KSÜ Tarım ve Doğa Derg 27 (Ek Sayı 1), 213-220, 2024
KSU J. Agric Nat 27 (Suppl 1), 213-220, 2024
DOI:10.18016/ksutarimdoga.vi.1459875

Determination of Nutrient Elements Content, Essential Oils Ratio and Biochemicals Composition of *Origanum rotundifolium* Boiss. and *Origanum syriacum* L.

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ABSTRACT
In the study, the biochemical composition of bioactive ingredients, essential oils ratio and compounds, mineral elements content, and antioxidant activities of two *Origanum* species (*O.rotundifolium* Boiss. and *O. syriacum* L.) were investigated. It has been observed that the total flavonoid and phenolic contents vary, with the amounts being 6.57 mg QE g^{-1} and 225.79 mg GAE g^{-1} for O. rotundifolium Boiss., and 184.65 mg QE g^{-1} and 114.46 mg GAE g^{-1} for O. syriacum L., respectively. The highest element contents have been determined for macroelement Calcium (Ca)> Potassium (K)> Magnesium (Mg); and for microelement Iron (Fe)> Manganese (Mn) > Zinc (Zn)> Copper (Cu)>, respectively. The essential oil yield was determined between 2.39% (*O. rotundifolium* Boiss) and 5.29% (*O. syriacum* L.). Essential oil compositions were determined by GC-MS (Gas Chromatography–Mass Spectrometry analysis). Besides, the major components found in two species were carvacrol, γ-terpinene and cymene. As a result of the study, *O. rotundifolium* Boiss. and *O. syriacum* L. species are rich in nutrients and biochemical content and can be used in many areas as an alternative food source.

Fields Crops

Research Article

Article History
Received : 27.03.2024
Accepted : 01.07.2024

Keywords
Anthocyanin
Nutrition elements
Dualex index
Oregano
NBI

Origanum rotundifolium Boiss. ve *Origanum syriacum* L. Türlerinin Besin Elementleri İçeriği, Uçucu Yağ Oranı ve Biyokimyasal Bileşiminin Belirlenmesi

ÖZET
Yürütülen çalışmada, iki *Origanum* türünün (*Origanum rotundifolium* Boiss. ve *Origanum syriacum* L.) biyoaktif bileşiklerin biyokimyasal içeriği, uçucu yağ miktarı ve bileşenleri, mineral element içeriği ve antioksidan aktiviteleri araştırılmıştır. Gözlemlenen toplam flavonoid ve fenolik içeriklerin değişiklik gösterdiği ve içeriklerin miktarları sırasıyla O. rotundifolium Boiss. için 6.57 mg QE g^{-1} ve 225.79 mg GAE g^{-1}, O. syriacum L. için 184.65 mg QE g^{-1} ve 114.46 mg GAE g^{-1} olduğu tespit edilmiştir. En yüksek element içerikleri makro elementlerde Kalsiyum (Ca) > Potasyum (K) > Magnezyum (Mg); mikro elementlerde ise Demir (Fe) > Manganez (Mn) > Çinko (Zn) > Bakır (Cu) olarak belirlenmiştir. Uçucu yağ oranı *O. rotundifolium* Boiss. için %2.39 ve *O. syriacum* L. için %5.29 olmuştur. Uçucu yağların kimyasal bileşimi Gaz Kromatografi-Kütle Spektrometresi analizi (GC-MS) ile belirlenmiş ve her iki türde bulunan başlıca bileşenler karvakrol, γ-terpinen ve simen olmuştur. Yapılan çalışmanın sonucunda, *O. rotundifolium* Boiss. ve *O. syriacum* L. türlerinin besin ve biyokimyasal içerikler açısından zengin olduğu ve birçok alanda alternatif bir gıda kaynağı olarak kullanılabileceği görülmüştür.

