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MICRO-NUTRIENT COMPOSITION OF SOME MEDICINAL AND AROMATIC PLANTS COMMONLY USED IN TURKEY

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Abstract

There has been a growing interest in monitoring nutrient composition and nutritional value of medicinal and aromatic plants in recent years. In this study, the levels of boron (B), copper (Cu), iron (Fe), zinc (Zn), manganese (Mn), and molybdenum (Mo) in selected medicinal and aromatic plants were monitored by inductively coupled plasma (ICP-OES). Samples of chamomile, nettle, rosemary, yarrow, bay leaf, St. John's wort, basil, lemon balm, linden, sage and thyme were subjected to chemical analysis. The contents of micronutrients in the plant samples were found in the ranges: 3.2-15.6 mg kg^{-1} for cupper, 93.0.1057.3 mg kg^{-1} for iron, 22.3-53.6 mg kg^{-1} for zinc, 28.3-148.3 mg kg^{-1} for manganese, 0.23-2.13 kg^{-1} for molybdenum and 15.0-64.3 mg kg^{-1} for boron. Results obtained are in agreement with data reported in the literature.

Key words: *herbal plants, nutrition, spices, trace elements.*

INTRODUCTION

The trace elements, in company with other essential nutrients, are required for growth, normal physiological functioning, and preserving of life; they must be provided by food, since the body cannot synthesis them. The scientific classification of trace side against macro minerals and trace elements are often considered as minerals required by the body in amounts less than 100 mg daily. While some of them are definitely important for health, the roles of others are unclear. Advised intakes have been set for some trace elements and their deficiency can lead to disease, but a lack of others does not cause any recognized problems. Trace elements have very important functions and it is believed that it has a variety of biochemical functions in all living organisms such as hemoprotein and hemoglobin even in low doses. However, the benefits of these micro-nutrients may be completely reversed if present at high concentrations (Bennett, 1993; Marschner, 1995). The micro elements copper, iron, manganese and zinc are not only constitutive elements with specific functions in plant growth, photosynthesis and respiration. However, in excess amounts, these elements are toxic to plants. Soil concentrations above 20 mg kg^{-1} Cu, 50 mg kg^{-1} Fe, 300 mg kg^{-1} Mn, 400 mg kg^{-1} Zn are toxic to plants (Bennett, 1993). On the other hand, Cu, Fe, Mn, Zn, B, Mo are trace elements that are significant for human physiology when they are captured in desired level (Arcasoy, 1998; Goldhaber, 2003). Plants have been used as source of food, animal feed, hiding place and medicines (Ghani et al., 2012). Many plants which are used in different traditional medicine systems of the world are determined as medicinal plants (Ishtiaq et al., 2007). These therapeutic plants have always been valued as a mode of treatment of variety of nuisances in folk cultures and have played a very important role in the discovering of the modern day medicines with newly-coined chemical constituents (Ishtiaq and Khan, 2008; Devi et al., 2008; Shirin et al., 2010).

The usefulness of medicinal plants for therapeutical objectives is in many instances accounted for in terms of their organic constituents like essential oils, vitamins, glycosides and other bio components. Now, it has been founded constituted fact that over dose or elongated taken down of medicinal plants may lead to chronic accumulation of different elements which cause various health problems (WHO, 1992; Sharma et al., 2009).

In this study, elemental contents of the medicinal plants and their proportion should be controlled in convenience with health safety measures and it is obligatory to screen for their quality check (Liang et al., 2004; Arceusz et al., 2010). In recent years, several authors across the world have reported in many studies, on the importance of elemental constituents of the herbal drugs which enhanced the awareness of trace elements in the plants (Basgel and Erdemoglu, 2006; Sharma et al., 2009; Koe and Sari, 2009). Trace elements have both a curative and a preventive role in combating diseases. It is very important to know the level of micro elements in medicinal plants and herbal medicaments and to estimate their role as sources of these components in the human diet because, at elevated levels, these metals can also be hazardous and poisonous. These precautions are indispensable when larger amounts of the products are consumed, when recommended dosages are followed and long term therapy is undertaken (Lesniewicz et al., 2005). Most of these studies elucidated that essential metals can also produce toxic (for example, Chen et al., 2003; Scarpa, 2004; Kumar et al., 2005) effects when the metal intake is in high concentrations, whereas non essential metals are toxic even in very low concentrations for human health. (Hayat et al., 2008; Ashraf et al., 2009). The present study was carried out in Black Sea Region which harbours quite rich medicinal plants. There is some information on trace element contents of spices and herbal plants grown and consumed in Turkey, the data available so far is not adequate or complete. The objective of the present study was to determine the concentrations of selected boron, copper, iron, zinc, manganese and molybdenum in some spices widely cultivated and traditionally consumed in Turkey.

