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MINERAL COMPOSITION AND NUTRITIONAL PROPERTIES OF *Trachystemon orientalis* (L.) G. Don POPULATIONS IN THE CENTRAL BLACK SEA REGION OF TURKEY

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ABSTRACT

This study was conducted to determine the mineral contents and some nutritional properties of *Trachystemon orientalis* L. growing in the Central Black Sea Region, Turkey, and that is consumed as vegetable. Surveys and field studies were started during the spring semester of 2011 (April–May) and they were collected from Samsun and Ordu, where they are intense. In the study, it is was observed that pH, dry matter, content of ash, N, protein, vitamin C, macro- and microelements examined in *Trachystemon orientalis* varied considerably. The pH, dry matter, ash, N, protein and C content of the plants ranged from 6.61 to 6.88, 13.0 to 22.1%, 9.2 to 17.0%, 2.3 to 3.3%, 14.1 to 20.3 % and 0.12 to 39.03 mg/100g, respectively. Mineral analysis showed that *Trachystemon orientalis* contained considerably high amounts of potassium (3883.8 to 5791.4 mg/100g), phosphorus (339.7 to 540.9 mg/100 g), calcium (159.4 to 432.4 mg/100g), magnesium (108.0 to 176.4 mg/100 g), iron (10.7 to 63.1 mg/100 g), sodium (22.1 to 66.3 mg/100g), copper (0.6 to 1.5 mg/100 g), manganese (1.5 to 3.6 mg/100g) and zinc (2.3 to 7.6 mg/100g). Mineral compositions of the plants varied significantly depending on the genotypes. *T. orientalis* was determined as abundant in contents of vitamin C, minerals and protein.

Key words: oriental borage, kaldirayak, edible wild plants, macro- and microelements, nutrients

INTRODUCTION

Turkey has a great potential in herbal diversity and is also a gene center for many plant species with natural flora. Turkish flora contains 11.707 plant species, 3.607 of which are endemic [Guner et al. 2012].

Especially in recent years, there has been an increase in tendency towards natural nutrition due to the increase of obesity all over the world. Consequently, the consumption of herbaceous plants that grow spontaneously in nature has become widespread. Today, vegetables are essential foods regarding nutrition and health. Especially after the positive effects of certain substances on the health of wild plants are revealed; these plants are getting more and more attention. Researchers have reported that these species are abundant in protein, vitamins, minerals, carbohydrates, fiber, antioxidants, secondary metabolites and phenolic substances [Bianco et al. 1998, Lyimo et al. 2003, Akubugwo et al. 2007]. Minerals with critical significance in human nutrition and health are essential nutrients for normal physiological functions of the body [Ertan et al. 2002]. In recent years, there has been increasing interest in determining the nutritional properties and mineral content of various wild edible plants in the world [Aberoumand and Deokule 2009]. Increases have begun in sales of wild plants in markets

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and grocery stores, because the public has been supplying vegetable needs from these in months when vegetable varieties have decreased and early grown [Kaya et al. 2004].

Edible plants that have significant medical and other economic characteristics (i.e. a food source) are widely used today. It is known that nowadays most of the plants consumed are cultivated plants and the local wild edible plant consumption is relatively restricted. Edible plants may have different uses in different areas of the same country. Additionally, people use them for some medicinal purposes due to economical and geographical reasons [Ozbucak et al. 2007].

Edible wild vegetables in Turkey are heavily consumed [Yıldırım et al. 2001, Sekeroglu et al. 2006]. Wild edible plants are abundant in terms of minerals and these plants play a great role in supplying the mineral requirements of local populations [Nordeide et al. 1996]. There are plant species adapted to climate conditions in the regions that have different characteristics. The Black Sea Region is one of the limited regions that is continuing the plant diversity in the nature and consumption culture with widespread untouched areas. Kaldirayak grown naturally in the Black Sea Region is an important source for people nutrition.

The aim of the study was to determine the mineral composition and the content of some nutritional compounds of *Trachystemon orientalis* L. consumed abundantly as vegetables in the Central Black Sea region of Turkey.

MATERIAL AND METHODS

In the study, Kaldirayak (*Trachystemon orientalis* L.) that is evaluated as vegetable in the Central Black Sea Region (Samsun, Ordu, Amasya and Tokat) was used for material.