Tarla Bitkileri

Araştırma Makalesi

Makale Tarihçesi
Geliş Tarihi : 27.03.2024
Kabul Tarihi : 01.07.2024

Anahtar Kelimeler
Antosiyanin
Besin elementi
Duakeks index
Kekik
NBI

Atıf İçin : Nohutçu, L., Tunçtürk, M., Selem, E., Tunçtürk, R., & Çınar, O (2024). *Origanum rotundifolium* Boiss ve *Origanum syriacum* L. Türlerinin Besin Elementleri İçeriği, Uçucu Yağ Oranı ve Biyokimyasal Bileşimi Üzerine Bir Araştırma. *KSÜ Tarım ve Doğa Derg 27* (Ek Sayı 1), 213-220. DOI: 10.18016/ksutarimdoga.vi.1459875.

To Cite: Nohutçu, L., Tunçtürk, M., Selem, E., Tunçtürk, R., & Çınar, O (2024). Study on Nutrient Elements Content, Essential Oils Ratio and Biochemicals Composition of *Origanum rotundifolium* Boiss. and *Origanum syriacum* L.. *KSU J. Agric Nat 27* (Suppl 1), 213-220. DOI: 10.18016/ksutarimdoga.vi.1459875.

INTRODUCTION

Many species of oregano, belonging to the Lamiaceae family, are known *Coridothymus, Thymus, Thymbra*, *Satureja*, and *Origanum* genera in Turkey. The endemism rate of this family, which is among the three richest families in Turkey, is 44.2% (Fakılı, 2010). The Lamiaceae (Labiatae) family, which also includes the *Origanum* L. genus, includes approximately 200 genera and 3500 species. There are 45 genera and more than 546 species belonging to this family in Turkey. The genus *Origanum* has 41 species in the world. 75% of these species naturally spread in the Mediterranean region, especially in the Eastern Mediterranean region. *Origanum* L. genus is represented by 23 species and 5 subspecies in the flora of Turkey. 15 of these species are endemic. Turkey is the most important origin in the world for many species belonging to the genus *Origanum* L. (Baytop, 1984; Işık,1995; Bayar and Çınar. 2020; Maral ve Kırıcı, 2022). Many species in the genus *Origanum* are in an important position due to their secondary metabolites, essential oils, nutrients, and biochemical contents.

Plants serve as a vital source of essential elements for human beings. The quantitative or qualitative assessment of mineral elements found in plants holds significance as the concentration and types of minerals are often required to be specified on food labels. The nutritional quality of many foods relies on the concentration and types of minerals they contain. Moreover, these minerals play a crucial role in combating various degenerative diseases and processes, mitigating the effects of environmental pollutants, and enhancing cognitive function and productivity. Certain minerals such as Phosphorus, Sodium, Potassium, and Calcium are indispensable for maintaining a healthy diet (Momin and Kadam, 2011). Hence, determining the nutrient profile of plant species holds paramount importance.

Oregano essential oils obtained from the genera *Origanum* are rich in carvacrol. Turkey is the biggest exporter of oregano herb and oil to the world markets. Oregano is mainly used in the spice, food, and pharmaceutical industries. Carvacrol is responsible for the biological activities of oregano. Many diverse activities of carvacrol such as antitumor, antimicrobial, analgesic, antimutagenic, antispasmodic, antigenotoxic, antiplatelet, angiogenic, antiparasitic, anti-inflammatory, anti-elastase, anti-hepatotoxic, insecticidal and hepatoprotective activities use such as feed additive, in honeybee breeding and gastrointestinal ailments have been shown (Can Baser, 2008).

The study was carried out to detect total ash, dry matter, total antioxidant, total phenolic and total flavonoids content, nitrogen balance index (NBI), chlorophyll, flavonol, anthocyanin, nutrient elements, essential oil composition, and yield of *O. rotundifolium* Boiss. and *O. syriacum* L., which is cultivated in the Van region and Turkey.

