Open Access Contents
Int. J. Drug Dev. & Res.
| January - March 2015 | Vol. 7 | Issue 1 | ISSN 0975-9344 |
www.ijddr.in

Full Length Original Research Paper

Determination of essential and potentially toxic elements by ICP-OES method of Panchsakar Churna: An Ayurvedic Formulation

Kumar Puspendra[1*]

Patel Durgawati[2]

Murtuja Sheikh[1]

Sanjeev Chauhan[1]

Chauhan Nitesh[1]

Alam Sanjar[1]

[1]KIET School of Pharmacy, KIET Group of Institutions, Ghaziabad, 201206. Uttar Pradesh, India.
[2]Department of Chemistry, Government Nagarjuna Post Graduate College of Science, Raipur, 492001, Chhattisgarh, India

Corresponding Authors:
Puspendra Kumar
KIET School of Pharmacy
KIET Group of Institutions, Ghaziabad, 201206. Uttar Pradesh, India.
Email: puspendrapatel9@gmail.com

Abstract:
The current study was undertaken to estimate the concentrations of elements present and in formulations of Panchsakar churna i.e. in-house and three marketed formulations. Energy dispersive spectrometer (EDS) was used for elemental analysis in the field of quality control procedures and research concerned with plant samples and concentrations of various elements present were estimated by inductively coupled plasma-optical emission spectrometry (ICP-OES). One marketed formulation shows presence of cadmium, whereas Cr and Pb both are present in In house and marketed formulations. The high levels of Ca, Cu, K, Na and Mg are present in all the formulations of Panchsakar churna. This study indicates the presence of essential and potentially toxic elements are within the limit and formulation can be used on regular basis without any harmful effect.

Keywords: Panchsakar churna, Potentially toxic elements, ICP-OES, EDS, Ayurvedic formulation.

Introduction

Ayurvedic medicine is one of the ancient medicine systems of India several thousand years ago [1, 2, 3]. In many ancient texts like 'Atharvaveda', 'Rigveda'; 'Sushruta-Samhita' and 'Charak-Samhita'; use of plant medicines and polyherbal formulations were highlighted for health augmentation. Development of plant-based medicinal remedies and formulations for health care system through quotidian life experiences is a important part of cultural heritage of India [4, 5]

Ayurvedic formulations are easily available from ethnic markets, medical practitioners, health food stores, and online shops [6, 7]. Generally, Ayurvedic practice involves the use of medications that typically contain herbs, metals, minerals and other materials Ayurvedic practitioners usually make up their own medicines, but several companies manufacture and sell such formulations for the Indian market and/or other countries. [2, 3, 8].

Panchsakar churna is an Ayurvedic proprietary medicine mentioned in the Ayurveda Sarsangraha. This churna is used in constipation, piles and other abdominal diseases. Panchsakar churna is the composition of one part for each ingredient *Cassia angustifolia* Vahl. leaf, *Terminalia chebula* Retz. fruit, *Zingiber officinale* Rosc. rhizome, *Foeniculum vulgare* Mill. fruit and *Saindhava lavana*. Dose is 1-2 gm along with warm water or milk once or twice a day before or after food. [9, 10, 11] reported the risks of heavy metal poisoning associated with the use of Ayurvedic medicines. Many literature also reports lead poisoning from ayurvedic formulations [12, 13, 14, 15, 16]. The effects of elements like Cd, Hg and Pb on humans are well known; these

elements have not any known biological function in the human body system and are simply tolerated at low levels, but become toxic above certain concentrations. Other elements, such as Cr, Cu, Fe, Mn, Zn and As; are essential to human life at adequate levels, but they may have unassertive effects if their concentrations exceed certain threshold limits [17]. Hence it is very interesting to determine the element content in traditional Ayurvedic medicines, taking into account their role as nutrients and/or toxins. In this study we determined the presence of various elements by Energy dispersive spectrometer and assessed the levels of 16 elements (Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Si, Ti, V and Zn) in Panchsakar churna formulations. Concentrations were determined by inductively coupled plasma-optical emission spectrometry (ICP-OES) after sample mineralization in a microwave oven and the selected technique had the advantage of being multi-elementary; hence it provides the concentrations of the analytes of interest in a single run.

