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Research Article

X-RAY FLUORESCENCE (XRF) ANALYSIS OF *ASHODHITA* AND *SHODHITA HARATAL*

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KEYWORDS: *Haratal, Shodhan, Swedana, Churnodaka, Ashudha,* XRF.

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ABSTRACT

In our classical texts, we find that *Shodhan* is defined as a process through which we attempt to remove impurities that may be present in any material of herbal or mineral origin. *Haratal* has been placed among the *Uprasavarga,* & along with *Manashila* & *Sankhiya* forms the *Mallavarga.* All these are highly toxic unless *Shodhan* is done. *Haratal shodhan* in our texts has been mentioned by subjecting it to *Swedana* in *Dola yantra*. The liquid medium being any, from the following i.e. *Kushmandaswarasa, Churnodak, Triphalakwathnimbuswarasa* etc, with the duration ranging from 1-2 *Prahar* (3 to 6 hrs). In the following study, *Ashudha haratal* was subjected to *Swedana* in *Churnodaka* for 2 *Prahar, i.e.,* for 6 hr. Samples were collected of *Ashudha haratal, Shudha haratal,* and the *Churnodaka* left after completion of *Swedan*. XRF analysis of *Shudha* and *Ashudha haratal* show that elements like iron were completely removed or in case of antimony and silicon reduction, was noted. While traces of elements like iron, arsenic etc were noted in the XRF analysis of the *Churnodaka* that was collected after the shodhan procedure. Since *Haratal* can be used in medicine/formulation after its purification, the current study has been undertaken to study the process of its purification (*Shodhan*).

INTRODUCTION

Shodhan is defined as the process by which we remove the impurities from any herbal or mineral material.[1] There are many ways to achieve this i.e. by *Bharjana, Swedansanskar, Nirvapan* etc. Some of the minerals in our texts have been mentioned which are purified by *Swedana* in *Dola yantra*. Only after the completion of this process we can use the minerals orally in proper dosage or use it as an ingredient for formulating other medicines. In case of *Haratal,* for formulating *Rasamanikya, Samirpannag rasa*, etc. *Haratal* (As_2S_3) also known as yellow orpiment is one of the toxic minerals mentioned in the classical texts. Taking it in its impure form causes decreases lifespan, *Vata* & *Kaphaprakopajanyavaydhi, Prameha, Santapa, Daha, Sphota*, etc.[2,3] In *Rasatarangini, Shodhan* of *haratal* has been mentioned to be done in *Churnodaka* by *Swedana* in *Dola yantra.*[4,5]

Aim & Objective

Aim

Study of *Shodhan* process of *Haratal* in *Churnodaka.*

Objectives

1) To analyse *Churnodaka* left after *Shodhan* process by XRF.
2) To analyse *Ashudha* and *Shudha haratal* by XRF.

Material & Method

Ingredients

Ashudha haratal Chuna and lime Water

Instruments and Equipments

S.S Vessel
Measuring cylinder
Cotton Cloth
Stove
Tongs
Stick/rod
Weighing machine
Khalva yantra

Method

1) In *Rasatarangini*, the ratio of lime to water is mentioned as 2 *Ratti* of lime to 5 *Tola* of water. 25 g of lime was added to 6 L of water and kept undisturbed for 24 hrs. Thus, *Churnodaka* was made.[6,7]
2) This was filtered through a cloth next day and used.
3) A coarse powder was made of *Ashudha haratal* and it was tied in a *Pottali*.
4) This *Pottali* was tied on to a stick/rod and suspended in a SS vessel, *Churnodaka* was added to this and filled to a level that the *Pottali* was submerged.
5) The SS vessel was kept on low flame for 6 hrs as mentioned in *Rasatarangini.*
6) Once the 6 hrs of *Swedan* were completed the *Pottali* was removed and the *Churnodaka* left behind was collected and was subjected for XRF analysis.
7) The *Shudha haratal* was then washed with lukewarm water and dried.

Fig 1: Schematic Representation of *Haratal Shodhan*

Results

Table 1: Temperature chart

Time	Temperature	
11:00	**29ºC**	
11:23	**92.5ºC**	Started boiling with fumes
12:30	**88.9ºC**	Fumes present
13:26	**87.3ºC**	Fumes present
14:20	**92.7ºC**	Fumes present
15:15	**96.8ºC**	Fumes present
16:20	**93.5ºC**	Fumes present
17:15	**98.8ºC**	Fumes present

Table 2: Physical parameters

	Ashudha haratal	***Shudha haratal***
Colour	Bright orange yellow	Golden Yellow
Mass	100g	82g
Luster	Present	Reduced Lustre

Analytical study

The analytical study was conducted Y.M.T Ayurvedic Medical College and Hospital, Kharghar, Navi Mumbai 410210. The XRF Analysis for *Haratal* before and after *Shodhan* was conducted at Varsha Bullion, Kalbadevi, Mumbai, whereas the XRF analysis of *Churnodaka* was conducted at *Shraddha* Analytical Services, Ghatkopar, Mumbai.