MATERIAL and METHOD

Plant material

The study materials consist of *Origanum* species grown in the Medicinal and Aromatic Plants Garden of Van Yüzüncü Yıl University, Faculty of Agriculture, Department of Field Crops. Diagnosed at the species level of plants were grown in the Medicinal and Aromatic Plants Garden to determine the adaptation ability. The study materials consist of two species. These are *O. rotundifolium* Boiss. and *O. syriacum* L.. Two years after the plants were planted, analyses were made in a single year. The harvest was made during the full bloom period. Samples were harvested from 9:00 to 10:00 in the morning.

Determination of ash, dry matter, heavy metal, and nutrient contents

The nutritious values such as total ash, dry matter, some heavy metals (As, Cd, Co, Ni, Cr, and Pb), and minerals (microelements, Fe, Zn, Cu, and Mn; macro elements, Mg, Ca, and K) and were measured in plant parts. For the total ash determination, an Electrical Muffle furnace set at 550 ºC was used. Dry matter was determined with the drying of the samples for 24 hours at 105 ºC in the oven. The mineral constituents of the plant samples were investigated as follows: at first, the dried samples were ashed in a furnace with hydrochloric acid and nitric acid (AR) (AOAC 2000). Then, distilled water (50 ml) was added to samples in a volumetric flask. All assays were performed in triplicate and the standard materials were utilized for chemical analyses. Atomic Absorption Spectrometry (AAS) was used to determine K, Ca, Mg, and Fe contents. ICP-OES (Inductively coupled plasma-optical emission spectrometer) was also used to determine other microelements and heavy metals (Cu, Zn, Ni, Mn, As, Cd, Co, Cr, and Pb).

Total antioxidant, total phenolic, and total flavonoid content

Total phenolic compound content was measured

according to Obanda et al. (1997) method. The antioxidant activity was also determined based on the Antioxidant Power (FRAP) (Iron (III) antioxidant power reduction) method (Benzie, Strain 1996) followed by readings of the absorbance at 593 nm, and antioxidant activity values were recorded as Trolox equivalent (TE) mg^{-1}. The total flavonoid content was determined with some modifications according to the method developed by Quettier-Deleu et al. (2000). The total amount of flavonoid was measured at 415 nm and calculated in mg quercetin equivalent (QE) 100 g^{-1} DM by using the calibration curve prepared using standard quercetin.

Determination of Nitrogen Balance Index, chlorophyll, flavonols, and anthocyanin

The Nitrogen balance index (NBI), chlorophyll, flavonol, and anthocyanin content were measured on the leaf non-destructively using and in real-time the Dualex scientific+ (FORCE-A, France) device before harvesting. Dualex measures flavonols and anthocyanins by analyzing their screening effect on chlorophyll fluorescence. The content of flavonols and anthocyanins is given in relative absorbance units ranging from 0 to 3 for flavanols and from 0 to 1.5 for anthocyanins.

Isolation of the Essential Oils

The leaves of *O. rotundifolium* Boiss. and *O. syriacum* L. species were used for the extraction of essential oils. All the plant parts (100 g for each plant species) were extracted separately by hydrodistillation using a Clevenger Apparatus for 3h at 100±5°C (Gezici et al., 2017). The obtained oils were dried over anhydrous sodium sulfate and stored at +4°C in the dark until analyzed and tested.

GC-MS analysis

Essential oil component analysis was performed using Gas chromatography (GC/GC-MS (Agilent 7890A)).

Sistem: Agilent 5975 GC-MSD sistemi

Essential oils 1:50 ratio hexane carrier gas: 0.8 mL/min flow rate helium gas

Split: 40:1

Injector temperature: at 250°C

Column temperature: 60°C (10 minutes) - 60°C to 220°C 4°C/minute - 220°C (10 minutes)

Total analysis time: 60 minutes

Mass detection scan range: (m/z) 35-450

Library: Wiley 7n, Nist 05 and Flavor and Fragrance Natural and Synthetic Compounds (ver. 1.3).

