Journal of Oleo Science
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doi : 10.5650/jos.ess24172
J. Oleo Sci. **74**, *(3) 309-319 (2025)*

Evaluation of Nutritional, Phytochemical, Fatty Acids and Mineral Composition of *Eremurus robustus* Leaves in Bradost Mountain, Kurdistan Region of Iraq

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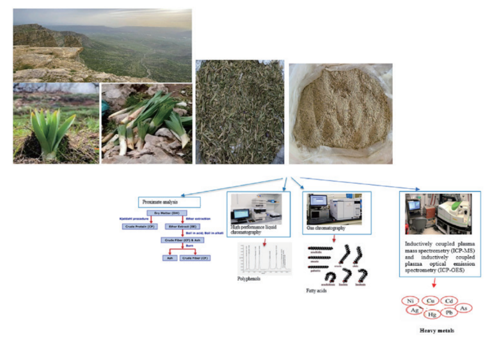

Abstract: One of the wild herbs that grows naturally in the springtime in Kurdistan's mountainous regions is *Eremurus robustus*. The study aimed to detect the proximate analysis, polyphenols, fatty acid profile, and mineral composition in the leaves of *Eremurus robustus*. Proximate composition revealed it is a source of vitamin C, fiber, and protein. Nine phenolic compounds and 24 fatty acids were detected, along with 14 saturated and 10 unsaturated fatty acids using high-performance liquid chromatography (HP-LC) and gas chromatography-mass spectrophotometers (GC-MS). Seventeen mineral compositions were found using an inductively coupled spectrophotometric technique. Vegetable trace metal concentrations can be assessed by comparing the daily diets of plants and humans. The research suggests that Eremurus robustus leaves can serve as nutritional supplements and functional foods, not just for therapeutic uses.

Key words: Bradost mountain, *Eremurus robustus*, heavy metals, polyphenols, wild vegetable

1 Introduction

Eremurus robustus is a member of the Asphodelaceae family, which includes 50–59 species[1]. This grass is native to the highlands and grows freely in most mountainous areas. Many Kurdish men and women hike to the hills and mountains in Rawnduze and the Soran region in the spring to gather natural herbs[2]. *Eremurus robustus* grows quickly in the spring, reaching up to 48 inches in length and 4 inches in width for its leaves. The plant flourishes in direct sunlight, and its stems can reach six to ten feet. However, *Eremurus robustus* does not reach its full height potential in this area as it is quickly harvested by people for consumption or sale. *Eremurus robustus*, known by various names in Kurdish such as Asrlik, Asterik, Cyrillic, Cyril, Chiresh, Strk, and Khwoja (ئەستریلک، سرێش، چرێش، سریش، خوژە), holds a prominent place in Kurdish cuisine due to its distinctive features. This plant emits a powerful aroma and boasts a delicious taste, making it a sought-after ingredient in cooking and preparing sauces. Kurdish cuisine offers several methods of preparation for *Eremurus robustus*: it can be lightly boiled and then fried with onions, finely chopped and mixed with rice, or used in soups with tomatoes and onions. Another popular Kurdish dish involves mixing *Eremurus robustus* with wheat and boiling it with 'dou' or 'yogurt', resulting in a preparation called 'doklu'[3]. Moreover, *Eremurus robustus*, after being dried in the shade, can be ground into a powder and mixed with water to create a brown dough, commonly referred to as 'Saresh.' This dough serves as a potent adhesive and finds particular use in paper glue applications. In Kurdish culture, this mixture is employed to treat broken limbs of sheep and cattle, and folk beliefs suggest that consuming this grass can lead to faster healing of fractures. Nutrients that are suitable for human consumption can be found in abundant amounts in edible wild plants[7]. Wild plants are perishable and seasonal, necessitating appropriate preparation and storage techniques[4]. Ascorbic acid, riboflavin, and thiamine levels are decreased by traditional drying[4]. One phase in the traditional manufacturing process of herbal treatments is infusion, or immersing in hot water[5]. Thus, it

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Accepted December 13, 2024 (received for review July 23, 2024)
Journal of Oleo Science ISSN 1345-8957 print / ISSN 1347-3352 online
https://www.jstage.jst.go.jp/browse/jos/ https://mc.manuscriptcentral.com/jjocs

