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DETERMINATION OF TRACE ELEMENT AND FATTY ACID LEVELS IN THE BULBS AND LEAVES OF *GLADIOLUS HUMILIS* STAPF AND *IXIOLIRION TATARICUM* (PALL.) SCHULT. & SCHULT.F. VAR. *TATARICUM*

CİHAN ÇİTİL[1*], AHMET ZAFER TEL[2] AND AHMET ÖZKAYA[3]

[1]Çankırı Karatekin University, Faculty of Science, Department of Biology, Çankırı, Türkiye
[2]Department of Agricultural Biotechnology, Agriculture Faculty, Iğdır University, Iğdır, Türkiye
[3]Department of Chemistry and Chemical Processing Techniques, Vocational School of Technical Sciences, Adıyaman University, Adıyaman, Türkiye

*Corresponding author's email: cihancitil@karatekin.edu.tr, aozkaya@adiyaman.edu.tr, azafer.tel@igdir.edu.tr

Abstract

In this study, fatty acids and mineral analyses were determined in the leaves and bulbs of the *Gladiolus humilis* and *Ixiolirion tataricum* var. *tataricum*. Mineral and fatty acid analyses were determined using an inductively coupled plasma atomic emission spectrometer (ICP-OES) and gas chromatography (GC). It was determined that the levels of myristic acid 10.39%), palmitic acid (20.14%), stearic acid (10.48%), oleic acid (13.62%), linoleic acid (13.62%), alpha-linolenic acid (10.42%) and docosahexaenoic acid (4.52%) are the major fatty acid components of the *Gladiolus humilis* leaf. In the bulb of the *Gladiolus humilis*, the levels of tridecanoic acid, palmitic acid, linoleic acid and alpha-linolenic acid were detected as 8.84%, 18.77%, 41.40% and 11.09%, respectively. While palmitic acid, stearic acid, oleic acid and linoleic acid are the major fatty acids in the leaves of the *Ixiolirion tataricum* var. *tataricum*; they were detected as 24.11%, 6.77%, 11.55% and 11.20% respectively. In the bulb of the *Ixiolirion tataricum* var. *tataricum*, palmitic acid, oleic acid and linoleic acid are determined to be 16.33%, 4.26% and 48.17%, respectively. In the leaves of *Gladiolus humilis* Ni, Ba, Al, Cu, Fe, Mn, Zn, Cr, K and Na are 1.22, 139.04, 232.95, 2.55, 227.85, 101.19, 43.68, 3.71 (µg/g), 43.85 and 0.10 (mg/g), respectively. In the bulb, Ni, Ba, Cu, Fe, Mn, Zn, Cr, K and Na are determined as 0.60, 12.77, 0.56, 12.21, 8.33, 19.43, 0.94 (µg/g), 22.78 and 0.04 (mg/g). Similarly Ni, Ba, Al, Cu, Fe, Mn, Zn, Cr, K and Na in the *Ixiolirion tataricum* var. *tataricum* leaf, were determined to be 4.05, 46.65, 1523, 3.85, 781.41, 131.57, 29.81, 12.51, 71 (µg/g), 44.96 and 0.23 (mg/g), respectively. In the *Ixiolirion tataricum* var. *tataricum* bulb, Ni, Ba, Al, Cu, Fe, Mn, Zn, Cr, K and Na are 0.14, 13.40, 4.24, 1.97, 17.08, 1.36, 21.37, 1.46 (µg/g), 11.64 and 0.03 (mg/g), respectively.

Fatty acid and element levels of *Gladiolus humilis* and *Ixiolirion tataricum* var. *tataricum* have been reported in detail for the first time. This study may be important for medical studies in the future.

Key words: *Gladiolus humilis*; *Ixiolirion tataricum* var. *tataricum*; Geophyte; Fatty acids; Trace element.

