

Original Article



Determination of some heavy metals in popular medicinal plants of Tehran 's market

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Abstract

Traditional medicines by medicinal plants have always played a key role in world health including Iran but their safety profile is a major concern in this regard. In fact some factors such as the method of extraction, contamination with microorganisms, existence of heavy metals, and pesticides may reduce the safety of herbal based pharmaceutical products. The objective of this research was to determine the level of Cd, Pb, Ni, Cu, and Hg as the major abundant heavy metals in some commonly used herbal medicines and herbal plants of Iran's market. For this purpose, 10 samples from eight different commonly used medicinal plants were collected from 10 different traditional stores in Tehran. Standardized international protocols were followed for the preparation of material and analysis of heavy metals contents. An automated continuous flow hydride vapor generation system was used for mercury determination. Atomic absorption spectroscopy (AAS) was also used for the determination of the concentration of Pb, Cd, Ni and Cu. Results show that Cuminum had the lowest Pb level and Syzigium cumin the highest. Cadmium concentration varied between 0.19- 9.26 ppm. Syzigium cumin, showed the highest Cd levels and Cuminum Cyminn showed the lowest levels. The concentration of Cu varied from 8.15 to 73.28 ppm. Cordia myxa contained the highest levels of Cu and Plantago psyllium contained the lowest levels. The highest level of Ni was detected in Myristica fragrams and the lowest in Plantago psyllium. Although the Hg concentration was not detectable in Cuminum Cyminn and Cordia myxa, some samples showed 0.71 ppm. Out of all samples, Syzigium cumin showed the highest Hg concentration. Environmental contamination with heavy metals is one of the major concerns in developing countries therefore regular controls on these plants should be performed by the government. It seems that using cultivated plants under controlled conditions can the level of contamination.

Key words: Medicinal plants, Heavy metals, Plantago psyllium, Cuminum, Syzigium cumin, Myristica fragrams, Cyminn, Cordia myxa

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1. Introduction

Physical evidence of the use of herbal remedies has been found from some 60000 years ago in a burial site of a Neanderthal man uncovered in 1960 in a cave in northern Iraq (Solecki and Shanidar, 1975).

Medicinal plants have played a key role in world health. They are distributed worldwide, but they are most abundant in tropical countries. It is estimated that about 25% of all modern medicines are directly or indirectly derived from higher plants (Ackerknecht, 1973; Bodeker et al., 2005). A vast number of plants have medicinal properties; in fact, many pharmaceutical agents were originally derived from plants. Herbal materials and medicinal plants are also often used as food, functional food, nutritional or dietary supplements in many countries such as Iran.

Due to poverty and limited access to modern medicine, about four billion people, 80% of the world's population, living in developing countries use herbal medicine as their source of primary health care (Farnsworth et al., 1985; Bisset, 1994; Bodeker et al., 2005). Natural products in medicine constitute a vast array of "raw materials", making clear definitions important. Quality criteria are based on clear scientific definitions of raw material. The term "herbal drugs" denotes plants or plant parts that have been converted into phytopharmaceuticals by means of simple process involving harvesting, drying, and storage (EMA, 1998). The quality of a plant product is determined by the prevailing conditions during growth, and accepted Good agricultural Practices (GAP) can control this. These include seed selection, growth conditions, and use of fertilizers, harvesting, drying and storage. In fact, GAP procedures are, and will be, an internal part of quality control. Apart from these criteria, factors such as the method of extraction, contamination with microorganisms, heavy metals, and pesticides can alter the quality,

safety and efficacy of herbal drugs. Using cultivated plants under controlled conditions instead of those collected from the wild can minimize most of these factors (Li et al., 1998; Eskinazi et al., 1999).

By far the majority of potentially hazardous contaminants and residues are found in the herbs and herbal materials.

The objective of this research was to determine the level of Cd, Pb, Ni, Cu, and Hg in some commonly used herbal medicines and herbal plants in Iran. In general determination of undesired chemical contaminants, impurities and residues in some commonly used Iranian herbal medicines by considering their dosages, quantities and frequency of their uses were considered in this paper.

The other matter of concern in this research was toxicological assessment of the trace heavy metals and comparing this data by the highest nationally recommended, authorized or registered uses and FAO/WHO evaluated safety of them and the joint FAO/WHO Expert Committee on Food Additives (JECFA) for contaminants in herbal medicines and food.