is believed that introducing new crops derived from edible wild plants is one of the most significant choices for a new "green revolution" that is community-driven, biodiverse, resilient, and sustainable[6]. Many drugs and therapies have been created from edible wild plants over time[7]. The granulation tissue production, epidermal regeneration, and angiogenesis that are promoted by the antioxidant and antibacterial properties of *Arum maculatum* leaf extract may aid in the healing of wounds[8]. It has been shown that anticancer effects of *Gundelia tournefortii* on the human colon cancer (HCT-116 cell line)[9]. With its antioxidant activity and polyphenolic content, the aerial portions and seeds of *Gundelia tournefortii* are effective in treating diabetes, diarrhea, and the mumps[10], they principally include gallic acid and quercetin, sitosterol, stigmasterol, lupeol, gitoxigenin, α-amyrin, and artemisinin[10]. Diseases of the intestines, bronchi, circulatory system, and liver are treated with *Lactuca serriola*[11]. Because lupeol, lupeol acetate, germinol, alpha amyrin, beta amyrin, and lactucone, lactucin, lactucic acids, vitamins, beta-carotene, iron, alkaloids, oxalic acid, lactucopicrin, sesquiterpene esters, and phenolic contents are the main chemicals identified from *Lactuca serriola*[12]. According to Narendhirakannan et al.[13], many inorganic trace elements, such as K, V, Zn, Cr, Cu, Ni, and Na, may account for the hypoglycemic nature of the leaves of *Murraya koenigii*, *Mentha piperitae*, *Ocimum sanctum*, and *Aegle marmelos*. The principal bioactive compounds found in crude extracts of herbs and spices—about half of the approximately 8,000 naturally occurring plant phenolics are flavonoids[14], and the aromatic properties of their compounds (terpenes, flavonoids, and essential oils)[15]. More than 100 distinct phytochemicals may be found in most wild plants, and many of these phytochemicals are rich in antioxidants, which makes them essential for preventing disease since they scavenge and repair the damage that free radicals do[16]. The World Health Organization (WHO) has estimated that 80% of the population in developing countries relies primarily on herbal medicine for basic health care[17]. Mountains and alpine environments are vulnerable to nearby pollutants, mostly through long-distance emission transport. Plants absorb Pb in trace amounts, with direct atmospheric deposition accounting for 80% of the accumulation[18]. Meteorological, local orographic, and altitude factors influence the distribution of atmospheric deposition of heavy metals in mountainous places[18]. Bradost mountain is 5,000 feet above sea level, about 25 miles long, and covered in vegetation and herbs. However, plant growth requires essential elements like Co, Cu, Fe, Mn, Mo, Ni, and Zn, but not heavy metals like As, Cd, Hg, Pb, and Se[19]. Hyperaccumulators, about 500 plant species, accumulate metallic elements without harm, detoxifying heavy metals in root tissues and minimizing ion translocation to shoots[19]. These materials make them attractive for sustainable biotechnologies such as phytoremediation and phytomining[20]. Significant challenges exist in evaluating these herbs and ensuring their safety and efficacy through registration and regulation[21]. To our knowledge, for the first time, there is no available data in the literature on the analysis of the antioxidant, fatty acid profile, and heavy metals of *Eremurus robustus* in mountain Bradost. Therefore, the objectives of this study were to: (i) determine proximate analysis content; (ii) screen polyphenol contents using high-performance liquid chromatography (HPLC); (iii) identify the fatty acid composition of the plants by using gas chromatographic mass spectrometry (GC-MS); and (iv) observe possible heavy metals compared with the rate permission allowed for *Eremurus robustus* grown in the Bradust mountain.

2 Materials and Methods

2.1 Description of the study area

The location of Bradost mountain is roughly 15 kilometers northwest of Rawanduze and 102 kilometers northeast of Erbil. It connects Soran and Megasor to make an uninterrupted ridge (Fig. 1). The region around Bradost mountain, which is home to about 160 plant species and covers an area of roughly 1247 hectares, has a high level of biodiversity. According to the Erbil Governorate[22] Shanader, Beeston, and Diana are the three well-known caverns in the region. They are located between 389 and 1345 meters above sea level. Of them, twelve Neanderthals' remains have been found in the archeological site of Shanidar cave, and this cave contains eleven Neanderthal skeletons that date between 35,000- and 65,000-years B.C.[23]. The data presented emphasizes the importance of Bradost mountain and its environs from a geological, archaeological, and ecological standpoint.

2.2 Collect and prepare herb samples

In April 2022, samples of *Eremurus robustus* were collected from Bradost mountain at the coordinates 36°44′3.48″N, 44°23′19.32″E. The identification of the herbs was performed by an expert from the National Herbarium of Kurdistan. After identification, the herbs were coded and preserved at the Salahaddin University Herbarium, located in the Education College (herbarium code: ESUH7998). For the study, leaves were used as the source material, and three randomly selected copies of the herbs were collected and then dried in the shade to prepare them for further processing. The next step involved mashing the dried herbs, and the resulting material was transformed into a homogenous powder. This powder was then stored at an extremely low temperature of −80℃ until the extraction process was performed. The storage at such a low temperature helps preserve the integrity of the plant's bioactive compounds until they are ready to be extracted for analysis

