

Pharmaceutico-Analytical study of Naga Bhasma (Incinerated lead) Prepared by Two Different Methods

Research Article

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Abstract

Naga bhasma (Incinerated Lead) even though having potent qualities is rarely used by the physicians as a medicine due to the fear of toxicity. *Marana* is a procedure which is followed after the *Shodana* (cleansing) to remove the ill effects caused by the *Naga (Lead)* and to make it easily absorbable and assimilable in the body. As various methods are adopted in the preparation, it is difficult to know if the *Naga Bhasma* prepared by different methods is identical or not. In the current era analysis with the help of current technology is mandatory to study the difference in the properties of *Naga Bhasma*, hence the present work is being undertaken. *Naga* necessary for the study was procured from Bangalore and Udupi and Hyderabad. Preparation of *Naga Bhasma* was done as explained in *Rasa Ratna Samucchaya* by *Jarana* (roasting) method (Sample 1) and *Ayurveda Prakasha* by *Putra* (enclosed heating) method (Sample 2). In the Analytical study, various parameters such as *Bhasma Pariksha*, Organoleptic Characters, Physical Constants, Quantitative and Qualitative Analysis were measured. The *Naga Bhasma* prepared by *Putra* method was more convenient and cost effective based on the labour work, number of drugs used and the pH of the sample.

Keywords: *Naga, Naga Bhasma, Shodana, Marana, Jarana, Putra.*

Introduction

Word '*Dhatu*' indicates anything that supports and forms building component of a standing structure. The *Dhatu* (metals) form a big group of inorganic elements which are available in nature in various forms and in combination with undesired other elements which are not suitable for consumption by humans. The modification and development in *Rasashastra* are for the purpose of making these elements easily acceptable by the body and to provide maximum therapeutic benefits. This can be achieved through standard classical procedures like *Shodana* (cleansing) and *Marana* (Incineration).

Pooti Lohas are one among the various categories of *Dhatu*. The word *Pooti Loha* indicates the bad smell which is perceived while heating and melting.

Naga (Lead) is one among the *Pooti Loha*. In this study *Naga* with acceptable qualities was taken and subjected to *Shodana* and *Marana* procedures and the physicochemical analysis of *Naga* and *Naga Bhasma* was carried out in recognized laboratories. The purpose of this study is aimed at preparing two genuine samples of *Naga Bhasma* as per *Rasa Ratna Samucchaya* (Sample 1) and *Ayurveda Prakasha* (Sample 2), to find

out the most convenient and economical methods of preparation, comparing the two samples and establishing the standard values through analytical studies such as Organoleptic characters, Physical Constants such as Ash value, Total ash, Water soluble ash, Moisture content, pH, Quantitative analysis such as Volumetric/ Gravimetric analysis, Particle size assessment, pH value, Crystallography by X-Ray Diffraction, Namburi Phased Spot Test.

Materials and Methods

Pharmaceutical study

Materials

Grahya Naga procured from Bangalore was taken for the study as it fulfilled the *grahya lakshnas* and contained 96.27% of Lead in it.

Methods

Samanya Shodana of *Naga* will be carried out as per *Rasa Ratna samucchaya*.

Naga Bhasma Sample 1-*Visesha shodana* of *Naga* and preparation of *Naga Bhasma* will be carried out as per *Rasa Ratna samucchaya*.

Naga Bhasma Sample 2 – *Visesha shodana* of *Naga* will be carried out as per *Rasa Tarangini* and preparation of *Naga Bhasma* will be carried out as per *Ayurveda Prakasha*.

Experiment 1

Samanya Shodana of Naga (1)

Materials

- *Ashoditha Naga* (Impure lead) – 2 kg

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- *Tila taila* (Sesame oil) – 10.5 litres
- *Takra* (Buttermilk)– 10.5 litres
- *Gomutra* (Cow's urine)– 10.5 litres
- *Aranala* (Sour gruel) – 10.5 litres
- *Kulatha kwatha* (Horse gram decoction) – 10.5 litres

Apparatus

Iron vessels, spoon, *kosthi* (fire place), *Peethara yantra*, Pyrometer.