The genus *Trachystemon* D. Don belongs to the family Boraginaceae and is represented by one species in Turkey: *T. orientalis* (L.) G. Don. This plant is distributed in East Bulgaria and West Caucasia and in various habitats in the Black Sea region in Turkey. The genus *Trachystemon* D. Don is represented by one species in Turkey [Akcin et al. 2004]. It is 30–40 cm tall, with a rhizome; it is hairy, with blue-red flowers and is perennial and herbaceous [Edmondson 1978, Baytop 1984]. Plant stems with flower buds and leaves are used extensively as a vegetable in different cities of Black Sea Region in Turkey. It was determined that the kaldirik plant was harvested with fresh rhizomes and leaves, petioles and flowers could be consumed separately or together [Demir et al. 2017]. Also its roots and petioles are consumed as pickle [Koca et al. 2015]. The plant is locally known as 'kaldirayak, kaldırık, burgı, tamara, zılbıt, balikotu, hodan, ispit, kaldirik, aci hodan, dogu hodan, or as borage, early-flowering borage, oriental borage' [Baytop 1994, Akcin et al. 2004, Clausen and Christopher 2015]. It mostly grows on northward side, streamside, bushes and wetlands.

In the study, plant samples were collected with land studies in natural and intensively grown areas of kaldirayak, which is consumed in various forms in the Black Sea Region. Surveys were carried out in Samsun, Ordu, Amasya and Tokat, where kaldirayak populations were intense in order to collect them from their natural environments during the spring semester of 2011 (April–May) and also benefited from Collection Form of Aegean Agricultural Research Institute. Five districts were selected from Samsun (Bafra, Çarşamba, Vezirköprü, Ladik, Havza), Ordu (Central district, Akkuş, Ünye, Ulubey, Perşembe), Amasya (Central district, Merzifon, Göynücek, Suluova, Taşova) and Tokat (Central district, Reşadiye, Niksar, Turhal and Erbaa) to be able to sample from different ecological and geographic areas as possible. In these counties, four stops were identified and plant samples were taken. As a result of material collection studies, thirty genotypes were obtained. Collection areas of *Trachystemon orientalis* genotypes were given in Table 1.

Flora of Turkey [Davis 1967, 1978] was used for botanical diagnosis of the plants. A label number was given to each collected plant material. This label was formed of license number of province that the sample taken from, the first two letters of the name of the county, stop number and number of samples taken, respectively [Balkaya 1999]. Then necessary analyses were done to determine nutritional characteristics of collected populations in Black Sea Agricultural Research Institute.

The plants were harvested at the beginning of April and analyses were made on leaves, flowers and stalks. Then the plant samples were weighed to obtain fresh

Table 1. Locations and GPS values where *Trachystemon orientalis* genotypes were collected

Accession number	Counties	District	GPS Coordinates		
			Latitude	Longitude	Altitude (m)
55 ÇA 01	Samsun	Çarşamba	41°12'200" N	36°47.555" E	20
55 ÇA 02	Samsun	Çarşamba	41°12'427" N	36°46'717" E	19
55 ÇA 03	Samsun	Çarşamba	41°15'183" N	36°40'681" E	13
55 ÇA 04	Samsun	Çarşamba	41°16'733" N	36°39'749" E	9
55 BA 01	Samsun	Bafra	41°30'180" N	35°57'684" E	88
55 BA 02	Samsun	Bafra	41°28'617" N	35°57'922" E	99
55 BA 03	Samsun	Bafra	41°28'220" N	35°56'570" E	83
55 BA 04	Samsun	Bafra	41°26'620" N	35°58'920" E	190
55 HA 01	Samsun	Havza	41°03'304" N	35°46'617" E	629
55 HA 02	Samsun	Havza	41°06'053" N	35°48'527" E	732
55 HA 03	Samsun	Havza	41°07'226" N	35°50'385" E	938
55 HA 04	Samsun	Havza	41°07'420" N	35°53'575" E	1016
55 VE 01	Samsun	Vezirköprü	41°04'106" N	35°30'281" E	680
55 VE 02	Samsun	Vezirköprü	41°13'315" N	35°39'345" E	939
55 VE 03	Samsun	Vezirköprü	41°15'074" N	35°39'492" E	923
55 LA 01	Samsun	Ladik	40°59'480" N	35°52'420" E	763
55 LA 02	Samsun	Ladik	40°59'320" N	35°50'455" E	743
55 LA 03	Samsun	Ladik	40°58'215" N	35°51'127" E	825
55 LA 04	Samsun	Ladik	40°54'666" N	35°57'188" E	916
52 ÜN 01	Ordu	Ünye	40°53'116" N	37°09'175" E	648
52 ÜN 02	Ordu	Ünye	41°00'446" N	37°14'258" E	164
52 AK 01	Ordu	Akkuş	40°52'489" N	37°03'521" E	1124
52 AK 02	Ordu	Akkuş	40°51'117" N	37°06'326" E	942
52 AK 03	Ordu	Akkuş	40°49'155" N	36°58'621" E	1095
52 PE 01	Ordu	Perşembe	41°04'445" N	37°37'415" E	28
52 PE 02	Ordu	Perşembe	41°05'385" N	37°38'850" E	135
52 Mİ 01	Ordu	Merkez	41°00'498" N	37°51'336" E	63
52 Mİ 02	Ordu	Merkez	41°00'203" N	37°51'064" E	367
52 UL 01	Ordu	Ulubey	40°52'202" N	37°45'208" E	589
60 RE 01	Tokat	Reşadiye	40°32'583" N	37°17'680" E	1321

