Macro- and Trace metals in three Medicinal Herbs Collected from Baghdad, Iraq Market.

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Abstract

Several metals (Ca, Mg, Zn, Fe, Pb, Cd, Cr, Mn, Ni, and Co) were determined in three medicinal herbs (**Feverfew** (Tanacetum parthenium), **Rosemary** (Rosmarinus officinalis), **Chamomile or camomile** (Matricaria chamomilla)) by applying Flame Atomic Absorption Spectrophotometer. The obtained results showed that **Calcium** content in tested herb was ranged (1-3.675) ppm. **Magnesium** maximum content (4247.5) ppm presented in rosemary was higher and with this content kidney stone may be formed easily with other affected factors. **Zinc** concentration varied from (4.8-35.5) ppm reflecting type of plant effect on element transfer and accumulation in plant. **Iron** was with higher content (32-490) ppm compared with WHO recommendations. L**ead** content (3 ppm) in all tested herbs was less than the WHO highest limits but higher than Germany limits. **Cadmium** content found (0.575 ppm) only in Rosemary among three tested herbs which is more than WHO and Germany limitations. **Chromium** ranged (6-12) ppm that may be a result of its low solubility water and plant uptake. **Manganese -** Chamomile was below WHO maximum limit (200) ppm in medicinal plants with the lowest concentration (10.25) ppm while rosemary and feverfew had (27.75 and 12.375) ppm respectively. **Nickel** content ranged (8.8125-10.25) ppm was higher than WHO limitations. **Cobalt** was found in rosemary herb (1.85 ppm) while feverfew and chamomile were with the same content (0.5 ppm).

Keywords: Feverfew, Rosemary, Chamomile, Calcium, Magnesium, Zinc, Iron, Lead, Cadmium, Chromium, Manganese, Nickel, Cobalt.

Introduction

In Iraq, herbs were found to be used as primary and available medicinal treatments besides other applications (food, nutritional supplements,..) from ancient times [1, 2]. World Health Organization (WHO) documented that heavy metals concentrations in herbs must be controlled [3]. This documentation is necessary to save all being life because heavy metals (cadmium, lead, nickel, ..) are considered as the most hazardous environmental contaminants [4, 5] as a result of their accumulation ability in plants, human, and other life chain.

Several factors affected element transfer (such as chemical form and concentration in water) to plants (type of plant, types of fertilizers, climate changes on earth surface, and soil chemistry (composition, pH,…)) [6]. It is generally accepted that the metal concentration in soil is the dominant factor [7]. Heavy metal availability can also be directly affected by plant itself [8].

Our objective in this paper was directed to determine several elements in plants (herbs) in Iraq and extensively used as food, pharmaceutical preparations, cosmetics, etc. and with we continued other researchers works in Iraq and other countries [9, 10, 11, 12].

Experimental section:

Chemicals

The nitric acid solution used (65%, Merck, Germany) and standards solutions for atomic absorption spectroscopy containing 1000 mg/ L metal in nitric acid (Fluka).

Instruments

A Phoenix -986-A atomic absorption spectrometer furnished with the Phoenix Deuterium ARC background correction, single element hollow cathode lamps and air-acetylene flame was used. All instrumental settings were those recommended by the manufacturer.

Methods

Working standard solutions were prepared bydiluting the stock solution with 0.1 M nitric acid. To prevent contamination with heavy metals, all glassware and equipment were thoroughly washed with 10%HNO_3 and then rinsed with deionized water prior to use.

Our studied herbal samples were collected randomly from Baghdad-Iraq markets and washed thoroughly with tap water then deionized water, and dried in the oven at 105^{o}C for 48 hrs. These steps followed by others such as grinding to fine powder then keeping dry in polyethylene bag in desiccators until analysis time.

According to Association of Official Analytical Chemists published document [13], 1 gm of each tested herb was subjected to slowly increasing heating from room temperature to 300^{o}C in muffle furnace to get white or gray herbal ash residue for 5hrs. That obtained residue was dissolved in 5 mL (25%, V/V) nitric acid then transferred to 10 mL volumetric flask and made up to the mark.

Calibration curves were prepared using seven concentrations, the linear correlation coefficients obtained ranging between 0.9900 - 0.9958. The standard operation conditions were those recommended for each metal in the instrument's method. All measurements were carried out in triplicates.