Introduction

Türkiye has a rich flora, and approximately 10,500 plant species have been identified within its borders. It has been reported that approximately 30% of these plant species are endemic (Davis, 1965–1985; Hudson *et al*., 2000). Nemrut Mountain in Adıyaman province, located in the Southeastern Anatolia Region of Turkey, is one of the regions that has not been deformed by humans since it is a cultural park. For this reason, the plants in this region are protected, and the plants proliferate. The Nemrut Mountain Region is a region rich in plant endemism. It is known that Turkey's plant endemism rate is higher than Europe's (Ugulu *et al*., 2008). It is known that many of these plants are used for medicinal purposes in Turkey (Baytop, 1999). *Gladiolus humilis* and *Ixiolirion tataricum* var. *tataricum* plant species grow in the Nemrut Mountain region of Adıyaman province (Figs. 1 and 2). *G. humilis* is a perennial herbaceous form. It is a tunic geophyte plant. The height varies in the range of 15-20 cm. The leaves are three and striped. The plant is densely covered with white hairs. The flowering period is June. It prefers the south faces of rocky slopes as habitat. It can grow up to an altitude of 2100 metres. The plant, which is endemic to our country, is an Irano-Turanian phytogeographical region element. The type specimen was identified from Adıyaman, Mount Nemrut (Davis *et al*., 1988).

I. tataricum var. *tataricum* is a perennial herb. It is a bulbous geophyte plant. Plant stem varies in the range of 20-45 cm. The flowers are in the form of 8 umbrellas. Basal leaves are linear. The flowering period is from April to June. It prefers rocky calcareous slopes, cultivated and fallow fields, vineyards, and roadsides as habitats. It can be grown at altitudes of 500-2000 metres. It is the element of the Irano-Turanian phytogeographic region. It spreads in the Eastern Anatolia region (Davis *et al*., 1988).

It has been reported that the presence of vitamins, flavonoids and phenolic compounds in the *Gladiolus* genus may play an important role in health-related areas (Souza *et al*., 2021). When the biochemical properties of different *Gladiolus* species were examined, it was seen that they had rich anthocyanin and carotenoid pigments (Kim *et al*., 2016). Additionally, the flowers of this plant contain beneficial compounds with antioxidant, anti-inflammatory and anticancer properties (Iriani *et al*., 2024). The use of tubers of *Gladiolus* species has been reported to play an important role in the treatment of various ailments such as chest discomfort, earaches,

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wounds, eye problems, asthma, intestinal parasites and gonorrhoea (Odhiambo, 2024). In addition, it is emphasised that the *Gladiolus* plant offers an alternative to traditional drugs for the treatment of depression (Matraszek *et al*., 2019). Similarly bioactive molecules found in *I. tataricum* var. *tataricum* leaves show high antioxidant activity. They also have inhibitory effects on various enzymes (cholinesterase, urease, tyrosinase, elastase and collagenase). It has been reported that this plant has benefits in health and nutrition (Yiğitkan *et al*., 2021). Additionally, it has been reported that the polyphenols contained in this plant may have potential health benefits due to their antioxidant properties (Momtaz *et al*., 2018; Alamdari *et al*., 2022).

Gladiolus crassifolius has been reported to be used in the treatment of digestion, headache, and general musculoskeletal disorders, especially low back pain (Moteetee *et al*., 2019). It has been reported that the infusion of leaves and bulbs of *Gladiolus kotschyanus* has positive effects in the treatment of haemorrhoids and obesity when consumed orally (Mehrnia *et al*., 2021). *Gladiolus psittacinus* has been used in folk medicine to treat diarrhoea, colds, asthma, intestinal parasites, diabetes, and gonorrhoea, to normalise blood flow during the menstrual cycle in women; and also as a sedative (Francois *et al*., 2013). Considering that *G. psittacinus* bulb is popularly used in the treatment of diseases such as diarrhoea, cold, asthma and intestinal parasites, diabetes, and gonorrhoea and as a sedative in individuals with mental disorders, it has been observed that this bulb may have a memory-enhancing effect (Oyetayo *et al*., 2023). It is administered orally or as an infusion via enema in the treatment of Diarrhoea and dysentery. It has been reported that two drops of scallion juice into each nostril of the patient are used as a sedative (Francois *et al*., 2013). *Gladiolus psittacinus* tubers have been used in food and traditional medicine in Nigeria, Cameroon and Ghana. In southwestern Nigeria, its tubers are used in the treatment of bacterial infections (Nuedia *et al*., 2004). *Gladiolus psittacinus* extracts have been shown to contain alkaloids, tannins, saponins, flavonoids, carbohydrates and are effective against the *Pseudomonas aeruginosa* bacterial species (Ameh *et al*., 2011). Fred-Jaiyesimi and Abo (2008) reported the anti-diabetic activity of *Gladiolus psitaccinus* in diabetic rats and revealed that oral administration of methanol extract of *Gladiolus psittacinus* caused a significant hypoglycemic effect in the oral glucose tolerance test. Moshood *et al*., (2017) reported the acute toxicity of *Gladiolus psittacinus* and that the plant is a potential ethnomedicinal plant, but oral consumption at very high doses caused a mild toxic effect.