weight, placed in paper envelope. For measuring the dry matter contents of the plant materials, the samples were dried at 105°C for 24 h in an oven. Dry matter content was calculated by subtracting percent moisture content from 100%. Prior to analysis, the dried plant samples were ground to fine powder by using an electric grinder. The ground samples were then packed in new plastic bags and stored at 4°C in a refrigerator until use for analysis. The dried and ground samples were used for the chemical analyses, except for the determination of dry matter, moisture, pH and vitamin C content in which fresh samples were used.

After determining the total N content by micro-Kjeldahl method, the data were multiplied by a coefficient of 6.25 and protein contents were calculated [Kacar 1972]. Ash content was measured by incinerating the dried sample in a muffle furnace at 550°C for about 8 h until gray white ash was obtained. The pH of the samples was measured using a digital pH meter. All values except for pH were expressed as percentage. Vitamin C as total ascorbic acid was determined according to Cakmak and Marschner [1992] and mineral element concentrations of the plant materials were done by using atomic absorption spectrometry in terms of wet burn method. The analyses were done in three replicates.

For mineral analysis, the plant samples were prepared by wet digestion method using H_2SO_4 and H_2O_2 [Kacar and Inal 2008]. Each mineral element (Ca, K, Mg, Na, P, S, B, Cu, Fe, Mn and Zn) was identified by spectrometry. Mineral contents of plant samples were calculated as mg/100 g dry weight. The analyses were done in three replicates.

RESULTS AND DISCUSSION

In the study thirty *Trachystemon orientalis* genotypes were collected at the end of the surveys. Values of pH, dry matter (%), ash (%), N (%), protein (%) and vitamin C (mg/100 g) are presented in Table 2. The highest pH value (6.88) was found in 55 ÇA 01 and the lowest (6.61) in 55 HA 01. According to results of the analyses, it has been determined that kaldirayak had acidic reaction. The pH value in the study was similar to studies in different wild edible plants grown in Turkey [Yıldırım et al. 2001, Kaya et al. 2004, Kibar and Temel 2016].

Amount of dry matter varied according to the genotypes (Tab. 2). The dry matter content of these genotype varied from 13.0 to 22.1%. 55 VE 01 had the highest dry matter content followed by 55 Mİ 02, while the lowest value was observed in 52 ÜN 02 (Tab. 2). Civelek and Balkaya [2013], reported for *Trachystemon orientalis* L. 14.73% dry matter. In another report, dry matter contents (10.49 g/100 g) were found in *Trachystemon orientalis* L. by Koca et al. [2015]. Dry matter content depends on the structure of the plant tissue; for this reason, diversity in the dry matter content for different plant species is expected [Kibar and Temel 2016].

The amount of ash differed by genotypes was in the range from 9.2 to 17.0% (Tab. 2). The highest and lowest ash contents were obtained from 52 AK 02 and 55 HA 03, respectively. Similar result was found for *Trachystemon orientalis* L. (15.53%) by Civelek and Balkaya [2013]. Some authors reported that the ash contents of wild species were 26 g/100 g (*Borago officinalis*) Medrano et al. [1992] , 22.8 g/100 g (*Amaranthus retroflexus*) Sekeroglu et al. [2006], 22 g/100 g (*Chenopodium album*) Kaya et al. [2004], 17.12% (*Beta corolliflora*) Kibar and Temel [2016] and 20.7% *(Heracleum persicum)* Tuncturk and Ozgokçe [2015].