2. Materials and Methods

A total of 8 commonly used medicinal plants were collected from Tehran's market. The samples were washed with deionized water and allowed to dry in oven for 72 hours at a temperature of 65°C. The samples were then ground and sieved through 0.5 mm sieve. The powdered samples then subjected to the acid digestion using nitric acid and perchloric acid (Li et al., 2005). In next step 250 mg of air-dried of each homogeneously medicinal plant samples accurately weighed and 1.0 mL of the digestion mixture (2 parts by weight of nitric acid & 1 part by weight perchloric acid) and heated slowly by an oven and then rise the temperature. In next stage the remaining dry inorganic residue was dissolved in 2.5 mL of nitric acid and used for the determination

of heavy metals. Atomic absorption spectroscopy (AA) was used for the determination of the concentration of Pb, Cd, Ni and Cu, standardized international protocols were followed for the preparation of material and analysis of heavy metals contents. Analytical grade reagents and distilled water were used throughout the experiment. All glassware and plastic containers used were washed with liquid soap, rinsed with water, soaked in 10% volume- volume nitric acid for 24hrs, cleaned thoroughly with distilled water and dried in such a manner to ensure that any contamination does not occur.

An automated continuous flow hydride vapor

generation system was used for mercury and all samples were tested as quickly as possible after collection , due to not physical or chemical changes occur and the water content of samples was below of 15% for the determination of pesticide residues.

3. Results

Heavy metal contents in medicinal plants depend on climatic factors, plant spices, air pollution, and other environmental factors. The listed of medicinal – herbal plants which were analyzed for heavy metals, local name, parts used are shown in Table 1.

Table 1: Characteristics of Medicinal plants

| Botanical name | Family | English name | Local name | Part used |
|--------------------|----------------|------------------|-----------------|-----------|
| Cuminum Cymim | Umbelliferae | Cumin | Zireh Sabz | Fruits |
| Myristica fragrams | Myristicaceae | Nutmeg | Joze Hendi | seeds |
| Ocimum basillicum | Labiateae | Basil | Tokhme sharbati | seeds |
| Foeniculum vulgare | Umbelliferae | Fennel | Razianeh | Seeds |
| Aloe barbedensis | Lilliaceae | Aloe | Aloe vera | Leaf Pulp |
| Syzigium cumin | Myrtaceae | Black plum | Alooche siah | Fruits |
| Plantago psyllium | plantaginaceae | Greater Plantain | sparzeh | seeds |
| Cordia myxa | Boraginaceae | Assyrian Plum | spistan | fruits |

The results of analysis are shown in Table 2.

Table 2: Level of Heavy metal in medicinal plants (mg/g of the dried plant materials)

| Botanical name | Pb | Cd | Cu | Ni | Hg |
|--------------------|-----------|-----------|------------|------------|-----------|
| Cuminum Cymim | 0.93±0.41 | 0.19±0.01 | 9.14±0.82 | 2.98±0.03 | ND |
| Myristica fragrams | 6.77 | 1.34±0.13 | 10.06±3.9 | 17.54±1.11 | 0.66±0.04 |
| Ocimum basillicum | 7.83 | 1.05±0.19 | 11.73±1.51 | 4.26±0.05 | 0.21±0.05 |
| Foeniculum vulgare | 13.30 | 2.04±0.02 | 9.36±0.12 | 3.19±0.98 | 0.36±0.03 |
| Aloe barbedensis | 1.56 | 0.86±0.21 | 11.46±0.04 | 11.05±0.04 | 0.49±0.04 |
| Syzigium cumin | 39.41 | 9.26±0.16 | 18.06±0.07 | 4.23±0.05 | 0.71±0.03 |
| Plantago psyllium | 9.86 | 2.00±0.03 | 8.15±0.07 | 1.73±0.16 | 0.48±0.06 |
| Cordia myxa | 10.46 | 0.78±0.03 | 73.28±0.02 | 13.49±0.17 | ND |

Level of Pb

Cuminum Cymim had the lowest Pb level and Syzigium cumin the highest. The WHO maximum limit of Lead prescribed in herbal medicines and products is 10 ppm while the dietary intake limit for Pb is 3 mg/week(WHO

,1989) .The findings for Lead residue in some medicinal herbal plants as per present study are much higher than acceptable global standards. The typical symptoms of lead poisoning are colic, anemia, headache, convulsions and chronic nephritis of the kidneys, brain damage

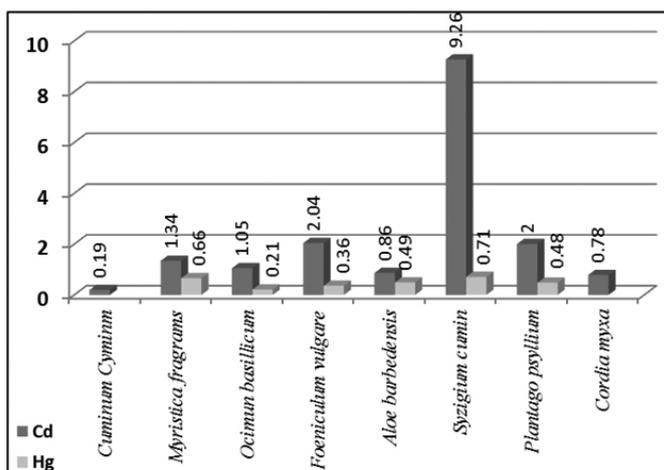
and central nervous system disorders(Fig 1).

