

COMPARATIVE XRF STUDY OF *HINGULA* PURIFIED IN TWO DIFFERENT MEDIA

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ABSTRACT

Shodhana is the primary and paramount procedure mentioned in *Rasashastra* for nearly every *rasadravya*, (metals and minerals) before any is being used in the preparation of therapeutic drugs. For a given *rasadravya*, multiple methods of *shodhana* are mentioned in various *rasagranthas* (classical *rasashastra* literature). In the present study *Hingula shodhana* is done by trituration method using *Nimbuka swarasa* (lemon juice) and *Ardraaka swarasa* (ginger juice) separately. XRF (X-Ray Fluorescence) analysis was done for *Ashuddha* (Raw) *Hingula*, after 1st *bhavana* (trituration), 3rd *bhavana* and 7th *bhavana* and finally again after *prakshalana* (wash). Arsenic levels were seen reducing with subsequent *bhavanas*. Iron, Lead, Zinc, Calcium, Copper which were initially absent in Raw *hingula* were found in small quantities in subsequent samples as trituration with the above media was done.

KEYWORDS: *Hingula*, *Shodhana*, *Bhavana*, Trituration, XRF

INTRODUCTION

Rasashastra is a branch of Ayurveda which deals with use of metals and minerals in the preparation of therapeutic drugs. Most of these *rasadravyas* (metals and minerals) being toxic in nature, have to undergo certain procedures mentioned in *rasashastra* literature to make them suitable to be used as therapeutic drugs for internal consumption. *Shodhana* is the first among the many procedures and it involves mainly purification, partial or complete detoxification and preparation of the *rasadravya* for further processes.¹ *Hingula* which is identified as cinnabar (HgS) in authoritative Ayurveda literature, is a commonly used *rasadravya* in Ayurveda

therapeutics. According to different *Rasagranthas* (classical *rasashastra* literature) *Hingula shodhana* is done by triturating it in different media for a specified period of time. In the present study *Hingula shodhana* is done by two methods according to the reference of *Rasatarangini*. Both methods involve trituration but the media used are different. As per the references, triturating of *Hingula* was done using *Nimbuk swarasa* (Lemon juice)² and *Ardraaka swarasa* (Ginger Juice separately)³ and analysed and compared.

MATERIAL AND METHODS

Material

610 gm of *Ashuddha* (Raw) *Hingula* was procured from the local market. A sample of 2gm was taken out for XRF (X-Ray

Fluorescence) analysis, and the remaining *Hingula* was divided in two parts weighing 300 gm each and were labeled as HN (Nimbu swarasa shodhita Hingula) and HA (Ardraka swarasa shodhita Hingula).

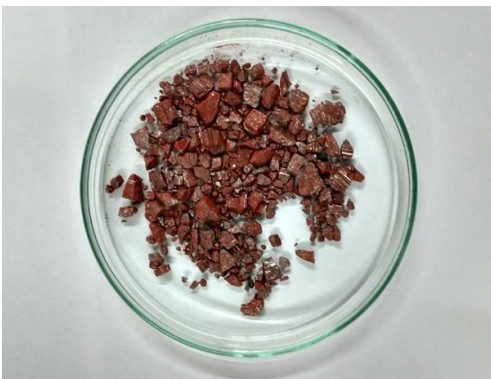
TABLE 1- MATERIAL FOR SHODHANA OF HN

SR. NO.	INGREDIENT	QUANTITY TAKEN
1.	Hingula	300 gm
2.	<i>Nimbuka swarasa</i> ie. Lemon(<i>Citrus limon</i>) Juice	1690 ml (in total throughout the procedure)

TABLE 2- MATERIAL FOR SHODHANA OF HA

SR.NO.	INGREDIENT	QUANTITY TAKEN
1.	Hingula	300 gm
2.	<i>Ardraka swarasa</i> ie. Juice of Rhizomes of Ginger (<i>Zinziber officinalis</i>)	1750 ml (in total throughout the procedure)

1.Ashuddha (Raw) Hingula



2.Nimbuka (Citrus limon)



