



**SHODHANA OF GANDHAKA WITH CHURNODAKA AND LAVANA DRAVAKA WITH
SPECIAL REFERENCE TO HEAVY METAL QUANTITY**

Dr. Udhaya Shankar T.*¹, Dr. Falguni B. Tandel² and Dr. M. R. Pandya³

¹Final Year PG Scholar, Dept. of Rasa Shastra & Bhaishajya Kalpana, Parul Institute of Ayurved, Parul University, Vadodara, India.

²Professor, Dept. of Quality Assurance, Parul Institute of Pharmacy, Parul University, Vadodara, India.

³Professor & H. O. D., Dept. of Rasa Shastra & Bhaishajya Kalpana, Parul Institute of Ayurved, Parul University, Vadodara, India.

***Corresponding Author: Dr. Udhaya Shankar T.**

Final Year PG Scholar, Dept. of Rasa Shastra & Bhaishajya Kalpana, Parul Institute of Ayurved, Parul University, Vadodara, India.

Article Received on 20/05/2018

Article Revised on 10/06/2018

Article Accepted on 30/06/2018

ABSTRACT

Rasa Shastra, the alchemic division of *Ayurveda* has described the use of several metal and minerals in treatment of diseases and maintenance of health. One such mineral, *Gandhaka*- the sulphur is prescribed in several diseases of skin but is restricted to be used unprocessed, as it may contain heavy metal impurities and other generic impurities of mines. In present study, the heavy metal analysis was checked by Inductively Coupled Plasma-Atomic Absorption Spectroscopy in raw *Gandhaka* and *Shodhita Gandhaka* with *Churnodaka* (lime water) and *Lavana Dravaka* (hydrochloric acid). The quantitative analysis shown that in raw sample lead, cadmium, mercury and arsenic were 9.64 ppm, 0 ppm, 1.15 ppm and 0.10 ppm respectively. Here it is observed that after *Shodhana* all four elements were not detected.

KEYWORDS: *Gandhaka*, Heavy metal, *Shodhana*.

INTRODUCTION

Rasa Cikitsa (treatment with metals and minerals) is considered to be one among the best therapies as they are able to show effect on diseases that are considered as *Asaadhya* (incurable).^[1] These drugs have no taste and show quick relief, even when used in lesser quantity.^[2] Above all *Rasa Cikitsais* irrespective to *Dosha*, *Dushya*, *Pumsa* (gender), *Desha* (habitat) and *Kala* (season).^[3]

Among the several *Rasa (Parthiva) Dravya* and their classifications, the *Gandhaka* (sulphur) is given an auspicious importance and is classified under *Upasaby* various *Acharya*.^{[4],[5]} Despite its auspiciousness *Gandhakacauses Chitta Vibhrama* (mental errors) and *Raktaja Vikara* (disorders related to blood) by increasing the body heat and hampers *Prasannata* (pleasantness), *Surupata* (good shape), *Shareerabandha* (compactness of body) and *Prabha* (lustre) when it is used in *Ashuddha* (impure) form,^[6] due to presence of *Shila Churna* (particles of stone and sand) and *Talaka-Pashanadi Visha* (arsenic and other elements / compounds).^[7] The arsenic and other such elements are classified as heavy metals and are considered dangerous to health.

Heavy metals are often assumed to be highly toxic or damaging to the environment.^[8] The term "heavy metal" has particular application to cadmium, mercury, lead and

arsenic all of which appear in the World Health Organisation's list of 10 chemicals of major public concern.^[9] Chromium, arsenic, cadmium, mercury and lead have the greatest potential to cause harm on account of their extensive use, the toxicity of some of their combined or elemental forms and their widespread distribution in the environment.^[10] These five elements have a strong affinity for sulphur; in the human body, they usually bind, via thiol groups (-SH), to enzymes responsible for controlling the speed of metabolic reactions. The resulting sulphur-metal bonds inhibit the proper functioning of the enzymes involved; human health deteriorates, some fatally.^{[11],[12]} The clinical presentations on exposure to heavy metals are as follows,^{[13],[14]}

Table 1: Effects of exposure to heavy metals.