Results and Discussion

To determine trace elements in plants or herbs, different analytical methods [14] with sample digestion were applied depending on their sensitivity, specificity, simplicity, and precision including Atomic Absorption Spectrometry (AAS) with acid digestion benefits. In sample treatment, dry and wet method used to overcome organic interfere or reaction with studied metal ions or used reagents.

Dry method produced oxides, sulphates, phosphates, chlorides, or silicates of the actual presented minerals in studied materials by applying high temperature muffle furnace and less required chemicals. The safety, expensive platinum crucible, volatilization loss, contamination, and some workup step difficulties are considered by analytical chemist in AAS-dry method of trace elements [15].

Elemental analysis for three herbal samples used in Iraq was carried out to determine the concentration of heavy metals using Atomic Absorption Spectrometer (Table (1)). Each given value is the mean of four determinations.

Calcium is essential material of structural parts of human and animals such as bones, teeth, egg shell, ... and necessary element in cellular processes with daily intake (350-1100) mg/day. It also used in several chemical applications (reducing, deoxidizer, …) [16, 17]. Its content in tested herb was ranged (1-3.675) ppm can be compared with other published articles [18, 19].

Magnesium is essential to cell like major action in biological compounds such as ATP, DNA, ... Its maximum content (4247.5) ppm presented in rosemary was higher than recently published article (15.75-532.72) ppm [20] and with this content kidney stone may be formed easily [19] with other affected factors.

Zinc is toxic metal at high concentration (>10 ppm) [21]. In all tested plants, its concentration varied from (4.8-35.5) ppm (Figure (1), Table (1)) reflecting type of plant effect on element transfer and accumulation in plant.

Iron is an essential element for plant growth human life by bound in haemoglobin, Fe-dependent tissue enzymes, ferritin, and hemosiderin [22]. It is not toxic in usual amount except Fe repletion can be considered as hazardous [23]. In our study, iron was with higher content (32-490) ppm (Table (1)) compared with WHO recommendations or other published studies [24, (Table (2)].

Lead is very toxic especially for kidney and nervous system. The highest acceptable concentrations set by WHO of **Cadmium and lead** are (0.2 and 10) ppm, respectively in all plant parts [3]. Canadian health authorities determined several heavy metals (Pb, As, Hg. Cd, and Sb) as toxic with highest acceptable limits (10 , 3, 3, 3, and 5) ppm respectively and above (20, 5, 5, 1, 10) ppm are considered technically avoidable [25]. This limitation in Canada was stated for tooth paste as natural health products. Also, Germany confirmed that heavy metals content should be less than (1, 0.5, 0.1, 0.2, and 0.5) ppm for (Pb, As, Hg. Cd, and Sb) respectively [26].

In this study**, lead** content (3 ppm) in all tested herbs was less than the WHO highest limits but higher than Germany limits (Table (1), Figure (1)). The highest presence of lead in Chamomile –Iraqi market (our present study) compared to all data in Table (2) or highest acceptable concentrations set by WHO as previously mentioned. These results should be taken in concern of national and international health institutions because of toxic lead accumulation.

Cadmium content found (0.575 ppm) only in Rosemary among three tested herbs which is more than WHO and Germany limitations [3, 26] as shown Table (1).

Chromium is required for human approximately (0.03 ppm) where its accumulation causes reducing glucose level in blood, gastrointestinal disorder, cardiovascular shock, etc…[3]. It naturally occurs in rocks and soil. Table (1) showed that chromium ranged (6-12) ppm that may be a result of its low solubility water and plant uptake.

Manganese is a trace element necessary for plant, animal, and human as enzyme cofactor [27]. In case of this element Chamomile had the lowest concentration (10.25) ppm while rosemary and feverfew had (27.75 and 12.375) ppm respectively. All obtained values were below WHO maximum limit (200) ppm in medicinal plants but in the range of other studies [18, 24, 28].

Nickel is an essential element for animal nutrition [29]. Jabeen et al. [30] reported permissible limit of nickel in herbs with 1.63 ppm because of its toxicity and responsibility for many serious health problems and diseases [31]. Our studied herbs content ranged (8.8125-10.25) ppm was higher than WHO limitations. It found in Chamomile –Iraqi market (our present study) to be higher than other Chamomile results in Table (2).

