ELEMENTAL ANALYSES OF A MEDICINAL AND FOOD PLANT: *TRACHYSTEMON ORIENTALIS* (L.) G. DON

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Introduction

The chemical constituents in plants, including trace elements and metal ions, are partially responsible for their medicinal and nutritional properties as well as their toxicity. The metals also play an important role in the plant metabolism and biosyntheses such as cofactors of enzymes (1).

Some metals are also essential nutrients (zinc, iron, copper, chromium, and cobalt) and only become toxic at high concentrations, while others (lead and cadmium) have no known beneficial properties and are hence exclusively toxic (2). However, all elements in high concentrations may become detrimental to organisms. The nutritional role of elements and the essentiality of trace elements as well as their biochemical and pathological significance to human and animals are wellknown.

Trachystemon orientalis (L.) G. Don (Boraginaceae) is a rhizomatous perennial herb, 30-40 cm tall. The plant is locally known as "Balıkotu, Hodan, Ispıt, Kaldırık, Acı hodan, or as Doğu hodanı". Phytochemical constituents are phenolic compounds, essential oils, mucilages, saponins and resins among others. According to literature it contains also some nitrates. *T. orientalis* is consumed as a food or vegetable plant and its recorded folkloric usages are as diuretic, blood purifier, emollient, antipyretic *etc*. (3, 4, 5).

In this present study, macro (N, C, H, S, P, K, Ca, Mg, Fe) and micro trace elements (Na, Cu, Zn, Mn) and heavy metals such as Ni and Al of *T. orientalis* collected from three different localities were determined by using various techniques.

Material and Methods

Plant Material: *T. orientale* were got in three different folk market of Turkey:

1.Bursa, İnegöl, Süle Köyü

2.Bursa, Osmangazi

3.Bursa

Analysis of Plants: Samples were dry-ashed in in a crucible in furnace at 65°C for about 48 h.(6). Sample was finely powdered for analyses.

N, C, H was determined by the dry combustion method using elemental analyses (LECO TruSpec CHN Analyzer), P and S was measured by a colorimetric method, whereas K and Na by flame photometry. Finally Ca, Mg, Fe, Cu, Zn, Mn, Ni and Al was detected and quantified by atomic absorption spectroscopy (AAS). All experiments were performed qualitatively and quantitatively with comparison to a certified reference plant material (RM) statistically. (7).

Table 1. Results of Elemental anaysis based on three replicates

Sample	N (mg/g)	C (mg/g)	H (mg/g)	K (mg/g)	S (mg/g)	P (mg/g)	Na (mg/g)	Ca (mg/g)	Mg (mg/g)	Fe (mg/g)	Cu (mg/g)	Zn (mg/g)	Mn (mg/g)	Ni (mg/g)	Al (mg/g)
RM	55,261	503,640	59,977	16,290	3,513	4,000	0,118	2,120	1,500	0,300	0,031	0,050	0,540	0,003	0,660
1a	34,405	392,210	54,085	60,870	3,788	6,250	0,144	1,980	1,660	1,975	0,055	0,041	0,100	0,006	2,780
1b	34,632	389,990	53,609	62,230	3,513	6,500	0,144	1,880	1,610	1,715	0,053	0,039	0,095	0,009	2,880
1c	34,329	390,240	53,631	60,870	3,513	6,500	0,144	1,800	1,660	2,190	0,057	0,044	0,111	0,009	3,470
2a	34,823	391,360	52,882	70,700	3,238	5,350	0,158	5,810	1,700	1,715	0,028	0,028	0,064	0,011	1,780
2b	35,032	390,850	52,639	70,700	3,238	5,250	0,173	6,330	1,725	1,930	0,030	0,028	0,068	0,011	1,930
2c	35,424	394,140	53,107	70,700	3,238	5,250	0,173	6,040	1,715	1,825	0,030	0,027	0,064	0,011	2,020
3a	42,136	393,430	52,049	73,650	4,338	7,500	0,262	5,950	1,735	2,045	0,047	0,054	0,068	0,014	2,580
3b	43,756	391,230	51,955	72,170	4,338	7,500	0,262	6,260	1,730	2,235	0,048	0,057	0,076	0,014	2,920
3c	42,519	391,930	51,828	60,870	4,063	7,500	0,242	6,650	1,735	2,295	0,047	0,058	0,074	0,015	2,660
4a	11,086	439,980	61,221	5,440	1,288	0,500	0,774	16,560	1,880	0,365	0,015	0,010	0,012	0,014	0,730
4b	11,261	439,700	61,329	5,440	1,288	0,450	0,774	16,030	1,895	0,370	0,013	0,011	0,010	0,012	0,550
4c	10,363	438,990	60,665	5,910	1,288	0,450	0,850	17,220	1,920	0,470	0,013	0,012	0,010	0,014	0,620

Results and Discussion

The elemental levels of *T. orientalis* samples analyzed are presented in Table 1 and Table 2 as mean values with their absolute standard deviations based on three replicates. The reliability of the results is based on previous analyses of reference materials (8) for which the elemental contents determined were found in agreement with the certifiesed values.