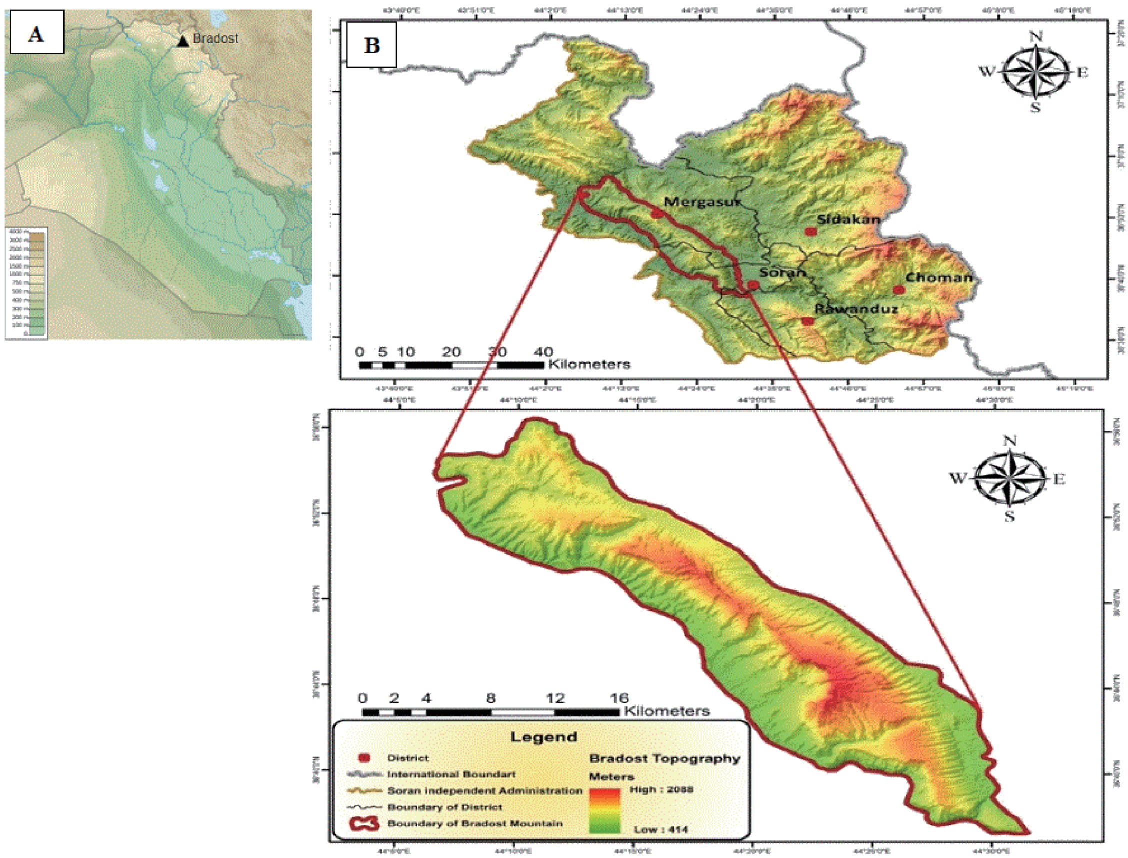

Fig. 1 Location of the research area on a map. A. Maps of Iraq, B. Bradost mountain.

or further studies.

2.3 Proximate analysis

Proximate analysis was utilized in accordance with the official analytical procedures of the Association of Official Analytical Chemists[24] to ascertain the concentrations of ash, moisture, protein, fat, and carbs in samples. Every test was done three times on every sample.

2.4 Total antioxidant

The total antioxidant was measured using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) standard, according to Brand-Williams et al.[25].

2.5 Vitamin C

Vitamin C was determined as specified by Mokhtarpour et al.[26] using the titration method and 1,2-dichlorophenol indophenol solution (DCIP).

2.6 Total sugar

The 0.5 milliliters of 0.1 N HCl were added to one milliliter of standard solution or an adequately diluted sample. The mixture was cooked in a 100℃ water bath for 15 minutes before cooling in cold water. After cooling, 0.5 mL of 0.1 N NaOH was added while mixing. To ascertain the extracted sample solution's total sugar concentration, Nelson's declining sugar test was used[27].

2.7 Determination of total phenolic content

The modified Folin-Ciocalteu method was used to determine the total phenolic content in the plant sample, as described by Iqbal et al.[28]. Then the content of phenol in extracts was expressed in terms of gallic acid equivalents (mg GAE/g extract).

2.8 Determination of total antioxidant capacity

The antioxidant activity of the samples was determined by utilizing the source of the stable 1,1-diphenyl-2-picrylhyorazyl (DPPH) free radical's scavenging activity[29].