The nitrogen content of plants varies according to a wide variety of factors and is mainly influenced by temperature and light intensity [Gurses 1983]. The nitrogen content of the *T. orientalis* was in the range from 2.3 to 3.3 %, which was the highest in 55 HA 02 and lowest in 52 ÜN 01, 55 VE 03 and 52 UL 01 (Tab. 2). The values obtained for total nitrogen content in the present study were higher than the values reported for some other wild edible plants [Yıldırım et al. 2001, Turan et al. 2003, Tuncturk and Ozgokce 2015]. However, our results were very similar to the values of Kibar and Temel (2016). The nitrogen content in the plants is of great importance as it can be considered approximately equivalent to protein content when multiplied by a factor of 6.25 [Kibar and Temel 2016]. Related to variation of the total nitrogen and protein contents of the plants studied changed in similar. As seen in Table 2, the protein values of the genotypes ranged 14.1 to 20.3 mg/100 g. The higher nitrogen content of 55 HA 02 indicated that its protein content was higher than other genotypes. Civelek

Table 2. Contents pH, dry matter, ash, N, protein and vitamin C of *T. orientalis* genotypes

Genotypes	pH	Dry matter (%)	Ash (%)	N (%)	Protein (%)	C vitamin (mg/100 g)
55 ÇA 01	6.88 ±0.01	19.1 ±1.6	13.8 ±0.2	3.2 ±0.02	19.7 ±0.2	24.39 ±4.9
55 ÇA 02	6.65 ±0.01	14.4 ±2.3	9.4 ±0.03	2.9 ±0.03	17.8 ±0.2	31.44 ±3.7
55 ÇA 03	6.85 ±0.01	14.1 ±2.1	11.1 ±0.3	2.9 ±0.04	18.0 ±0.3	0.23 ±0.04
55 ÇA 04	6.70 ±0.01	17.1 ±1.2	11.4 ±0.4	2.5 ±0.01	15.7 ±0.1	30.95 ±3.8
55 BA 01	6.83 ±0.01	15.2 ±0.4	11.8 ±0.6	3.0 ±0.01	18.9 ±0.1	0.12 ±0.1
55 BA 02	6.74 ±0.01	16.5 ±0.9	11.9 ±0.1	2.9 ±0.04	18.3 ±0.3	22.59 ±1.5
55 BA 03	6.66 ±0.01	16.4 ±0.4	12.3 ±0.08	2.9 ±0.04	17.9 ±0.3	14.78 ±4.7
55 BA 04	6.74 ±0.01	20.6 ±1.8	12.6 ±0.07	3.0 ±0.04	18.7 ±0.3	9.66 ±3.2
55 HA 01	6.61 ±0.01	14.8 ±1.3	10.5 ±0.1	2.9 ±0.01	17.9 ±0.1	25.71 ±5.4
55 HA 02	6.83 ±0.01	15.6 ±0.3	12.2 ±0.1	3.3 ±0.02	20.3 ±0.1	17.24 ±7.5
55 HA 03	6.66 ±0.005	19.3 ±0.5	9.2 ±0.1	2.7 ±0.01	16.8 ±0.02	26.16 ±3.0
55 HA 04	6.76 ±0.01	16.8 ±0.7	11.4 ±0.06	3.2 ±0.03	20.0 ±0.2	18.17 ±3.5
55 VE 01	6.72 ±0.02	22.1 ±2.1	11.3 ±0.05	3.0 ±0.02	18.5 ±0.1	39.03 ±5.4
55 VE 02	6.70 ±0.01	16.9 ±0.9	13.2 ±0.03	2.8 ±0.02	17.3 ±0.1	25.52 ±2.2
55 VE 03	6.73 ±0.02	17.9 ±0.3	12.2 ±0.4	2.3 ±0.01	14.1 ±0.1	22.40 ±4.3
55 LA 01	6.66 ±0.06	17.8 ±1.0	9.8 ±0.2	3.0 ±0.02	19.0 ±0.1	20.96 ±10.3
55 LA 02	6.80 ±0.01	20.5 ±1.7	12.6 ±0.1	2.6 ±0.03	16.1 ±0.2	23.42 ±3.5
55 LA 03	6.62 ±0.005	16.1 ±1.0	11.0 ±0.6	2.7 ±0.02	16.6 ±0.1	23.76 ±6.4
55 LA 04	6.85 ±0.01	14.6 ±1.1	10.2 ±0.2	3.0 ±0.02	18.7 ±0.1	0.20 ±0.03
52 ÜN 01	6.83 ±0.02	16.5 ±1.4	14.6 ±0.5	2.3 ±0.01	14.3 ±0.04	29.0 ±9.1
52 ÜN 02	6.81 ±0.01	13.0 ±0.6	12.9 ±0.3	3.0 ±0.03	18.6 ±0.2	11.95 ±2.3
52 AK 01	6.69 ±0.02	15.2 ±0.7	12.5 ±0.06	2.8 ±0.04	17.4 ±0.3	15.15 ±5.2
52 AK 02	6.65 ±0.02	17.3 ±1.1	17.0 ±0.5	2.8 ±0.03	17.3 ±0.2	13.94 ±2.3
52 AK 03	6.72 ±0.01	15.3 ±1.5	11.6 ±0.2	3.1 ±0.02	19.1 ±0.1	25.80 ±6.5
52 PE 01	6.81 ±0.01	15.4 ±0.4	13.3 ±0.1	3.0 ±0.01	18.7 ±0.1	0.13 ±0.1
52 PE 02	6.75 ±0.01	16.7 ±0.7	13.6 ±0.1	3.0 ±0.04	18.7 ±0.3	12.81 ±3.2
52 Mİ 01	6.84 ±0.02	15.4 ±0.5	13.7 ±0.02	3.1 ±0.05	19.3 ±0.3	0.12 ±0.03
52 Mİ 02	6.66 ±0.01	21.5 ±0.01	12.9 ±0.1	2.5 ±0.02	15.7 ±0.1	21.76 ±1.5
52 UL 01	6.64 ±0.01	19.5 ±0.5	13.0 ±0.3	2.3 ±0.03	14.3 ±0.2	18.33 ±4.5
60 RE 01	6.69 ±0.03	21.2 ±1.6	11.2 ±0.2	3.1 ±0.05	19.3 ±0.3	32.51 ±9.1