Cobalt required as a trace element for several biological actions in human body [32]. Its highest concentration was found in rosemary herb (1.85 ppm) while feverfew and chamomile were with the same content (0.5 ppm) but higher than previous Iraqi chamomile study (0.002 ppm) (Table (2), [33].

In comparison with Iraqi published article [33], our chamomile - metal results were higher in all except cadmium.

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Tables:

Table (1): Concentration (ppm) of Some elements **[Mean±SD]** in three studied herbs.

Conc., ppm	**Feverfew** (Tanacetum parthenium)	**Rosemary** (Rosmarinus officinalis)	**Chamomile or camomile** (Matricaria chamomilla)	Max., ppm
Ca	**3.675±0.29**	**3.19±0.55**	**1**	**3.675**
Mg	**12.5**	**4247.5±103.72**	**x**	**4247.5**
Zn	**4.8**	**9.6**	**35.5±2.89**	**35.5**
Fe	**32±1.63**	**490±20**	**480.71**	**490**
Pb	**3**	**3**	**3**	3
Cd	**x**	**0.575±0.05**	**x**	**0.575**
Cr	**6.75±1.5**	**12±2.45**	**6**	**12**
Mn	**12.375±0.35**	**27.75±0.5**	**10.25±0.5**	**27.75**
Ni	**6.8125±0.38**	**8.4±0.4**	**10.25±0.5**	**10.25**
Co	**0.5**	**1.85±0.29**	**0.5**	**1.85**

X: not measured

Table (2): Previously published studies of heavy metals in Chamomile (in ppm).

Country	Ca	Fe	Zn	Co	Mn	Cr	Cd	Ni	Pb	Data were extracted from
Iraq	-	6.870	1.250	0.002	-	-	0.010	0.450	0.046	33
Lebanon	3.860	0.420	61	-	71	9.3	-	-	7.300	18
Jordan	-	-	-	-	1.730	-	6.867	6.550	1.133	34
Romania	-	-	2.920	-	-	-	14.200	-	0.070	35

Figures:

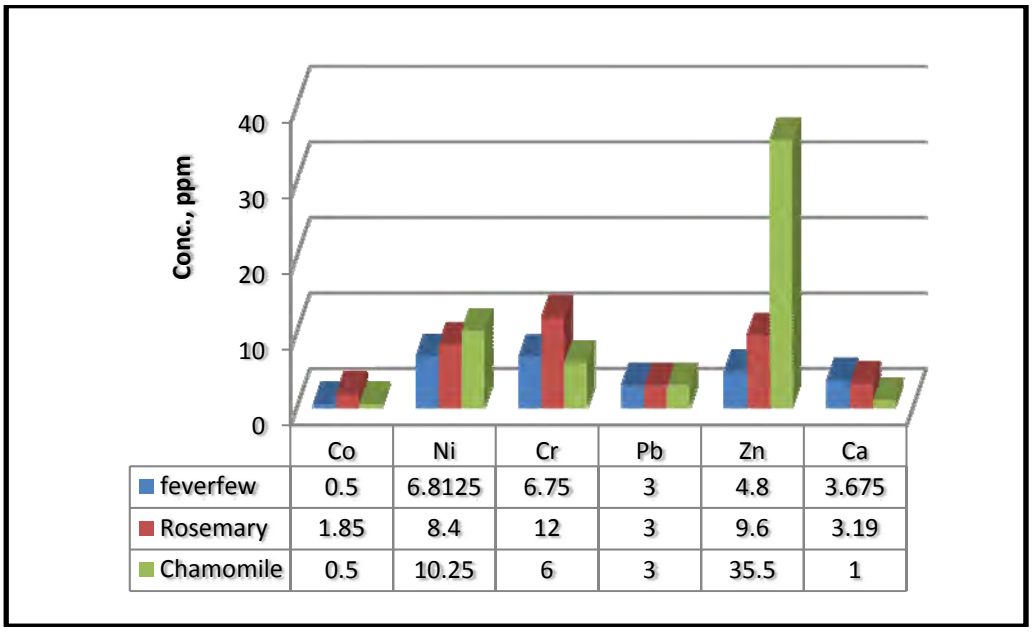

Figure -1-: Concentration (ppm) of different metals in three studied herbs.