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A COMPARATIVE STUDY ON TWO METHODS OF NAVASAGAR SHODHANA

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ABSTRACT

In *Rasashastra* (the branch of *Ayurveda* that deals with pharmaceutical processing of *Ayurvedic* formulations), *shodhana* is a process that is employed either to detoxify, purify or to potentiate the efficacy of the raw materials (of herbal, mineral, metal or animal origin). *Navasagar* (NH_4Cl) is used in *Ayurveda* as a single drug as well as in the preparation of many *Ayurvedic* medicines. It may contain impurities & adulterants like sand, NaCl, etc. *Navasagar shodhana* aims at removing these impurities. In this paper we have documented *Navasagar shodhana* done by 2 methods & the Elemental analysis of *Navasagar* before & after *shodhana* using XRF technique.

KEYWORDS: *Navasagar, Shodhana, Rasashastra.*

INTRODUCTION

Ayurveda involves the use of drugs obtained from plant, animal & mineral origin. These crude drugs/ raw materials are naturally available, so they generally possess unwanted impurities, adulterants & toxic substances, which can lead to harmful health problems. Hence to prevent this, *shodhana* (purification/ detoxification) process of these raw materials is described in *Ayurveda* before they can be used as medicines. *Shodhana* is a process in which, *kshalana* (washing), *mardana* (pounding), *bhavana* (levigation), *swedana* (boiling), *bharjana* (frying), *nirvapa* (heating & dipping in specified liquids), etc. are carried out on raw materials with a view to eliminate impurities.[1] *Navasagar* (Ammonium chloride (NH_4Cl)) is an inorganic salt which comes under the group of '*Sadharana rasa'* in *Rasashastra*.[2] In *Ayurveda, Navasagar* is used as a *Jatharagni pradipak* (improves digestion/ appetizer),

saraka (purgative), *expectorant*, etc.[3] It is also used in the preparation of many *Ayurvedic* medicines such as – *Rasasindur, Shankha drava, Shwet parpati, Vrishchik danshahara lepa*, etc.[4] Raw *Navasagar* may contain impurities & adulterants like sand, NaCl, etc.[5] *Navasagar shodhana* aims at eliminating these impurities. In the classical *Ayurvedic* text *'Rasatarangini'*, two methods of *Navasagar shodhnana* are mentioned, they are-[3]

1. Dissolving the *Ashuddha Navsagar* in 3 times water, filtering it through filter cloth & then heating the solution till all the water evaporates leaving behind *Shuddha Navasagar*.[3]
2. By *Urdhvapatana* (sublimation) using *Damruyantra.*[3]

MATERIALS AND METHOD

Table 1: Materials for first method.

Ashuddha Navasagar	***Khalwa yantra***	**Weighing machine**	**Water**
Measuring cylinder	Stainless steel vessels & spoon	Cloth for filtration	Gas stove

Table 2: Materials for second method.

Ashuddha Navasagar	***Khalwa yantra***	**Weighing machine**	**2 earthen pots**	**Cloth**
Multani mati (soil)	Gas stove	Water	Pyrometer	Knife

***Navasagar shodhana* method 1**

- *Ashuddha Navasagar* was taken in *khalwa yanta* & powdered. With the help of weighing machine, 200 gm of *Ashuddha Navasagar* powder was weighed & taken in stainless steel vessel.
- To this, 3 times water i.e. 600 ml water was added. The mixture was stirred till the *Navasagar* completely dissolved in water.
- The above solution was filtered through 4 layers of filter cloth. Filtration was repeated 3 times.
- Then the solution was heated on gas stove on medium-low flame (initially on medium flame & when most of the water evaporated, the gas was turned to low flame; during this period the *Navasagar* solution was stirred continuously) till all the water evaporated leaving behind *Shuddha Navasagar* in fine white powder form.
- Weight of *Shuddha Navasagar* obtained was noted.