The concentration of K ranges from 60,8 to 73,6 mg/g. Potassium is one of the most abundant elements in the leafy materials with sodium. Potassium is accumulated within human cells by the action of the Na+, K+ ATPase (sodium pump). K is an activator of some enzymes, in particular co-enzyme for normal growth and muscle function (9).

The levels of phosporus are 5000-8000 mg/gr. The recommended daily dietary intake of phosphorus set by the FDA is 1000-mg.

The National Academy of Sciences Institute of Medicine, have published recommendations on daily sodium limits. Most recommend not exceeding the range of 1,500 and 2,400 milligrams (mg) a day for healthy adults (10). The level of Na is 0,144-0,262 mg/g in our study.

Calcium is essential for healthy bones, teeth and blood (11, 12). The health of the muscles and nerves depends on calcium. It isrequired for the absorption of dietary vitamin B, for the synthesis of the neurotransmitter acetylcholine, for the activation of enzymes such as the pancreatic lypase. The recommended daily allowance for Ca is for children between 500 and 1000 mg and for adults 800 mg. To achieve a Ca level of nearly one percent of the total diet would be rather difficult. The concentration of Ca is in the range of 1.8±6.65 mg/g.

Magnesium is an important mineral that is needed by every cell in the human body. The Recommended Dietary Allowance, or RDA for males are: 410 mg for ages 14 to 18; 400 mg for ages 19 to 30; 420 mg for ages 31 and above. The RDA for females are: 360 mg for ages 14 to 18; 310 mg for ages 19 to 30; 320 mg for ages 31 and above. The level of magnesium in our study is 1.6-1.7 mg/g.

Fe and Zn are essential trace elements (micro nutrients) for living organisms. Iron occupies an unique role in the metabolic process. The role of iron in the body is clearly associated with haemoglobin and the transfer of oxygen from lungs to the tissue cells (13). Iron deficiency is the most prevalent nutritional deficiency in humans (14) and is commonly caused by insufficient dietary intake, excessive menstrual flow or multiple births. In this case, it results especially an anaemia. Fe is important because it eliminates phlegm and strengthens the function of stomach. Hence the daily intake of iron is necessary. The requirement of Fe for an adult is 20 mg/day and for a child is 10 mg/day. The Fe concentration in the samples analyzed ranges from 1.7 to 2.3 mg/g.

Zinc is relatively non-toxic (15). The concentration of Zn ranges from 0.03 to 0.06 mg/g. It is necessary for the growth and multiplication of cells (enzymes responsible for DNA and RNA synthesis), for skin integrity, bone metabolism and func- tioning of taste and eyesight (16). WHO permissible limit of zinc in foods of 6 mg/100 g is well above these values.

The copper level is between 0,028-0,057 mg/g. These levels are below the WHO permissible limits in foods, which is 4 mg/100 g.

The level of manganese is between 1.6-1.7 mg/g. The recommended dietary allowance of 2-5 mg Mn2+ per day is 10-fold the upper levels found per gram in these plants.

Nickel is a compound generally recognized as safe when used as a direct ingredient in human food and also is not a cumulative toxin in animals and in humans (17). The level of nickel in our study (0,006-0,015 mg/g) is in optimum limit the average breast-fed infant consumable amount (0,005-0,015 mg/g Ni/day).

The amount of aluminum in the human body ranges between 50 and 150 mg., with an average of about 65 mg. Most of this mineral is found in the lungs, brain, kidneys, liver, and thyroid. Our daily intake of aluminum may range from 10-110 mg., but the body will eliminate most of this in the feces and urine and some in the sweat. With decreased kidney function, more aluminum will be stored, particularly in the bones.

Table 2. Minumum, Maximumi Standart error and Standart deviation of element levels

Element	N	Minimum	Maximum	Mean		Std.	Variance
				Statistic	Std. Error		
N	9	34,329	43,756	37,451	1,350	4,050	16,400
C	9	389,990	394,140	391,709	0,462	1,386	1,922
H	9	51,828	54,085	52,865	0,272	0,815	0,663
K	9	60,870	73,650	66,973	1,854	5,562	30,937
S	9	3,238	4,338	3,696	0,152	0,456	0,208
P	9	5,000	8,000	6,400	0,320	0,960	0,927
Na	9	0,144	0,262	0,189	0,017	0,051	0,003
Ca	9	1,800	6,650	4,744	0,719	2,157	4,653
Mg	9	1,600	1,700	1,697	0,015	0,044	0,002
Fe	9	1,700	2,300	1,992	0,073	0,217	0,047
Cu	9	0,028	0,057	0,044	0,004	0,012	0,000
Zn	9	0,030	0,060	0,042	0,004	0,013	0,000
Mn	9	0,060	0,110	0,080	0,006	0,018	0,000
Ni	9	0,006	0,015	0,011	0,001	0,003	0,000
Al	9	1,780	3,470	2,558	0,183	0,550	0,302

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