43±0.12 AB	1.83±0.077 C	3.68±0.11 C
10	4.59±0.176 B	1.95±0.003 D	**5.62±0.21 A**	4.49±0.194 B	1.75±0.12 EF
11	0.81±0.003 D	1.67±0.070 EF	3.06±0.01 C	**5.19±0.268 A**	1.59±0.01 F

A,B; p<0.01, **ab**; p<0.05.

1: Elderberry (*Sambucus nigra*) fruit; 2: Blueberry (*Vaccinium arctostaphylos*) fruit; 3: Fox grape (*Vitis labrusca*) fruit; 4: Fox grape (*Vitis labrusca*) pulp; 5: Cherry laurel (*Laurocerasus officinalis*) fruit; 6: Blueberry (*Vaccinium corymbosum*) fruit; 7: Anatolian sage (*Salvia fruticosa*) leaf; 8: Tarragon (*Artemisia dracunculus*) leaf: 9: Lemon verbana (*Lippia citriodora*) leaf; 10: Highland thyme (*Thymus nummularius*) leaf; 11: Blueberry (*Vaccinium arctostaphylos*) leaf.

Trace element and heavy metal contents (Cu, Zn, Mn, Fe, Cr, Ni and Cd) detected in the fruit of the elderberry plant cultivated in the Eastern Black Sea region were found to be quite low compared to other studies (Ognik et al., 2006; Koodziej et al., 2012). Sanches et al. (2021) found lower Fe (0.157 mg kg^{-1}), Cu (0.037mg kg^{-1}) and Zn (0.025mg kg^{-1}) in their study on black Borgoña (*Vitis labrusca* L.) grapes, contrary to our results another study, macro elements K (107.4 mg kg^{-1}), Ca (344.1 mg kg^{-1}) and Na (18.9 mg kg^{-1}) and microelements (Fe, Zn and Cu) were found in the very low content of *Artemisia vulgaris* L. It has been reported that the Cr content is especially high (Bhat et al., 2010). In our study on tarragon (*Artemisia dracunculus*) leaves, it was determined that the heavy metal contents were lower, and the macro and trace element contents were higher. The reasons for these differences in literature are diversity, geographical location, climate, and seasonal effects, which can be attributed to soil composition.

In the research conducted by Pruteanu et al. (2019) the highest zinc (Zn) content was detected in plum (8.19 -12.5 mg kg^{-1}) and sour cherry fruits (19.0 mg kg^{-1}), while the lowest lead content was determined in plum and sour cherry fruits. In our study, the highest Zn content (2.85mg kg^{-1}) was detected in fox grape (*Vitis*

labrusca) pulp (Table 2). The investigation for the difference in Zn content between the studies and our research include contaminated soils, environmental pollution, pesticide residues, etc. can be shown.

Metals are elements that are necessary for biochemical and physiological functions in maintaining the health of living things. Excess or deficiency of trace elements can have harmful effects on the human body. Depending on growing techniques and plant species, fruits may contain and accumulate heavy metals. In a study, it was determined that the most assimilated element in plum fruits was zinc, followed by copper and a very small amount of lead (Figas et al., 2024). Similarly, in our study, the highest trace element zinc was detected in Fox grape (*Vitis labrusca*) pulp.

Heavy metals contents of medicinal fruit and herb

In this research, toxic heavy metals aluminum (Al), arsenic (As), barium (Ba), cadmium (Cd), cobalt (Co), chromium (Cr), molybdenum (Mo), nickel (Ni), lead (Pb) and selenium (Se) were examined in materials from different plants. According to our analyses, the highest level of Al was found to be (0.55 mg kg^{-1}) from Lemon verbena leaves, As (26.19 mg kg^{-1}) from Anatolian sage leaves Ba (4.56 mg.kg^{-1}ppm) Lemon verbena leaves and Cd (0.06 mg kg^{-1}; 0.07 mg kg^{-1}; 0.6 mg kg^{-1}) fox grape pulp, cherry laurel fruit, blueberry (*Vaccinium corymbosum*) fruit respectively.