3. Ardraka (Zinziber officinalis)

Method

Shodhana procedure for substances HN and HA were performed separately in separate mortar and pestle by a process called *bhavana*. According to *Rasatarangini*, the procedure that involves trituration of powdered substances (like metals, minerals etc.) with a liquid media till the added liquid dries up is termed as *bhavana*.⁴ HN was subjected to seven times *bhavana* with lemon juice and HA was subjected to seven times *bhavana* with ginger juice. First HN was taken in a mortar and pestle and grounded to fine powder. 300 ml lemon juice was added to it till the HN powder in the mortar was just submerged in the juice. Trituration was done till the contents in the mortar were dried up. After complete drying, a 2 gm sample was taken out for XRF analysis and labeled as HN 1st. Again 300 ml lemon juice was added to the contents in the mortar after 1st *bhavana* and again trituated till dried. Similar procedure was carried out further for 5 number times (quantity of lemon juice used at each *bhavana* given in Table 3), ie. as per *Rasatarangini*, a total of 7 *bhavanas* of lemon juice were given.² Samples for XRF were taken after 3rd and 7th *bhavana* (2 gm

each) and labeled as HN 3rd and HN 7th respectively. After 7th *bhavana*, *prakshalana* procedure was done. For this clean purified water was added to the above mortar and the mixture was thoroughly mixed and stirred using the pestle and later on allowed to sediment. After sedimentation, the water at the top was carefully decanted and the fine *hingula* powder sediment at the bottom was dried. This is *suddha hingula* obtained from *nimbuka swarasa bhavana* method. A sample of 2 gm was taken for XRF analysis and labeled as HN Wash. Similar procedure (seven *bhavana*) was carried out for HA except the lemon juice in the above procedure was replaced by Ginger juice (quantity of ginger juice used at each *bhavana* given in Table 3) as mentioned in *Rasatarangini*.³ 2 gm samples were taken at the same intervals as they were taken in case of HN and were labeled as HA 1st, HA 3rd and HA 7th respectively. *Prakshalana* procedure was done as mentioned above and dried to obtain *shuddha hingula* by *ardraka swarasa bhavana* method. A sample of 2 gm was taken for XRF analysis and labeled as HA Wash.

OBSERVATIONS



4. *Nimbuka and Nimbuka swarasa*



5. *Bhavana of Nimbuka swarasa*



6. Shuddha hingula by Nimbuka swarasa bhavana method.



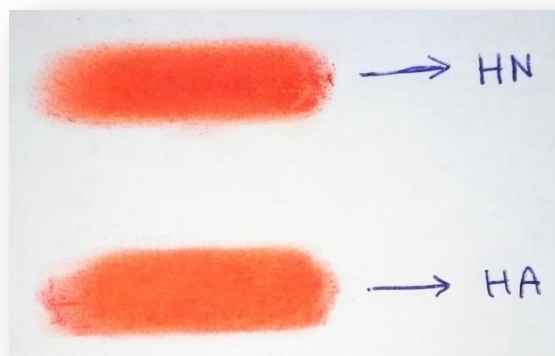
7. Ardraka and Ardraka swarasa



8. Bhavana of Ardraka swarasa



9. Shuddha hingula by Ardraka swarasa bhavana method.



10. 100 mg of *Shuddha* HN and *Shuddha* HA taken on white paper and rubbed for 20 times each using index finger and labeled respectively to elicit the slight difference in Red colour of both samples. Red colour of *Shuddha* HN is slightly brighter and darker compared to *Shuddha* HA

TABLE 3- QUANTITY OF LIQUID MEDIA USED FOR EACH BHAVANA PROCESS AND TIME REQUIRED FOR THE SAME

Sr. No.	Bhavana	HN Quantity of Lemon juice used in ml/ Time taken for bhavana in hours (hrs) and minutes	HA Quantity of Ginger juice used in ml/ Time taken for bhavana in hours and minutes
1.	1 st	300 ml / 5 hrs	300 ml / 5 hrs
2.	2 nd	300 ml / 5 hrs	300 ml / 5 hrs
3.	3 rd	250 ml / 5 hrs	270 ml / 4 hrs and 45 minutes
4.	4 th	210 ml / 4 hrs	220 ml / 4 hrs
5.	5 th	210 ml / 4 hrs	220 ml / 4 hrs
6.	6 th	210 ml / 4 hrs	220 ml / 4 hrs
7.	7 th	210 ml / 4 hrs	220 ml / 4 hrs

TABLE 4- IN-PROCESS OBSERVATIONS MADE DURING THE SHODHANA OF HN AND HA

Sl. No	Observations	HN	HA
1	Odour emitted while triturating	Distinct pungent	Ginger like
2	Colour of decanted water removed post <i>prakshalana</i> and sedimentation	Straw coloured and At the end Yellowish orange	Milky Light orange (milky was probably due the presence of white starch in ginger juice) and at the end milky dark orange
3	Appearance of <i>Shuddha Hingula</i>	Fine powder	Fine powder
4	Colour of <i>Shuddha hingula</i>	Red (Comparatively more brighter and darker)	Red (Comparatively a little dull and slightly lighter)
5	Smell of <i>shuddha</i>	Very light- pungent	Very light- ginger like

