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Chemical Characterization of Some Wild Edible Plants of Eastern Region of Anatolia, Turkey

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Abstract
Thymus transcaucasicus Ronniger, *Lamium amplexicaule* L. and *Salvia suffruticosa* Montbre. & Aucher ex Bentham are of the commonly consumed wild edible plants as food, spice and medicinal purposes inhabitants in Eastern Anatolia Region of Turkey. Nutritional value and mineral compositions of wild edible plants have been investigated for food security and human health. It is though that wild edible plants gathered from nature are cheaper food and important for human health. They are also special ingredients for the distinguished taste and aroma of traditional cousins. Although they are cheap and available in the near, their mineral composition and nutritional value are important for public health. Thus, in the present study nutritional value and mineral composition of used parts of selected plant species were investigated. In laboratory analysis, dry matter, total ash, % N, crude protein, crude fiber and pH were examined as nutritional value. Useful minerals (Ca, Cu, Fe, K, Mg, Mn, Na, P, S and Zn) and heavy metals (Cd, Co, Cr and Pb) that hazardous elements for livings were also determined. According to results obtained from laboratory analysis, among the investigated species *Salvia suffruticosa* Montbre. & Aucher ex Bentham had the richest chemical composition. Although *Thymus transcaucasicus* Ronniger was rich in dry matter, potassium and phosphorus, *Lamium amplexicaule* L. had highest values for sulphur and lead.

Keywords: Mineral content, Wild vegetable, East Anatolia

1. Introduction
From past to present humans have used plants abundantly in their daily life. Nutritious purposes, both humans and their animals are the main uses of the plants. Wild edible plants have maintained their importance in human history, especially in famine periods and some drought climates. By cultivation and modern field production of some traditional crops, wild edible plants have been used in certain quantities. Because of some health problems come from unhealthy nourishment, pollution in agricultural lands, increase in hazardous chemicals in crop production, losing their taste and aroma of fruit and vegetables, looking for a distinguished aroma and taste, opinion that wild plants are healthier, wild edible plants have reputed once again in last decades all over the world. Having great plant genetic diversity, Turkey holds a number of wild edible plants in different geographic regions.
These plants have been used different food purposes such as wild vegetable, salads, wild fruit, spice and condiments, herbal tea etc. in local cousins. Because of its distinguished climate and soil types, Eastern Anatolia has a great deal of plant variety. Hard and long winters don't permit crop production in large scale. Thus, the inhabitants, especially in rural parts of the regions have used wild plants much more than other parts of the country. *Thymus transcaucasicus* Ronniger, *Lamium amplexicaule* L. and *Salvia suffruticosa* Montbre. & Aucher ex Bentham are of the mostly collected and used wild edible plants as food, spice and medicinal purposes in Eastern Anatolia Region of Turkey.
Studies on chemical compositions and nutritional values of wild edible plants have recently been popular all over the world. There are a number of scientific works in Turkey and other countries in this topic [1-4]. In this work, some nutritional value and mineral composition of three wild edible plants were determined in details. Results obtained from laboratory analysis were compared with previous scientific report findings.

2. Materials and Methods
2.1 Plant material and preparation of plants for analysis
Thymus transcaucasicus Ronniger, *Lamium amplexicaule* L. and *Salvia suffruticosa* Montbre. & Aucher ex Bentham were the plant species that analyzed their chemical compositions. The

plants were collected from Van Lake district in 2010, and botanical identifications were done according to Flora of Turkey [5] by Dr. Fevzi Özgökçe at Yuzuncu Yıl University Biology Department. Some characteristics of the analyzed plant species are given in Table 1.

Wild collected plant materials were cleaned from foreign materials, separated into used parts and washed by deionized water. After drying well ventilated place in shade at laboratory, plant parts were ground and kept in plastic bags until chemical analysis. As chemical analyses, dry matter, total ash, % N, crude protein, crude fiber and pH were examined as nutritional value, mineral composition (Ca, Cu, Fe, K, Mg, Mn, Na, P, S and Zn) and heavy metals (Cd, Co, Cr and Pb) were also determined in the plant samples.

Table 1: Some traits of three wild edible plants from East Anatolia

Plants' Scientific Name	Family	Local Name	Used Parts	Use	Locality	Col. No.
Thymus transcaucasicus Ronniger	*Lamiaceae*	Kekik, catri	Aboveground parts	Spice	L1	F 9297
Lamium amplexicaule L.	*Lamiaceae*	Baltutan, kavrul, pisir	Aboveground parts	Food	L2	F 9291
Salvia suffruticosa Montbre. & Aucher ex Bentham	*Lamiaceae*	adacayı	Aboveground parts	Salad, food	L3	F 9401

L1: B9 Van: Gevas, north slopes of Alacabük Mountain, east of the Altınsac church, steppe, 2800 m.
L2: B9 Bitlis: Tatvan, north slopes of Alacabük Mountain, steppe, 2400 m,
L3: B9 Van: Gevas, north slopes of Alacabük Mountain, east of Altınsac church, steppe, 2900 m.