MATERIALS AND METHODS

Plant materials of twelve species were gained in September 2012 from spice wholesalers and spice shop in the Black Sea Region (Samsun, Ordu and Giresun provinces) of Turkey. For chemical analysis, Table 1 shows the plant names and the part of the plant used. The samples (1000 g) in the plastic bags were kept at room temperature until to be analyzed. The samples were dried at 70ºC for 48 hours in an oven and ground for chemical analysis.

Table 1. Some characteristic of twelve selected medicinal plants

Plant scientific names	Common name	Turkish name	Part use
Matricaria chamomilla L.	chamomile	papatya	flowers
Thymus vulgaris L.	thyme	kekik	herb
Rosmarinus officinalis L.	rosemary	biberiye	leaves
Hypericum perforatum L.	St John's wort	kantaron	herb
Urtica dioica L.	nettle	isirgan	leaves
Lavandula stoechas	flos lavandulae	karabas	flowers
Salvia officinalis L.	sage	adaçayi	leaves, flowers
Ocimum basilicum L.	basil	feslegen	leaves, stem, seeds
Melissa officinalis	lemon balm	ogulotu	herb
Laurus nobilis L.	bay leaf	defne	leaves
Achillea millefolium	yarrow	civanperçemi	flowers
Tilia argentea Desf.	linden	ihlamur	flowers

In summary, 0.2 g of the sample was transferred into a burning cup and 5 ml of 65% HNO_3 and 2 ml of 30% H_2O_2 were added. The samples were incinerated in an HP-500 CEM MARS 5 microwave (Mathews, NC, USA) at 200°C and cooled at room temperature for 45 min. The extracts were passed through a Whatman 42 filter paper, and the filtrates were collected by high de-ionized water in 20 mL polyethylene bottles and kept at 4°C, in the laboratory, for inductively coupled plasma atomic emission spectrometry (ICP–OES) analysis. Each sample was analyzed in triplicate. Merck standards (R1 and R2 groups) were used as analytical reagent grade chemicals. Standard solutions of B, Cu, Fe, Zn, Mn and Mo were prepared in 1% HNO_3 immediately before the analysis by serial dilution of 1000 mg L^{-1} stock solution stored in polyethylene bottles. Peach leaves (Standard Reference Material, 1547) and corn bran (Standard Reference Material, 8433) was used as reference materials (N.I.S.T, 2004). Scanning ICP-OES (Varian Vista-Pro, Australia) with high resolution nitrogen purged with 1 m monochromator was used. B, Cu, Fe, Zn, Mn and Mo contents were ascertained using ICP-OES. In addition, to determine cadmium concentration in the extracts, inductively coupled argon plasma-optical emission spectrometry (ICP-OES; U 5000 AT + Ultrasonic Nebulizer; Cetac Technologies, Omaha, NE, USA) (214.438 nm/0.1 µgkg^{-1}) was also used.

RESULTS AND DISCUSSIONS

In this study twelve different plant samples collected in the Black Sea Region of Turkey (from Samsun, Ordu and Giresun provinces) were subjected to chemical analysis for their trace element contents. The mean values of boron (B), copper (Cu), iron (Fe), zinc (Zn), manganese (Mn), and molybdenum (Mo) concentrations in plant samples obtained from each sampling site are presented in Tables 1 and 2, respectively. The values, based on plant's dry weight, are the means of three replicates and given as mean ± SD. The correlation coefficients of the calibration curves were generally within the range of 0.996-0.999 and receivable recoveries (>95%) were procured for the analysis.

Table 2. Micronutrient concentrations of selected medicinal plants

Plant sample	Cu (mg kg^{-1})	Zn (mg kg^{-1})	Fe (mg kg^{-1})	Mn (mg kg^{-1})	B (mg kg^{-1})	Mo (mg kg^{-1})
Matricaria chamomilla L.	10.0±1.70	34.3±3.56	350.0±42.5	45.7±3.45	35.0±2.70	0.64±0.19
Thymus vulgaris L.	7.66±0.60	25.3±2.55	905.7±423	51.0±14.5	36.7±3.90	0.28±0.10
Rosmarinus officinalis L.	7.33±0.90	23.3±1.50	386.7±94.1	32.7±2.30	41.7±3.90	0.48±0.19
Hypericum perforatum L.	10.7±2.60	53.6±16.3	191.7±61.3	60.7±34.4	39.0±3.90	0.25±0.11
Urtica dioica L.	8.66±2.90	26.0±3.00	794.0±186	82.3±58.7	64.3±17.0	1.14±0.54
Lavandula stoechas	7.00±0.40	23.7±4.50	236.3±44.2	148.3±87.6	24.7±5.20	0.25±0.06
Salvia officinalis L.	7.66±1.10	47.3±17.6	739.0±283	55.3±15.1	33.7±3.00	0.35±0.05
Ocimum basilicum L.	15.6±3.90	36.0±9.50	1057.3±282	95.3±7.30	58.3±36.0	0.69±0.24
Melissa officinalis	11.7±3.50	30.7±3.45	319.7±70.4	50.7±45.3	47.3±9.60	2.13±1.54
Laurus nobilis L.	3.20±1.4	27.0±9.34	197.7±78.2	79.7±40.3	15.0±2.2	0.23±0.12
Achillea millefolium	10.7±0.8	22.3±6.86	93.0±45.4	28.3±7.23	37.3±12.0	1.13±0.23
Tilia argentea Desf.	10.3±4.1	24.0±2.68	220.7±90.8	32.7±10.5	32.7±3.9	0.46±0.43