Element	Acute exposure (usually a day or less)	Chronic exposure (often months or years)
Cadmium	Pneumonitis	Lung cancer, osteomalacia, proteinuria & kidney damage
Mercury	Diarrhoea, fever & vomiting	Stomatitis, nausea, nephrotic syndrome, neurasthenia, parageusia & pink disease
Lead	Encephalopathy	Anaemia, palsy, encephalopathy & nephropathy
Arsenic	Nausea, encephalopathy, vomiting, diarrhoea, arrhythmia & neuropathy	Diabetes, cancer & hypopigmentation/hyperkeratosis

Hence *Shodhana*(purification) of *Gandhakais* advised before any formulation. The *Shodhana* of *Gandhakais* described by various *Acharyas* with various methods and media.^{[16],[17]}

The heavy metals are validated quantitatively by several analytical techniques which includes Inductively Coupled Plasma & Atomic Absorption Spectroscopy (ICP- AAS). The spectroscopy uses Inductively Couple Plasma to produce excited atoms and ions that emit electromagnetic radiation at wavelengths characteristic of a particular element.^[18] AAS is an analytical technique used to measure a wide range of elements concentration in samples, where the free atoms of the sprayed element solution absorbed the radiation of the hollow cathode lamp of the analyzed element.^[19] The *Gandhakas* were analysed for heavy metals before and after *Shodhana*.

The metals and minerals are mined from earth which results in presence of impurities to a large extent. Hence *Shodhana*, the combination of processes which removes unwanted portion from the drug; control the unwanted or

toxic effect and enhances the medicinal properties of drug and make it suitable for desired action is employed. To cleanse, to extract, to sort, to clarify, to dehydrate, to stream, to de husk, to mix, to shift, to filter, to wash etc. words can be used to define the procedure of *Shodhana*.^[20]

MATERIALS AND METHODS

1. Collection of raw materials

Amlasara Gandhaka having *Harita-pita varnam* (greenish-yellow colour), *Sudha Churna*(lime powder) and *Lavana Dravakam*(hydrochloric acid) were procured and the *Shodhanas* were carried out as described^[21] in 3 batches.

2. Gandhaka Shodhana

Gandhaka Shodhana was done in *Rasa Shastra & Bhaishajya Kalpana* Laboratory, Parul Institute of Ayurved, following the classical guidelines of *Rasa Tarangini*.^[22] The whole process took 60 minutes for completion.

Table 2: Ingredients for shodhana.

Ingredients	English name	Quantity
<i>Ashuddha Gandhaka Churna</i>	Sulphur	100g
<i>Churna Jala</i>	Lime water	650ml
<i>Lavana Dravaka</i>	Hydrochloric acid	60ml
<i>Ushna Jala</i>	Warm water	QS

Method

Lime stones measuring 975g are taken, 3 times of water measuring 2925 ml is added to it and the clear water above called *Churnodaka*(lime water) is taken for use. 13 Parts of collected lime water measuring 650ml is taken and 2 parts of *Gandhaka* measuring 100g is mixed to it and heated in strong fire, till the mixture attains *Kapila*

Varnam (reddish colour). It is filtered with a big clean cloth into a glass vessel. When it gets cooled, it is stirred by adding little by little of *Lavana Dravakam* measuring 60 ml, till all the particles of *Gandhaka* settled down. Later the *Gandhaka* is collected and washed several (10) times in water and dried and thus the *Gandhaka* is purified.

Table 3: Quantitative observation of shodhana.

