Quantification of Medicinal Inorganic Elements in Herbal Drugs

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Abstract

Medical elementology entails the role of elements in human health and diseases. The balance of elements in number, quantity and its proportion in human body is also basis of sound health. The present study is intended to quantify the certain inorganic elements (cadmium, calcium, copper, iron, magnesium, manganese, nickel, potassium, sodium and zinc.) in herbal drugs viz. *Acorus calamus* L.; *Asparagus racemosus* Willd.; *Calotropis procera* R.Br.; *Cissampelos pareira* L.; *Cyperus rotundus* L.; *Desmodium gangeticum* DC.; *Nardostachys jatamansi* DC.; *Picroorhiza kurroa* Royle ex Benth.; *Plumbago zeylanca* L. and *Withania somnifera* Dunal.

Keywords: Inorganic elements, Human diseases, Herbal drugs

Introduction

The plants take up inorganic elements from soil resources during their physiological activity as nutritional requirements. The drugs of plant origin are constituted of a number of inorganic elements. There are certain inorganic elements which are medicinally potent and their concentration in drug have relevance to the medicinal quality of drug. It has been known that some trace elements such as iron, manganese, nickel, zinc etc. present in human body are essential for health (Goodman and Gilman, 1966; Diplama, 1971). It is shown in various studies that eighty one out of ninety two naturally occurring elements were present in the human body and has active role in large number of diseases or functions (Table 1) (Vohara, 1881, 1982, 1983). As a result of this great expansion in therapeutic application, present parameter was studied for subjected drugs. The pharmacognostical references of the past contributions reveal that this parameter pertaining to qualification of medicinal inorganic elements have rarely been included in their studies (Ahmad and Siddiqui, 1985) so far. In the present study subjected drugs have been screened and quantitatively analysed for cadmium, calcium, copper, iron, magnesium, manganese, nickel, potassium, sodium and zinc.

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Table 1 Inorganic elements and their role in human diseases (Vohora, 1983).

Inorganic elements	Role in diseases and conditions
Cadmium (Cd)	Cancer, Cardo-vascular diseases, Rheumatoid arthritis, Hepatic diseases, Renal diseases, Anaemias, Respiratory diseases, Aging
Calcium (Ca)	Cancer, Cardo-vascular diseases, Rheumatoid arthritis, Diabetes mellitus, Hepatic diseases, Renal diseases, Anaemias, Aging
Copper (Cu)	Cancer, Cardo-vascular diseases, Rheumatoid arthritis, Diabetes mellitus, Hepatic diseases, Renal diseases, Anaemias, Respiratory diseases, Aging
Iron (Fe)	Cancer, Cardo-vascular diseases, Rheumatoid arthritis, Diabetes mellitus, Hepatic diseases, Renal diseases, Anaemias, Aging
Magnesium (Mg)	Cancer, Cardo-vascular diseases, Rheumatoid arthritis, Hepatic diseases, Renal diseases, Anaemias, Aging
Manganese (Mn)	Cancer, Cardo-vascular diseases, Rheumatoid arthritis, Diabetes mellitus, Hepatic diseases, Renal diseases, Aging
Nickle (Ni)	Cancer, Cardo-vascular diseases, Rheumatoid arthritis, Hepatic diseases, Renal diseases, Anaemias, Respiratory diseases
Potassium (K)	Cardo-vascular diseases, Rheumatoid arthritis, Diabetes mellitus, Hepatic diseases, Renal diseases, Respiratory diseases, Aging
Sodium (Na)	Cancer, Cardo-vascular diseases, Rheumatoid arthritis, Hepatic diseases, Renal diseases, Respiratory diseases, Aging
Zinc (Zn)	Cancer, Cardo-vascular diseases, Rheumatoid arthritis, Diabetes mellitus, Hepatic diseases, Renal diseases, Anaemias, Respiratory diseases

Material and Methodology

1. Materials

The herbal drugs under study (Table 2) were collected from natural habitats and authenticated with references to regulatory standards of Ayurvedic and Unani Pharmacopoeia (Anonymous 1978, 1986, 1998, 1999, 2001, 2004, 2006, 2007, 2008a, 2008b & 2009).

Table 2 Herbal drugs under study

Botanical Name	Morphological Part	Official Name	Official reference
Acorus calamus L.	Rhizome	Vacha	API-II
		Waj Turki	UPI-V
Asparagus racemosus Willd.	Root	Shatavari	API-IV
		Satawar	UPI-VI
Calotropis procera R.Br.	Root	Arka	API-I
Cissampelos pareira L.	Root	Patha	API-I
Cyperus rotundus L.	Tuber	Musta	API-III
		Sad Kufi	UPI-IV
Desmodium gangeticum DC.	Root	Shalparni	API-III
Nardostachys jatamansi DC.	Rhizome	Jatamansi	API-I
Picroorhiza kurroa Royle ex Benth.	Rhizome	Katuki	API-II
		Kutki	UPI-IV
Plumbago zeylanca L.	Root	Chitrak	API-VI
Withania somnifera Dunal.	Root	Ashwagandha	API-I
		Asgand	UPI-I

Abbreviations: API- The Ayurvedic Pharmacopoeia of India, Part- I, UPI- The Unani Pharmacopoeia of India, Part-I

2. Quantification of inorganic elements

The quantification of the inorganic elements (cadmium, calcium, copper, iron, magnesium, manganese, nickel, potassium, sodium and zinc) were performed adopting following methodology (Humphries, 1956; Khan *et al*., 1985).