Table 3:Analytical study

	Ashudha haratal	***Shudha haratal***
pH [Electrode method]	7.52	8.04
L.O. D	4.031%	0.3%
Total Ash	6.82%	4.01%
Acid Insoluble Ash	5.38	3.18

Table 4: pH value

Churnodaka	**Before *Shodhan***	**After *Shodhan***
pH [Electrode method]	12.09	11.26

Solubility test[8]

Asudhaharatal was taken in a beaker and added to the chemicals mentioned in table 5, it was shaken well & heated. Solubility was observed on the basis of clarity of mixture.

Table 5: Solubility test

Chemical	***Ashudha Haratal***	***Shudha Haratal***
Distilled water	Not soluble	Partially soluble
Conc. H_2SO_4	Not soluble	Partially soluble
Conc.HCl	Not soluble	Partially soluble
Methanol	Not soluble	Partially soluble
Ethanol	Not soluble	Partially soluble

Fig 2: Solubility Test

Table 6: XRF Analysis: Element concentration in %

Ashudha Haratal	**Mass%**	***Shudha Haratal***	**Mass%**
Silicon	1.036	Silicon	0.561
Sulfur	12.525	Sulfur	14.281
Calcium	0.913	Calcium	1.008
Iron	0.092	Iron	-
Arsenic	48.361	Arsenic	45.625
Antimony	1.040	Antimony	0.699
Oxygen	36.033	Oxygen	37.243
		Phosphorous	0.000

Table 7: Oxides concentration in %

Ashudha Haratal	Mass%	*Shudha Haratal*	Mass%
SiO2	2.216	SiO2	1.200
SO3	31.276	P2O5	0.000
CaO	1.277	SO3	35.661
Fe2O3	0.132	CaO	1.410
As2O3	63.854	As2O3	60.240
Sb2O3	1.245	Sb2O3	0.837

Table 8: *Churnodaka* After *Shodhan*

Elements	Mass%	Oxides	Mass%		Mass%
Sulfur	0.57	Sulfur	0.439	SO3	1.096
Calcium	34.90	Calcium	26.512	CaO	37.096
Iron	0.07	Iron	0.052	Fe2O3	0.074
Copper	0.05	Copper	0.035	CuO	0.044
Arsenic	64.42	Arsenic	46.723	As2O3	61.690
		Oxygen	26.239		

