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Review

A review on the elemental contents of Pakistani medicinal plants: Implications for folk medicines



Muhammad Abdul Aziz^a, Muhammad Adnan^{a,*}, Shaheen Begum^b, Azizullah Azizullah^a,
Ruqia Nazir^c, Shazia Iram^b

^a Department of Botany, Kohat University of Science and Technology, Kohat 26000, Pakistan

^b Department of Environmental Sciences, Fatima Jinnah Women University, The Mall Rawalpindi 46000, Pakistan

^c Department of Chemistry, Kohat University of Science and Technology, Kohat 26000, Pakistan

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ABSTRACT

Ethnopharmacological relevance: Substantially, plants produce chemicals such as primary and secondary metabolites, which have significant applications in modern therapy. Indigenous people mostly rely on traditional medicines derived from medicinal plants. These plants have the capacity to absorb a variety of toxic elements. The ingestion of such plants for medicinal purpose can have imperative side effects. Hence, with regard to the toxicological consideration of medicinal plants, an effort has been made to review the elemental contents of ethno medicinally important plants of Pakistan and to highlight the existing gaps in knowledge of the safety and efficacy of traditional herbal medications.

Materials and methods: Literature related to the elemental contents of ethno medicinal plants was acquired by utilizing electronic databases. We reviewed only macro-elemental and trace elemental contents of 69 medicinal plant taxa, which are traditionally used in Pakistan for the treatment of sundry ailments, including anemia, jaundice, cancer, piles, diarrhea, dysentery, headache, diabetes, asthma, blood purification, sedative and ulcer.

Results: A majority of plants showed elemental contents above the permissible levels as recommended by the World health organization (WHO). As an example, the concentrations of Cadmium (Cd) and Lead (Pb) were reportedly found higher than the WHO permissible levels in 43 and 42 medicinal plants, respectively. More specifically, the concentrations of Pb (54 ppm: *Silybum marianum*) and Cd (5.25 ppm: *Artemisia herba-alba*) were found highest in the Asteraceae family.

Conclusions: The reported medicinal plants contain a higher amount of trace and toxic elements. Intake of these plants as traditional medicines may trigger the accumulation of trace and toxic elements in human bodies, which can cause different types of diseases. Thus, a clear understanding about the nature of toxic substances and factors affecting their concentrations in traditional medicines are essential prerequisites for efficacious herbal therapeutics with lesser or no side effects.

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* Corresponding author.

E-mail address: ghurzang@hotmail.com (M. Adnan).

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1. Introduction

A large number of clinical agents have been developed by the pharmaceutical industry, though indigenous phytotherapy is still practiced in many rural areas, using ethno medicinal treatments bequeathed from generation to generation (Abbasi et al., 2010). Plants engender primary and secondary metabolites, which have significant applications in modern therapy (Agbor and Naidoo, 2015). However, studies have indicated high levels of trace elements in traditional medicines as one of the problems that encountered frequently in herbal therapy (Arceusz et al., 2010; Ashraf et al., 2010b) by causing several health disorders.

Mostly in the developing world, people have less access to modern drugs and therefore, they use different traditional herbal formulations to combat ailments (Calixto, 2005). In Pakistan, there are 350 classical herbal formulations used to treat various diseases (Ahmad and Husain, 2008). Medicinal plants are rich in different elemental contents and thereby providing a possible link to the therapeutic action of the medicine (Singh and Garg, 1997). Plants have the capacity of high intake of different elemental contents of the soil in response to concentration gradients (Huang and Cunningham, 1996). Research has proven that due to the non-biodegradable nature of elements, they tend to accumulate in the biological compartment and move through the food chain, affecting normal body functions (Zivkovic et al., 2012).

This study has been planned to document and analyze the elemental contents of ethno medicinally important plants of Pakistan, and to highlight the existing scientific gaps in terms of their toxicological considerations. Particular stress is on those medicinal plants having high quantities of trace elements and other toxic compounds. In addition, this review will provide future recommendations for the safe and effective doses of such medicinal flora, which are being under the use of indigenous people without any scientific validation.

2. Methodology

Literature on elemental composition of Pakistani medicinal plants was gathered from indexed and non indexed journals by using online bibliographic databases: PubMed, Scopus, Google, Google Scholar, Web of Science, ISI Web of Knowledge and Science Direct Navigator, as well as some library sources. Inside the databases, we used words like elemental contents; macro-element, micro-elements, trace elements and toxic elements' concentrations of medicinal plants of Pakistan. In total, 138 potentially interesting articles published in English language were selected for this review while articles in languages other than English were hardly found locally. Only those articles were selected for this review, which had data on the elemental contents (macro- and

trace elements) of ethno medicinally preferred native (widely distributed) plants of Pakistan. Thus, 69 plant species (53 genera and 33 families) have been documented in this study consisting of 46 herbs, 17 shrubs and 6 tree species. These plant species belong to different areas of the country including semi arid regions (Mardan, Karak, Kohat), sub humid regions (Islamabad, Murree, Kurram, Parachinar), humid regions (Swat, Murree, upper Hazara division) and sub-tropical regions (Haripur, Waziristan area) (Fig. 1). All the data is summarized into one table and two figures. The table consist data on the locality of plants, traditional uses, part used and concentration of macro- and trace elements Elemental values of plants had been reportedly obtained from single and multiple dried plant samples (standard deviation values provided). Elemental concentrations were converted to ppm for uniformity by using online unit's converter. The table also consist data on volumes taken for the determination of elemental concentrations in the selected medicinal plant species. Moreover, the reported studies had limited information on the sampling procedures for plants collection and seasonal variation of elemental contents in plant samples.

3. Taxonomic problems

One plant species had synonym issue as per the current Botanical Nomenclature. The accepted name of the species along with its synonym has been rectified and mentioned in Table 1. Moreover, spelling mistakes in the family names and publication authors were also corrected. Plant database "The Plant List" was used for the taxonomic corrections of all the documented plant species (www.theplantlist.org).

4. Macro-elements

Macro-elements are required in substantial amount (more than 100 mg/day) for carrying out different functions of living organisms (Murray et al., 2000). The elements documented in this review included calcium (Ca), magnesium (Mg), potassium (K) and sodium (Na) as they were abundantly found in the Pakistani medicinal flora (Table 1).

4.1. Calcium (Ca)

Ca overcomes the problems of high blood pressure, heart attack, premenstrual syndrome, colon cancer, weak bones and risks of osteoporosis in old age (Murray et al., 2000). According to a study by Leśniewicz et al. (2006), the reported tolerable upper intake level of Ca in herbs is 2500 mg/day. It has been suggested that doses up to 1500 mg/day of supplemental calcium would not

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