2.2 Dry matter determination and Total ash determination

Dry matter contents were determined by drying of the plant samples at 105 ºC for 24 hours in electrical oven. For the determination of total ash content (inorganic matter) Electric Muffle Furnace set at 550 ºC was used.

2.3 Total nitrogen determination and crude protein calculation

Kjeldahl apparatus and method were used for analyzing of total N content. Crude protein contents were calculated by above formulas from total nitrogen contents.

1. $\% Nitrogen = \frac{(V1-V2)x0.014}{m} x100$

2. $\% Protein = \% Nitrogen \; x \; F$

2.4 PH determination and Total crude fibre determination

PH-meter was used for pH values of the plant samples according to the procedure established by AOAC method 981.12 [6]. Crude fiber analyses were achieved by AOAC method 962.09 [7].

2.5 Total Mineral determination

Mineral compositions of the samples were determined as follows: dried plant samples were ashed in a furnace by nitric (AR) and hydrochloric acid (AOAC). Then, distilled water (50 ml) was added to samples in a volumetric flask. All the analyses were triplicated. Standard chemical materials were used for all the analyses. Mineral contents of the plants samples were determined by Atomic Absorption Spectrometry (AAS). Mean values of the obtained data were calculated and are given in Table 3 with their standard deviations.

3. Results and Discussion

Chemical compositions of selected wild edible plants grown in Eastern Anatolia were analyzed and the results are given in Table 2 and Table 3. In the present study, three plant species that mostly used in Eastern Anatolia as food purposes *T. transcaucasicus*, *L. amplexicaule* L. and *S. suffruticosa* were studied. According to chemical analyses results, *S. suffruticosa* were the richest among the analyzed plants by means of total ash, nitrogen, crude protein, crude fiber and pH except for dry matter content (Table 2).

Table 2: Mean values of chemical composition values of some wild edible plants

Parameters	*Thymus transcaucasicus* Ronniger	*Lamium amplexicaule* L.	*Salvia suffruticosa* Montbre. & Aucher ex Bentham
Dry matter (%)	21.12 ± 1.24	18.36 ± 1.36	18.26 ± 0.87
Total ash (%)	7.67 ± 0.58	5.00 ± 1.00	8.33 ± 0.57
N (%)	1.33 ± 0.07	1.39 ± 0.05	2.31 ± 0.18
Crude protein (%)	8.56 ± 0.18	8.63 ± 0.38	14.75 ± 0.57
PH (%)	6.00 ± 0.10	6.05 ± 0.07	6.68 ± 0.29
Crude Fiber (%)	35.28 ± 1.09	31.19 ± 2.04	36.38 ± 1.37

The highest dry matter content was obtained from *T. transcaucasicus*, *L. amplexicaule*. According to chemical analysis results, dry matter contents of analyzed plant samples ranged from 18.26 to 21.12 % (Table 2). In previous works related wild edible plants; dry matter contents were reported between 7.50 and 20.87 % [4, 8]. The total ash content of the plant samples changed from 7.67 to 8.33 % (Table 2). Total ash contents of different wild edible plants were reported between 7.00 and 26.70 % in previous works by Yıldırım [8], Turan, *et al.* [9] and Sekeroglu [4]. Total nitrogen and crude protein contents were found in intervals 1.33 – 2.31 and 8.56 – 14.75 %, respectively (Table 2). In previous scientific studies, total N and crude protein content of some medicinal and edible plants were found as 0.20 – 1.70 % and 1.30 – 11.56 % [4, 8, 9]. In the present study, pH values of analyzed plant parts varied from 6.00 – 6.68. Yıldırım [8] found that pH values of some wild vegetables vary between 3.50 – 6.50. Crude fiber contents of the analyzed plant samples found between 35.28 – 36.38 % (Table 2). Nutritional values of indigenous wild edible herbs used in Eastern Chhattisgarh, India were studied by Vishwakarma and Dubey [10] and they reported that crude fiber contents of the analyzed plants were 0.90 (*Moringa oleifera*) to 28.59 % (*Marsilea minuta*). In conclusion here, dry matter, total ash, total nitrogen, crude protein, pH and crude fiber obtained in this study are accompanied by the previous scientific reports on wild edible plants. According to previous

reports, it could be concluded that the chemical composition of plants is affected by a number of internal and external factors such as plant genetic structure, growing conditions, soil properties, used plant parts etc.

Table 2 shows that *S. suffruticosa* had the highest mineral contents among the screened plants species in this work. This plant species had the highest values for almost all determined minerals. Mineral compositions of the plants are affected a number of factors such as plant genetic structure, growing conditions, soil characteristics, water availability, growing seasons, etc. Thus, great variability in mineral compositions of the plants and their different parts is expected. This phenomenon has been supported by scientific reports [4, 8, 10-12].

