Journal of Chemical Health Risks

Journal of Chemical Health Risks (2016) 6(2), 105-112

ORIGINAL ARTICLE

Determination of Essential Nutrients in Some Indigenous Pharmacological Plants Growing in Fars Province, Iran

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(Received: 9 December 2015 Accepted: 13 February 2016)

KEYWORDS

Health risk;
Medicinal plants;
Elemental composition;
WHO

ABSTRACT: The essential nutrients in the pharmacological plants play a significant role in the remedy of illnesses but, these elements at high levels; can also be dangerous and toxic. The aim of this study was to determine the concentration of macro (Mg, Ca, P, and K) and micro (Cu, Zn, Fe and Mn) essential elements in seven indigenous pharmacological plants growing in Fars Province, southern Iran. They were established using flame atomic absorption spectrophotometer (FAAS) and flame photometer. The results showed that there was very large variation in the element levels in studied medicinal plants. The studied medicinal plants contain appreciable quantity of K, P, Ca and Mg which are essential component of human nutrition. The highest concentration of Zn (50.7 mg kg^{-1} DM), Mn (1503.0 mg kg^{-1} DM) and Fe (1339.7 mg kg^{-1} DM) was found in *Vitex pesedo-negundo*. *Verbascum thapsus* had the highest concentration of Cu (23.0 mg kg^{-1} DM). Most of the detected values for all micro nutrients in studied medicinal plants were upper the WHO/FAO permissible levels and may cause a health hazard for consumers; thus, these medicinal plants should be used with more caution when taken orally or consumed as part of diet.

INTRODUCTION

Medicinal plants have been consumed for many years to treat a serious variety of illnesses. Based on WHO, the use of traditional herbaceous drug has deploy not only in the developing countries but also in the industrialized ones, as a supplementary procedure to cure and to arrest diseases [1].

The pharmacological features of the medicinal herbs depend on the presence of active components responsible for significant physiological operation in living organisms. Essential nutrients in medicinal plants play a considerable role in the reactions which will cause to the formation of these active components [2].

Pharmacological herbs are natural sources for essential nutrients. Micro nutrients such as copper (Cu), manganese (Mn) iron (Fe) and zinc (Zn) are important elements for continuing the life processes in plants and animals. The required amounts of micro nutrients are much lower than the needed amounts of macro nutrients such as Ca, Mg, K and P [3].

It is of major interest to establish the levels of some metallic elements in common medicinal plants because, at elevated levels, these metals could be

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dangerous and toxic. The dose rate of many of these medicinal plants is not well defined and left to the judgment of the users. This can occasionally cause problems to consumer as the probability of taking overdose to speed up healing is highly elevated, ignorant of the dangers in doing so. Thus, measurement of the elemental composition of these medicinal plants is highly necessary [4].

Flora of the Iran has more than 7500 plant species and many of them are called medical plants [5]. Fars Province, which is wide in scope due to the topography and climatic conditions have a variety of medicinal plants with specific genetic variation in each area of its annual so that large amounts of medicinal products is exported to European countries. Fars now ranks first in export of medicinal plants in Iran. Although, the medicinal properties of these plant products are well recognized, data with regard to their metal composition are scanty. Thus, it is necessary to evaluate the elemental composition of those plants in addition to their components that promote health care.

Most of the medicinal plants were used after soaking in water and thus only this water extract is taken for the cure of disease. However, some are taken as a whole in the form of powder mixed with milk, honey and yoghurt or eaten as a fruit.

The aim of this study was to determine the concentration of some micro and macro elements of several common medicinal plants growing in Fars Province extensively used in the preparation of herbal products in Iran and comparing their elemental concentrations with the permissible concentration limits of edible plants set by WHO/FAO [6]. Because of these medicinal plants, the elemental concentration levels could potentially be either dangerous or useful for humans who are consuming them.

MATERIALS AND METHODS

Sample Collection and Preparation

The samples of medicinal plants (shoot) used in this research included panjangosht (*Vitex pesedo-negundo*); khooshak (*Daphne mucronata*), Golmahour (*Verbascum thapsus*), maryamgoli (*Saliva mirzayanni*), khatmi (*Alcea koelzii*), kakgoriz (*Pulicaria undulata*) and avishan (*Thymus daenensis*) were obtained directly from seven regions (each region for one medicinal plant) the growing fields of Fars Province, southern Iran. In each region, composite samples of each medicinal plant were collected. Botanical identification and verification were done at college of agriculture and natural resources, University of Shiraz, Iran. The scientific name, local name, family and medicinal uses of the studied plants were illustrated in Table 1. All samples were washed, dried overnight at 70 ^{o}C in an electronic oven, powdered and used for analyzing the macro (P, K, Ca, Mg) and micro nutrient (Cu, Fe, Mn, Zn) concentration.