(a) Preparation of Samples: The representative 1 g accurately weighed air dried coarsely powdered drugs were ashed by heating in the furnace maintained at 500°C overnight. The known quantities of the above ashes were digested in 5 ml hydrochloric acid, (20% v/v) warming the solution wherever necessary, then filtered the solution through an acid washed filter paper and dissolved in 100 ml of deionized water in volumetric flask previously washed thoroughly with nitric acid and then rinsed with deionized water.

(b) Preparation of Standard Solutions: The standard solution of cadmium, calcium, copper, iron, magnesium, manganese, nickel, potassium, sodium and zinc were prepared as per prescribed specifications.

(c) Experimental: The Atomic Absorption spectrophotometer (Perkin Elmer, Model-2380) was set up and optimized with simultaneous background correction according to the manufacturer's instruction manual. The sample and standards were aspirated as per the prescribed absorbance for particular element. The estimation of the elements in different drugs (mg/g of ash) was carried out by using the concentration ratios of the sample and standards allowing for differences arising out of weights and dilutions by using the sample and the standards along with blanks.

Observations

All the quantitative data for medicinal inorganic elements in studied herbal drugs are tabulated in Table 3.

Results and Discussion

The results presented in Table 2 indicate that sodium, potassium, iron and calcium contribute maximum amount of their contents while cadmium, manganese and zinc are available in meager quantities. Copper, magnesium and nickel are present comparatively in reasonable amount. The presence of copper in *Asparagus racemosus* Willd., *Cissampelos pareira* Linn. and *Desmodium gangeticum* DC. is lower in comparison to other subjected drugs. The quantity of zinc was so negligible, that it could not be detected in *Calotropis procera* R.Br. These finding in respect of each drug can be established as a parameter to ascertain medicinal quality of the drug. In a prevous work, contributed by Aiyer and Kolamal (1953-66) reported the presence of the iron, manganese, calcium and sodium qualitatively in *Cissampelos pareira* L. Dhalla *et al.* (1961) reported the presence of calcium, iron, magnesium, potassium and sodium in *Withania somnifera* Dunal. qualitatively. The findings of present studies confirm the presence of these elements qualitatively and quantitatively. On the basis of availability of elements these herbal drugs can be undertaken for further studies on their respective role in different diseases.

Table 3 Quantitative data for inorganic elements in drugs

	Quantitative value, mg/g of ash									
Inorganic elements	AC	AR	CLP	CSP	CR	DG	NJ	PK	PZ	WS
1. Cadmium	0.0018	0.0009	0.0008	0.0011	0.0011	0.0003	0.0069	0.0022	0.0057	0.0016
2. Calcium	1.7240	0.1720	0.4140	0.2620	0.3950	0.9980	3.6110	1.8150	0.2370	1.2860
3. Copper	0.3100	0.0331	0.0962	0.2240	0.1950	0.0610	0.3720	0.8801	0.1150	0.0731

Quantitative value, mg/g of ash										
Inorganic elements	AC	AR	CLP	CSP	CR	DG	NJ	PK	PZ	WS
4. Iron	0.6601	0.2402	1.0530	1.1482	2.1700	0.5901	1.1191	0.9302	1.4821	0.2182
5. Magnesium	0.8592	0.1690	0.6274	0.4000	0.4330	0.2110	0.8912	0.7600	0.4140	0.1900
6. Manganese	0.0240	0.0074	0.0320	0.0173	0.0170	0.0082	0.0320	0.0110	0.0240	0.0038
7. Nickle	0.6740	0.1051	0.1471	0.0650	0.1190	0.0120	0.3910	0.6211	0.1890	0.1262
8. Potassium	30.3006	8.3200	4.8311	10.0700	9.2100	2.6312	11.0211	13.4000	7.7112	6.8722
9. Sodium	10.6203	14.6002	30.8900	20.9321	24.2400	10.8401	58.5700	15.9000	19.4000	15.0801
10. Zinc	0.0131	0.0720	ND	0.0093	0.0006	0.0181	0.1042	0.0016	0.0018	0.0026

Abbreviations : AC- *Acorus calamus* L.; AR- *Asparagus racemosus* Willd.; CLP- *Calotropis procera* R.Br.; CSP- *Cissampelos pareira* L.; CR- *Cyperus rotundus* L.; DG- *Desmodium gangeticum* DC.; NJ- *Nardostachys jatamansi* DC.; PK- *Picroorhiza kurroa* Royle ex Benth.; PZ- *Plumbago zeylanca* L. and WS- *Withania somnifera* Dunal.; ND- Not detected

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