2.9 Polyphenol extraction

Two grams of the powdered sample was taken in order to extract the polyphenols. Then, 4 milliliters of a methanol solvent with 1% acetic acid was added. For the next twenty minutes, the extraction process was carried out using ultrasonic waves. Using the Agilent USA model 1100 series HPLC (high-performance liquid chromatography) system, the phenolic acids were identified, separated, and measured. It has four solvent gradient pumps, a 20-microliter injection loop, a degassing system, a column oven set to

25℃ and a diode array detector with settings for 250, 272, and 310 nm, respectively[7].

2.10 Fatty acid analysis

One hundred grams of plant powder and 500 mL of hexane were put in a flask with a round bottom, and a soxhlet chamber was then set up to extract the mixture for 6 hours at 50℃. To prevent thermal destruction of the bioactive components, the extracts were heated to a gentle extraction temperature of 50℃ before beginning the distillation process. After the extraction process, the solvent and extractor were put in a water bath to let the solvent evaporate. The oil samples were homogenized using a vortex, and each sample was precisely weighed at 100 mg. The fat was then transformed into methyl ester by adding 3 mL of soap methanolic potassium hydroxide (2 M) and 5 mL of methanolic sulfuric acid (12% v/v). The fatty acid methyl ester was extracted using one milliliter of ordinary heptane, and the fatty acid profile was evaluated using a gas chromatography-mass spectrophotometer (GC-MS) (Agilent HP 6890 Series coupled with Agilent HP 5973 Mass Selective Detector). The standard fatty acid solution made by Sigma Company was used to identify each fatty acid by comparing the inhibition times[7].

2.11 Elemental analysis

The dried samples (0.5 g) and the solid sample were added to borosilicate glass digestion tubes. 10 mL of HNO_3-HCl-H_2O_2 (8:1:1, v/v/v) were added to each of the tubes, and the tubes were then put on a heating block with the temperature adjusted to rise to 120℃ for approximately 3 hours or until the solutions were thoroughly digested. Following completion of the digestion, the clear solutions were poured into 50-mL volumetric flasks and diluted with ultrapure (UP) water. High-density polyethylene bottles were used to hold the diluted samples until analysis. The samples were examined twice. 10 mL of HNO_3-HCl-H_2O_2 (8:1:1, v/v/v) were used as a blank solution[30]. Then, it was examined using two instruments with a broad operating range: an inductively coupled plasma mass spectrometry (ICP-MS) instrument (4500 Elan DRC, Perkin Elmer, ION 300X, USA model) and an inductively coupled plasma-optical emission spectrophotometric (Optima 5300 DV ICP-OES, Perkin Elmer Instruments, USA)[31].

2.12 Statistical analysis

The study used PROC UNIVARIATE SAS software for statistical analysis, checking for normality. Means and SEM were displayed, and Tukey's post hoc comparison test was used to explain ANOVA results (Graph Pad Prism 9.5.1). We used a 95% level of confidence for statistical operations.

3 Results and Discussion

The current research may be significant as a source of nutrients and bioactive substances that are abundant in herbs and have the potential to treat or prevent disease. For example, they have blood pressure-lowering, anti-obesity, anti-diabetic, anti-inflammatory, and cardioprotective qualities[32]. For proximate analysis, the leaves of *Eremurus robustus* were arranged in descending order (Table 1) starting from Vitamin C (743.9 ppm) >, total antioxidant capacity (55.4%) >, fiber (29.6 g/100 g) >, protein (14.4 %) >, ash (10.4%) >, total polyphenols (3.6 g/GAE 100 g) >, nitrogen (2.6%) >, and moisture (2.33%), respectively. Citrus fruits and vegetables are rich in vitamin C, which promotes the healing of wounds, the conversion of folic acid into tyrosine, the metabolism of iron and carbohydrates, and the synthesis of proteins resistant to infection and DNA damage[33]. The current investigation revealed that *Eremurus robustus* leaves contain higher levels of vitamin C (743.9 mg/100 g) compared to emblic, guava, sweet pepper, passion fruit, lemon, and schomburgkia (226.0, 80.1, 52.8, 39.1, 10.5, and 4.6 mg/100 g), respectively[34]. This can be traced to the phylogenetic origin of the plant. In raw materials, vitamin C levels are higher; however, heat treatment, freezing, and long-term storage can deplete them, steaming is the least damaging method[35]. The vitamin C content of onion *Allium cepa* L. varieties was 2.1-4.41 mg/100 g, respectively[35]. The WHO (2004) recommends 45–50 mg of vitamin C per day, which can be obtained from vegetables. Intense exercise and the cold months require 250 mg daily, whereas illness-related circumstances require 500 mg[36]. The average moisture content in *Eremurus robustus* leaves (2%) was lower than the leaves of Egyptian leeks (87.75%) and onions (89%)[37]. A sample's high moisture content reflects inadequate storage since samples with more than 15% moisture

Table 1 Proximate composition of *Eremurus robustus* leaves collected from Bradost mountain.