Among other heavy metals, the highest amount of Cr was determined in elderberry fruit (0.10 mg.kg^{-1}), Mo in fox grape pulp (0.22 mg.kg^{-1}), Ni and lead Pb in Lemon verbana leaves (respectively 0.35 mg.kg^{-1} and 1.47 mg.kg^{-1}) and Se in blueberry fruits (1.64 mg kg^{-1}) (Table 4).

When Blueberry (*Vaccinium arctostaphylos*) fruit and Blueberry (*Vaccinium corymbosum*) fruit were compared, it was determined that Cd, one of the heavy metals, was higher in the cultivated Vaccinium corymbosum species (Table 3).

Table 3. The heavy metal contents of medicinal fruit and herb.

Plant samples	Al	As	Ba	Cd	Co
	---------- (mg kg^{-1}) ----------				
1	0.47±0.004 BC	17.53±0.06 C	0.39±0.001 CDE	0.06±0.008 a	0.10±0.0001
2	0.45±0.026 CD	20.36±0.07 B	0.48±0.004 CD	0.003±0.001 d	0.08±0.011
3	0.44±0.007 CDE	19.30±0.60 B	0.20±0.024 EFG	0.01±0.001 cd	0.07±0.0002
4	0.45±0.019 CD	3.58±0.03 F	0.28±0.019 D-G	**0.06±0.023 a**	0.24±0.1806
5	0.43±0.006 C-F	7.48±0.09 E	0.13±0.016 FG	**0.07±0.005 a**	0.15±0.0064
6	0.39±0.001 DEF	9.92±0.17 D	0.08±0.004 G	**0.06±0.012 a**	0.07±0.0176
7	0.53±0.016 AB	**26.19±0.89 A**	1.85±0.008 B	0.04±0.012 abc	0.21±0.0031
8	0.41±0.019 C-F	9.50±0.49 D	0.56±0.042 C	0.02±0.005 bcd	0.15± 0.0182
9	**0.55±0.014 A**	16.76±0.42 C	**4.56±0.140 A**	0.03±0.005 bcd	0.18±0.0001
10	0.36±0.018 F	1.57±0.17 G	4.49±0.105 a	0.02±0.015 bcd	0.06±0.0006
11	0.37±0.024 EF	4.48±0.18 F	0.34±0.003 C-F	0.05±0.010 ab	0.09±0.0003

A,B; p<0.01, **ab**; p<0.05.

1: Elderberry (Sambucus nigra) fruit; 2: Blueberry (Vaccinium arctostaphylos) fruit; 3: Fox grape (Vitis labrusca) fruit; 4: Fox grape (Vitis labrusca) pulp; 5: Cherry laurel (Laurocerasus officinalis) fruit; 6: Blueberry (Vaccinium corymbosum) fruit; 7: Anatolian sage (Salvia fruticosa) leaf; 8: Tarragon (Artemisia dracunculus) leaf: 9: Lemon verbana (Lippia citriodora) leaf; 10: Highland thyme (Thymus nummularius) leaf; 11: Blueberry (Vaccinium arctostaphylos) leaf.

On the other hand in our research, when foxberry (*Vitis labrusca*) fruit and foxberry (*Vitis labrusca*) pulp were compared in terms of heavy metal content; Foxberry (*Vitis labrusca*) pulp contained higher Mo (0.22 mg kg^{-1}) and Cd (0.06 mg kg^{-1}) content.

The limit values in the aerial parts of *S. Virgata* for Cd, Cr, and Ni determined by the WHO/FDA are 0.3 - 0.02 and 1.63 mg kg^{-1}, respectively (Lone et al., 2003). In our study, Cd and Ni, (*Salvia fruticosa*) among the heavy metals detected, were below the limit values, while Cr value was above the limit value. This study shows that whether medicinal plants are collected from nature or cultivated, they can be contaminated with heavy metals through pre-harvest and post-harvest cultural processes such as irrigation, fertilization and pesticides.