***Navasagar shodhana* method 2**

- With the help of weighing machine, 180 gm of powdered *Ashuddha Navasagar* was weighed & taken in one earthen pot.
- Another earthen pot having a round bottom was inverted & placed on top of the first earthen pot such that the mouths of both the earthen pots were perfectly aligned on each other.
- This joint between the two pots was sealed by *matkapad* layer (cloth strip was wrapped on the joint & *multani mati* paste (*multani mati* + water) layer was given on it). Then it was allowed to dry. Seven such *matkapad* layers were given to completely seal the joint. Thus the '*Damruyantra*' was prepared.
- The *Damruyantra* was then placed on the gas stove & heat was given to the lower pot.
- A Wet cloth was placed on top of the upper pot & I.V. drip set was used to ensure a slow steady flow of cool water on this cloth to keep the cloth continuously cool throughout the process, thus maintaining the cool temperature of the upper pot in comparison to the lower pot. (Fig. 1).
- Temperature of the upper pot & lower pot was monitored throughout the process using pyrometer.
- The outer temperature of the lower pot was maintained between 300-320^{0}C since *Navasagar* sublimates at 338^{0}C. Outer temperature of the upper pot was maintained in between 40-50^{0}C.
- This process was carried out for 3 hours.
- After 3 hours, heating was stopped & the *Damruyantra* was allowed to cool down at room temperature.
- After that, the *matkapad* layer seal was scrapped & removed using a knife. The upper pot was carefully separated.
- *Shuddha Navasagar* deposited inside the upper pot (Fig. 2) was collected & weighed.
- The impurities that remained behind in the lower pot (Fig. 3) were also collected separately & weighed.

Fig. 1 ***Damruyantra***

Fig. 2: *Shuddha Navasagar* deposited in upper pot.

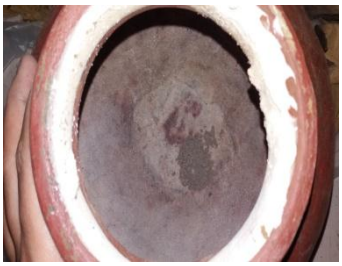

Fig. 3 Impurities that remained behind in lower pot

OBSERVATIONS

Table 3: Observations.

	Method 1 (Filtration Method)	**Method 2 (*Urdhvapatana* Method)**
Time required for complete procedure	4 hours	3 days (2 days for preparing *damruyantra* by giving *matkapad* layer + 1 day for *urdhvapatana*)
Color & form of *Shuddha Navasagar*	White coloured fine powder	Yellowish white coloured fine powder.
Weight of *Navasagar* before *shodhana*	200 gm	180 gm
Weight of *Navasagar* after *shodhana*	199 gm	60 gm
Total loss in weight after *shodhana* process	1 gm	120 gm
Percentage of loss in weight after *shodhana* process	0.5%	66.67%
Weight of impurities	Very few impurities like a few sand particles were observed on the filter cloth after filtration; but these impurities could not be collected for weighing.	2.053 gm (In the form of fine powder brownish black in color)
Other observations during the procedure	When *navasagar* was dissolved in water the resulting solution became cool (endothermic reaction).	When lower pot of *damruyantra* was heated, white fumes were observed from the top of the upper pot even though there were no visible cracks in the pot. When the *Damruyantra* was opened, the *shuddha Navasagar* was observed to be deposited only near the mouth region of the upper pot & not at the round bottom region.

RESULTS

Table 4: Elemental analysis result of *Ashuddha Navasagar* by XRF technique.

No.	Component	Result
1	Cl	98.4 mass%
2	K	0.461 mass%
3	Ca	0.460 mass%
4	Si	0.448 mass%
5	Fe	0.122 mass%
6	Br	0.0243 mass%
7	Pb	0.0231 mass%
8	Cu	0.0173 mass%
9	Zn	0.0131 mass%

Table 5: Elemental analysis result of *Shuddha Navasagar* obtained by first method (filtration method) by XRF technique.

No.	Component	Result
1	Cl	99.8 mass%
2	CaO	0.0977 mass%
3	Fe_2O_3	0.0740 mass%
4	Br	0.0214 mass%
5	CuO	0.0082 mass%
6	ZnO	0.0061 mass%
7	PbO	0.0027 mass%

Table 6: Elemental analysis result of *Shuddha Navasagar* obtained by second method (*Urdhvapatana* method) by XRF technique.

