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Some Chemical Compounds of *Cichorium intybus* L. Species Distributed in Van Region

Murat TUNCTURK[1], Ruveyde TUNCTURK[1], Tamer ERYIGIT[2*], Lütfi NOHUTÇU[1]

[1]Van Yuzuncu Yil University, Agricultural Faculty, Field Crops Department, Van-Turkey
[2]Van Y.Y.U. Gevas Vocational School, Department of Plant and Animal Production, Van-Turkey

Research Article

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Abstract

Cichorium intybus L. is a perennial plant species included the *Asteraceae* family and *Cichorium* genus. It is known as "Beyaz Hindiba" in the Turkey. *C. intybus* shows spread generally in Europe, West Asia and North Africa. In Turkey, it is in almost every region. The roots of this plant are used commonly in the treatment of diseases such as high fever, anorexia, headache, inflammation, indigestion, gout, skin allergy, asthma, colic, epilepsy and pharyngitis from time immemorial. In the study, it is aimed to determine some nutrients and mineral substance contents of *C. intybus* which is naturally grown around the Van lake in the Eastern Anatolia Region, Turkey. In plant samples, some nutrients and mineral contents such as total ash, crude protein, pH, crude cellulose and N, Na, Mg, K, Ca, P, S, Mn, Fe, Cu, Zn, Cd, Co have been investigated. As a result of the research; it has been determined as crude protein ratio 9.53%, pH 6.25, total nitrogen content 1.53 %, crude ash content 6.21% and crude cellulose content 41.60%. In addition, while some mineral substance contents were determined as K 14.05 g/kg, Ca 12.25 g/kg, P 1.59 g/kg, Mn 20.04 mg/kg, Fe 161.68 mg/kg and Zn 18.84 mg/kg, heavy metal content were determined as Cr 0.09 mg/kg, Cd 0.15 mg/kg, Co 1.33 mg/kg and Pb 0.14 mg/kg.

Keywords: *Cichorium intybus* L., eastern Anatolia, heavy metal, medicinal plants

1. INTRODUCTION

The genus *Cichorium*, belonging to Asteraceae family, consists of six species with a large distribution in temperate and semi-arid regions in Europe and Asia [1-3]. *Cichorium intybus* L., which is known as "Beyaz Hindiba" in the Turkey, commonly known as chicory in the world, grows naturally in many parts of Turkey as in many countries, is the world's safely used since the Middle Ages [2]. It is a fairly woody perennial plant, which has a height of about 80-90 cm, large basal leaves, usually bright blue, rarely white or pink flowers, and about 75 cm long a fleshy taproots [1, 4]. Due to the presence of a number of important compounds such as anthocyanins, inulin, alkaloids, coumarins, sesquiterpenes, vitamins, unsaturated sterols, chlorophyll pigments,

*Author for correspondence: Tamer ERYIGIT, Van Y.Y.U. Gevas Vocational School, Department of Plant and Animal Production, Van-Turkey, tamyigit@hotmail.com

flavonoids, tannins and saponins, flavonoids, cinnamic and quinic acid derivatives, all parts of these plants have a great medical prescription [5-8]. Fresh chicory has been reported to contain 68% inulin, 14% sucrose, 6% protein, 5% cellulose, 4% ash and 3% other compounds and dried chicory contains approximately 98% inulin and 2% other compounds. [9, 10]. Chicory leaves are a good source of phenol, vitamins A, C as well as calcium, potassium, and phosphorus [8]. Moreover, well known *C. intybus* species has been found to be a good bio-monitor of heavy metals such as Pb, Zn, Cu, and Cd [11].

The plants which are consumed in the world today are mostly cultivated plants and the consumption of local wild edible plants are restricted comparatively. But, for centuries, people from many parts of North Africa to South Asia have been practicing chicory as medicine. It has been used in diabetic, amenorrhoeic dysmenorrhea, asthma, colic, jaundice, stomach, heart and liver related diseases as diuretic, fatigue and relieving pain, appetite and indigestion [2, 12].

When the previous literatures were carefully examined, it was found that there isn't enough information about nutritional value and mineral content of the consumed plant parts of *C. intybus*. For this reason, this study aimed to investigate *C. intybus* nutritional value and mineral content.