Table 1. Scientific name, local name, family and medicinal uses of investigated medicinal plants

Scientific name	Local name	Family	Medicinal uses	Ref.
Thymus daenensis	Avishan	Lamiacae	Thymus oil is a combination of monoterpenes and those will acts as antioxidative, antimicrobial, medicinal drug, antitussive, antispasmodic, and antibacterial activities.	[7]
Pulicaria Undulata	kakgoriz	Compositae	Pulicaria species have been used as insect repellents, alactagogues, antiepileptics, and as tonics.	[8]
Verbascum thapsus	Golmahor	Scrophulariaceae	Dyspepsia, Antidiarrhea, Expectorant,Antiacid, Stomach Tonic.	[9]
salvia mirzayanii	maryamgoly	Lamiaceae	Female Fertility, Hypoglycemic,Menopause, Stomach Tonic.	[9]
Alcea Koelzii	chatmy	Malvaceae	The plant is useful in the Antitussive, Febrifuge, and Treatment of pimples, Laxative, Depurative, and Treatment of gum swelling, Mouth Wounds, Bone Fracture, Treatment of Bruises, and Treatment of Dysuria.	[9]
Daphne mucronata	shoshak	Thymelaeaceae	The extract of Daphne mucronata has a reducing effect on rat breast adenocarcinoma and enhances TNF-α release from monocytes.	[10]
Vitex pesedo-negundo	Panjanghosht (bangro)	Verbenaceae	Plant is bitter, acrid, astringent, cephalic, stomachic, antiseptic, alterant,thermogenic, depurative, rejuvenating, ophthalmic, anti-gonorrhoeic,anti-inflammatory.	[11]

Plant elemental analysis

The total concentration of nutrients were measured in produced extract from powdered medicinal plant samples after ashing at about 500-550 ^{0}C and dissolving the ash into 20% HCl [12].The concentration of K was determined with a flame photometer (Corning-M410, UK), whereas those of Ca, Mg, Zn, Mn, Fe and Cu determined with a flame atomic absorption spectrophotometer (PG990, UK). Total P was determined using the molybdate-ascorbic acid procedure by spectro photometry (Spectronic, 20D$^+$, U.S.) at 460 nm wave length [13]. Actual amount of phosphorus was calculated using a standard curve developed using the known standards of K_2PO_4.

RESULTS AND DISCUSION

Information on the micro and macro nutrient content in medicinal plants is very momentous, because, many of them play important roles in the formation of active constituents responsible for the remedial properties. Furthermore, some of these nutrients are vitally significant for different metabolic processes in the human body. They are closely related to human growth and general health [14].

In this research, a total of eight elements (P, Ca, Mg, K, Mn, Fe, Cu and Zn) were determined in the powdered medicinal plant samples. The mean concentrations of various nutrients in the plant samples were indicated in Table 2. The present research showed that all the nutrients were accumulated to greater or lesser extents by all eight studied plant species. Moreover, we observed obvious differences in the concentrations of all nutrients in each studied medicinal plants. This result is supported earlier [14], which revealed differences in the mineral composition of several medicinal plants.

The variation in elemental concentration is mainly attributed to the differences in botanical structure, as well as in the mineral composition of the soil in which the plants are cultivated. Other factors responsible for a variation in elemental content are preferential absorbability of the plant, use of fertilizers, irrigation water and climatologic conditions [3].

Table 2. Total concentration (mg kg^{-1} DM) of essential nutrients in investigated medicinal plants (n=3)

Scientific name	K	Ca	Mg	P	Fe	Mn	Cu	Zn
Vitex agnus-castus	8000	1238.9	1619	70	1339.7	1503	10.9	50.7
Daphne mucronata	5200	1208.2	1185.8	50	444.6	85.3	10.2	49.4
Verbascum thapsus	12000	23444	7772.6	1350	895.9	49.8	23	37.7
Salvia mirzayanii	18000	16885.8	5477.7	1875	882.3	171.7	14.4	38.9
Alcea koelzii	16000	15994	6782.8	1875	653	41.9	15.9	40.4
Thymus daenensis	5400	17481.4	9372.4	1300	760.6	26.2	14.5	30.1
Pulicaria undulata	14000	11634.4	4977.9	800	559.8	31.5	19.7	22

Potassium

The K contents varied from 5200 mg kg^{-1} DM (*S. mirzayanii*) to 18000 mg kg^{-1} DM (*D. mucronata*) (Table 2). All the studied plants show high K contents and our results were in agreement with the previous researches on medicinal herbs [15, 16]. The high concentration of potassium in plants is needed for many essential processes including enzyme activation, photosynthesis, water use efficiency, starch formation and protein synthesis. Potassium participates actively in the maintenance of the cardiac rhythm [17] and in constipation.