We estimated the elemental content of Panchsakar churna formulations (i.e. In house formulation and Marketed formulations); and compared the estimated daily intake of each element with reference values (Table 3), considering maximum tolerable intake levels or recommended nutrient amounts issued by internationally recognized organizations.

Materials and methods

Plant Materials

The plant materials of Panchsakar churna were collected from the different sources and standardized to maintain the quality and authentication of the crude drug. i.e. Senna (*Cassia angustifolia* Vahl.) was purchased from K. Mohamad and co., Tinnevally, Tamilnadu (India); Haritaki (*Terminalia chebula* Retz.) was collected from the Raigarh district of Chhatisgarh(India); Ginger (*Zingiber officinale* Rosc.) was collected from the Bilaspur district of Chhatisgarh(India); Fennel (*Foeniculum vulgare* Mill.) and Saindhav lavana was purchased from the local market of Ranchi, Jharkhand (India).

Parts of the ingredients was crushed to powder using grinder and passed through sieve number #85. In-house Panchsakar churna was prepared from these powders by mixing them in one part for each ingredient. Marketed Panchsakar churna supplied from three different companies were also procured and named as M1, M2 and M3.

Chemicals and instrumentation

Methanol, concentrated Nitric acid, concentrated hydrogen peroxide and concentrated hydrochloric acid were purchased from Rankem RFCL Limited. Weighing balance (Mettler Toledo AB265-S), UV-Visible Spectrophotometer (Shimadzu/UV-1700), Multiwave 3000 SOLV (Anton Paar) and Optical 2100DV inductively coupled plasma optical emission spectrometry (Perkin Elmer) were used for weighing, spectrophotometric analysis, digestion and elemental analysis respectively.

Elemental Analysis

The human body needs a variety of elements (often called minerals) for almost all aspects of body function. These elements are required in amounts that range from 50 µg to 18mg per day. There are more than 20 chemical elements necessary for humans. Deficiency in such essential nutrients Leads to a wide range of symptoms depending on the deficient mineral.

The Energy Dispersive Spectrometer (EDS) was used to irradiate the samples and to collect its

characteristic spectra. The system is fully controlled by an IBM PC using the software package XpertEase running under windows 3:1:1 and with the conditions like EDX Detector: Silicon, Window: SATW, Tilt (deg): 0.0, Elevation (deg): 33.0, Azimuth (deg): 0.0, Magnification: 750X, Accelerating voltage (kV): 20.00, working distance: 10mm. Before each run, the spectrometer is programmed by the user to operate under the appropriate fixed conditions for the sample using XpertEase. In the present work, the samples were irradiated under five different fixed conditions, namely Very light elements (VLE), Solids (S-V), Steels (ST), Medium elements (ME) and Very heavy elements (VHE). It is suitable for measuring the concentrations of the elements S through V using their K-Lines and the elements Ba through Sn using their L-lines. [18] Table 1.

Powdered sample (0.5 gm) was digested in Multiwave 3000 SOLV 3000 SOLV at 1400 watt for three hours in the solvent system of concentrated Nitric acid, concentrated hydrogen peroxide and concentrated hydrochloric acid in the ratio of 4:2:1; diluted to 100 ml and filtered. The heavy metals present in the sample were estimated quantitatively with the help of instrument ICP-OES. Calculations of the elements were done in mg/kg. (Table 2)

Results

Elemental analysis

Elements modify the action of drug on the body. So the elemental analysis was carried out. Presence of different elements in the in-house and marketed formulations were shown in Figure 1-4 and Table 1.