2. MATERIAL AND METHODS

Cichorium intybus L. aerial parts were collected in 2013 from the Van Lake Basin Van Turkey where it can be found naturally. Afterwards, botanically identification of the collected plants was performed at Van Yuzuncu Yil University, Science Faculty, Biology Department according to Flora of Turkey [13]. Plant samples were roughly cleaned from contaminants and washed with deionized water, then dried at room temperature, grounded, and held in plastic bags for laboratory analysis.

2.1 The determination of total ash

Three grams of milled plant samples were taken into porcelain crucibles and 1 ml of alcohol was added to them, and then, the total ash content was measured by burning in an Electric Muffle Furnace set at 550 °C [14].

2.2 The determination of total nitrogen and crude protein ratio

The Kjeldahl apparatus and method were used to observe the total nitrogen content of the samples according to AOAC [15]. After the total nitrogen content was determined, the crude protein ratio was calculated using the following formulas.

$$\%\ Nitrogen = \frac{(V1-V2)x0.014}{m} x100 \longrightarrow \%\ Protein\ = \%\ Nitrogen\ x\ F$$

2.3 The determination of pH and total crude fibre

pH of the plant samples was determined by pH-meter based on the method 981.12 of AOAC [16]. The total crude fiber contents were observed according to the method 962.09 of AOAC [15].

2.4 The determination of mineral contents

The mineral content determination of the samples was performed by an Atomic Absorption Spectrometer (AAS) according to the Hanlon[17] procedure.

The phosphorus levels were observed by the molybdate-vanadate method and the sulfur concentrations were observed by UV-spectrophotometer (Shimadzu UV-1201 V, Shimadzu, Kyoto, Japan) based on the method reported by Mitchell [18]. All analyzes were performed in triplicate, the mean values and standard deviations of the data from all analyzes were calculated to best interpret the results.

3. RESULTS AND DISCUSSION

In the present study, some nutritive values, mineral contents and some heavy metal content of *Cichorium intybus* L., one of an edible wild medicinal plant species that mostly used in Eastern Anatolia for folk medicinal purpose, was investigated. The analyze results of some

Table 1. Some properties of *Cichorium intybus* L. consumed in Eastern Anatolia

Plants	Family	Local Name	Used Parts	Col. No. - Locality
Cichorium intybus L.	Asteraceae	Talişk, talik, çekçeko, çatlak otu	Aerial parts	F 12326 - L

L: Bitlis, Tatvan, Alacabük mountain, Kesan brook, 10 km away from highway, around Sallıca village, humid slopes, altitude of 1650- 1750 m

nutrient, mineral and some selected heavy metals' contents of *C. intybus* are given in Table 2.

The analytical results of total ash content, nitrogen, crude protein, pH and raw fiber ratios of *C. intybus* species were given in Table 2 as 6.21%, 1.53%, 9.53%, 6.25% and 41.60%, respectively. The total ash content of chicory previously reported by Jančić, Todorović, et al. [4] as 1.16 - 1.36 %, is lower than the study results. In previous scientific studies, that presented by Özbucak, Akçin Ergen, et al. [19] and [20] total nitrogen contents of different parts of *C. intybus* were varied among 1.3 - 2.5 %, and the crude protein ratios calculated from the total nitrogen ratio were determined as 4.65 - 16.17 %. The crude fibre results presented in Table 2 is higher than the data (5.12-16.78 %) reported by Nwafor, Shale, et al. [20]. It was supposed that the climatic, soil, topographic, etc. conditions may cause the variation between the study findings and previously reported results.

In the study, with an admissible level, some critical minerals that effectsly affect living beings, for example, sodium (Na), magnesium (Mg), potassium (K), calcium (Ca), phosphorus (P) and sulfur (S) were investigated. As seen in Table 2, the contents of Na, Mg, K, Ca, P and S in the samples of *C. intybus* L. were given as 0.46, 1.98, 14.05, 12.25, 1.59 and 1.6 mg kg^{-1}, respectively. Regarding mineral composition, *C. intybus* can be evaluated as a rich source of macro and micro-nutrients, especially K was the most abundant mineral element in intybus as presented in Table 2.

In a previous study, Van Eekeren, Wagenaar, et al. [21] reported the concentrations of Na, Mg, K, Ca, P and S in the *C. intybus* plant samples as 3.78-9.1, 3.70-3.80, 30.6-54.6, 13.30-15.10, 4.60-5.76 and 4.33-5.32 mg kg^{-1}, respectively. In another study which was carried out by Volpe, Nazzaro, et al. [22] on sandy and clayey soils, the concentrations of Na, Mg, K and Ca were determined for the *C. intybus* plant samples as 1.28-7.21, 2.55-4.53, 29.68-47.45 and 3.42-7.25 mg kg^{-1}, respectively. When compared with the results of these two studies, the results of this study were found to be lower than the both study results of Van Eekeren, Wagenaar, et al. [21] and Volpe, Nazzaro, et al. [22].