Parameters	Value
Ash %	10.4 ± 0.23
Moistures %	2.33 ± 0.01
N %	2.6 ± 0.11
Protein %	14.4 ± 0.18
Vit C (ppm)	743.9 ± 0.33
Fiber (g/100 g)	29.6 ± 0.08
Carbohydrate %	38.6 ± 0.17
Total phenols (g/GAE 100 g)	3.65 ± 0.3
Total antioxidant capacity %	55.4 ± 0.01

The values are Mean ± SE in three replicates.
N (nitrogen); Vit C (vitamin ascorbic acid).

content encourage the growth of microorganisms[37]. A high ash content in leaves can serve as a source of inorganic minerals. *Eremurus robustus* had an average ash level of 10.4%, which was higher than that of the various onion (*Allium cepa* L.) cultivars, which ranged from 4.14 to 8.3%[35] and lower than that of the Egyptian leek leaves (15.90%)[37]. According to the results of the current study, the crude fiber content of the leaves of *Eremurus robustus* (29.6%) was higher than that of all onion (*Allium cepa* L.) types (3.8 to 5.15%)[35] and Egyptian leek (23.82%) leaves[37]. By reducing blood levels of cholesterol that clog arteries, soluble fiber helps to prevent cardiovascular disease. A higher crude fiber content in the samples increases protection against constipation[38]. Accordingly, the variance in the mineral content of the cultivated region was the cause of the large discrepancy in fiber content between the value found in the literature and the value found in this study[39]. This investigation revealed that the protein content of *Eremurus robustus* (14.4%) was higher than that of onion bulbs, ranging from 9.84 to 12.09 g/100 g[40] and leaves of Egyptian leek (8.50%)[37]. About 80% of protein intake can be of vegetable origin, especially in developing countries, as it is more economical than animal protein. Therefore, consumption of *Eremurus robustus* might supply a considerable amount for human needs. Table 1 indicted that *Eremurus robustus* had a higher result for carbs (34.8%) than onions (*Allium cepa* L) and cultivars (16.77 to 21.87 g/100 g)[5]. Meanwhile, the carbohydrate content of Egyptian leeks was 45.28%[41] and that of sweet basil was 48.75%[37]. *Eremurus robustus* leaves have a higher carbohydrate content of 38.6% compared to a protein content of 14.4%. This agrees with earlier research reporting that celery leaf carbohydrates (81.64%) were higher than protein (5.04%), indicating that starches from cereals, roots, and tubers are primary energy sources in developing nations[42]. Native fruits, nuts, and green vegetables are rich in carbohydrates, impacting photosynthesis in source leaves but not young sink leaves. Reduced rubisco content causes carbohydrate repression[43]. Potato plants may accumulate starch under nitrogen-stress conditions[44]. The determination of total phenolic content was done by the Folin Ciocalteu method, which was introduced by Abdulwahid-Kurdi[14]. The leaves of the present study, *Eremurus robustus*, had higher levels of total phenolic content (3.65 g/GAE 100 g) compared to the leaves of Egyptian leek (0.961 g/GAE 100 g)[37]. The total phenolic contents and percentage antioxidant activity of four (red, violet, white, and green) varieties of *Allium cepa* ranged from 0.004 to 0.0741 mg/g GAE and 13.6% to 84.1%. It is important to remember that various factors can impact antioxidant activity, including soil type, climatic conditions, geographic location, and plant variety[39].