All analyses carried out in the study were performed in three repetitions and standard deviations were determined. The data obtained as a result of the research were subjected to variance analysis according to the Randomized Parcel Trial Design. Statistical calculations were made using the computer analysis program COSTAT (Version 6.3). Differences between averages were determined according to the Duncan Multiple Comparison Method.

RESULTS and DISCUSSION

The dry matter (%), total ash (%), total flavonoid content (mg QE/100 g), total antioxidant activity (µmol TE/g), total phenolic content (mg GAE g^{-1}), NBI, chlorophyll, flavonol and anthocyanin contents of *O. rotundifolium* Boiss. and *O. syriacum* L. species are given in Table 1.

Table 1. Biochemical and bioactive compounds of *Origanum* species.
Çizelge1. Origanum türlerinin biyokimyasal ve biyoaktif bileşikleri.

	O. rotundifolium ± SD	*O. syriacum* ± SD	CV
Total Ash (%)	9.51±0.88	10.84±0.48	6.87 ns
Dry Matter (%)	34.49±1.56	32.87±0.56	2.09 ns
Total Flavonoid Content (mg QE 100 g^{-1})	6.57±0.27 b	184.65±56.44 a	2.22 **
Total Antioxidant Content (µmol TE g^{-1})	102.12±1.01 b	172.03±2.43 a	0.01 **
Total Phenolic Content (mg GAE g^{-1})	225.79±0.72a	114.46±12.85 b	1.25 **
NBI	11.17±4.07	10.47±0.40	6.56 ns
Chlorophyll	19.63±8.12	21.13±0.80	3.43 ns
Flavonol	1.73±0.11 b	2.02±0.02 a	0.38 **
Anthocyanin	0.11±0.01	0.13±0.01	5.89 ns

* Significant at P<0.05 level, ** Significant at P<0.01 level, and there is no statistical difference between the means indicated with letters. CV: Coefficient of Variation, SD: Standart daviation, ns: not significant.

The parameters investigated, including total flavanol content, total antioxidant activity, total phenolic content, and the number of flavonoids, were found to be statistically significant at the 1% level among the species. It was determined that the other parameters were not statistically significant. The dry matter from *O. rotundifolium* Boiss. and *O. syriacum* L. was 34.49% and 32.87%, respectively. Total ash was determined as

10.84% (*O. syriacum*) and 9.51% (O. *rotundifolium*). Biochemical content was determined as total flavonoid content, from 6.57 mg QE 100 g^{-1} (*O. rotundifolium* Boiss.) to 184.65 mg QE 100 g^{-1} (*O. syriacum* L.), total phenolic content from 114.46 mg GAE g^{-1} (*O. syriacum* L.) to 225.79 mg GAE/g (*O. rotundifolium* Boiss.). *O. rotundifolium* Boiss. and *O. syriacum* L. are also high in total antioxidant content (102.12 and 172.03 µmol TE g^{-1} dry mass, respectively).

The NBI contents were from 10.47 dualex index (*O. syriacum* L.) to 11.17 dualex index (*O. rotundifolium* Boiss.), chlorophyll from 19.63 (*O. syriacum* L.) to 21.13 (*O. rotundifolium* Boiss.), flavonol from 1.73 dualex index (*O. syriacum* L.) to 2.02 dualex index (*O. rotundifolium* Boiss.) and anthocyanin from 0.11 dualex index (*O. syriacum* L.) to 0.13 dualex index (*O. rotundifolium* Boiss.).