	<i>hingula</i>		
6	Initial weight	300 gm	300 gm
7	Total weight lost in Sampling	8 gm (4 samples taken, 2 gm each)	8 gm (4 samples taken, 2 gm each)
8	Final weight at the end of <i>shodhana</i>	284 gm	276 gm

RESULTS OF XRF ANALYSIS

X-ray fluorescence (XRF) spectrometry is an elemental analysis technique. XRF is based on the principle that individual atoms, when excited by an external energy source,

emit X-ray photons of a characteristic energy or wavelength. By counting the number of photons of each energy emitted from a sample, the elements present may be identified and quantitated.⁵

TABLE 5- ELEMENTS IDENTIFIED ON XRF ANALYSIS

Sl. No	Sample	Elements identified
1.	<i>Ashuddha (Raw) Hingula</i>	Hg, S, As
2.	HN after <i>shodhana</i>	Hg, S, As, Ca, Fe
3.	HA after <i>shodhana</i>	Hg, S, As, Ca, Fe, Cu, Pb, Zn

TABLE 6- QUANTITATIVE ANALYSIS OF ELEMENTS OTHER THAN HG AND S IN SAMPLES TAKEN DURING SHODHANA OF HN IN MASS%

Element	<i>Ashuddha hingula</i>	HN 1 st	HN 3 rd	HN7 th	HN Wash
As	4.23	3.71	3.67	3.22	3.49
Ca		0.06	0.12	0.41	0.22
Fe		0.11	0.25	0.68	0.19

TABLE 7- QUANTITATIVE ANALYSIS OF ELEMENTS OTHER THAN HG AND S IN SAMPLES TAKEN DURING SHODHANA OF HA IN MASS%

Element	<i>Ashuddha hingula</i>	HA 1 st	HA 3 rd	HA 7 th	HA Wash
As	4.23	4.06	4.03	4	3.65
Fe		0.0218	0.0377	0.0332	0.0036
Pb		0.0462	0.0668	0.068	0.0982
Cu		0.0083	0.0245	<0.0001	0.0035
Zn			<0.0001	<0.0001	<0.001
Ca		<0.0001	<0.0001		

DISCUSSION AND CONCLUSION

The decanted water removed post *prakshalana* and sedimentation from HN was clear and straw colour whereas the decanted water removed post *prakshalana* and sedimentation from HA was milky and opaque probably due to the presence of starch in ginger juice. The water decanted initially was milky light orange in colour but

towards the end the colour grew slightly deeper and at the end it was milky dark orange. Some fine particles of *hingula* got adhered to the starch particles and got washed out might be the reason for this. The final yield from the purification by ginger juice method which was 8 gm less compared to the purification by lemon juice method is

also consistent with the hypothesis made (from the colour and appearance of decanted water) that fine particles of *hingula* did get adhered to the starch and got washed away during *prakshalana*.

In both methods of *shodhana* (*bhavana* by two different media), it was observed that *Hingula* was reduced to very fine powdered form. Thus reducing the particle size is one of the objectives behind the *shodhana* by trituration method as smaller particle size ensures greater surface area when the drug enters the body thus improving efficacy. Use of different media for *bhavana*, might have a therapeutic role but assessment of this was beyond the scope of this study. Arsenic (As) levels in *Ashuddha* (Raw) *Hingula* and after subsequent *bhavanas* in both the tables reveals that in both methods of *shodhana*, As levels show a decreasing trend. *Ashuddha Hingula* contained Hg, S and As. But after *shodhana* with lemon juice, the elements Ca and Fe were indentified. They kept on increasing quantitatively with subsequent *bhavanas* and finally showed a reduction after *prakshalana*. It can be hypothesized that these elements might be present in lemon juice. A review of research work done on lemons confirmed this.^[6] Similar was the case after *shodhana* with ginger juice and was supported by a research work done on *Zinziber officinalis*.^[7] Pb however is never found in *Zinziber officinalis* rhizomes naturally. It might be due to pollution in the soil. But to find a definitive cause behind this shows scope for further study. The present study has highlighted the changes in *Ashuddha Hingula* during and after its *shodhana* using lemon juice and ginger juice. In light of

these changes, a comparative in-vivo toxicity study of *Ashuddha Hingula* and *Shuddha hingula* can be considered as a scope for further study.

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ABBREVIATIONS AND SYMBOLS

Q.S – Quantum satis, As - Arsenic, Ca- Calcium, Fe- Iron, Pb- Lead, Cu- Copper, Zn- Zinc, Hg-Mercury, S-Sulphur

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