No.	Component	Result
1	Cl	99.8 mass%
2	Fe_2O_3	0.101 mass%
3	CaO	0.0714 mass%
4	Br	0.0115 mass%
5	CuO	0.0082 mass%
6	ZnO	0.0070 mass%
7	SrO	0.0008 mass%

DISCUSSION

The two methods of *Navasagar shodhana* are based on the properties of *Navasagar* i.e. it is easily soluble in water & it sublimates at 338^0C temperature.[5]

The first method is based on the property of *Navasagar* that it is easily soluble in water. Using the first *shodhana* method, we can eliminate only those impurities & adulterants that are insoluble in water, like sand particles; but impurities like NaCl that are soluble in water

cannot be eliminated by this method as they would also dissolve in water along with *Navasagar* & easily pass through the filter cloth & sediment back when heated.

The second method i.e. *urdhvapatana* is based on the sublimation property of *Navasagar*. Sublimation is the process in which a solid turns to a gas without first forming a liquid (or vice versa).[6] When *Navasagar* in the lower pot of *Damruyantra* is heated, it sublimates at 338^0C & is converted in to gaseous state. These vapours then rise up in the *Damruyantra* & come in contact with the cool surface of the upper pot, which converts the vapours back into solid state & it gets deposited inside the upper pot. This method of *shodhana* can be used to eliminate impurities that are both soluble & insoluble in water since sublimation is the special property of *Navasagar* & all those substances that cannot sublimate will remain behind in the lower pot & only *Shuddha Navasagar* will sublimate & get deposited in the upper pot of *Damruyantra.*

After the filtration process, the percentage of loss in weight of *Navasagar* was only 0.5%, since only insoluble impurities were eliminated by this process. Whereas after *urdhvapatana* process, the percentage of loss in weight of *Navasagar* was 66.67% even though the impurities that remained behind amounted to only 1.14%. The remaining 65.53% loss may be due to the percolation of water that was used to cool the upper pot through the porous surface of the earthen pot. *Navasagar* being readily soluble in water, must have dissolved in it & must have been brought to the surface of the upper pot of *Damruyantra,* some of it must have flowed down along with the water, whereas some of it may have evaporated. This may be one of the reasons why white fumes were observed from the top of the upper pot even though there were no visible cracks in the pot. This also explains why, when the *Damruyantra* was opened, the *shuddha Navasagar* was observed to be deposited only near the mouth region of the upper pot & not at the round bottom region. All the *Navasagar* that reached the round bottom region of the upper pot must have dissolved in the water that was used to cool the pot & since the area near the mouth of the upper pot was not in direct contact with water, the *shuddha Navasaagar* that deposited in this part remained as it is.

So it may be better to use a pot that is not porous instead of the traditional earthen pot used for making the *Damruyantra.* This can be the further scope for this study.

From the XRF analysis reports it is evident that the elements K & Si have been eliminated from *Ashuddha Navasagar* after the first *shodhana* method, whereas K, Si & Pb have been

eliminated after the second *shodhana* method. An increase of 1.4 mass% can be seen in the mass% of Cl in both *shuddha Navasagars* in comparison to the *ashuddha Navasagar*. It can also be observed that the rest of the elements have also been eliminated to some extent after both the *shodhana* processes & have remained only in trace quantities. The SrO element is seen in very trace quantity (0.0008 mass %) in *shuddha Navasagar* obtained by *urdhvapatana* method which may be the addition from the earthen pot.

CONCLUSION

Filtration method of *Navasagar shodhana* is useful for eliminating only those impurities that are insoluble in water.

Urdhvapatana (sublimation) method of *Navasagar shodhana* is useful to eliminate impurities that are both soluble/ insoluble in water. But instead of the porous earthen pot used for making *damruyantra*, it may be better to use some other pot (like borosilicate glassware) that is not porous, to prevent loss of *shuddha Navasagar*.

Since *Navasagar* contains impurities that are both soluble/ insoluble in water, it is better to use *urdhvapatana* (sublimation) method to eliminate all the impurities from it.

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