Procedure

A clean iron vessel was taken and *ashoditha Naga* (impure lead) was placed in it and was heated till the whole *Naga* melted and converted into liquid state. Later the molten *Naga* was poured through *Peethara Yantra* into *tila taila*. The same procedure was repeated for totally 7 times with fresh media being taken each time. At the end of the repetition for 7 times, *Naga* was washed with hot water dried and weighed. The same procedure was repeated in *takra*, *gomutra*, *aranala* and *kulatha kwatha*.

Table 1: Observations in Naga during the Samanya Shodana

Media	Quantity (before Shodana)	Quantity (after Shodana)	Loss / gain		Colour Changes	
			In grams	In %	Initial	Final
<i>Tila taila</i>	2000	2015	15 (gain)	0.75%	Grey	Dull silver
<i>Takra</i>	2015	1990	25(loss)	1.24%	Dull silver	Dull silver
<i>Gomutra</i>	1990	1700	290(loss)	14.57%	Dull silver	Bright silver
<i>Aranala</i>	1700	1600	100(loss)	5.88%	Bright silver	Bright silver
<i>Kulatha kwatha</i>	1600	1450	150(loss)	9.37%	Bright silver	Bright silver

Table 2: Changes in the media during Samanya Shodana

Media	Initial colour	Final colour	pH	
			Initial	Final
<i>Tila taila</i>	Light brown	Dark brown		-
<i>Takra</i>	White	Dull white	4.09	4.13
<i>Gomutra</i>	Yellow	Mud colour	7.93	9.14
<i>Aranala</i>	White	Dull white	3.48	5.30
<i>Kulatha kwatha</i>	Brown	Brown	6.92	6.66

Results

Initial quantity – 2000 grams
 Final quantity obtained – 1450 grams
 Loss of weight – 550gms (27.5%)

Experiment 2

Visesha Shodana of Naga as per Rasa Ratna Samucchaya. (2)

Materials

- *Samanya shoditha Naga* (purified Lead) – 550 grams
- *Nirgundi mula churna* (Powder of root of *Vitex negundo* Linn.) – 32 grams
- *Renuka churna* (Powder of seeds of *Vitex negundo* Linn.) – 32 grams
- *Haridra churna* (*Curcuma longa* Linn. powder) – 32 grams
- *Nirgundi patra swarasa* (Juice of *Vitex negundo* Linn. leaves) – 2 litres

Apparatus

Gas stove, iron vessel, *Peethara yantra*, spoon.

Procedure

Fine powders of *Nirgundi mula*, *Renuka* and *Haridra* were added to *Nirgundi patra Swarasa*, stirred well and kept aside. Iron vessel was taken and *Naga* was placed in it and heated. When *Naga* melted completely it was carefully poured through *peethara yantra* containing *Nirgundi swarasa*. This process was repeated

for 3 times. At the end of the procedure, *Naga* was washed with hot water, dried and weighed.

Observations

- *Naga* started to melt at 325°C.
- A layer of scum was formed above the molten *Naga* which was removed.
- The colour of the *visesha shoditha Naga* was bright silver.

Results

- Initial Quantity -550 grams
- Final quantity obtained – 500 grams
- Loss of weight – 50 grams (9.09%).