Batch	1	2	3
Quantity of <i>Churnodaka</i> (in ml)	650	650	650
Quantity of <i>Gandhaka Churna</i> (in g)	100	100	100
Temperature of <i>Kapila Varna</i> (in °C)	125	127	125
Quantity of <i>Lavana Dravaka</i> used (in ml)	60	60	60
Number of times washed	10	10	10
<i>Gandhaka</i> quantity obtained after washing and drying (in g)	79	84	72
Weight loss (in g)	21	16	28

OBSERVATIONS

- i. Practically, the *Gandhaka* doesn't melt until all water portions evaporate and the *Kapila Varnais* attained only after evaporation of water. Hence the melted *Gandhaka* is filtered through the clean cloth, into the glass bowl and is treated with *Lavana Dravaka*, measured sufficiently to submerge the *Gandhaka*.
- ii. As a method of precaution, the above mixture was diluted with enough water before being taken for wash.

3. Inductively Coupled Plasma- Atomic Absorption Spectroscopy

An Inductively Coupled Plasma or Transformer Coupled Plasma is a type of plasma source in which energy is supplied by electric currents which are produced by electromagnetic induction, that is, by time-varying magnetic fields.^[23]

Atomic Absorption Spectroscopy or Spectrophotometry is used in the heavy metal elements and some non-metal elements in the atomic state. It is designed to determine the concentration of an object element in a sample, utilizing the phenomenon that the atoms in the ground state absorb the light of characteristic wavelength passing through an atomic vapour layer of the element.

Table 4: Report of heavy metal analysis.

Elements	Limit as per API	<i>Ashuddha Gandhaka</i>	<i>Shuddha Gandhaka</i>
	Quantity (in ppm)	Quantity (in ppm)	Quantity (in ppm)
Lead	10	9.64	ND
Cadmium	0.3	ND	ND
Mercury	1	1.15	ND
Arsenic	3	0.10	ND

Abbreviations

API- Ayurvedic Pharmacopoeia of India
ppm- parts per million

DISCUSSION**Importance of Shodhana**

A formulation processed without purification is mere poison and can possibly be fatal, hence avoid a medicament to cause adverse effects, it is subjected to *Shodhana*.^[26] A poison readily spread throughout body and shows its noxious effects but with etiquette handling it can work like an elixir and cure diseases.^[27] Every *Acharya* of *Rasa Shastra* has mentioned the importance of *Shodhana* of *Rasa* and *Visha Dravya*. The importance of *Shodhana* is mentioned by a comparison of the ill-effects of the impure drugs with the medicinal effects of purified drugs, so that a *Rasashastri* obey the norm forever.

As described earlier *Shodhana* in *Rasa Shastra* and *Bhaishajya Kalpana* does not merely mean purification, it means something more by which *Sa-indriyatva* is achieved by the drug to be administered as medicine.^[28] This is why despite the availability of any element in their purest form they are supposed to be subjected for *Shodhana*, before addition to a formulation.

The light of characteristic wavelength emitted from a cathodic discharge lamp is absorbed when it passes through the atomic vapour generated from sample containing the element of examination atomised to ground state.^[24]

The obtained resultants were weighed, 25% from each batch was collected by simple random sampling and mixed and the analytical study was carried out.

Simple Random Sampling^[25]

The method of experimental study is applicable when the population is small, homogeneous and readily available. The principle of this method is that, every unit of population has equal chance of being selected. Hence this method is also called "unrestricted random sampling".

RESULT

- i. An average of 21.66% loss was observed in *Shodhana* of *Gandhaka*.
- ii. Instrumental analysis: ICP-AAS

Site of Commencement: Vasu Research Centre, GIDC Makarpura, Vadodara.

- i. Churnodaka is an alkaline soluble extract of calcium carbonate commonly called as milk of lime. $\text{CaCO}_3 + \text{H}_2\text{O} + \text{CO}_2 \rightarrow \text{Ca}(\text{HCO}_3)_2$

The milkiness disappears since calcium bicarbonate is water-soluble.