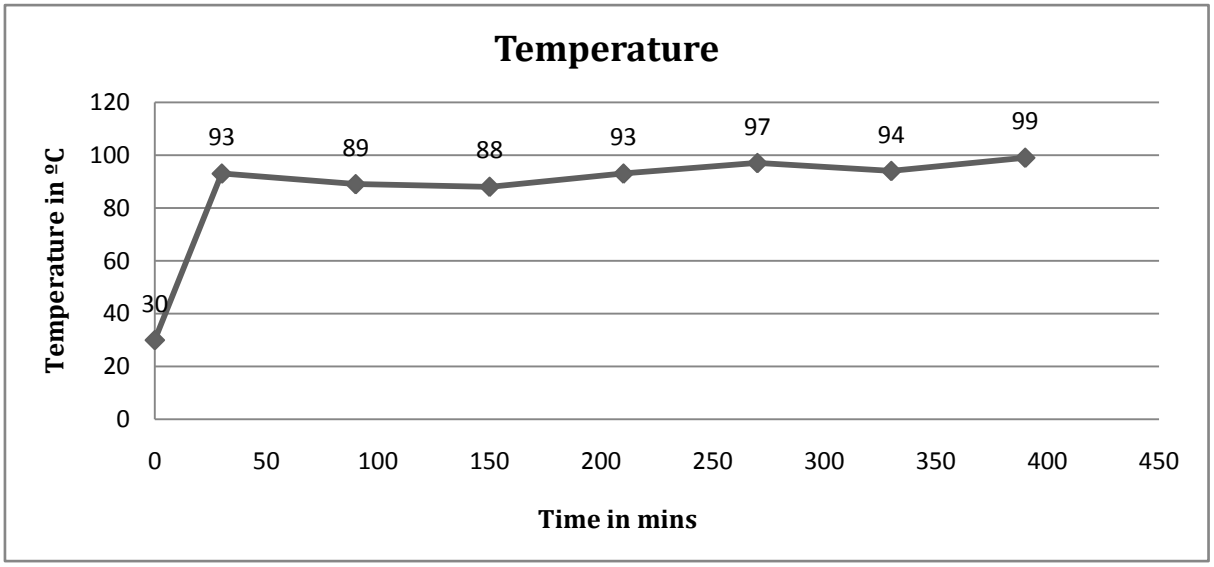

Fig 3: Graphical Representation of Temperature Chart

The pH of *Ashudha haratal* was 7.52 whereas that of *Shodhitharatal* was 8.04, also there was difference in the pH of *Churnodaka* used, before *Shodhan* it was 12.09 while after *Shodhan* it was 11.26. This shows that there was increase in alkalinity of *Haratal* after purification. The L.O.D and Total Ash of *Shudha haratal* was less than that of *Ashudha haratal*, whereas the Acid Insoluble Ash was increased for *Shudha haratal*. As total ash indicates the amount of inorganic residue left behind, we can see that inorganic matter is reduced in the *Shudha haratal* sample. The solubilty tests showed that *Shudha haratal* is partially soluble in chemicals.

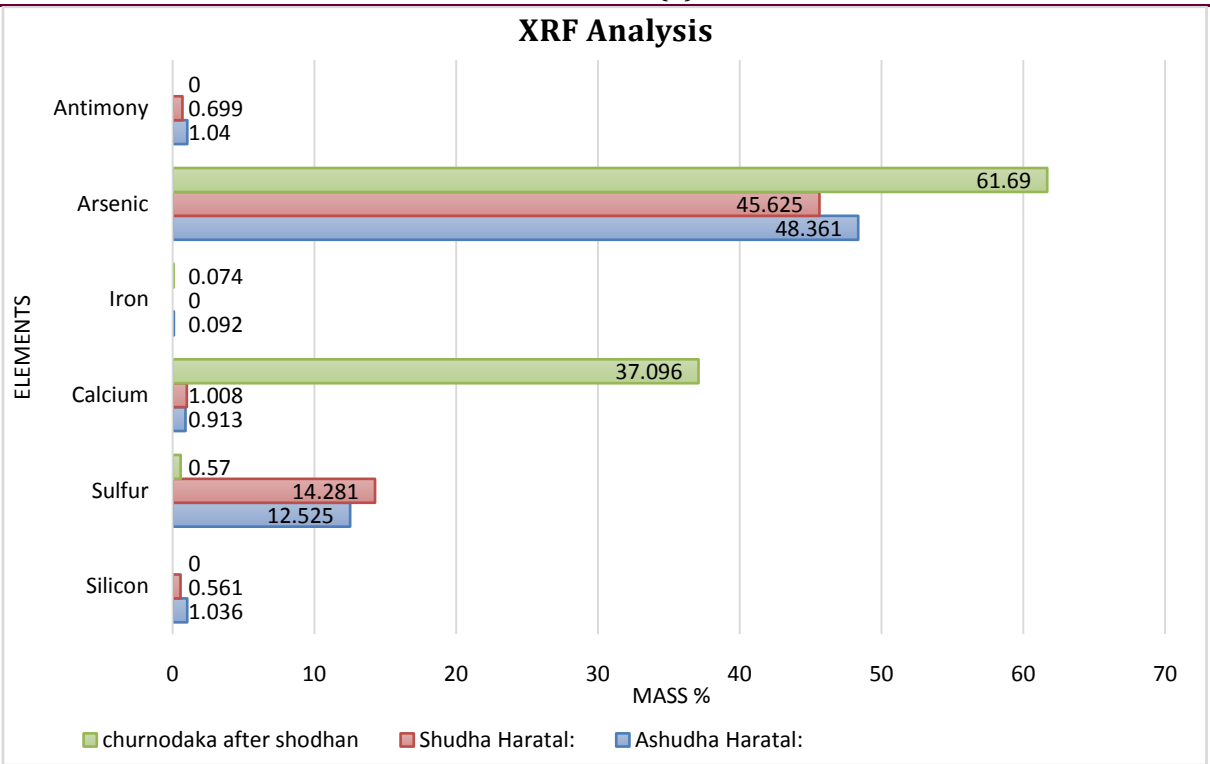

Fig 4: Graphical Representation of XRF Analysis

XRF analysis of *Ashudha haratal* and *Shudha haratal* shows that sulfur content had increased whereas arsenic was reduced. Also, we can see that iron was completely eliminated from *Shudha haratal* while there are traces of it in the *Churnodaka* sample. The other elements that we found reduced in the *Shudha haratal* were antimony and silicon, while calcium content was slightly increased. From the XRF analysis of the *Churnodaka* which was collected after *Shodhan,* we can see the presence of sulfur and arsenic [fig 4]. Observing the XRF reports, we can verify that *Shodhan* does remove impurities i.e. *Mala-vichitaye.*