Macro and microelement contents of *O. rotundifolium* Boiss. and *O. syriacum* L. species are given in Table 2 and Figure 1. This study determined the existence of seven elements in two *Origanum* (*O. rotundifolium* Boiss. and *O. syriacum* L.) species. It has been determined that the elements K, Fe, Zn, Cu, and Mn are statistically significant at the 1% level in terms of nutrient elements. It was found that the other elements are statistically insignificant. The concentrations of micronutrients were within the ranges of 234.775-280.100 mg kg^{-1} for Fe, 32.415-36.150 mg kg^{-1} for Zn, 11.660-15.610 mg kg^{-1} for Cu, 54.755-65.040 mg kg^{-1} for Mn. It was observed that the micro and macroelement values of *O. syriacum* L. were high, especially those of K (11.728 mg kg^{-1}), Fe (280.100 mg kg^{-1}), Ca (11.981 mg kg^{-1}) and Mg (4.032 mg kg^{-1}), in comparison with the other species. According to the results, *O. rotundifolium* Boiss. and *O. syriacum* L. appeared to have high nutritional value for consumption.

Table 2. Macro and micro element contents of *Origanum* species
Çizelge2. Origanum türlerinin makro ve mikro element içeriği

	O. rotundifolium ± SD	*O. syriacum* ± SD	CV
K(g/kg)	8,60±2.21 b	11,73±2.15 a	0.20 **
Ca(g/kg)	9,09±1.60	11,98±1.54	13.49 ns
Mg(g/kg)	2,96± 0.32	4,03±1.06	19.82 ns
Fe (mg/kg)	234,77±15.48 b	280,10±65.71 a	0.27 **
Zn(mg/kg)	36,15±0.90 a	32,41±0.82 b	0.06 **
Cu(mg/kg)	15,61±0.17 a	11,66±0.13 b	0.05 **
Mn(mg/kg)	65,04±2.40 a	54,75±3.81 b	0.02 **

* Significant at P<0.05 level, ** Significant at P<0.01 level, and there is no statistical difference between the means indicated with letters. CV: Coefficient of Variation, SD: Standard deviation, ns: not significant.

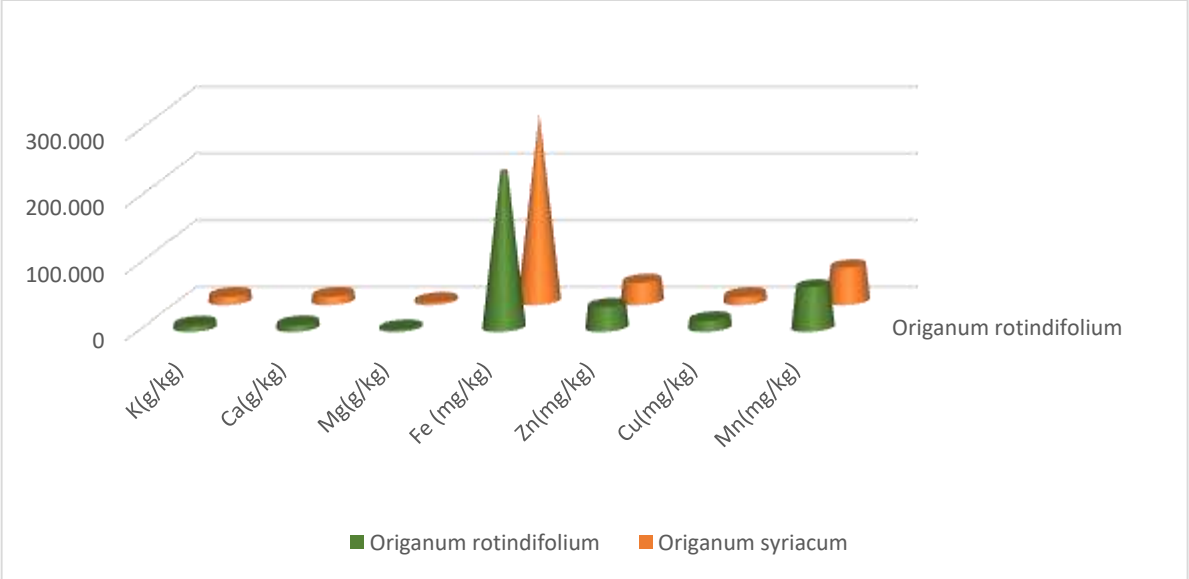

Figure 1. Macro and microelement contents of *O. rotundifolium* Boiss. and *O. syriacum* L. species.
Şekil 1. O. rotundifolium Boiss. ve O. syriacum L. türlerinin makro ve mikro element içerikleri.