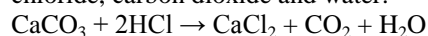
In industries it is used to clean toxic sulphur gases. $\text{Ca}(\text{OH})_2 + \text{SO}_2 \rightarrow \text{CaSO}_3 + \text{H}_2\text{O}$

It is indicated in treatment of *Visha*, *Krumi* and *Pittaja Vikarain Rasa Tarangini*.

- ii. *Lavana Dravaka*, the hydrochloric acid is a corrosive, strong mineral acid with many medical uses. As per modern references, it was discovered by alchemist *Jabir ibn Hayyan* around the year 800 AD^{[29],[30]} and was historically called *acidumsalis*, muriatic acid and spirits of salt because it was produced from rock salt and green vitriol by *Basilus Valentinus* in the 15th century and later from the chemically similar common salt (*Saindhava*) and sulphuric acid (*Gandhaka Dravaka*) by *Johann Rudolph Glauber* in the 17th century.

Hydrochloric acid has been used for dissolving calcium carbonate, i.e. such things as de-scaling kettles and for

cleaning mortar off brickwork, but it is a hazardous liquid which must be used with care. When used on brickwork the reaction with the mortar only continues until the acid has all been converted, producing calcium chloride, carbon dioxide and water:



iii. As the lime water has an affinity towards the toxins, on heating *Gandhaka* with lime water, the *Gandhaka* melts and loses its toxic contents into it. Then the added *Lavana Dravaka* absorbs the solidified lime with its impurities to leave behind pure sulphur on wash.

CONCLUSION

i. The method of *Shodhana* proves effective in removal of heavy metals. Comparative clinical study is necessary to determine the effect of this method of *Shodhana*.

ii. The safe to use *Gandhaka* can be obtained by any one method of *Shodhana*; still *Acharya* described different methods considering the *Guna* of the *Shodhana Dravya*.