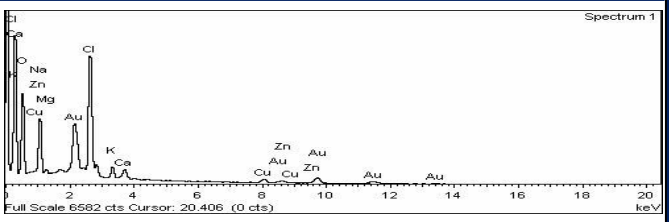

Figure 1: EDS spectra of Formulation-IH

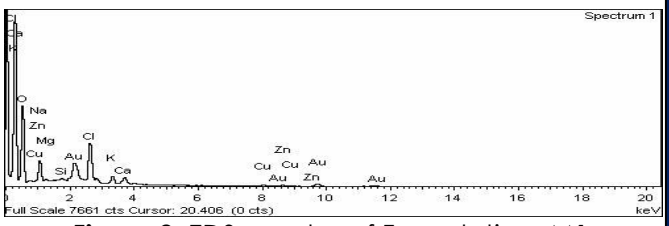

Figure 2: EDS spectra of Formulation -M1

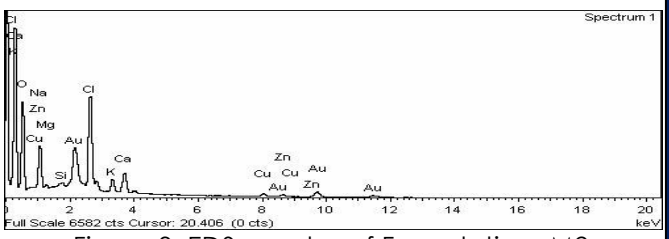

Figure 3: EDS spectra of Formulation -M2

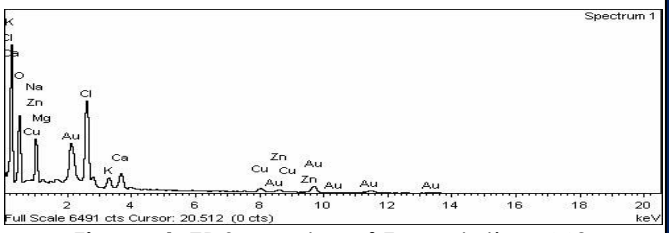

Figure 4: EDS spectra of Formulation -M3

Table 1: Weight percentage of different elements in Panchsakar churna formulations

S. No.	Name of element	Name of lines	Weight percentage of elements			
			IH	M1	M2	M3
1	C	K	40.03	38.88	37.52	41.47
2	O	K	23.07	25.34	26.28	21.36
3	Na	K	12.34	13.28	9.61	11.73
4	Mg	K	0.99	0.78	0.9	0.98
5	Si	K	--	0.68	0.61	--
6	Cl	K	11.87	10.24	12.49	13.49
7	K	K	2.66	3.04	2.98	2.75
8	Ca	K	2.54	3.05	4.93	3.65
9	Cu	K	4.22	2.77	2.47	2.62
10	Zn	K	2.28	1.94	2.21	1.95

Element concentrations in the investigated formulations are reported in Table 2. Formulation; M1 shows the presence of cadmium, whereas the presence of Cr and Pb are found in all the

formulation; formulation M3 contains higher concentration of Cr and Pb with reference to other formulations. The high levels of Ca, Cu and Mg are present in all the formulations. Higher concentration of K & Na was found in all the formulation because *Saindhava lavana* is present in the formulations.

Daily intake and reference values: The daily intake of each investigated element upon consumption of Ayurvedic medicines was calculated taking into account the posology reported in the product packages, when present, or indications from the literature. Minimum and maximum amounts ingested daily are reported in Table 3.

Table 2: Amount of different elements in various Panchsakar churna formulations

S. No.	Name of Element	Amount of Elements (mg/kg)			
		IH	M1	M2	M3
1	Ca	15605.329	18856.704	26006.888	21940.417
2	Cd	nd	0.192	nd	nd
3	Co	nd	0.192	0.405	nd
4	Cr	0.579	0.384	2.431	1.589
5	Cu	20216.258	12261.654	10794.165	9864.945
6	Fe	237.498	362.363	272.488	413.108
7	K	10208.534	12227.124	14965.559	12498.510
8	Mg	4999.035	3702.283	4442.869	4713.009
9	Mn	40.548	65.222	50.648	37.736
10	Na	61459.741	63763.668	56091.977	59346.574
11	Ni	0.579	0.767	2.836	1.390
12	Pb	1.545	2.110	2.431	5.760
13	Si	nd	1135.622	925.851	nd
14	Ti	nd	nd	nd	nd
15	V	nd	nd	0.203	nd
16	Zn	2183.047	2054.863	1983.306	2090.268

Asparagus racemosus (AR), *Tribulus terrestris* (TT), *Mucuna pruriens* (MP), *Withania somnifera* (WS), *Chlorophytum tuberosum* (CT), *In-house* formulation (IH), Marketed formulation (M), not detected (nd)

Table 3: Estimation of elements daily intake upon consumption of Panchsakar churna formulation (mg/day, minimum–maximum)