Mineral concentrations results of some wild edible and medicinal plants obtained previous studies were summarized for above minerals here: Na concentrations varied from 0.21 to 63.32 g kg^{-1} [11-15], Mg values of medicinal and edible plants were found between 1.17 and 86.43 g kg^{-1} [9, 12, 13, 16]. K content changed between 245.78 – 557.91g kg^{-1} in wild vegetables [12]; Ca concentrations were found in a wide range from 0.03 to 777.52 g kg^{-1} [11, 12, 15, 17]; P contents varied from 34.92 to 69.13 g kg^{-1} [12, 18]; S concentrations were reported in the range of 12.34 – 108.01 g kg^{-1} [11, 12, 15]. Macro element concentrations of some medicinal and wild edible plants reported in previous studies were summarized above. When compared with the results of them, our findings agree with the researchers' results (Table 3). Previous reports also state that mineral compositions of plant species are affected a number of factors [4, 8, 10-12]. As can be seen in the Table 3, in this work, a great variation in macro element contents among the studied plant species was also determined.

Table 3: Mean values of mineral compositions of some wild edible plants

Minerals	*Thymus transcaucasicus* Ronniger	*Lamium amplexicaule* L.	*Salvia suffruticosa* Montbre. & Aucher ex Bentham
Na (g/kg)	0.50 ± 0.01	0.49 ± 0.01	0.71 ± 0.01
Mg (g/kg)	0.38 ± 0.23	1.73 ± 0.05	10.94 ± 0.42
K (g/kg)	14.50 ± 0.99	10.21 ± 0.18	10.65 ± 0.22
Ca (g/kg)	8.74 ± 0.91	13.88 ± 0.83	17.89 ± 0.33
P (g/kg)	3.37 ± 0.39	2.47 ± 0.09	2.27 ± 0.31
S (g/kg)	1.44 ± 0.09	1.93 ± 0.21	0.44 ± 0.08
Mn (mg/kg)	34.81 ± 0.53	24.96 ± 0.73	77.99 ± 3.33
Fe (mg/kg)	198.51 ± 5.46	186.84 ± 0.61	352.46 ± 11.60
Cu (mg/kg)	15.09 ± 0.64	20.06 ± 2.00	26.08 ± 3.27
Zn (mg/kg)	20.00 ± 0.69	17.70 ± 0.31	26.80 ± 1.52
Cr (mg/kg)	0.98 ± 0.08	0.51 ± 0.06	1.04 ± 0.08
Cd (mg/kg)	0.08 ± 0.01	0.08 ± 0.01	0.14 ± 0.04
Co (mg/kg)	0.68 ± 0.13	0.60 ± 0.12	1.16 ± 0.17
Pb (mg/kg)	0.03 ± 0.01	0.29 ± 0.07	0.08 ± 0.02

In previous scientific studies, manganese levels of edible plants were reported in the ranges of 5-244 mg kg^{-1} [19-21]. Iron (Fe) levels of analyzed plants were in the ranges of 1.70 – 975.00 mg kg^{-1} [4, 8, 9, 12, 21]. Average values for copper content of some edible plants varied from 0.05 – 18.4 mg kg^{-1} [8, 9, 12, 22, 23]. For some medicinal and edible plants Zn values were reported between 10 and 97 mg kg^{-1} [24-26]. These minerals are generally known as micro elements and are thought as useful for human health in certain quantities. They run in a number of physiological functions in living organisms. In this study, determined concentrations of the minerals are accordance with the previous studies.

The study with a permissible results, analyzed plant samples had limited and trace levels of Cr, Cd, Co and Pb (Table 3). These metals known as heavy metals and their hazardous effects on living organisms in certain quantities were reported [27]. The Cr concentration of some edible and medicinal plants were found as 0.65 – 19.10 mg kg^{-1} [11, 12, 15, 28]. Cadmium concentrations were reported between 0.012 – 0.440 mg kg^{-1} for medicinal plants and wild vegetables [11, 19, 21, 29]. Cobalt concentrations of some medicinal and edible plants were stated in previous studies in the ranges of 0.047 – 1.69 mg kg^{-1} [11, 12, 30]. Pb concentrations of wild edible plants were reported between 0.04 – 1.40 mg kg^{-1} [12]. Heavy metal concentrations of the analyzed plant samples found in this work are some lower than previous studies' findings.

4. Conclusion

In the last decades the number and variety of illnesses have scarily increased all over the world. It is thought that uses of chemicals in all sectors such as food, medicine, textile, and cosmetics etc. support this. Thus, organic, ecological, village crops and wild plants have gained importance in food habits recently. Besides wild collection, domestication and field cultivation of wild plants have started to increase. Moreover, the distinguished taste and aroma of these kinds of plants supported their reputations. With the increase in consumption, wild edible plants, scientific concern on their nutritional values and probable hazardous effects have grown. In the present study, we also screened some wild edible plant species for their chemical compositions.

Additionally, the findings generally suggest that the use of these plant species will not cause heavy metal toxicity and may be beneficial to the users in cases of micronutrient deficiency, where these metals were found to be present in the readily bioavailable form.

In conclusion, all the analyzed plant samples had close chemical values in comparison to previous scientific results. *S. suffruticosa* was the richest chemical composition among the analyzed plant species in this work.

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