Experiment 3

Naga Marana as per Rasa Ratna Samucchaya - Sample 1 (3)

Materials

- *Visesha Shoditha Naga* (Pure Lead) – 500 grams
- *Shuddha Parada* (Purified Mercury) – 7 grams
- *Arjuna kshara* (ash of stem bark of *Terminalia arjuna* Roxb.) – 25 grams
- *Vibhitaki kshara* (ash of fruit of *Terminalia bellerica* (Gaertn.) Roxb.) – 25 grams
- *Aragwadha kshara* (ash of stem bark of *Cassia fistula* Linn.) – 25 grams
- *Dadhima kshara* (ash of outer covering of fruit of *Punica granatum* Linn.) – 25 grams

- *Apamarga kshara* (ash of whole plant of *Achyranthes aspera* Linn.) – 25 grams

Apparatus

Gas stove, iron vessel, spoon, khalwa yantra (Mortar and pestle), pyrometer, cloth.

Procedure

An amalgam of *Naga* and *Parada* (Purified Mercury) was prepared by grinding Molten *Parada* and Molten *Naga* together in *Khalwa Yantra* (mortar and pestle). This mixture of *Naga* and *Parada* was taken in a pan and heated. As the amalgam melted, *Arjuna kshara* was added to it and stirred continuously till the whole mixture got converted into powder. Later the stirring was done frequently and *Vibhitaki*, *Aragwadha*, *Dadhima* and *Apamarga kshara* were added to the mixture one after the other with the time interval of four days respectively and the heating was carried out for 21 days. The temperature during heating process was maintained in between 600 – 700^o C.

Observation

Total time duration taken for the *Marana* (Incineration) of the *Naga* was 21 days (480 hours).

Table 3: Observation in Naga Marana (Sample 1)

No. of days	Observation
Day 1	Molten <i>Naga</i> + <i>Arjuna kshara</i> continuous stirring. Fine droplets of molten <i>Naga</i> . After continuous stirring for 5 hours bright yellow coloured powder was formed.
Day 5	<i>Vibhitaki kshara</i> was added and stirring was done for around 30 minutes. The colour of the powder resembled ash with a dull yellowish tinge.
Day 9	<i>Aragwadha kshara</i> was added and stirring was done for around 30 minutes. The colour of the powder changed to grey with reddish tinge.
Day 13	<i>Dadhima kshara</i> was added to it and stirred for around 30 minutes. The colour of the powder resembled ash with reddish tinge.
Day 17	<i>Apamarga kshara</i> was added to it and stirred for around 30 minutes. The colour of the <i>bhasma</i> resembled ash with reddish tinge.
Day 21	The colour of the <i>bhasma</i> was red and heating was stopped.



Figure 1: Naga Bhasma (Sample 1)

Results

- Initial quantity – 500 grams (*Naga*)
- Final Quantity obtained – 240 grams
- Loss of weight – 260 grams (52%)

Experiment 4

Visesha Shodana of Naga as per Rasa Tarangini. (4)

Materials

- *Samanya shoditha Naga* (Purified lead) – 130 grams
- *Churnodaka* (limewater) – 6 litres

Apparatus

Gas stove, iron ladle, vessels, *peethara yantra*, pyrometer.

Procedure

Samanya Shoditha Naga was taken and melted in an iron ladle. After melting it was poured through *peethara yantra* into the vessel containing *Churnodaka* (Lime water). This procedure was repeated for 7 times with each time fresh *Churnodaka* being taken.

Observation

- *Naga* melted at 325^oC.
- A layer of scum was formed during the melting.
- No bad smell was perceived during melting.
- Initial pH of the *Churnodaka* was 10.43 and after *Dhalana* the pH was 8.93.

Result

- Initial quantity – 130 grams
- Final quantity obtained – 100 grams
- Loss – 30 grams (23.07%)

Experiment 5

Naga Marana as per Ayurveda Prakasha – Sample 2 (5)

Materials required

- *Visesha Shoditha Naga* – 100 grams
- *Shuddha Manashila* (Purified realgar) – 100 grams
- *Tambula patra swarasa* (Juice of *Piper betle* Linn.) – 850 ml

Apparatus required

Iron ladle, hammer, *sharava*, cora cloth, multani mitti gas stove, cowdung cakes, pyrometer.