S. No.	Element	Formulations				Reference	
		IH	M1	M2	M3	Dosage (Per Day)	Parameter
1.	Ca	15.6053-62.4213	18.8567-75.4268	26.0069-104.0276	21.9404-87.7617	1000mg	RLNI (SINU)
2.	Cd	0.0000-0.0000	0.0002-0.0008	0.0000-0.0000	0.0000-0.0000	0.06mg	PTDI (JECFA)
3.	Co	0.0000-0.0000	0.0002-0.0008	0.0004-0.0016	0.0000-0.0000	0.05-1mg	RLNI (ATSDR)
4.	Cr	0.0006-0.0023	0.0004-0.0015	0.0024-0.0097	0.0016-0.0064	0.05-0.20mg	RLNI (SINU)
5.	Cu	20.2163-80.8650	12.2617-49.0466	10.7942-43.1767	9.8649-39.4598	1.2mg	RLNI (SINU)
6.	Fe	0.2375-0.9500	0.3624-1.4495	0.2725-1.0900	0.4131-1.6524	10mg	RLNI (SINU)
7.	K	10.2085-40.8341	12.2271-48.9085	14.9656-59.8622	12.4985-49.9940	3100mg	LARN (SINU)
8.	Mg	4.9990-19.9961	3.7023-14.8091	4.4429-17.7715	4.7130-18.8520	150-500mg	RLNI (SINU)
9.	Mn	0.0405-0.1622	0.0652-0.2609	0.0506-0.2026	0.0377-0.1509	1-10mg	RLNI (SINU)
10.	Na	61.4597-245.8390	63.7637-255.0547	56.0920-224.3679	59.3466-237.3863	575-3500mg	LARN (SINU)
11.	Ni	0.0006-0.0023	0.0008-0.0031	0.0028-0.0113	0.0014-0.0056	3-7mg	PSL (ATSDR)
12.	Pb	0.0015-0.0062	0.0021-0.0084	0.0024-0.0097	0.0058-0.0230	0.21mg	PTDI (JECFA)
13.	Si	0.0000-0.0000	1.1356-4.5425	0.9259-3.7034	0.0000-0.0000	700mg	SUL (EVM)
14.	Ti	0.0000-0.0000	0.0000-0.0000	0.0000-0.0000	0.0000-0.0000	0.0003mg	PSL (IPCS)
15.	V	0.0013-0.0027	0.0000-0.0000	0.0002-0.0008	0.0000-0.0000	0.01-0.02mg	PSL (EFSA)
16.	Zn	2.1830-8.7322	2.0549-8.2195	1.9833-9.9332	2.0903-8.3611	10mg	LARN (SINU)

PTDI: Provisional Tolerable Daily Intake, RLNI: Recommended Level of Nutrient Intake, PSL: Prescribed Safety Limit, EFSA: European Food Safety Authority, LARN: Recommended Level of Nutrient Intake, SUL: Safe Upper Level, EVM: Expert Group of Vitamins & Minerals, JEFCA: Joint FAO/WHO Expert Committee on Food Additive, SINU: Italian Society for Human Nutrition, EVM: Expert group on Vitamins and Minerals. ATSDR: Agency for Toxic Substances and Disease Registry, IPCS: International Programme on Chemical Safety. [19, 20, 21, 22, 23]

Covered in Scopus & Embase, Elsevier Int. J. Drug Dev. & Res., January-March 2015, 7 (1): 210-215

Discussion

The analysis of ingredients and samples of Panchsakar churna showed that they were passed the maximum tolerable limit of the elements. The comparison between the calculated daily intake of the analyzed elements upon use of the investigated products and reference values showed that the all the elements were present within the limit for in-house as well as marketed formulations. The given method can be used for determination of elements in any powder formulations.

Conflict of interest statement

We declare that we have no conflict of statement.