Minerals are biochemical substances that are essential for plant and animal metabolism. These minerals, which are necessary for metabolism, are necessary for the activation of many biomolecules. Insufficient or excessive amounts of minerals in plant and animal metabolism also cause metabolic abnormalities (Koichi & Masayoshi, 2003; Arzani *et al*., 2007; Nikolov *et al*., 2009). Minerals can be found in trace and major levels in metabolism. Plants have an important place in mineral resources required for animal metabolism. The use of plants is widespread for both nutritional and medicinal purposes. Trace elements found in plants used for medicinal purposes play an important role in the formation of active chemical compounds (Karak & Bhagat, 2010; Kremer *et al*., 2012). Trace elements have positive pharmacological effects on metabolic diseases, and their healing effects on immunological reactions, skin diseases, the immune system and serious infection cases have been reported (Chaturvedi *et al*., 2004; Selvaraju *et al*., 2009; Emsley, 2011).

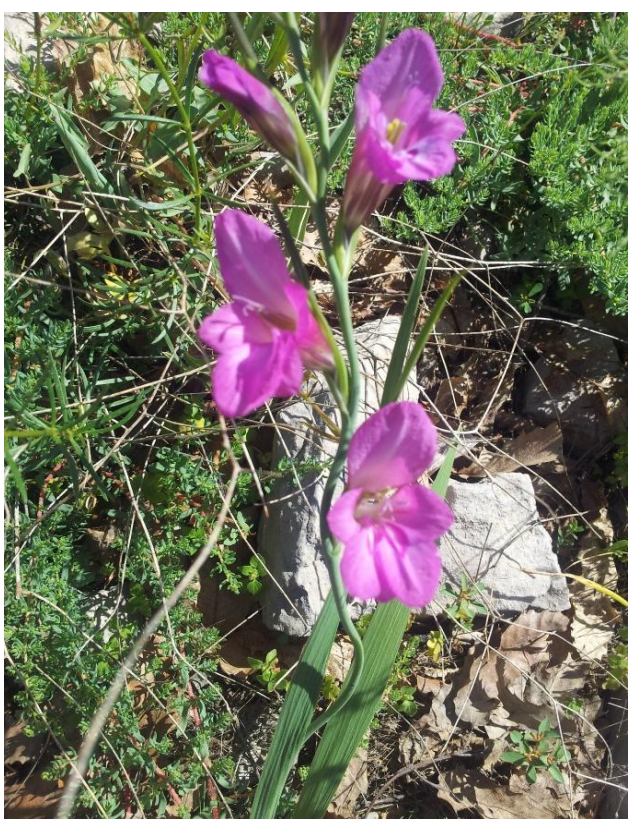

Fig. 1. Habit of *Gladiolus humilis*.

Fig. 2. Habit/ flowers of *Ixiolirion tataricum* var. *tataricum*.