The most common phenolic compounds found in *Eremurus robustus* leaves were chlorogenic acid (549), followed by caffeic acid (484), coumaric and apigenin (432), quercetin (79), gallic acid (25.4), rosmaric acid (17.8), and cinnamic acid (14) in ppm. These findings were further corroborated by HPLC analysis (Table 2). Plant species include bioactive compounds called polyphenols, which have a variety of structures and well-established biological effects. These effects include anti-inflammatory, antiviral, antibacterial, anti-mutagenic, antioxidant, and antithrombogenic qualities[14]. The gallic acid content in the leaves of *Eremurus robustus* is higher compared to the chili pepper (3.33 mg/g), lemon (2.03 mg/g), spinach (1.82 mg/g), onion bulb (1.55 mg/g), and cabbage (0.49 mg/g)[45]. The author found that chlorogenic acid, caffeic acid, coumaric acid, and apigenin in the leaves of *Eremurus robustus* were higher than in Aloe vera[46]. Taile et al.[5] demonstrated that quercetin, caffeic, chlorogenic, and gallic acids, identified as predominant plant polyphenols, protect cerebral endothelial cells during hyperglycemic conditions. According to studies, quercetin and gallic acid were the only phenolic substances found in onion extracts[47]. The leaves of *Eremurus robustus* are high in gallic acid and quercetin. Quercetin is reported to have anti-inflammatory, anti-histamine, and anti-cancer activities, which primarily align with its antioxidant qualities[45]. Apigenin, found in vegetables, fruits, and herbs, is absorbed into the digestive tract and enters the brain, potentially improving the clinical use of benzodiazepines[48]. According to research by Zhao et al.[49] apigenin can decrease insoluble β-amyloid peptide concentrations, decrease fibrillar amyloid deposits, and enhance memory and learning when given orally. It is thought that *p*-coumaric acid, or cinnamic acid, exhibits antioxidant properties that prevent the stomach from producing nitrosamines, which can cause cancer. Rutin is an extra polyphenol that is used to treat hemorrhoids, varicose veins, hemorrhagic stroke, and mucositis[45]. Chlorogenic acid's numerous

Table 2 Polyphenolic compounds determined by HPLC of *Eremurus robustus* leaves collected from Bradost mountain.

Polyphenols	ppm
Gallic acid	25.4 ± 0.23
Caffeic acid	484.2 ± 0.20
Chlorogenic acid	549 ± 0.18
Rutin	32.2 ± 0.08
Coumaric	432 ± 0.57
Rosmaric acid	17.8 ± 0.05
Quercetin	79 ± 0.57
Cinnamic acid	14 ± 1.15
Apigenin	432 ± 1.45

The values are Mean ± SE in three replicates.
ppm: parts per million.

health benefits, including cholesterol reduction, hypoglycemia reduction, antiviral, antibacterial, anti-inflammatory, anti-cardiovascular, antimutagenic, anticancer, and immunomodulatory effects, make it a crucial tool in chronic disease prevention[50].

Using a gas chromatography mass spectrophotometer, 24 fatty acids unique to *Eremurus robustus* leaves were found. The main fatty acid composition was determined to be as follows: γ-linolenic (1.87%), palmitoleic (1.43%), caprylic (1.4%), myristic (0.64%), *cis*-11,14-eicosadienoic (0.44%), *cis*-10-hexadecenoic (0.43%), *cis*-13,16-docasadienoic (0.06%), lignoceric acid (18.5%), arachidic acid (9.3%), palmitic acid (8.4%), *cis*-11-eicosenoic acid (6.2%), linoleic acid (5.6%), pentadecanoic (4.22%), oleic (4.21%), stearic (3.5%), tricosanoic (3.22%), lauric (3.2%), tridecanoic (2.9%), capric (2.545%), arachidonic (2.43%), γ-linolenic (1.87%), palmitoleic (1.43%), caprylic (1.4%), myristic (0.64%), *cis*-11,14-eicosadienoic (Table 3). The study found that lignoceric acid, a crucial nutrient for brain growth and development, was predominant in the leaves of *Ficus religiosa* Linn and 1.56% in the stem bark[51]. The study found the highest undecanoic acid, arachnidonic acid, in castor oil's primary fatty acid, ricinoleic acid, which is used in topical lotions, antibiotics, anticancer chemicals, and insect pheromones[52]. To date, it has been reported that compounds in *Eremurus robustus* were evaluated for their cytotoxic activity against SBC-3 human small-cell lung cancer and induced apoptotic cell death[53]. Arachidonic acid is an essential fatty acid involved in cell regulation, metabolites, vasodilation, and constriction[54]. The study found that palmitic acid methyl ester, released from the superior cervical ganglion cerebral blood

Table 3 Fatty acids content *Eremurus robustus* leaves were obtained from Bradost mountain using gas chromatography.