Procedure

Visesha shoditha Naga was taken and heated. After melting it was soon poured into *khalwa yantra* and it was hammered to obtain thin sheet. The process was repeated till all the *Naga* was converted into thin sheets. The paste of *shuddha manashila* (Purified realgar) triturated with *tambula patra swarasa* (Juice of *Piper betle* Linn.) was then applied over *Naga* sheets and was allowed to dry under sunlight. After drying the sheets were enclosed in *sharava samputa* (sealed mud saucers).

Next day after drying, the *sharava samputa* was subjected to *puta* with 50 cow dung cakes. The temperature was recorded using a pyrometer and the *sharava* was collected only after self-cooling. The contents were collected and weighed. The temperature

recorded during the 1st *puta* exceeded the melting point of Naga and hence 30 cow dung cakes were used for the next *puta* and the temperature was recorded and noted. From the 2nd *puta* onwards *Manashila* was added in equal quantity to that of *Naga Bhasma* and was given bhavana with *tambula patra swarasa* and later *chakrikas*

(Pellets) were prepared and dried. The weight of the *chakrikas* were noted and subjected to *puta*. Next day after self-cooling *chakrikas* were collected. This process was repeated till *Bhasma Siddhi Lakshanas* were obtained.

Table No. 4: Observations during the *Naga Marana* (Sample 2)

No. Of Puta	Weight After Each Puta (grams). Initial weight of <i>Naga</i> 100 grams	Gain in%	Loss in %	Peak Temperature (celsius)	Weight of the Cow dung cakes (kg)
1	123 grams	23	-	512	5kg
2	121 grams	-	1.6	248	3.1kg
3	118 grams	-	2.47	252	3.1kg
4	116 grams	-	1.6	254	3.1kg
5	112 grams	-	3.4	249	3.1kg
6	110 grams	-	1.7	250	3.1kg
7	107 grams	-	2.7	250	3.1kg



Figure 2: *Naga Bhasma* (Sample 2)

Results

- Initial Quantity – 100 grams.
- Final quantity obtained – 107 grams.
- Gain - 7grams (7%).

Analytical study

Materials

Naga collected from 3 places and 2 samples of *Naga Bhasma* were subjected to analytical studies at SDM Centre for research and allied science - Udupi, Bangalore Test House -Bangalore and National Institute of Technology – Surathkal and MIT, Maipal.

- 3 Samples of *Naga* were collected from Bangalore, Hyderabad and Udupi.
- 2 samples of *Naga Bhasma* are as follows
- Sample I – Prepared according to *Rasa Ratna Samucchaya*.
- Sample II – Prepared according to *Ayurveda Prakasha*.

Methods

The above samples were subjected to following analysis.

- *Bhasmapariksha* as told in the classics.
- Organoleptic characters.
- Physical constants such as – loss on drying, total ash,

acid insoluble ash, water soluble ash and pH determination.

- Quantitative analysis by titration method.
- Crystallography by X-Ray Diffraction.
- Namboori Phased Spot test.
- Particle size assessment and elemental analysis by SEM –EDAX.

Bhasma Pariksha

Bhasma pariksha was carried out in the practical hall of Dept. of *Rasashastra & Bhaishajya kalpana*, SDMCA, Udupi.

- *Varitara*– Pinch of sample 1 & 2 of *Naga Bhasma* were taken in between the index and the thumb finger, pressed and were gently placed over the stagnant surface of water. Both the sample were found to be floating on the surface of the water. (6)



Figure 3: *Varitara* test (Sample 1)

Figure 4: *Varitara* test (Sample 2)

- *Unama* - A rice grain was placed over the floating *bhasma*, which also floated indicating *Unama* as positive for both the samples. (7)
- *Rekhapurna* – Pinch of sample 1 & 2 of *Naga bhasma* was taken in between the thumb and the index finger and was rubbed between the two fingers. The *bhasma* got embedded in the creases of the finger indicating *Rekhapurnatva* as positive for

both the samples. (8)