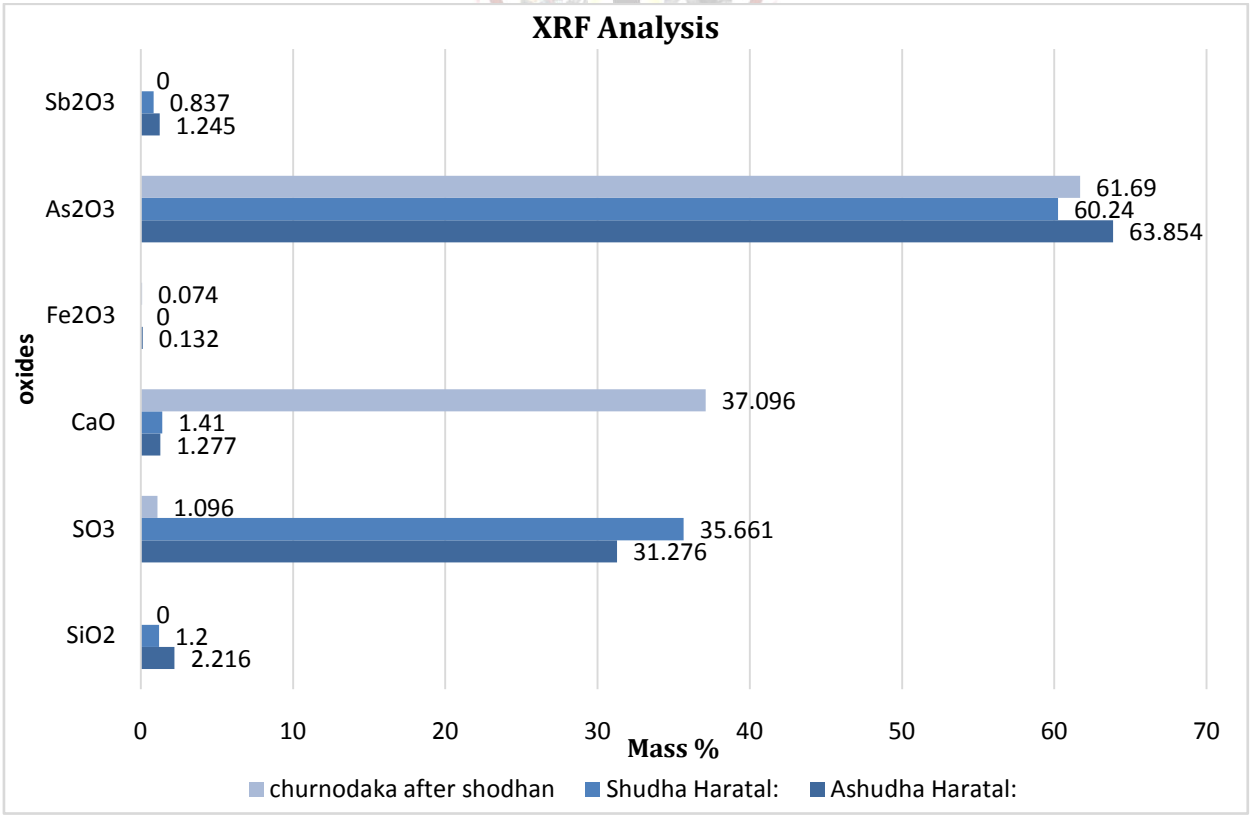

Fig 5: Graphical Representation of XRF Analysis [oxides]

CONCLUSION

Physically the *Ashudha haratal* appears to be shinier than the *Shudha haratal*. From the initial weight of 100 g the *Shodhita haratal* weighed 82g. Therefore 18% loss in *Haratal* after the purification was evident. From the temperature chart, we can see that the temperature did not exceed 100ºC [fig3]. There were continuous fumes of sulphur once the *Churnodaka* started boiling.

Our ancient text advocate that *Shodhan* of any drug should be done before its use as an ingredient in any formulation. *Shodhan* process eliminates all the impurities and foreign matter that is unwanted. Through the analysis of *Churnodaka* after the *Shodhan* of *Haratal* it can be seen that it contained traces of iron, copper etc. study conducted by Dr.Mishra. S.Shanker et al, comparative toxicity study on impure *Haratal*, pure *Haratal* and *Rasamanikya*, show no pathological changes, *Shodhan* reduces the toxicity of *Haratal*, also stating that detoxified *Hartal* and *Rasamanikya* are safe and least toxic to kidney. It makes *Haratal* suitable for better absorption without causing the epithelial cells damage of GIT. [9]

Further study on the various *Shodhan* process described by our *Acharyas* can be done to distinguish which *Shodhan* media gives better result using advanced analytical techniques. Since bioavailability of herbal drugs is decreasing day-by-day, use of metals, minerals etc is a great avenue for treating diseases. Therefore, we need to establish some of our basic concepts to satisfy the contemporary science and the general population. More can be done in this subject with the help of integrative approach in understanding our science.

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