One of the biochemical molecules that are found in plant and animal metabolism and play a role in important reactions is fatty acids. Fatty acids in metabolism are divided into saturated and unsaturated fatty acids. Fatty acids are classified as monounsaturated and polyunsaturated fatty acids according to the double bonds in their structure. Especially polyunsaturated fatty acids (PUFA), which contain more than two double bonds, are very important for metabolism. PUFA is very important for the metabolism of omega-6 (n-6) and omega-3 (n-3) fatty acids. The most common fatty acids synthesized by plants are linoleic acid (18:2 n6) and linolenic acid (18:3 n3). These fatty acids are considered essential fatty acids because they cannot be synthesized by animal metabolism. Since animal metabolism cannot synthesize such fatty acids, they must be obtained through diet (Siddiqui *et al*., 2008). For these reasons, it is very important to investigate the mineral and fatty acid levels and components of plants.

Therefore, in this study, the mineral and fatty acid levels of geophyte plants *G. humilis* and *I. tataricum* var. *tataricum* were investigated, and it was aimed to introduce them to the literature for the first time.

Materials and Methods

Plant material: *Gladiolus humilis* and *Ixiolirion tataricum* var. *tataricum* plants were collected from Adıyaman/Nemrut Mountain. The plant material was identified by Dr Ahmet Zafer Tel (Ozkaya *et al*., 2017). After the plants were picked up, they were naturally dried in a shady place. The plant specimens were deposited in the Adıyaman University Herbarium (ADYUHER) with code numbers 1316 and 1317, respectively.

Chemicals used in the experiment: All chemicals used during the studies are of analytical purity. Methanol, hexane, isopropyl alcohol, H_2SO_4, HNO_3, Ni, Ba, Al, Cu, Fe, Mn, Zn, Cr, K and Na standard solutions (1000 mg/L) were supplied from Merck. Calibration standard solutions were prepared by appropriate dilutions of single stock standards.

Determination of mineral levels: 0.5g of plant samples were taken, and the samples were placed in polytetrafluoroethylene bombs. 4 mL of HNO_3 (65% w/w) solution was added to the samples, and they were digested in the microwave system. Then, the sample solutions were analysed by Inductively Coupled Plasma Atomic Emission Spectrometry (Ciftci *et al*., 2009).

Fatty acid analysis: 1.00g of leaf and bulb samples of *G. humilis* and *I. tataricum* var. *tataricum* were weighed on a precision balance. The plant samples were homogenised in a hexane/isopropanol (3:2 v/v) mixture. Then, the lipid extracts were centrifuged for 5 min at 10000 rpm. The lipid phase was taken. 2% methanolic/sulphuric acid (v/v) was added to the fatty acids in the lipid extract and converted to their methyl esters (Hara & Radin, 1978; Christie, 1990). Purified fatty acids were analysed by SHIMADZU GC 2025 gas chromatography (GC). The results were determined as the percentage of each fatty acid among total fatty acids. Calculations were made using the GC Solution 2.3 program.

Statistical analysis

All the measurements were repeated three times, and the results were presented as the mean ± standard error mean.

Results

Fatty acid levels of *G. humilis* and *I. tataricum* var. *tataricum* leaf and bulb samples are given in Table 1. Major fatty acids in the leaf content of *G. humilis*: 14:0 10.39%, 16:0 20.14%, 18:0 10.48%, 18:1n9c 13.62%, 18:2n6c 8.19%, 18:3n3 10.42%, 20:3n3 4.29% and 22:6n3 4.52% were observed. Also, a total saturated fatty acid (∑SFA) level of 44.76%, a total unsaturated fatty acid (∑USFA) level of 55.24%, a monounsaturated fatty acid (∑MUFA) level of 21.81%, and a polyunsaturated fatty acid level (∑PUFA) of 33.43% were observed. Major fatty acids in the bulb content of *G. humilis* plant: 13:0 8.84%, 16:0 18.77%, 18:0 4.22%, 22:0 4.50%, 18:1n9c 4.06%, 18:2n6c 41.40% and 18:3n3 11.09%, were observed. Also, ∑SFA 38.51%, ∑USFA 61.49%, ∑MUFA 6.63% and ∑PUFA 54.86% were observed. Major fatty acids in the leaf content of *I. tataricum* var. *tataricum* plant, 14:0 4.55%**,** 16:0 24.11%, 18:0 6.77%, 18:1n9c 11.55%, 22:1n9 8.09%, 18:2n6c 11.20% and 18:3n3 14.15%, were observed. Also, ∑SFA 40.16%, ∑USFA 59.84%, ∑MUFA 25.28% and ∑PUFA 34.56% were observed. Major fatty acids in the bulb content of *I. tataricum* var. *tataricum* plant; 14:0 5.48%, 16:0 16.33%, 18:0 5.50%, 18:1n9c 4.26%, 18:2n6c 48.17%, 18:3n3 4.79% and 20:3n3 4.55%, were observed. Also, ∑SFA 30.18%, ∑USFA 69.82%, ∑MUFA 8.28% and ∑PUFA 61.54% were observed.