- *Nischandratva* – Pinch of sample of *Naga bhasma* was taken and observed under direct sunlight for the presence of metallic lusture. Both the samples passed this test as there was no lusture. (9)
- *Avami* - Pinch of sample 1 & 2 of *Naga bhasma* was taken and placed on the tongue. No nausea and vomiting were seen in both the samples indicating *Avami* as positive for both the samples.(10)
- *Nisvadu* – Pinch of sample 1 & 2 of *Naga bhasma* was taken and placed on the tongue individually. No taste was perceived indicating *Nisvadu* as positive for both the samples. (11)
- *Dantagrekachakacha* – Pinch of sample 1 & 2 of *Naga bhasma* was taken and placed in between the teeth and grinded. There was no harsh sensation indicating the test as positive for both the samples. (12)
- *Niruttha* – Equal quantity of sample 1 & 2 of *Naga Bhasma* and silver were taken and placed in different crucible and heated to 450⁰C for 1 hour. After self-cooling the silver was collected and the weight was noted. No increase in the weight of the silver was found, indicating *Niruttha* as positive for both the samples. (13)
- *Apunarbhava* – 2 grams of sample 1 & 2 of *Naga Bhasma* each were taken separately along with equal quantites of *gunja* (*Abrus precatorius* Linn.), *guda* (jaggery), *tankana* (Purified borax), *madhu* (honey) and *ghrita* (ghee) were taken and grinded. *Chakrikas* of both the samples of *Naga Bhasma* were prepared and dried and later was subjected to puta at 450⁰C. No metallic particles were seen after heating indicating *Apunarbhava* as positive for both the samples. (14)

Organoleptic characters

Organoleptic characters of *ashodita naga* and both the samples of *Naga Bhasma* was carried out in the practical hall of Dept. of *Rasashastra & Bhaishajya kalpana*, SDMCA, Udupi.

Table 5: Organoleptic characters of Ashodita Naga

Parameter	Sample 1
Appearance	Solid Mass
Colour	Dull Silver
Taste	Tasteless
Touch	Smooth
Odour	Odourless

Table 6: Organoleptic characters of Naga Bhasma

Parameter	Sample 1	Sample 2
Appearance	Powder	Powder
Colour	Red	Dull black
Taste	Tasteless	Tasteless
Touch	Smooth	Smooth
Odour	Odourless	Odourless

Physico – chemical analysis of *Naga Bhasma* was carried out at SDM Centre for research and allied science – Udupi.

Table 7: Physico – Chemical analysis of Naga Bhasma

Parameter	Naga Bhasma Sample 1	Naga Bhasma Sample 2
Loss on drying	0.46%	0.1%
Total Ash	96.27%	100%
Acid Insoluble Ash	23.21%	75.09%
Water Soluble Ash	11.28%	0%
pH	9.8	6.27

Percentage of Lead in *Naga Bhasma* (Sample 1 & 2) respectively was analysed at Bangalore Test House, Bangalore.

Table 8: Percentage of Lead in Naga Bhasma – Titration Method

Sample	% of Lead
Sample 1	37.93
Sample 2	70.81

X – Ray Diffraction (X-RD)

X- Ray Diffraction of *Naga Bhasma* (Sample 1 & 2) respectively was carried out at MIT, Manipal. Instrument used – X ray diffractometer.

Sample Preparation

About 1 gram of fine powder of both the samples of *Naga Bhasma* was placed in the sample holder of the X-Ray diffractometer. Surface of the sample was made flat to avoid any error out of the rough surface specimen. The X – ray diffractograms were taken in a X-Ray diffractometer with a target at 25KV and 10MA.

The reports of the X-RD showing the peak height intensity are shown below.