	Fatty acids %	Retention times (min)	%	Types
1	Caprylic acid methyl ester (C8:0)	11.540	1.4 ± 0.01	Saturated
2	Capric acid methyl ester (C10:0)	12.698	2.545 ± 0.00	Saturated
3	Undecanoic acid methyl ester (C11:0)	13.273	9.3 ± 0.12	Saturated
4	Lauric acid methyl ester (C12:0)	14.804	3.2 ± 0.14	Saturated
5	Tridecanoic acid methyl ester (C13:0)	15.925	2.9 ± 0.05	Saturated
6	Myristic acid methyl ester (C14:0)	16.237	0.64 ± 0.08	Saturated
7	Methyl myristoleate (C14:1)	16.579	2.21 ± 0.05	Saturated
8	Pentadecanoic acid methyl ester (C15:0)	17.450	4.22 ± 0.01	Saturated
9	Palmitic acid methyl ester (C16:0)	17.732	8.4 ± 0.14	Saturated
10	Palmitoleic acid methyl ester (C16:1)	18.038	1.43 ± 0.06	Saturated
11	*cis*-10-Heptadecenoic acid methyl ester (C17:1)	18.970	0.43 ± 0.02	Unsaturated
12	Stearic acid methyl ester (C18:0)	19.416	3.5 ± 0.10	Unsaturated
13	Oleic acid methyl ester (C18:1n9c)	19.932	4.21 ± 0.08	Unsaturated
14	Linoleic acid methyl ester (C18:2n6c)	20.323	5.6 ± 0.10	Unsaturated
15	γ-Linolenic acid methyl ester (C18:3n6)	20.518	1.87 ± 0.08	Unsaturated
16	α-Linolenic acid methyl ester (C18:3n3)	20.815	0.21 ± 0.08	Unsaturated
17	Arachidic acid methyl ester (C20:0)	20.901	9.3 ± 0.11	Saturated
18	*cis*-11-Eicosenoic acid methyl ester (C20:1)	21.294	6.2 ± 0.11	Unsaturated
19	*cis*-11,14-Eicosadienoic acid methyl ester (C20:2)	21.885	0.44 ± 0.01	Unsaturated
20	Arachidonic acid methyl ester (C20:4n6)	22.603	2.43 ± 0.14	Saturated
21	Erucic acid methyl ester (C22:1n9)	23.275	0.3 ± 0.02	Unsaturated
22	*cis*-13,16-Docasadienoic acid methyl ester (C22:2n6)	25.283	0.06 ± 0.05	Unsaturated
23	Tricosanoic acid methyl ester (C23:0)	25.418	3.22 ± 0.02	Saturated
24	Lignoceric acid methyl ester (C24:0)	25.651	18.5 ± 0.10	Saturated
	Total saturated %		69.70	
	Total unsaturated %		22.82	

The values are Mean ± SE in three replicates.

flow in rats immediately after cardiopulmonary resuscitation, improves functional learning and spatial memory[55]. The study investigates fatty acid profiles in *Eremurus robustus*, finding palmitic acid as the major saturated fatty acid in edible Allium aerial parts, with the highest levels in French leek and red onion[56]. Gas chromatography analysis of the extracted oil from the outer scale part showed the highest percentage of linoleic acid at 52.87%[57]. The fatty acid composition of edible Allium species, including onion, garlic, and leek, consists of four fatty acids: linoleic, palmitic, oleic, and α-linolenic acid. Palmitic acid is the major saturated fatty acid[58]. Allium species contain palmitoleic acid, linoleic acid, and α-linolenic acid, essential polyunsaturated fatty acids for human health that are anti-inflammatory, hypolipidemic, and anti-cancer[58]. *Eremurus robustus* leaves contain more saturated (69.70%) fatty acids than unsaturated (22.82%) fatty acids. Similarly, Zambiazi et al.[59] found that coconut and palm fats, which included more than 80% of saturated fatty acids, had increased saturated fatty acid concentrations. Leaf tissue is a particularly useful material because it can produce a wide range of saturated and unsaturated fatty acids quickly[60]. According to Abdulwahid Kurdi's[7] study, leaves have higher concentrations of saturated fatty acids than unsaturated ones found in fruit, pods, or seeds; the most prevalent forms are tricosanoic and palmitic. On the other hand, *Moringa oleifera* leaves have a high quantity of mono- and polyunsaturated fatty acids; the generation of oil and the concentration of C22:0 and C18:1 are affected by dryness[61]. In addition to genotypes, a plant's total fatty acid content is influenced by the year, the growing region, and the climate. The latitude and the annual average humidity have an impact on the scent of these fatty acids. Antioxidants, fiber, fruits, and vegetables can all interact with these fatty acids. The mineral composition of *Eremurus robustus* leaves, for which 17 elements were identified in the current study (Table 4). The concentrations of the mineral compositions varied widely and were arranged in descending order; Ca, K, Na, Zn, Cu, Fe, Mg, Mn, Pb, Se, As, Mo, Cd, Hg, Cr, Ni, and Co. The WHO and FDA report that the concentration of Fe, Cu, Zn, Cr, Hg, Cd, Co, Pb, Se, Mo, and as in the leaves of *Eremurus robustus* was greater than usual. Barley and oats tolerate metals like Cu, Cd, and Zn, accumulating medium to high levels in their tissues[62]. Pep-

Table 4 The selected mineral content of *Eremurus robustus* leaves were collected from Bradost mountain.