Essential oil yield and the chemical composition of *O. rotundifolium* Boiss. and *O. syriacum* L. species are given in Tables 3 and 4. The essential oil yield was determined at 2.39% in *O. rotundifolium* Boiss. At GC/MS analyses, a total of 13 compounds were determined in *O. rotundifolium* Boiss. The identified

components in the essential oil are given in Table 3. The major chemical composition of the essential oil in *O. rotundifolium* Boiss. were carvacrol (76.68%), gamma-terpinene (7.97%), and *p*-cymene (7.68%).

The essential oil yield of *O. syriacum* L. was found 5.29%. Essention oil analysis has shown that *O. syriacum* L. species contained fifteen compounds. Carvacrol was the dominant essential oil (76.25%) in *O. syriacum* L. species, followed by gamma-terpinene (11.79%) and *p*-cymene (2.94%) (Table 4).

Table 3. Essential oil yield and the chemical composition of *O. rotundifolium* Boiss.
Çizelge 3. O. rotundifolium Boiss'in uçucu yağ verimi ve kimyasal bileşimi.

RI	Essential oil compounds	Amount of Essential oil compounds (%)
1016	*α*-pinene	0.71
1019	*α*-thujene	0.91
1155	Myrcene	1.99
1173	*α*-terpinene	1.57
1204	1,8-cineole	0.41
1239	*γ*-terpinene	7.97
1264	*p*-cymene	7.68
1437	1-octen-3-ol	0.26
1457	*trans*-sabinene hydrate	0.22
1539	*cis*-sabinene hydrate	0.22
1597	*β*-caryophyllene	1.11
2182	Thymol	0.28
2223	Carvacrol	76.67
	Essential oil yield (% of dry weight): 2.39%	**Total: 100**

RI: Retention index

Table 4. Essential oil yield and the chemical composition of *O. syriacum* L.
Çizelge 4. O. syriacum L.'un uçucu yağ verimi ve kimyasal bileşimi.

RI	Essential oil compounds	Amount of Essential oil compounds (%)
1016	*α*-pinene	0.38
1019	*α*-thujene	0.57
1155	Myrcene	1.97
1156	*α*-phellandrene	0.28
1173	*α*-terpinene	1.98
1192	Limonene	0.21
1239	*γ*-terpinene	11.79
1264	*p*-cymene	2.94
1382	3-octanol	0.31
1437	1-octen-3-ol	0.19
1457	*trans*-sabinene hydrate	0.87
1539	*cis*-sabinene hydrate	0.26
1597	*β*-caryophyllene	1.75
2182	Thymol	0.25
2223	Carvacrol	76.25
	Essential oil yield (% of dry weight): 5.29%	**Total:100**

RI: Retention index

The ash of a food is the inorganic residue left after the combustion of organic matter. With ash determination, the quality of foodstuffs can be determined. For example, the high amount of ash in foodstuffs such as spices is an undesirable feature in terms of quality (Anonymous, 2022). Momin and Kadam (2011) found that the total ash of bark ranges from 11.80% to 12.10% in *Sesbania grandiflora*. The study is in good harmony with the results (ranging from 6.67–15.33%) that were recorded by researchers on several other edible plant species from Anatolia (Tuncturk et al. 2015). Ibrahim et al (2012) obtained the dry matter from wild and cultivated *O. syriacum* was 65.2% and 22.1%, respectively. The highest content of dry matter is higher than the maximum data reported by Tunçtürk et al. (2007) for the same Lamiaceae species (11.23 and 20.80%).