The results of the element composition analysis of *G. humilis* leaf revealed that Ni, Ba, Al, Cu, Fe, Mn, Zn and Cr were at respective levels of 1.22, 139.04, 232.95, 2.55, 227.85, 101.19, 43.68 and 3.71 µg/g, whereas K and Na levels were at 43.85 and 0.10 mg/g (dry matter), respectively (Table 2). The results of the element composition analysis of *G. humilis* bulb revealed that Ni, Ba, Cu, Fe, Mn, Zn and Cr were at respective levels of 0.60, 12.77, 0.56, 12.21, 8.33, 19.43 and 0.94 µg/g, whereas K and Na levels were at 22.78 and 0.04 mg/g (dry matter), respectively. The results of the element composition analysis of *I. tataricum* var. *tataricum* leaf revealed that Ni, Ba, Al, Cu, Fe, Mn, Zn and Cr were at respective levels of 4.05, 46.65, 1523, 3.85, 781.41, 131.57, 29.81 and 12.51 µg/g, whereas K and Na levels were at 44.96 and 0.23 mg/g (dry matter), respectively. The results of the element composition analysis of *I. tataricum* var. *tataricum* bulb revealed that Ni, Ba, Al, Cu, Fe, Mn, Zn and Cr were at respective levels of 0.14, 13.40, 4.24, 1.97, 17.08, 1.36, 21.37 and 1.46 µg/g, whereas K and Na levels were at 11.64 and 0.03 mg/g (dry matter), respectively. Pb levels in the leaf and bulb content of species *G. humilis* and *I. tataricum* var. *tataricum* could not be detected because they were below the device reading limits.

Table 1. Fatty acid composition of *G. humilis* and *I. tataricum* var. *tataricum* leaves and bulb samples (%).