Calcium

Calcium is an important trace element because of its role in bones, teeth, muscular system and heart functions [18]. It is required for absorption of dietary Vit. B, for synthesis of neurotransmitter acetylcholine and is also required for activation of enzyme pancreatic lipase [19]. Calcium is necessary for the coagulation of blood, the proper functioning of the heart and nervous system and the normal contraction of muscles. Its most important function is to aid in the formation of bones and teeth. Calcium contents of all medicinal studied plants were high similar to K content. concentrations were in the range 1208.2-23444 mg kg^{-1} DM. Tow samples had concentrations lower than 1250 mg kg^{-1} DM and five samples in the range 11634.4-23444 mg kg^{-1} DM. *D. macronata* had the highest Ca concentration (23444 mg kg^{-1} DM) whereas *V. thapsus* had the lowest (1208.2 mg kg^{-1} DM) (Table 2). Our data revealed that the studied medicinal plants are not deficient in Ca. our results are similar to findings of other researchers [20, 21].

Magnesium

Magnesium deficiency in humans caused muscle spasms, and has been associated with a high blood pressure, many cardiovascular diseases, diabetes and osteoporosis. The necessary daily intake is 350 mg day^{-1} for men and 300 mg day^{-1} for women [22]. The values obtained for Magnesium in analyzed medicinal plants ranged between 1185.8 – 9372 mg kg^{-1} DM. The highest content was measured in *T. daenensis* (9372 mg kg^{-1} DM) and the smallest in *D. mucronata* (1185.8 mg kg^{-1} DM) (Table 2). Generally, the concentrations of Mg in soil is higher than that of K but the uptake of Mg by root cells is much lower than the uptake of K [20]. Khattak [23] investigated the concentration of some nutrients in seven medicinal plants in Baluchistan and indicated that the highest concentration of magnesium was present in *Thymus vulgaris* (188.49 mg kg^{-1} DM) and *Carum petroselium* had the minimum concentration of magnesium (58.88 mg kg^{-1} DM). Imelouane et al. [20] reported that Magnesium concentration in their studied medicinal plant (*Lavandula dentate*, *Rosmarinus tournofortii*, *Thymus vulgaris* and *Artemisia herbaalb*) ranged between 3395- 68382 mg kg^{-1} DM. They indicated that the levels of magnesium in plants depend on soil types generally.

Phosphorous

Phosphate ions are the major anions of intracellular fluids, phospholipids and the coenzyme NAD and NADP and especially of ATP and other high energy compounds. It helps in the process of ossification of bones by getting deposited in the form of calcium phosphate [24]. In our study, phosphorous concentration was found to be maximum at 1875 mg kg^{-1} DM in *A. kolezi* and minimum at 50 mg kg^{-1} DM in *D. mucronata* (Table 2). Konieczyński and Wesołowski [25] determined the phosphorous concentration in several botanical species of medicinal plants and observed that the concentration of phosphorous in their studied medicinal plants ranged between 1730 – 7370 mg kg^{-1} DM, so that, the highest concentration was related to *Urtica dioica* L. and the lowest concentration was attributed to *Hypericum perforatum* L. the concentration of phosphorous in eleven medicinal plant in Bangladesh, [26] were lower than 12 mg kg^{-1} DM. these results indicated that the concentration of phosphorous in medicinal plants can be different depending on plant type and whether condition.

Zinc

Zinc is the component of more than 270 enzymes and its deficiency in the organism is accompanied by multisystem dysfunction. Besides, Zn is responsible for sperm manufacture, fetus development and proper function of immune response [27]. The range of Zn concentration as shown in Table 2 varied from 22 mg kg^{-1} DM in *P. undulate* and 50.7 mg kg^{-1} DM in *V. pesedo- negundo*. The permissible limit set by FAO/WHO [6] in edible plants was 27.4 mg kg^{-1} DM.

Compared to the metal permissible limits set by FAO/WHO, all plants studied except *P. undulate* (22 mg kg^{-1} DM) were upper the stipulated limit for Zn. similar to our result, in most medicinal plants studied by Konieczyński and Wesołowski [25], the concentration of zinc was upper the permission limit of WHO. Moreover, Bhowmik et al. [26] with investigating of chemical composition of some medicinal plant in Bangladesh, observed that the concentration of zinc in all plant studied (except *Terminalia chebula* and *Terminalia belerica*) was more than permission limit set by WHO.