As a general definition, antioxidants are substances that protect against oxidation and prevent further reactions with oxygen or peroxides. Most of these substances are used as preservatives in various products (Bakır, 2010). Phenolics contribute to the

mechanical strength of the cell wall and play a regulatory role in plant growth (Naczk and Shahidi, 2004). Flavonoids and other plant phenolics are important antioxidants with their high redox potential. The antioxidant effects of phenolic compounds are very important because they bind free radicals, form chelates with metals, and inactivate some enzymes (Yang and Tsao, 2003). Oke-Altuntas et al. (2018), determined the total phenolic contents in the between 21.34 and 231.55 µg mg^{-1}. These values are directly proportional to the values obtained in this study (Table 1). It has been reported that the total phenolic contents in *Thymbra spicata* var. *spicata* and *Origanum onites* plants vary between 31.02 and 60.6 mg GAE g^{-1}, respectively (Yılmaz et al., 2019). In the study conducted by Bener in 2019, the total phenolic contents of the *Thymbra spicata* var. *spicata* plant were stated as 67.30 mg GAE g^{-1} dry plant (Bener, 2019). Antioxidant compounds exert their effects through various mechanisms, including the chelation of transition metal ions, inhibition of hydrogen abstraction, decomposition of peroxides, and scavenging of free radicals (Saadart et al. 2017; Ozkan and Ozcan, 2017). Yılmaz et al., (2019) determined the FRAP value in *O. onites* as 289.51 ± 9.59 mg TE g^{-1}. According to other studies from the literature, was observed FRAP from 38.16±0.47 to 132.71±1.86 µM TE g^{-1} dw in *Achilla collina*. In this study, it differed in the range of 102.12-172.03 µmol TE g^{-1}. The highest total flavonoid contents (8.50±0.43mg QE g^{-1}) were found in the leaf parts of *A. collina* (Yılmaz et al., 2021). Lee et al. (2003) found the total flavonoid content of green and black tea to be 47 and 34 mg QE g^{-1}, respectively. It was observed that the total flavonoid content in *O. syriacum* species was higher than the value found in the literature. Differences in terms of total flavonoids, antioxidants, and phenolics content are due to genetic derivation because all plants were of the same grown and age under the same ecological conditions (Ercisli and Orhan, 2007).

In the study, chlorophyll, NBI, flavonol, and anthocyanin were measured in fresh material with a Dualex device. Dualex values are a commonly used method for determining plant health and plant development. Altuner et al. (2022) reported that the NBI value differed between 42.500 and 100.767 dualex indexes in wheat landraces and cereals. In the study, this rate was found to be lower. It is thought that different species and climatic conditions may be effective in this situation. It is known that the amount of chlorophyll varies according to the development status of the plant, ecological conditions, and plant species. Studies have shown that the amount of chlorophyll is 39.6 SPAD in *Calendula officinalis* (Selem et al., 2021), 32.53-36.63 SPAD in *Salvia officinalis* (Aytekin et al., 2021), and 32.9-37.2 SPAD in *O. vulgare* ssp. *hirtum* (Dordas, 2009). It is observed that the species in this study have lower SPAD chlorophyll measurement values. It is thought that this result is due to ecological differences and the changes in the morphological and physiological structure of the plants growing at the time of cutting and their interaction with each other (Oğuz, 2014). Altuner et al. (2022) reported that the flavonol value differed between 0.427 and 0.607 dualex indexes in wheat landraces and cereals. In the study, this rate was found to be higher.