Heavy metals that may contribute to biochemical processes, but which have not been essential are Al, As, Ba, Cd, Co, Cr, Mo, Ni, Pb and Se are known for their toxicological properties. Heavy metals were in no or low quantities suggesting their safe use as required.

Medicinal plants can also accumulate trace metals in their tissues, and the increase in the concentrations of these elements reduces the bioavailability of plant material. High concentration of heavy metals in plant tissues can adversely affect human health (Ognik et al., 2006).

Table 4. The heavy metal contents of medicinal fruit and herb.

Plant samples	Cr	Mo	Ni	Pb	Se
	---------- (mg kg^{-1}) ----------				
1	**0.10±0.001 A**	0.18±0.005 A-D	0.16±0.012 BC	0.55±0.011 F	0.63±0.016 E
2	0.08±0.005 B	0.16±0.002 CDE	0.09±0.003 EF	0.61±1.54 EF	**1.64±0.004 A**
3	0.01±0.003 E	0.21±0.005 AB	0.20±0.014 B	0.83±0.04 D	1.62±0.003 AB
4	0.06±0.001 BC	**0.22±0.025 A**	0.17±0.001 BC	1.06±0.02 C	1.36±0.006 CD
5	0.05±0.007 CD	0.17±0.008 B-E	0.06±0.014 FG	0.98±0.03 C	1.22±0.078 D
6	0.08±0.001 B	0.19±0.016 ABC	0.18±0.002 BC	0.73±0.02 DE	1.33±0.058 CD
7	0.02±0.001 E	0.06±0.002 G	0.03±0.007 G	1.35±0.05 AB	0.41±0.002 F
8	0.04±0.008 D	0.11±0.014 F	0.06±0.002 FG	1.28±0.01 B	0.51±0.093 EF
9	0.08±0.008 B	0.13±0.001 EF	**0.35±0.013 A**	**1.47±0.09 A**	0.21±0.015 D
10	0.04±0.0013 D	0.14±0.005 DEF	0.14±0.010 CD	0.57±0.01 F	0.55±0.001 EF
11	0.07±0.0076 BC	0.10±0.009 FG	0.11±0.025 DE	0.61±0.04 EF	1.46±0.027 BC

A,B; p<0.01, **ab**; p<0.05.

1: Elderberry (*Sambucus nigra*) fruit; 2: Blueberry (*Vaccinium arctostaphylos*) fruit; 3: Fox grape (*Vitis labrusca*) fruit; 4: Fox grape (*Vitis labrusca*) pulp; 5: Cherry laurel (*Laurocerasus officinalis*) fruit; 6: Blueberry (*Vaccinium corymbosum*) fruit; 7: Anatolian sage (*Salvia fruticosa*) leaf; 8: Tarragon (*Artemisia dracunculus*) leaf: 9: Lemon verbana (*Lippia citriodora*) leaf; 10: Highland thyme (*Thymus nummularius*) leaf; 11: Blueberry (*Vaccinium arctostaphylos*) leaf.

Conclusion

In conclusion, these results have shown that the macro, trace element and heavy metal contents of some medicinal fruits and herbs used as functional food for medicinal purposes may be differences significantly depending on the species of plant, the part of the plant consumed and the ecological conditions in which it grows naturally or is cultivated.

Forming the raw material of herbal medicines and food supplements mineral content and heavy metal concentrations of medicinal plants are extremely important for human health. In this study, determining the mineral and heavy metal contents of some edible fruits and plants with medicinal properties is important in guiding future studies to evaluate the quality of herbal products.

Author Contributions

Authors participated in this study arranging and development. A. Korkmaz contributed to this work lab processing of samples, data analysis. A. Kan data interpretation, article writing, and discussion. The authors approved the final manuscript.

Conflict of Interest

A. Korkmaz and A. Kan declare that they have no competing interests.

Ethics Committee Approval

As the authors of this study, we declare that we have no ethics committee approval.

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