	Metals (mg/100 g)	*Eremurus robustus*	Recommended daily dietary allowance in (mg/day)	FAO/WHO maximum permissible values for plants (mg/100 g)	References
1	Calcium (Ca) (soft)	543.4 ± 0.01	800 − 1300	500 − 1400	73
2	Sodium (Na) (light)	87 ± 0.57	2400	2.28 − 94	73
3	Potassium (K) (light)	108 ± 0.57	3500	20 − 730	73
4	Iron (Fe) (heavy)	31 ± 0.57	10 − 28	2	74
5	Copper (Cu) (heavy)	44 ± 0.58	1.0 − 1.6	0.3	73, 74, 75
6	Zinc (Zn) (heavy)	54 ± 0.33	15	2.74	76
7	Chromium (Cr) (heavy)	0.02 ± 0.01	0.02 − 0.25	0.002	74
8	Mercury (Hg) (heavy)	0.03 ± 0.01	0.005	0.02	74
9	Cadmium (Cd) (heavy)	0.1 ± 0.011	0.01 − 0.2	0.03	77
10	Cobalt (Co) (heavy)	0.0043 ± 0.011	0.13	0.001	73, 74
11	Nickel (Ni) (heavy)	0.01 ± 0.011	0.32 − 0.735	0.15	75
12	Magnesium (Mg) (light)	34.7 ± 0.05	200 − 400	5.5 − 191	73
13	Manganese (Mn) (light)	18 ± 0.57	11	20	75
14	Lead (Pb) (heavy)	14 ± 0.57	10	0.001 − 0.02	78
15	Selenium (Se) (heavy)	2 ± 0.66	0.002 − 0.88	0.0001 − 0.06	73, 79
16	Molybdenum (Mo) (transition)	0.48 ± 0.03	0.1–0.5	0.01 − 0.2	80, 81
17	Arsenic (As) (heavy)	1.5 ± 0.03	0.015 − 0.1	0.1 − 0.5	74

The values are Mean ± SE in three replicates.
Heavy metals are relatively high densities, atomic weights, or atomic numbers.
Light metals are relatively low density.
Soft metals are soft, shiny metals with low melting points, making them easily workable.
Transition metals are an incomplete inner orbit in their atomic structure.

permint extracts heavy metals from the soil, and tested mint varieties can grow on polluted soils[63]. Medical plants like mint, St. John's wort, lavender, and hemp accumulate toxic heavy metals; they can be used in phytoremediation and replace food crops[62]. Trace metal concentrations in vegetables can be determined by comparing daily human consumption[64]. Long-term exposure to Cd increases lung, liver, and kidney cancer risk due to heavy reliance on Cd-based pesticides, herbicides, and fertilizers in agricultural areas. Extra care may be necessary to avoid Fe poisoning, which can result in nausea, vomiting, diarrhea, and liver problems[2]. Toxic Cu poisoning has been linked to liver damage in cases of chronic poisoning as well as gastrointestinal symptoms such as cramps, nausea, diarrhea, and vomiting in acute episodes[65]. Soil concentrations of Mo and Se in plants increase during the winter due to geogenic sources, mining activities, rainwater leaching, and industrial waste discharge[66]. Selenium can alleviate heavy metal stress and enhance plant antioxidant capacity[67]. Toxic metals, including Cd, organic Hg, and Pb, are present in medicinal preparations, particularly in Chinese, Mexican, and Indian remedies, causing negative effects on the brain, kidneys, and fetus[68]. Slovakia's mountainous regions, particularly agricultural soils, are found to be contaminated with heavy metals, particularly Cd and Pb, indicating air deposition'[69]. Toth et al.'s study[70]reveals that Cd and Ni are the primary polluting agents in agricultural soils at the base of the high and low Tatras. Plants in the Mediterranean climate are significantly impacted by soil contamination with Fe and Mn, originating from anthropogenic and natural sources[71]. Climate change and deforestation disrupt hydrological processes, causing increased surface runoff and nutrient loss in the mountain and forest ecosystems[72].

4 Conclusions

For humans, *Eremurus robustus* leaves provide a substantial number of vitamins, antioxidants, carbohydrates, proteins, oil, and minerals. This is the first investigation into the phytochemical profile and identification of the majority of these wild herbs' constituents. The negative effects of metal poisoning should be known to the public, especially when large amounts are consumed. These findings support the idea that *Eremurus robustus* leaves are a rich source of minerals and essential oils that are beneficial to human health. *Eremurus robustus* leaves are wild herbs that can be gathered and collected in the spring and used to make delicious food and calming and therapeutic tinctures. The author suggests enhancing and growing the house and yard. Subsequent investigations ought to concentrate on their biological mechanisms of action.

Acknowledgment

I would like to gratefully thank Mam Kurdo for helping to pick and harvest plants in the Bradost mountain throughout the spring.

Competing Interests

I have no conflicts of interest.

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