It is well known that plant mineral compositions are affected to a significant extent by many factors, such as plant genetic structure, soil characteristics, growing conditions, growing seasons, water availability, and etc. [23, 24].

According to data in Table 2, manganese (Mn), iron (Fe), copper (Cu) and Zinc (Zn) contents of *C. intybus* were determined as 20.04, 161.8, 10.80 and 18.84 mg kg^{-1}.

In some previous researches, Mn, Fe, Cu and Zn contents of *C. intybus* species were reported in a wide range. While Volpe, Nazzaro, et al. [22] reported that Mn, Fe, Cu and Zn concentrations were observed as 19.0-35.54, 18.84-120.4, 5.57-14.53 and 27.30-74.16 mg kg^{-1}, Van Eekeren, Wagenaar, et al. [21] declared high and wide variations as 29.7-117.0, 131.6-178.0, 11.97-19.76 and 47.00-229.2 mg kg^{-1}, respectively.

The micro nutrients, minerals and trace elements present in plants are conditioned, the content is also influenced by the chemical and physical properties of the soil, such as pH and the presence of organic matter, and with the ability of plants to selectively accumulate some of these elements. Potential causes of variation in the content of mineral elements include agricultural practices, precipitation and temperature [22]. Therefore, it is obvious that there is a wide variation between the results of this study and the previously reported results.

Table 2. Mean values of some nutritional and mineral contents of wild edible *Cichorium intybus* L.

Parameters	**Mean ± SD**	Minerals	Mean ± SD	Minerals	Mean ± SD
Total ash (%)	6.21 ± 0.13	Na (g/kg)	0.46 ± 0.014	Mn (mg/kg)	20.04 ± 2.460
N (%)	1.53 ± 0.08	Mg (g/kg)	1.98 ± 0.090	Fe (mg/kg)	161.68 ± 12.520
Crude protein (%)	9.53 ± 0.32	K (g/kg)	14.05 ± 0.520	Cu (mg/kg)	10.80 ± 0.660
pH (%)	6.25 ± 0.41	Ca (g/kg)	12.25 ± 0.150	Zn (mg/kg)	18.84 ± 0.370
Crude Fiber (%)	41.60 ± 3.74	P (g/kg)	1.59 ± 0.080	Cr (mg/kg)	0.09 ± 0.001
		S (g/kg)	1.66 ± 0.110	Cd (mg/kg)	0.15 ± 0.002
				Co (mg/kg)	1.33 ± 0.240
				Pb (mg/kg)	0.14 ± 0.020

SD: Standard deviation

On the other hand, some trace metals such as chromium (Cr), cadmium (Cd), cobalt (Co) and lead (Pb) that has hazardous effects on human health in certain quantities were studied in this study. As shown in Table 2, Cr, Cd, Co and Pb contents of *C. intybus* were measured as 0.09 mg kg^{-1}, 0.15 mg kg^{-1}, 1.33 mg kg^{-1} and 0.14 mg kg^{-1}, respectively.

In the previous studies the concentrations of Cr, Cd, Co and Pb were reported as Cr; 0.007 mg kg^{-1} [25], Cd; 0.002 mg kg^{-1} [25], 0.2-2.79 mg kg^{-1} [11], Co; 0.083-0.114 mg kg^{-1} [21], 0.002 mg kg^{-1} [25] and Pb; 0.3 kg^{-1} [20], 15.4-103.21 mg kg^{-1} [11], respectively.

Considering previous studies on *C. intybus* species' heavy metal concentrations of, our findings are in harmony with the researchers' results, except Pb because of its low level than results from Aksoy [11].

4. CONCLUSION

In this study, some nutritive value, chemical composition of *C. intybus* species, which is an edible wild plant, were determined. There is not tolerable upper intake level for consuming of some trace elements such as Cr, Cd, Co and Pb. Aerial parts of *C. intybus* have macro and microelements in plenty amount; therefore, they can be used in people's diets, since, it not exceeds permissible limits set by WHO and FAO, RDA/AI and UL. The fact that there are no reports of adverse effects following the overfeeding of a nutrient does not mean that adverse effects do not come to fruition.

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