Fatty acids	*G. humilis* leaves	*G. humilis* bulb	*I. tataricum* var. *tataricum* leave	*I. tataricum* var. *tataricum* bulb
12:0 (Lauric Acid)	0.65 ± 0.02		0.35 ± 0.01	
13:0 (Tridecanoic Acid)	0.53 ± 0.02	8.84 ± 1.21		0.31 ± 0.01
14:0 (Myristic Acid)	10.39 ± 1.02	0.19 ± 0.01	4.55 ± 0.08	5.48 ± 0.08
15:0 (Pentadecanoic Acid)	0.34 ± 0.01	0.49 ± 0.03	0.50 ± 0.02	0.32 ± 0.01
16:0 (Palmitic Acid)	20.14 ± 1.56	18.77 ± 1.45	24.11 ± 1.25	16.33 ± 1.04
17:0 (Heptadecanoic Acid)	0.34 ± 0.01	0.64 ± 0.02	0.87 ± 0.03	0.71 ± 0.02
18:0 (Stearic Acid)	10.48 ± 1.85	4.22 ± 0.07	6.77 ± 0.07	5.50 ± 0.07
20:0 (Arachidic Acid)		0.11 ± 0.01	1.66 ± 0.05	
21:0 (Heneicosanoic Acid)	0.43 ± 0.03	0.12 ± 0.01		0.66 ± 0.02
22:0 (Behenic Acid)		4.50 ± 0.06		
23:0 (Tricosanoic Acid)		0.17 ± 0.01	0.36 ± 0.01	0.17 ± 0.01
24:0 (Lignoceric Acid)	1.46 ± 0.08	0.46 ± 0.02	0.99 ± 0.03	0.70 ± 0.02
∑SFA	44.76 ± 2.42	38.51 ± 1.52	40.16 ± 2.02	30.18 ± 1.17
14:1n5 (Myristoleic Acid)		0.02 ± 0.01	3.05 ± 0.05	
15:1n5 (Cis-10-Pentadecanoic Acid)	1.73 ± 0.04	0.28 ± 0.01	0.29 ± 0.01	0.61 ± 0.01
16:1n7 (Palmiteloic Acid)	0.81 ± 0.06	0.59 ± 0.03	1.98 ± 0.08	1.18 ± 0.04
17:1n7 (Cis-10-Heptadecanoic Acid)	2.76 ± 0.07	0.05 ± 0.01	0.32 ± 0.01	0.43 ± 0.02
18:1n9t (Elaidic Acid)	1.41 ± 0.05			0.47 ± 0.03
18:1n9c (Oleic Acid)	13.62 ± 0.09	4.06 ± 0.06	11.55 ± 0.09	4.26 ± 0.07
20:1n9 (Cis-11-Eicosenoic Acid)	0.21 ± 0.01	0.02 ± 0.01		0.12 ± 0.01
22:1n9 (Erucic Acid)	0.62 ± 0.03	0.96 ± 0.04	8.09 ± 0.08	0.89 ± 0.08
24:1n9 (Nervonic Acid)	0.65 ± 0.04	0.65 ± 0.03		0.32 ± 0.02
∑MUFA	21.81 ± 1.46	6.63 ± 0.09	25.28 ± 1.45	8.28 ± 0.09
18:2n6t (Linolelaidic Acid)	0.87 ± 0.08		0.97 ± 0.05	0.33 ± 0.03
18:2n6c (Linoleic Acid)	8.19 ± 1.09	41.40 ± 2.46	11.20 ± 0.09	48.17 ± 2.74
18:3n6 (Gama-Linolenik Acid)	0.72 ± 0.05		1.90 ± 0.04	0.18 ± 0.01
18:3n3 (Alpha-Linolenic Acid)	10.42 ± 1.53	11.09 ± 0.09	14.15 ± 1.31	4.79 ± 0.07
20:2n6 (Cis-11,14-Eicosadienoic Acid)	0.14 ± 0.01	0.04 ± 0.01		0.23 ± 0.01
20:3n6 (Cis-8,11,14-Eicosatrienoic Acid)	1.26 ± 0.06	0.46 ± 0.02	1.20 ± 0.05	0.56 ± 0.04
20:3n3 (Cis-11,14,17-Eicosatrienoic Acid)	4.29 ± 0.07		1.56 ± 0.08	4.55 ± 0.74
20:4n6 (Arachidonic Acid)	0.66 ± 0.03	0.61 ± 0.03	0.61 ± 0.03	0.31 ± 0.02
22:2n6 (Cis-13,16-Docosadienoic Acid)	0.34 ± 0.02	0.12 ± 0.01	0.17 ± 0.01	0.42 ± 0.05
20:5n3 (Cis-5,8,11,14,17-Eicosapentaenoic Acid)	2.02 ± 0.07	0.53 ± 0.03	1.71 ± 0.05	0.40 ± 0.04
22:6n3 (Cis-4,7,10,13,16,19-Docosahexaenoic Acid)	4.52 ± 0.09	0.61 ± 0.04	1.09 ± 0.06	1.60 ± 0.08
∑PUFA	33.43 ± 2.05	54.86 ± 3.04	34.56 ± 2.41	61.54 ± 3.21
∑USFA	55.24 ± 3.04	61.49 ± 3.78	59.84 ± 2.91	69.82 ± 3.84

Table 2. The mineral composition of the leaves and bulbs of *G. humilis* and *I. tataricum* var. *tataricum*.