[2011], reported for *Trachystemon orientalis* L. 22.58% content. Similar results was found for *Trachystemon orientalis* L. (14.42 %) by Koca et al. [2015] and *Borago officinalis* (13.0%) by Medrano et al. [1992]. This study also revealed similar results (20.3%) for same species.

Yücel et al. [2011] reported that protein content was very high in most of wild plants and may have contributed significantly to meet the daily protein requirement in the case of consumption. When studies carried out by different researchers were examined; it was seen that there were differences in protein contents in locally consumed wild plants [Colakoglu and Tomek 1975, Colakoglu and Bilgir 1977, Kaya et al. 2004]. It was reported that this may have been due to the fact that the protein content of wild plants varied depending on the product variety, the region where plant grown, as well as different parts of plant such as leaf, stem and root [Yucel et al. 2011].

Aktan and Bilgir [1978] stated that wild plants were rich in vitamin A and C and also contained significant amount of minerals such as calcium, phosphorous and iron. Vitamin C content showed variation among genotypes (Tab. 2). The vitamin C content of the various these genotype was in the range from 0.12 mg/100 g to 39.3 mg/100g (Tab. 2). Vitamin C is an important antioxidant that protects the body against radicals [Saldamlı 1998]. Humans (adults and children aged 4 and older) need 60 mg vitamin C daily [Samancıoglu et al. 2016].

It was observed that the vitamin C contents in these wild species were higher than that of commonly used vegetables such as 23.9 mg/100 g mint, 36.8 mg/100 g spinach, 4.9 mg/100 g carrot (Singh et al. 2001). Thus, kaldirayak genotypes can be accepted as an abundant source of vitamin C.

Some authors reported that the vitamin C contents of wild species were 161.25 mg/100 g (*L. tuberosus*) Yıldırım et al. [2001], 96.40 mg/100 g (*Tragopoxgom reticulatus* Boiss) Demir [2006], 72 mg/100 g (*Rumex acetosella* L.) Samancıoglu et al. [2016], 129.4 mg/100 g (*Eremurus spectabilis* M. Bieb) Guzelsoy et al. [2017], 9.2 mg/100 g (*Borago officinalis* L.) Borowy et al. [2017].

The main minerals are important in human nutrition and healthy [Sekeroglu et al. 2006]. Values of minerals which are presented in Table 3. Factors affecting the mineral composition of these plants may be due to differences in genotypes, growing conditions, genetic factors, geographical variations, different analytical methods, soil characteristics, water availability in the soil, growth stage of the plant during collection, the growing area of plants, climate and weather conditions [Ozcan 2004, Baloch et al. 2014].

Among the macroelements, potassium has a special place in plant development and for human health [Tuncturk ve Ozgokce 2015]. Potassium concentrations of the genotypes varied between 3883.8 and 5791.4 mg/100g (Tab. 3). The highest value of K was determined in 55 ÇA 01 (5791.4 mg/100 g) and the lowest value was determined in 55 LA 01 (3883.8 mg/100 g). Similar results were reported for K contents that were obtained in the related studies for 542.88 to 1544.38 mg/100 g [Yıldırım et al. 2004], 60.8 to 73.6 mg/g [Kose et al. 2010], 16.10 to 84.40 mg/g [Seal 2011], 245.78 to 557.91 g/kg [Akgunlu 2012] and 2.663 to 892.93 mg/100 g [Kibar and Temel 2016]. The highest macro element in many wild edible plants studied by Akgunlu [2012] was determined as potassium. The highest macro element was also identified as K in our study.