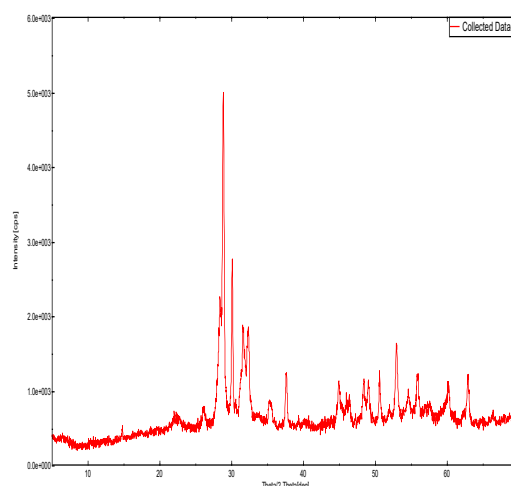


Figure 5: Naga Bhasma Sample 1

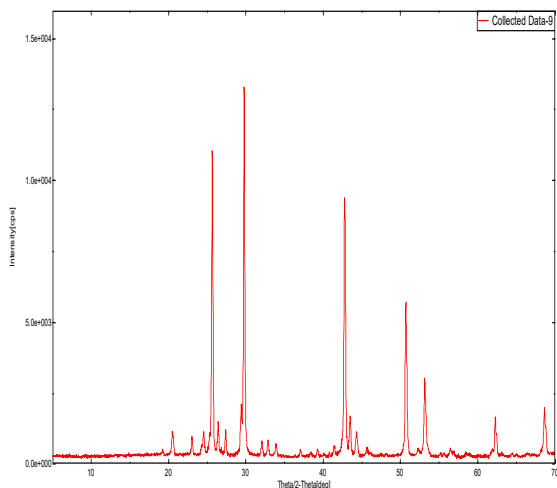


Figure 6: *Naga Bhasma* - Sample 2

The above 2 graphs indicate the crystalline nature of both the samples of *Naga Bhasma*.

Namburi Phased Spot Test (NPST)

NPST of *Naga Bhasma* (Sample 1 & 2) respectively was carried out in the practical hall of Dept. of *Rasashastra & Bhaishajya kalpana*, SDMCA, Udupi.

Apparatus

Petri dish, 0.5 ml pipette, Digital Balance, Test tubes, Whatman Paper No. 1.

Procedure

Two Whatman filter paper No. 1 were taken and were soaked in a petri dish containing 10% Potassium iodide Solution, removed and later allowed to dry. 0.25 grams of both the samples of *Naga Bhasma* were taken in a test tube and to this 0.5 ml of 5N HNO₃ was added and heated for a period of about 1 minute. The contents were later allowed to react for a period of 72 hours by shaking the test tube every now and then. After 72 hours the supernatant fluid was taken and was dropped with the help of a dropper at the centre of 10% potassium iodide paper. Observations were done up to 5 minutes (I phase), 20 minutes (II Phase) and 24 hours (III Phase).

Sample 1

1st phase - A solid yellow spot was formed which turned immediately into deep yellow central solid spot with a light red spot surrounding the yellow spot.

2nd phase – It continued to be the same in the 2nd phase.

3rd phase – The yellow colour around the central spot faded partially.

Sample 2

1st phase –A solid yellow spot was formed which turned immediately into deep yellow central solid spot with a dark red spot surrounding the yellow spot.

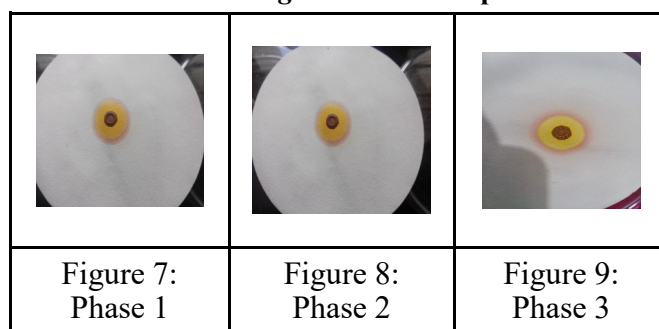
2nd phase – The red colour around the yellow spot was darker and started to spread.