Minerals	*G. humilis* leaves	*G. humilis* bulb	*I. tataricum* var. *tataricum* leaves	*I. tataricum* var. *tataricum* bulb
Ni µg /g	1.22 ± 0.25	0.60 ± 0.06	4.05 ± 0.41	0.14 ± 0.02
Pb µg /g	-	-	-	-
Ba µg /g	139.04 ± 9.24	12.77 ± 1.02	46.65 ± 2.78	13.40 ± 0.85
Al µg /g	232.95 ± 15.56	-	1523 ± 47.52	4.24 ± 0.05
Cu µg /g	2.55 ± 0.21	0.56 ± 0.02	3,85 ± 0.22	1.97 ± 0.20
Fe µg /g	227.85 ± 16.41	12.21 ± 0.74	781.41 ± 43.25	17.08 ± 1.43
Mn µg /g	101.19 ± 7.23	8.33 ± 0.06	131.57 ± 9.41	1.36 ± 0.11
Zn µg /g	43.68 ± 2.98	19.43 ± 1.04	29.81 ± 1.45	21.37 ± 1.85
Cr µg /g	3.71 ± 0.251	0.94 ± 0.07	12.51 ± 0.89	1.46 ± 0.13
K mg/g	43.85 ± 3.45	22.78 ± 1.75	44.96 ± 2.78	11.64 ± 1.12
Na mg/g	0.10 ± 0.01	0.04 ± 0.01	0.23 ± 0.02	0.03 ± 0.01

Discussion

People use plants extensively in food, ornamental and traditional medicine. It is observed that with the development of analytical devices, the detection of chemical compositions in plant content has increased. Determining the presence of minerals and fatty acids that are essential for human and animal metabolism is very important in this respect. For these reasons, in our research, mineral and fatty acid levels were determined in the leaves and bulbs of the geophyte plant species *G. humilis* and *I. tataricum* var. *tataricum*.

Unsaturated fatty acids are essential biomolecules for human metabolism. Unsaturated fatty acids in the cell have important roles in regulating the immune system, cholesterol metabolism, membrane structure and brain functions. Such fatty acids are responsible for skin diseases (Steffens & Wirth, 2005), arthritis (Kremer *et al*., 1988), asthma (Lands, 1986), lupus erythematosus (Kelley *et al*., 1985), cardiovascular diseases (Li & Hu, 2009), inflammatory disease (Calder, 2006), coronary heart disease (De Lorgeril *et al*., 1999). It has been reported that they have positive effects against various diseases such as hypertension (Appel *et al*., 1993),

ulcerative colitis (Stenson *et al*., 1992) and multiple sclerosis (Bates *et al*., 1989). Our study suggests that these plants may be important for medicinal purposes due to the high levels of ∑USFA and individual unsaturated fatty acids in the leaf and bulb fatty acid compositions of *G. humilis* and *I. tataricum* var. *tataricum*.

It is found that the most striking minerals found in the leaves and bulbs of *G. humilis* and *I. tataricum* var. *tataricum* are Ba, Cu, Fe, Mn, Zn and K. Fe, Cu, Mn and Zn minerals are important trace elements for human metabolism. While, iron is necessary in haemoglobin formation, the immune system, and energy production (Ullah *et al*., 2012). Especially Mn, Zn and Cu are found as cofactors in antioxidant enzymes that play an important role in defense against free radicals (Ayodele & Bayero, 2010; Bhowmik *et al*., 2010). Deficiency of these elements causes many diseases in metabolism (Linder & Hazegh-Azam, 1996; Saracoglu *et al*., 2009). Since these minerals in our study are important for metabolism, as stated in the literature, the geophyte species *G. humilis* (endemic) and *I. tataricum* var. *tataricum* are medically important.