Level of Cd

Cd concentration varies between 0.19- 9.26 ppm with *Syzigium cumin*, had the highest Cd level and *Cuminum Cyminm* had the lowest.

The permissible limit laid down in the local law for Cd in herbal medicines and products is 0.3 mg/kg and in food stuff is 0.6 ppm (Fig 1). Cd intoxication can lead to kidney, bone and pulmonary damages (Godt et al. ,2006).

Figure 1: Cd and Hg concentration (mg/g of the dried plant materials)

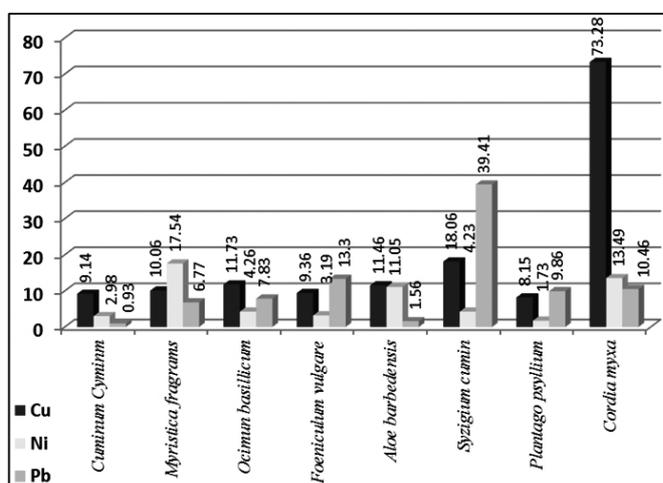


Level of Cu

The concentration of Cu varied from 8.15 to 73.28 ppm, *Cordia myxa* contains the highest level of Cu and *Plantago psyllium* contains the lowest. There is no permissible limit prescribed in local food law or by WHO,

but WHO (1996) has recommended the lower limit of the acceptable range of Cu as 20 mg/mg body weight per day (FDA, 1993; Watson,1993), ,however, national limits in Sangapore for herbal medicines and products is 150 ppm(Fig 2).

Figure 2: Pb, Ni, and Cu concentration (mg/g of the dried plant materials)



Level of Ni

The highest level of Ni occurred in *Myristica fragrans* and the lowest in *Plantago psyllium*. The Ni concentration varied from 1.73 to 17.54 ppm. Except for *Myristica fragrans*, *Aloe barbadensis* and *Cordia myxa* the results of present study shows Ni contents well within the permissible limits of 8 ppm. The most common ailment arising from Ni is an allergic dermatitis known as Nickel itch, which usually occurs when skin is moist, further more Ni has been identified as a suspected carcinogen and adversely affects lungs and nasal cavities.

Level of Hg

The Hg concentration varied from not detected for *Cuminum Cyminum* and *Cordia myxa* to 0.71 ppm, *Syzigium cumini* had the highest Hg concentration. Most samples had Hg contents more than the permissible limits of national limits in herbal medicines and products. The national health authorities of Canada announced limitation of 0.2 ppm and China, Malaysia and Singapore 0.5 ppm in herbal medicines and products.

4. Discussion

One of the major environmental pollution in the developing countries is the heavy metal pollution and the pollution from the use of excessive insecticides, pesticides and fertilizers in the agriculture fields. By a comparison between acceptable global standards and the level of Hg, Cd and Pb in investigated herbal medicine and herbal - medicinal plants, our results showed that the majority of medicinal plants samples had higher level of these heavy metals. Due to lack of research data and technical limitations at present, more research is needed in order to establish the scientific criteria for herbal medicines.

The problem is rather more serious in Iran and the other developing countries. Because herbal - medicinal plants neither controlled

nor probably regulated by quality assurance parameters.

The results suggest that medicinal plants used for human consumption or for preparation of herbal products and standardized extracts should be collected from an unpolluted natural habitat.

As heavy metal toxicity through contamination of preparation continues to be recognized risk, voluntary programs to provide community education regarding the potential risk of herbal preparations should be supported by the availability of free heavy metal testing services. These testing services would most hopefully be provided through existing general practice and pathology testing services, and would contribute to health protection.

Manufacturers should be adhered to complete quality control and good manufacturing procedures including microscopic, physical, chemical, and biological analysis. Organization such as Health ministry help by carrying out premarket reviews of all herbal drugs before they could be authorized for sale. The products available in the markets should be analyzed regularly to ensure that they are free of unsafe ingredients and that the products actually contain the ingredients indicated on the labels.

Conflict of interests : None declared.

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