Copper

Copper (Cu) is an essential redox active transition element that play vital role in various metabolic processes. Being toxic, its quantity in plants should be very low. It is essential to the human body since it forms a component in many enzyme systems, such as cytochrome oxidase, lysyl oxidase and an iron-oxidizing enzyme in blood. The observation of anemia in copper deficiency is probably related to its role in facilitating iron absorption and in the incorporation of iron in hemoglobin. However, copper deficiency in humans is a rare occurrence. Copper could be toxic depending on the dose and duration of exposure [28]. The concentration of Cu among the other nutrients was in minimal in all the studied medicinal plants. The lowest content of Cu was 10.2 mg kg^{-1} DM which was seen in *D. mucronata* and maximum concentration was detected as 23 mg kg^{-1} DM in *V. thapsus* (Table 2). The permissible limit set by FAO/WHO [6] for copper in edible plants was 3.00 mg kg^{-1} DM. However, for medicinal plants the WHO limits not yet been established for Cu. Permissible limits for Cu set by China and Singapore for medicinal plants, were 20 mg kg^{-1} DM and 150 mg kg^{-1} DM, respectively [29]. After comparison of the metal limit in the studied medicinal plants with those proposed by FAO/WHO [6], all plants accumulated Cu upper this limit. High level of Cu may cause Monday morning fever which is an illness caused primarily by exposure to certain fumes [30]. our result is consistent with the findings of Gogoasaf et al. [31] who observed that Cu concentration in all studied medicinal plant in Romania (*Cynara scolymus, Achillea millefolium,Calendula officinalis, Mentha piperita , Hypericum perforatum, Matricaria chamomilla*) was more than the permission limit of Cu concentration set by WHO.

Iron

Iron (Fe) is an essential element for human beings and animals and is an essential component of hemoglobin. It facilitates the oxidation of carbohydrates, protein and fat to control body weight, which is very important factor in diabetes [32]. In studied plants, Fe concentration varied from 444.6 mg kg^{-1} DM in *D. mucronata* and 1339.7 mg kg^{-1} DM in *V. pesedo-negundo* as seen in Table 2. The permissible limit set by FAO/WHO in edible plant was 20 mg kg^{-1} DM. According to FAO/WHO [6], the concentration of Fe in all studied medicinal plants *was* found to exceed the maximum permissible limit. This result is corresponded to findings of Aparana and Aruna [4].

Manganese

The activity of this element is noticed in the metabolism of food which is incorporated into the bone. Manganese (Mn) is essential element required for various biochemical processes [33]. The kidney and liver are the main storage places for the manganese in the body. Mn is essential for the normal bone structure, reproduction and normal functioning of the central nervous system. Its deficiency causes reproductive failure in both male and female [19]. Apart from physiological importance experimental data have pointed out the pharmacological implication of this element especially in prevention and treatment of diabetes mellitus [34]. The range of Mn concentration as shown in Table 2 varied from 26.2 mg kg^{-1} DM in *T. daenensis* and 1503 mg kg^{-1} DM in *V. pesedo- negundo*. The permissible limit set by FAO/WHO [6] in edible plant was 2 mg kg^{-1} DM. for

our study; Mn concentration was above the permissible limit proposed by FAO/WHO [6] in all studied plants. This finding harmonizes with the results of Mtunzi et al. [35].

CONCLUSIONS

The present study gives a new perspective about the presence of some macro and micro elements in some indigenous (Fars province, Iran) medicinal plants. At the conclusion, there is very large variation in the element levels in studied medicinal plants. The variation in elemental concentration is mainly attributed to the differences in botanical structure, as well as in the mineral composition of the soil in which the plants are cultivated. Other factors responsible for a variation in elemental content are preferential absorbability of the plant, use of fertilizers, irrigation and climatologically conditions. The studied medicinal plants contain appreciable quantity of K, P, Ca and Mg which are essential component of human and animal nutrition. The highest concentration of Zn (50.7 mg kg^{-1} DM), Mn (1503.0 mg kg^{-1} DM) and Fe (1339.7 mg kg^{-1} DM) was found in *V. pesedo-negundo* and *V. thapsus* had the highest concentration of Cu (23.0 mg kg^{-1} DM) respectively. Most of the detected values for micro elements (Zn, Cu, Mn and Fe) in medicinal plants studied here are upper the WHO/FAO (1984) permissible levels and may cause a health hazard for consumers; thus, these medicinal plants should be used with more caution when taken orally or consumed as part of diet.

ACKNOWLEDGMENTS

The authors would like to appreciate Shiraz University for providing research facilities. The authors declare that there is no conflict of interests.

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