References

1) Patwardhan B, Vaidhya ADB, Chorchade M. Ayurveda and natural products drug discovery. Curr. Sci 2004; **86**: 789-799.
2) Balachandran P, Govindarajan R. Ayurvedic drug discovery, Expert Opin. Drug Discovery 2. 2007; 1631-1652.
3) Chopra A, Doiphode VV. Ayurvedic medicine: core concept, therapeutic principles, and current relevance. Med. Clin. North Am 2002; **86**: 75-89.
4) Hegde, H.V., Hegde, G.R., Kholkute, S.D., 2007. Herbal care for reproductive health: Ethnomedicobotany from Uttara Kannada district in Karnataka, India. Complementary therapies in clinical Research 13, 38-45.
5) Narayana, D.B.A., Katayar, C.K., Brindavanam, N.B., 1998. Original system: search, research or re-search. IDMA Bulletin 29, 413-416.
6) McElvaine MD, Harder EM, Johnson M, Baer RD, Satzger RD, Lead poisoning from the use of Indian folk medicines. J. Am. Med. Assoc 1990; **264:** 2212-2213.
7) Saper RB, Phillips RS, Sehgal A, Khouri N, Davis RB, Paquin J, et al. Lead, mercury, and arsenic in US- and Indian-manufactured Ayurvedic medicines sold via the Internet. J. Am. Med. Assoc 2008; **300:** 915-923.
8) Thatte UM, Rege NN, Phatak SD, Dahanukar SA. The flip side of Ayurveda. J. Postgrad. Med 1993; **39**: 179-182.
9) Kumar P., Jha S. and Naved T., 2011. Pharmacognostical characterization of an ayurvedic powdered formulation: panchsakar churna, International Journal of Research In Pharmacy And Chemistry, 1(4), 1034-1041.
10) Pathak RR. Ayurved Sarsangrah. 12th ed. Allahbad, India: Shree Baidyanath Ayurved Bhawan Ltd.; 2003. p. 589.
11) Dargan PI, Gawarammana IB, Archer JRH, House IM, Shaw D, Wood DM. Heavy metal poisoning from Ayurvedic traditional medicines: an emerging problem. Int. J. Environ. Health 2 2008; 463-674.
12) Dunbabin DW, Tallis GA, Popplewell PY, Lee RA. Lead poisoning from Indian herbal medicine (Ayurveda). Med. J. Aust 1992; **157**: 835-836.
13) Keen RW, Deacon AC, Delves HT, Moreton JA, Frost PG. Indian herbal remedies for diabetes as a cause of lead poisoning. J. Postgrad. Med 1994; **70**: 113-114.
14) Bayly GR, Braithwai A, Sheehan TM, Dyer NH, Grimley C, Ferner RE. Lead poisoning from Asian traditional remedies in the West Midlands-report of a series of five cases. Hum. Exp. Toxicol 1995; **14:** 24-28.
15) Prpic-Majic D, Pizent A, Jurasovic J, Pongracic J, Restek-Samarzija N. Lead poisoning associated with the use of Ayurvedic metal-mineral tonics J. Toxicol. Clin. Toxicol 2006; **34**: 417-423.
16) Tait PA, Vora A, James S, Fitzgerald DJ, Pester BA. Severe congenital lead poisoning in a preterm infant due to a herbal remedy. Med. J. Aust 2002; **177**: 193-195.
17) Merian E. Metals and Their Compounds in the Environment: Occurrence, Analysis and

Biological Relevance. Wiley-VCH, Weinheim; 1990.

18) Kumar P., Jha S. and Naved T., 2013. Pharmacognostical, physicochemical and elemental investigation of an ayurvedic powdered formulation: shatavaryadi churna, International Journal of Pharmaceutical Sciences and Research, 4(10), 4058-4066.

19) Giacomino A, Abollino O, Malandrino M, Karthik M, Murugesan V. Determination and assessment of the contents of essential and potentially toxic elements in Ayurvedic medicine formulations by inductively coupled plasma-optical emission spectrometry. Microchem. J. 2011; **99:** 2-6.

20) European Food Safety Authority (EFSA). Opinion of the Scientific Panel on Dietetic Products, Nutrition and Allergies on a request from the Commission related to the Tolerable Upper Intake Level of Vanadium, The EFSA J. 2004; **33:** 1-22

21) Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Zinc and Cobalt. US Department of Health and Human Services, Public Health Service. 1994. p.205-288.

22) Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Cadmium and Nickel. US Department of Health and Human Services, Public Health Service. 1999. p.205-293.

23) International Programme on Chemical Safety (IPCS). Environmental Health Criteria for Titanium. World Health Organization, Geneva; 1982.

Article History: ----------

Date of Submission: 16-01-2015

Date of Acceptance: 29-01-2015

Conflict of Interest: NIL

Source of Support: NONE