

Determination of Trace Elements in an Ayurvedic Preparation Using Inductively Coupled Plasma–Mass Spectrometer

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Ayurvedic preparations contain various plant extracts. Plants take up number of mineral elements from various sources and when these plant extracts are used in the final preparation it is likely that some concentration of these elements may be present in the final ayurvedic preparation also. If the concentration of these elements exceeds the recommended value, it leads to toxic effects. Hence in the present study, a widely prescribed ayurvedic preparation used in infants and young children as digestive tonic was selected in order to find the concentration of various trace elements present in that preparation using inductively coupled plasma–mass spectrometer.

Plants contain many mineral elements, which play a crucial role in the physiological action attributed to them¹⁻³. Minerals that are essential nutrients can also exert toxic action if the hemostatic mechanism maintaining them within physiologic limits is unbalanced⁴. Significant concentrations of heavy metals have been found in a number of Asian medicines and cosmetics which affects infants very much⁵. High levels of lead may cause damage to proximal tubules, chromosomal aberrations⁵. Cadmium in excess may cause cerebral damage⁶. Arsenic accumulates in the body and ultimately cause gastrointestinal disturbances and peripheral neuropathy. Hence in the present study, the widely prescribed ayurvedic preparation used in infants and young children as digestive tonic was selected to find whether the level of these elements exceed the toxic levels in relation to the beneficial effects of these elements.

Each teaspoon full (tsp, 5 ml) of the ayurvedic preparation selected for our study contains oil of Mishreya 0.0018 ml plus 0.5 mg each of the extracts as mentioned

in Table 1. Dosage of this digestive tonic is usually 3 to 4 times a d. For infants of less than 1 mo age, the dose is ¼ to ½ tsp, for children in the age group of 1 mo to 6 mo, it is up to 1 tsp, of 6 mo to 1 y, the dosage is 2 tsp and till 2 y it is 2 to 3 tsp.

TABLE 1: VARIOUS PLANT EXTRACTS USED IN THE DIGESTIVE TONIC

Plant Extracts	
1.	Amalakai
2.	Biranjaspipa
3.	Ela
4.	Gokshura
5.	Guduchi
6.	Haritaki
7.	Himsra
8.	Jhavuka
9.	Kasamarda
10.	Punarnara

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The concentration of various elements were analyzed by using inductively coupled plasma-mass spectrometer (ICP-MS), plasma Quad PQ 1 (Fisons Instruments, U.K.) controlled by an IBM PC-XT microcomputer and associated software. The ion detection system consists of a channeltron electron multiplier (CEM) and a multi channel analyzer (Trichor Northern).

The sample was prepared⁶ by taking an aliquot of the Ayurvedic preparation, which was freeze-dried and weighed. The dried sample (0.5 g) was taken into a clean

beaker and 5 ml nitric acid was added, covered with a watch glass and left to cold soak for 7 d. A further 5 ml nitric acid was added, watch glass was replaced and heated at 80° for 4 h and then at 180° until solution volume is reduced to 5 ml. The beaker was removed from hot plate and allowed to cool for 1 min. Carefully 1.0 ml hydrogen peroxide was added drop wise to the solution. After the reaction subsided, the beaker was covered with watch glass and kept on a hot plate. When the evolution of brown NO₂ fumes ceased, hydrogen peroxide addition was repeated 4 times and the solution was allowed to cool for 1 min before

TABLE 2: PLASMAQUAD ANALYSIS REPORT

Elements: Concentration								
Marketed	Co	19.26	Te	316.60	Hg	553.89	Fe	6283.27
Ayurved	Rb	67.45	Ti	355.24	V	13909.07	As	2522.44
Prepn.	Cs	16.90	Cu	423.01	Ba	1603.19	Pb	2207.53
	Ga	58.56	Sr	221.21	Zn	7978.36	Ni	7696.96
	Sb	56.96	Cr	753.89	Rh	10000.00	Se	2308.97
	Ti	22.74	Cd	157.79	Mn	1426.89	Bi	10000.41
Standards Used								
NISTSTD	Co	25.89	Te	1.82	Hg	2.66	Fe	99.63
	Rb	0.75	Ti	99.88	V	65.92	As	64.01
	Cs	0.36	Cu	29.41	Ba	917.01	Pb	23.92
	Ga	9.32	Sr	221.78	Zn	66.04	Ni	49.24
	Sb	0.45	Cr	18.99	Rh	100.00	Se	26.46
	Ti	6.34	Cd	18.05	Mn	33.49	Bi	99.99
NPL 100	Co	93.25	Te	99.91	Hg	105.37	Fe	88.32
	Rb	92.26	Ti	87.08	V	82.64	As	98.56
	Cs	100.85	Cu	88.69	Ba	100.08	Pb	194.34
	Ga	93.62	Sr	103.13	Zn	86.09	Ni	92.75
	Sb	99.19	Cr	91.91	Rh	100.00	Se	86.14
	Ti	101.21	Cd	212.77	Mn	90.76	Bi	100.00
In water	Co	26.00	Sr	227.00	Zn	66.00	As	49.00
	V	45.20	Ba	44.00	Mn	28.00	Ni	49.00
	Cu	21.90	Cr	18.60	Cd	20.00	Se	9.70
	Pb	23.70	Ti	8.00	Fe	99.00	Bi	11.00

Concentrations are in ppb (ng/ml), Internal Standards used are: Rh, Bi.

each addition. After the final addition of hydrogen peroxide the solution (pale yellow) was cooled and 5.0 ml per chloric acid was added and heated at 180° for 1 h. The watch glass was removed and heated until approximately 1 ml remained in the beaker. The solution was cooled for 1 min and 2 ml hydrogen peroxide was taken, adding 1 ml at a time. After each 1 ml addition the solution was kept on the hot plate until effervescence has ceased. The solution was cooled and 15.0 ml deionised water was added. It was gently heated for up to 5 min to get a clear solution. The solution was allowed to cool and transferred to the volumetric flask and diluted with deionised water to the required level and then the sample was analyzed by ICP-MS. A 100 PPb multi element mixture (NPL-100) was used as the calibration standard and also as an unknown. NIST standard 1643 b that was a highly dependable standard was also run along with the sample. Ruthenium and bismuth were used as internal standards and so the values cannot be used.

The sample, which was analyzed, contained a number of elements at different concentration as reported in Table 2. Some metals like V, Cu, Pb, Sr, Ba, Zn, Cd, Fe, As, Ni, Se, Bi were found to be present in concentrations higher than the acceptable levels of the same metals in drinking water (assuming a person consumes 2 l of water a day). As

the marketed ayurvedic preparation is intended for use in infants and young children, proper care should be taken to keep the concentration of the above mentioned elements at low levels. Since it is true that plants grown in polluted water, polluted atmosphere, hills and rocky areas take up a number of elements, it is necessary that the medicinal plants should be grown in a good environment.

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***In vitro* Permeation of Ionized and Unionized Diclofenac: Comparison of Chitosan Membranes with Rat Skin**

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To predict permeability of drugs through the skin chitosan membranes have been formulated. The *in vitro* permeability of ionized and unionized diclofenac through chitosan membranes has been compared with that of dorsal skin of Wistar rats. The chitosan membranes were prepared by cast drying to achieve thickness of hairless-dorsal-skin of Wistar rats. The thickness of chitosan membrane varied with change in concentration of chitosan and sodium tripolyphosphate. The

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