The concentration of the monitored trace elements, the highest concentration found was that of iron followed by manganese and zinc. On the other hand, the lowest concentration found was that of molybdenum followed by boron and copper. Copper is essential micronutrient for living organisms due to a wide range of biological functions as component of redox and enzymatic systems, the latter of which is an important enzyme co-factor for human fatty acid (FA) metabolism (Deferne et al., 1996; Mclaughlin et al., 1999). Concentrations of copper in twelve spices were the ranges 3.20 mg kg^{-1}-15.6 mg kg^{-1}, the lowest in bay leaf (*Laurus nobilis* L.) and the highest in basil (*Ocimum basilicum* L.) samples (Table 2). The permissible limit set by WHO (1999) for edible plants was 3.00 mg kg^{-1}. After comparison of metal limit in the studied medicinal plants with those proposed by WHO (1999), it was found that all plants accumulated Cu above this limit. Reddy and Reddy (1997) reported that the range of Cu contents in the 50 medicinally important leafy material growing in India were 17.6 to 57.3 mg kg^{-1}. Zn is an essential micronutrient and is associated with a number of enzymes, especially those for synthesis of ribonucleic acids. Zinc deficiency resulted from inadequate dietary intake is of growing concern in the developing world. Zinc concentrations of the plant samples varied between 22.3-53.6 mg kg^{-1} with yarrow (*Achillea millefolium*) sample containing the lowest and in St John's wort. (*Hypericum perforatum* L.) sample having the highest, respectively. The permissible limit set by WHO (1999) for edible plants was 27.4 mg kg^{-1}. After comparison of metal limit in the studied medicinal plants with those proposed by WHO (1999), it was found that *Matricaria chamomilla* L., *Hypericum perforatum* L., *Salvia officinalis* L., *Ocimum basilicum* L. and *Melissa officinalis* are above this limit, while all others plants accumulated Zn within this limit. Fe is necessary for the formation of hemoglobin and also plays an important role in oxygen. The range of Fe in the studied plants was high with a minimum of 93.0 mg kg^{-1} in yarrow and maximum of 1057.3 mg kg^{-1} in basil. The permissible limit set by WHO (1999) in edible plants was 20 mg kg^{-1}. After comparison of metal limit in the studied medicinal plants with those proposed by WHO (1999), it was found that all plants accumulated Fe above this limit. Sheded et al., (2006) reported that the range of Fe in their study was between 261 and 1239 mg kg^{-1} in selective medicinal plants of Egypt. Manganese is an important element activating numerous essential enzymes. In the case of manganese, the flos lavandulae (*Lavandula stoechas*) samples occurred as the richest (148.3 mg kg^{-1}) whereby the lowest level (28.3 mg kg^{-1}) was recorded in yarrow (*Achillea millefolium*). The permissible limit set by WHO (1999) in edible plants was 2 mg kg^{-1}. After comparison of metal limit in the studied medicinal plants with those proposed by WHO (1999), it was found that all plants accumulated Mn above this limit. Sheded et al., (2006) reported that the range of Mn in their study was between 44.6 and 339 mg kg^{-1} in selective medicinal plants of Egypt. Concentrations of boron in twelve spices were the ranges 15.0 mg kg^{-1}-64.4 mg kg^{-1}, the lowest in bay leaf (*Laurus nobilis* L.) and the highest in nettle (*Urtica dioica* L.) samples. The range of Mo varied with values between 0.25 mg kg^{-1} in *Lavandula stoechas* and 2.13 mg kg^{-1} in *Melissa officinalis*. In trace amounts, may be beneficial in activating some enzyme systems, but its toxicity at higher levels is more prominent (Divrikli et al., 2006). Some of our results of mineral contents of medicinal and aromatic plants used in experiment show minor differences when compared with literature these differences might be due to growth conditions, genetic factors, geographical variations and analytical procedures (Özcan, 2004; Belaqziz, 2010).

CONCLUSIONS

This study indicates that some of these plants collect specific elements, and this property is dissolved by the use of these plants for medicinal objectives in addition to their bioactive secondary metabolites constituents. The total concentrations of micro elements were measured in herbal medicaments. Important numbers of herbal medicines, of various medical properties being used usually in long time therapy, were examined. Nutritive values of the examined herbal medicinal products were evaluated. Results proffered here clearly show that the analyzed herbal remedies play a meaningful role in human nutrition as micro-nutrients sources. Their recommended daily dose depletion is not healthful.

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