Magnesium is an important mineral that is needed by every cell in the human body [Kose et al. 2010]. The highest and the lowest Mg values were observed in 55 ÇA 02 and 55 BA 01, respectively (Tab. 3). Magnesium contents of various wild edible plants varied from 15.2 to 468.0 mg/100 g [Demir 2006, Turan et al. 2003, Coruh et al. 2007, Kagale and Sabale 2014, Kibar and Temel 2016, Guzelsoy et al. 2017]. These differences may be due to ecological factors and collection time.

Other nutrient that has an important effect on human nutrition is calcium. The most important function of calcium is to maintain development and health of bones and teeth. It provides regular contraction and relaxation of balance heart muscle among sodium, potassium and magnesium ions [Saldamlı 1998]. The highest Ca contents of genotypes were 55 ÇA 02 (432.4 mg/100 g), the lowest Ca values were determined 55 LA 01 (159.4 mg/100 g) (Tab. 3). Civelek [2011] the highest K, Mg and Ca contents of wild species were determined in *T. orientalis*.

Analyses showed that there were wide ranges of variations among the genotypes regarding iron concentrations (Tab. 3). The richest and poorest plants were 55 LA 02 (63.1 mg/100 g) and 55 BA 01 (10.7

Table 3. Mineral concentrations (mg/100 g) of *T. orientalis* genotypes

Genotypes	K	Mg	Fe	Zn	Mn	Cu	P	Na	Ca
55 ÇA 01	5791.4 ±412.9	135.3 ±10.6	12.7 ±0.9	3.8 ±0.74	2.1 ±0.14	1.1 ±0.01	474.7 ±12.0	32.2 ±3.3	230.3 ±24.6
55 ÇA 02	4669.6 ±230.3	176.4 ±1.0	28.8 ±0.8	3.1 ±0.48	2.5 ±0.12	0.8 ±0.03	350.8 ±3.2	35.1 ±1.0	432.4 ±20.0
55 ÇA 03	5359.7 ±902.0	124.4 ±11.7	12.5 ±0.9	3.2 ±0.36	2.0 ±0.15	0.9 ±0.12	421.4 ±1.9	22.7 ±0.7	173.6 ±17.4
55 ÇA 04	4800.1 ±215.5	125.0 ±11.9	15.6 ±0.9	3.3 ±0.54	2.0 ±0.01	0.8 ±0.01	346.8 ±8.2	32.0 ±0.5	198.1 ±9.2
55 BA 01	5048.3 ±223.2	108.0 ±2.5	10.7 ±0.6	3.2 ±0.52	1.5 ±0.05	0.7 ±0.08	406.9 ±0.3	23.9 ±0.4	161.4 ±0.3
55 BA 02	5394.3 ±531.6	147.5 ±11.7	11.7 ±0.6	3.0 ±0.63	2.1 ±0.14	0.9 ±0.07	415.8 ±8.5	35.5 ±3.2	210.1 ±19.0
55 BA 03	4375.2 ±85.1	130.4 ±2.2	11.4 ±0.03	2.8 ±0.35	1.5 ±0.01	0.6 ±0.05	393.3 ±17.2	41.2 ±0.5	171.0 ±9.5
55 BA 04	5021.5 ±65.6	122.1 ±1.0	16.8 ±0.1	3.0 ±0.33	2.1 ±0.09	1.0 ±0.07	381.6 ±16.1	30.5 ±3.7	165.4 ±5.9
55 HA 01	3957.6 ±68.8	123.2 ±3.9	20.7 ±0.5	3.0 ±0.46	1.9 ±0.03	0.9 ±0.09	385.9 ±23.5	33.7 ±0.1	160.2 ±16.8
55 HA 02	5239.2 ±310.8	125.1 ±5.7	16.2 ±1.5	7.6 ±0.31	2.1 ±0.11	1.4 ±0.10	410.4 ±6.3	29.8 ±0.5	178.3 ±4.6
55 HA 03	4186.2 ±42.3	145.5 ±12.7	21.3 ±1.4	2.8 ±0.40	2.8 ±0.04	0.8 ±0.02	372.3 ±8.1	33.6 ±1.2	212.5 ±3.8