Mineral nutrition plays a crucial role in maintaining good health, and thus, the determination of elements such as Ca, Fe, Mg, Na, K, Zn, etc., is imperative. The utilization of mineral elements has been widely developed and utilized to address various health concerns (Momin and Kadam, 2011). In recent years, there has been a growing interest in the elemental content of herbs. These elements are integral to enzymatic activities and their activation influences biochemical processes within living cells. While some are required in significant quantities, such as Ca, K, Mg, and Na, others are needed in trace amounts. Microelements like Cu, Fe, Ni, Zn, and Mn play crucial roles in biological systems (Martínez-Ballesta et al., 2010; Moghaddam et al., 2020). Many plant species are abundant in essential minerals including K, Ca, Mn, Zn, Fe, and Cu. These minerals are fundamental components of tissues due to their multifaceted roles, which include facilitating nerve conduction, muscle function, and enzyme systems, aiding in the transportation of nutrients into cells, providing structural support for tissues, and regulating organ functions (Bhat et al., 2010; Tunçtürk et al., 2017). Dogan et al. (2021) showed that in *Achillea collina*, from high to low, macro elements are K > Ca > P > Mg > Na, and microelements are Mn > Cu > Fe > B. This study found a similar conclusion in *O. rotundifolium* Boiss. and *O. syriacum* L. Ca > K > Mg for macroelements and Fe > Mn > Zn > Cu for microelements. As seen in Table 2, iron (Fe), calcium (Ca), potassium (K), and magnesium (Mg) ratios, which are essential elements for healthy development, are high in both species. Considering the results obtained, *O. rotundifolium* Boiss. and *O. syriacum* L. species as tea, spice, or nutrient will have a positive effect on human health.

Many substances obtained from essential oils are used primarily in the production of pharmaceutical raw materials or fragrance substances by semi-synthesis (Çalıkoğlu et al., 2006). Kaçar et al. (2006) found that the essential oil ratio in flowers was between 2.85-4.53% and in leaves between 1.88%-3.06% in their study of *O. onites* species. In the same study, they determined that the main component of the essential oil is carvacrol. Bayar and Çınar (2020) determined the rate of carvacrol as 70.59% in the first year and 69.20% in the second year in *O. onites*. Similar to results from

previous studies, the main component of essential oil of *O. rotundifolium* Boiss. and *O. syriacum* L. species was determined as carvacrol. Ibrahim et al (2012) found that cultivated and wild leaves of *O. syriacum* yielded 0.97% and 1.3% w/w oil, respectively. In the study, this rate was determined as 5.29%. Baser et al. (1992) determined that the essential oil yield of *O. sipyleum* is between 0.1-1.7%. They also reported that the components with the highest ratio detected in essential oil were gamma-terpinene (10.80-26.60%) and *p*-cymen (3.76-36.60%). In study, it was determined that they were the components with the highest amount after carvacrol. Karik et al. (2018) reported that different components may occur in the essential oils of samples collected from different places. Karık and Tınmaz (2007) reported in their study that many different chemotypes emerged based on the essential oils of other subspecies belonging to the *O. vulgare* species.

CONCLUSION

In conclusion of this study, it can be said that *Origanum* species are a valuable medicinal and aromatic product, based on their rich and beneficial nutrient composition. It was determined that the essential oil content of the plants was higher with 5.29% in *O. syriacum* L. species. In the study, *O. rotundifolium* Boiss. and *O. syriacum* L. species essential oil is carvacrol, followed by gamma-terpinene and *p*-cymene. As a result of the study, it was determined that the order of the two species in element contents was for macroelements Ca > K > Mg and microelements Fe > Mn > Zn > Cu. When biochemical and bioactive compound parameters were examined, it was observed that total ash, flavanol, anthocyanin, chlorophyll, total antioxidant, and total flavonoid contents were higher in *O. syriacum* L. species. The results of the conducted study indicate that the species are rich in terms of the examined parameters and that their cultivation is of great importance in preventing intensive harvesting from nature.

Author's Contribution

The authors declare that they have contributed equally to the article.

Conflict of interests/Competing interests

The authors declare that there is no conflict of interest.

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