Na and K are the most important cations in balancing extracellular and intracellular fluids. These minerals have functions such as regulating fluid balance, membrane potential, and muscle contraction. It is known that these minerals have important roles in many diseases, such as cardiovascular diseases, stomach cancer, kidney stones, glucose intolerance and muscle weakness (Whelton & He, 2014).

Although Cu is necessary for human metabolism, it is known that excess Cu has toxic effects. It has been reported that Cu mineral is associated with bone health, immunity, infection frequency, cardiovascular diseases, and cholesterol metabolism (Araya *et al*., 2007). Zn is an important antioxidant mineral both for the growth of the organism and for reducing the effectiveness of free radicals. This mineral has many functions in metabolism, such as cell division, cell growth, the immune system, and protein synthesis. This mineral, which is found in many tissues in metabolism, plays a role in many enzymatic reactions (Chasapis *et al*., 2020).

Ba is an alkaline earth metal found in low to moderate concentrations in the natural environment. This mineral is found as a trace element in food and drinking water, and it is known that its use in the industrial field has been increasing in recent years (Kravchenko *et al*., 2014). The functional role of the mineral Ni as a trace element for animals and humans is not yet known. However, due to the widespread use of Ni mineral in industry, it has effects such as allergy, cardiovascular disease, kidney disease, and lung fibrosis (Genchi *et al*., 2020). Although humans absorb Al mineral into their metabolism through food and drinking water, it is not a mineral required for metabolism. It is known that this mineral, taken throughout life, accumulates in many tissues and has toxic effects, causing serious damage to brain metabolism and causing diseases such as Alzheimer's (Fekete *et al*., 2013).

It was observed that cortical and hippocampal GSH content and SOD activity increased significantly in the group supplemented with *Gladiolus psittacinus* bulb compared to the control group (Oyetayo *et al*., 2023). When the effect of *Gladiolus psittacinus* bulb on memory impairment in adult male albino Wistar rats was evaluated, it was reported that when rats with decreased memory index were fed with *Gladiolus psittacinus* bulb, acetylcholinesterase (AChE) and butyrylcholinesterase (BChE) enzymes were suppressed, resulting in positive cognitive effects. Some phytochemicals in *Gladiolus psittacinus* bulb have been reported to improve memory function and may protect against oxidative damage (Oyetayo *et al*., 2023). *Ixiolirion tataricum* var. *tataricum* is a species with high medicinal effects (Lü *et al*., 2019), and the flavonoids it contains have high antioxidant activity (Momtaz *et al*., 2018). A study showed that the inclusion of fennel essential oil in both free and nanoliposomal forms into *Ixiolirion tataricum* var. *tataricum* mucilage films increased their antibacterial activities against *E. coli* and *S. aureus.* In addition, it has been observed that films containing free essential oil show higher antimicrobial activity compared to encapsulated films, and this has been reported to be related to the controlled release of the active compounds of the essential oil (Marand *et al*., 2023). It has been reported that consuming raw bulbs, leaves and flowers of *Ixiolirion tataricum* var. *tataricum* is good for digestive health problems (Bibi *et al*., 2014). *Ixiolirion tataricum* var. *tataricum* flowers have been reported to be used as an astringent (Cakilcioglu *et al*., 2011) and skin conditioner (Mehrnia *et al*., 2021). It has been reported that boiling and consuming the whole *Ixiolirion tataricum* var. *tataricum* is good for allergies (Al-Ramahi *et al*., 2014).

It is concluded that these studies presented the biochemical parameters, trace elements and fatty acid levels in the leaves and bulbs of *G. humilis* endemic and *I. tataricum* var. *tataricum*. There are some biochemical parameters (vitamins, antioxidant capacity levels) among the shortcomings of the present study. It is assumed that completing these deficiencies in future studies will better reveal the medicinal importance of these plants.

Conflict of Interest: The authors declare that there are no conflicts of interest regarding the publication of this paper.

Author's Contribution: CC: Planning of the study, experimental phase and paper writing; **AZT**: Collection and systematic identification analysis of plants. **AO**: Biochemical analysis, conducted experiments, provided evaluation of the results.

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