55 HA 04	4822.9 ±215.6	139.3 ±3.9	20.4 ±0.9	3.1 ±0.45	2.2 ±0.15	1.0 ±0.03	432.4 ±1.6	27.5 ±0.5	159.5 ±6.2
55 VE 01	4211.6 ±55.6	108.5 ±0.04	28.7 ±0.3	2.3 ±0.16	2.0 ±0.01	0.9 ±0.02	428.2 ±34.9	30.7 ±4.9	164.1 ±3.1
55 VE 02	4884.3 ±264.5	150.4 ±1.9	31.7 ±0.8	3.2 ±0.51	2.4 ±0.08	1.3 ±0.07	414.4 ±2.2	37.8 ±0.7	213.9 ±2.2
55 VE 03	4449.4 ±69.3	124.2 ±1.6	31.4 ±1.0	2.5 ±0.28	2.6 ±0.02	0.9 ±0.08	384.5 ±21.5	33.4 ±1.9	183.1 ±6.0
55 LA 01	3883.8 ±138.6	133.4 ±3.3	31.5 ±1.6	3.5 ±0.58	1.8 ±0.05	0.8 ±0.01	408.6 ±5.9	27.6 ±0.9	159.4 ±5.3
55 LA 02	4145.5 ±96.8	158.7 ±7.6	63.1 ±4.4	3.7 ±0.15	3.6 ±0.17	1.2 ±0.02	441.4 ±10.4	40.2 ±3.9	238.8 ±12.3
55 LA 03	4627.0 ±176.1	128.7 ±5.9	23.7 ±0.8	2.8 ±0.36	2.8 ±0.10	1.0 ±0.03	339.7 ±18.4	26.2 ±6.5	252.3 ±25.7
55 LA 04	4121.7 ±329.9	129.6 ±9.1	14.9 ±0.9	3.0 ±0.55	2.2 ±0.13	0.9 ±0.02	367.7 ±6.3	22.1 ±2.1	248.8 ±27.7
52 ÜN 01	5083.2 ±202.9	126.4 ±6.3	32.6 ±1.5	2.9 ±0.52	1.9 ±0.10	0.8 ±0.02	363.1 ±4.6	35.4 ±1.3	348.2 ±33.5
52 ÜN 02	4568.3 ±190.7	156.1 ±3.4	16.2 ±0.8	3.1 ±0.38	2.0 ±0.14	1.5 ±0.04	510.3 ±3.5	31.0 ±2.7	190.1 ±4.7
52 AK 01	4660.3 ±362.1	164.9 ±14.4	29.7 ±4.1	3.1 ±0.56	2.1 ±0.15	1.0 ±0.01	389.9 ±15.4	35.2 ±0.9	268.3 ±30.8
52 AK 02	4859.3 ±8.3	137.1 ±1.6	34.5 ±1.0	5.9 ±0.09	3.0 ±0.10	0.6 ±0.19	420.5 ±22.9	27.5 ±3.2	181.8 ±4.7
52 AK 03	4807.2 ±226.7	121.5 ±6.1	15.7 ±1.4	3.6 ±0.71	1.8 ±0.13	0.8 ±0.04	387.0 ±2.4	24.9 ±2.3	182.7 ±31.5
52 PE 01	5068.7 ±316.3	159.4 ±9.1	13.7 ±0.6	3.2 ±0.19	1.8 ±0.11	0.8 ±0.04	493.5 ±0.4	26.8 ±1.0	214.7 ±4.1
52 PE 02	5045.7 ±313.2	147.0 ±5.1	25.0 ±2.2	3.1 ±0.47	1.6 ±0.08	1.3 ±0.04	540.9 ±4.9	35.5 ±0.9	220.1 ±2.9
52 Mİ 01	4530.1 ±104.7	152.6 ±2.0	36.1 ±0.5	2.9 ±0.22	1.9 ±0.04	1.0 ±0.17	528.3 ±28.4	29.9 ±1.1	229.0 ±0.04
52 Mİ 02	4589.3 ±90.2	144.8 ±0.7	24.0 ±0.4	3.3 ±0.48	3.1 ±0.07	0.9 ±0.10	402.2 ±7.6	66.3 ±0.4	199.8 ±4.4
52 UL 01	5786.8 ±496.6	123.6 ±8.04	13.2 ±1.5	2.7 ±0.33	2.9 ±0.31	0.8 ±0.06	438.0 ±14.4	54.9 ±6.3	169.1 ±19.5

mg/100 g), respectively. Civelek and Balkaya [2013], reported for *Trachystemon orientalis* L. 25.12 mg/100 g and Sekeroglu et al. [2006] 27.10 mg/100 g. In the study of Singh et al. [2001], amounts of total iron were determined for 50.6 mg/100 g mint, 22.3 mg/100 g coriander, 35.8 mg/100 g spinach, 7.7 mg/100 g carrot. In our study, amounts of iron in kaldirayak populations were found to be higher than that of cultivated plants. In terms of iron deficiency which is seen intensely in our people, kaldirik can be proposed as an alternative nutrient.