REFERENCES

1. Dr. Indradev Tripathi. Rasaratnasamucchaya of Vagbhattacharya. Varanasi: Chaukhamba Sanskrit Sansthan, 2013.
2. Ambikadatta Shastri. Rasaratnasamucchaya of Vagbhattacharya. Edition- 9. Varanasi: Chaukhamba Amarabharati Prakashan, 1994.
3. Shri Brahmashankar Mishra. Bhaishajya Ratnavali of ShriGovind Das. Edition- 19. Varanasi: Chaukhambha Prakashan, 2008.
4. Kashinath Shastri. Rasa Tarangini of Sadananda Sharmana. Edition- 11. Delhi: Motilal Banarasidas; 2004. Chapter- 8.
5. Dr. A. D. Satpute. Rasaratnasamucchaya of Vagbhattacharya. Varanasi; 2006. Chapter- 3, Shloka- 1, Page no.53.
6. Kashinath Shastri. Rasa Tarangini of Sadananda Sharmana. Edition- 11. Delhi: Motilal Banarasidas; 2004. Chapter- 8, Shloka: 5 & 6: Page no. 175.
7. Dr. Damodar Joshi. Rasa Shastra. Varanasi: Chaukhambha Orientalia; 2013. Chapter- 5(ii): Page no. 199.
8. Duffus JH(2002) "Heavy Metals"-A Meaningless Term? Pure and Applied Chemistry, 74(5): 793-807.
9. Brathwaite RL, Rabone SD (1985) "Heavy Metal Sulphide Deposits and Geochemical Surveys for Heavy Metals in New Zealand". Journal of Royal Society of New Zealand, 15(4): 363-370.
10. Colin Baird & Michael Cann. Environmental Chemistry. Volume- 1. Edition- 5. New York: W. H. Freeman and Company, 2012. Page no. 519.
11. Colin Baird & Michael Cann. Environmental Chemistry. Volume- 1. Edition- 5. New York: W. H. Freeman and Company, 2012; 519-520; 567.
12. Rusyniak DE, Arroyo A, Accani J, Froberg B, Kao L, Furbee B. Heavy Metal Poisoning: management of intoxication and antidotes. Indianapolis: 2010, Page no. 387.
13. Neilen, MWF & Marvin, HJP. Food Contamination and Residue Analysis. Challenges in Chemical Food Contaminants and Residue Analysis. 2008, Page no. 10.
14. Afala & Wiener S. W. Metal Toxicity. Medscape.org; 2014.
15. Dr. A. D. Satpute. Rasaratnasamucchaya of Vagbhattacharya. Varanasi; 2006. Chapter- 3, Shloka- 19 to 25, Page no. 56-57.
16. Kashinath Shastri. Rasa Tarangini of Sadananda Sharmana. Edition- 11. Delhi: Motilal Banarasidas; 2004. Chapter - 8, Shloka- 7 to 31: Page no. 176-180.
17. Hieftje, Gray; et al. (1982). "Design and Construction of a Low-Flow, Low-Power Torch for Inductively Coupled Plasma Spectroscopy". Applied Spectroscopy. 36(6): 627-631. Bibcode: 1982ApSpe..36..627R. doi: 10.1366/0003702824639105. Retrieved 5 April 2015.
18. Robert Bunsen and Gustav Kirchhoff. "Science History Institute. Retrieved 20 March 2018.
19. Kashinath Shastri. Rasa Tarangini of Sadananda Sharmana. Edition- 11. Delhi: Motilal Banarasidas; 2004. Chapter- 2, Shloka- 52: Page no. 22.
20. Kashinath Shastri. Rasa Tarangini of Sadananda Sharmana. Edition- 11. Delhi: Motilal Banarasidas; 2004. Chapter - 8, Shloka: 26-31: Page no. 179.
21. Kashinath Shastri. Rasa Tarangini of Sadananda Sharmana. Edition- 11. Delhi: Motilal Banarasidas; 1979. Chapter - 8, Shloka: 26-31: Page no. 179.
22. High density fluorocarbon etching of silicon in an inductively coupled plasma: Mechanism of etching through a thick steady state fluorocarbon layer. T. E. F. M. Standaert, M. Schaepekens, N. R. Rueger, P. G. M. Sebel and G. S. Oehrleinc.
23. Dr. Devendra Joshi, Dr. Geeta Joshi. Quality Control & Standard of Ayurvedic Medicines. Edition- 1. Varanasi: Chaukhambha Orientalia; 2011: Page no- 143.
24. Mahajan. Methods in Biostatistics. Edition- 8. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd; 2016: Page no- 121.
25. Dr. Mona S Mashru, Dr. Damodar Pandey. A Comparative Pharmaco-Clinical study of Rasaparpati prepared from Anuvasita, Ashtasamskarita and Samanya Sodhita Parada. IPGT & RA. Jamnagar: 2001: Conceptual Study. Page no. 18.
26. Dr. Mona S Mashru, Dr. Damodar Pandey. A Comparative Pharmaco-Clinical study of Rasaparpati prepared from Anuvasita, Ashtasamskarita and Samanya Sodhita Parada. IPGT & RA. Jamnagar: 2001: Conceptual Study. Page no. 18.
27. Dr. Pramod R. Yadav, Dr. P. K. Prajapati, Dr. Galib, Dr. B. Ravishankar. The Pharmaceutical Standardization of Gandhakadi Yoga and its effect on Thalassaemic Iron Over Load w.s.r. to Kadali as

Pathya (Dietary Intervention). IPGT & RA. Jamnagar: 2010: Conceptual Study. Page no. 11.

28. "Human Metabolome Database: Showing metabocard for Hydrochloric acid (HMDB0002306)". www.hmdb.ca. Retrieved 2017-11-04.
29. Pubchem. "Hydrochloric acid". Pubchem.ncbi.nlm.nih.gov. Retrieved 2017-11-04.a