The highest value of zinc was determined in 55 HA 02 (7.6 mg/100 g) and the lowest value was determined in 55 VE 01 (2.3 mg/100 g) (Tab. 3). In previous studies, the levels of zinc in different wild edible plants were in the ranges of 2.28 to 12.1 mg/100 g [Demir 2006, Coruh et al. 2007, Kagale and Sabale 2014, Kibar and Temel 2016].

It was reported that amount of manganese varied widely in plant species and organs [Akgunlu et al. 2016]. Manganese is a trace element commonly found in plant and animal cells [Saldamlı 1998]. It was found to Mn concentration of the genotypes analyzed varied between 1.5 to 3.6 mg/100 g (Tab. 3), while the highest Mn values were obtained from 55 LA 02, the lowest values 55 BA 01 and 55 BA 03. Similar result was found for *Trachystemon orientalis* L (3.08 mg/100 g) by Sekeroglu et al. [2006]. Some authors reported that Mn concentrations of wild species were 3.6 mg/100 g (*Borago officinalis*) – Medrano et al. [1992], 2.23 mg/100 g (*Tragopoxgom reticulatus* Boiss.) – Demir [2006], 47 mg/100 g *(P. aviculare)* Coruh et al. [2007], 5.39 mg/100 g (*B. corolliflora*) – Kibar and Temel [2016].

The highest and lowest copper contents were observed: 52 ÜN 02 (1.5 mg/100 g), 55 BA 03 and 52 AK 02 (0.6 mg/100 g), respectively (Tab. 3). Copper is obtained from fresh green vegetables and fish on daily basis of people. Cu content in general, varies from 3 to 8 mg/kg for leafy vegetables [Kabata-Pendias and Mukherjee 2007]. For adults, 0.9 mg of daily Cu intake can meet their daily requirement [Otten et al. 2006]. This means that these plants contain also a sufficient amount of copper. Similar result was found for *Borago officinalis* (1.5 mg/100g) by Medrano et al. [1992]. Sekeroglu et al. [2006], reported for *Trachystemon orientalis* L. 9.2 mg/kg. Thus, kaldirayak genotypes wild edible vegetables used in this study can be accepted as an abundant source of Cu.

Phosphorus is the most abundant mineral in the body after calcium. It is a building material of bones and teeth together with calcium [Saldamlı 1998]. The highest value of P was determined in 52 PE 02 (540.9 mg/100 g) and the lowest value was determined in 55 LA 03 (339.7 mg/100 g) (Tab. 3). It was found that kaldirayak was also rich in phosphorus. Akgunlu [2012] reported similar results for the phosphorus content of some wild edible vegetables grown in Turkey (349.2 to 691.3 mg/100 g). The phosphorus levels of some wild plants were found in the ranges of 164 to 255 mg/100 g [Coruh et al. 2007]; 94.0 to 431.0 mg/100 g [Tuncturk and Ozgokce 2015] and 27.6 to 80.3 mg/100 g [Guzelsoy et al. 2017].

Sodium concentrations of the plants studied varied between 22.1 and 66.3 mg/100 g (Tab. 3), while the highest Na values were obtained from 55 Mİ 02, the lowest one resulted in 55 LA 04. Compared with other major elements (K, P, Ca and Mg) examined in this study, the sodium content of the plants was found to be relatively low (Tab. 3). Holland et al. [1992] reported that amount of Na was 210 mg/100 g in spinach, 110 mg/100 g in turnip, 120 mg/100 g in broccoli, 191 mg/100 g in celery. In our study, Na contents of kaldirayak genotypes were lower than that of cultivated plants. However, the sodium levels determined in the current study are compatible with findings of Roe et al. [2013] on some common vegetables (0.5 to 30 mg/100 g) and findings of Kibar and Temel [2016] on different wild plants (26.24 to 36.10 mg/100 g).

CONCLUSIONS

It was determined in the study that pH, dry matter, ash, nitrogen, protein, vitamin C, amounts of macro- and microelements in *T. orientalis* were significantly different according to genotypes. The difference in wild species has revealed that this result could be arisen from genetic structure and ecology. All nutrients evaluated in the research are really important for human health and must be taken with diet. Considering the analysis results, it was found that nutrients of *T. orientalis* were at important levels. *T. orientalis* was determined as abundant in contents of vitamin C, mineral and protein.

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