3rd phase –The yellow colour around the central spot faded partially and the red spot surrounding the yellow spot was seen spreading further.

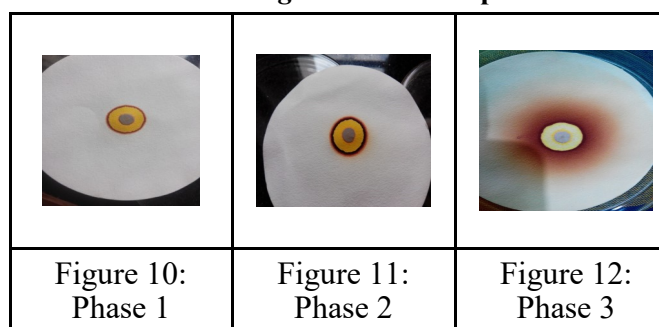
Dissimilarities in the NPST of the two samples.

- The central yellow spot in sample 2 was less bright than that of sample 1.
- The red spot surrounding the yellow spot in the sample 1 was light when compared to that of sample 2.
- The red spot did not spread further in sample 1 whereas in sample 2 it spread further.

NPST of *Naga Bhasma* Sample 1



NPST of *Naga Bhasma* Sample 2



Atomic Absorption Spectroscopy (AAS)

Percentage of Iron and Arsenic in *Naga Bhasma* by Atomic absorption Spectroscopy was carried out at Bangalore test house, Bangalore.

Instrument used – AAS spectrometer.

Apparatus

Nitric Acid, Hydrogen Peroxide, Microwave Digester, AAS Spectrometer, Volumetric flasks.

Procedure

0.5 grams of the samples of *Naga Bhasma* were taken in different digestion vessels. 8 ml of Nitric Acid and 2 ml of Hydrogen Peroxide were added to individual vessels and kept for 30 minutes and were digested at 150^oC for about 15 minutes. After digestion the volume was made upto 50 ml with MilliQ water. Blank and various concentrations of standard were prepared. Calibration curve was plotted using appropriate standards. *Bhasma* samples were analyzed and the results were calculated according to the weight of the samples taken for digestion.

Table 9: Percentage of Iron and Arsenic determined in Naga bhasma by AAS

Sample	Iron in %	Arsenic in %
Sample 1	6.28%	-
Sample 2	-	2.18%

Elemental analysis of Ashodita Naga and Naga Bhasma and particle size assessment of Naga Bhasma

Elemental analysis of *ashodhita naga*, *Naga Bhasma* (Sample 1 & 2) and particle size estimation of *Naga Bhasma* (Sample 1 & 2) was carried out at NITK, Surathkal.

Instrument used – Scanning Electron Microscope – Energy dispersive x-ray analyser (SEM - EDAX).

Elemental analysis of *ashodhita naga* and two samples of *Naga Bhasma* was done using Energy dispersive x-ray analyser whereas the particle size assessment of both the samples of *Naga Bhasma* was done using scanning electron microscope.

Sample preparation

Three samples of *ashoditha Naga* of an appropriate size and two samples of *Naga Bhasma* were taken so as to fit in the specimen chamber and were generally mounted rigidly on a specimen holder called the specimen stub and scanned under the microscope.

Table 10: Elemental Analysis of Ashodhita Naga (Impure Lead)

Elements (Mass %)	Bangalore	Hyderabad	Udupi
Lead (Pb)	97.36	59.69	69.01
Sulphur (S)	1.30	1.69	1.01
Carbon (C)	18.03	22.52	-
Oxygen (O)	1.34	14.63	10.47
Sodium (Na)	-	1.46	-
Aluminium (Al)	-	-	0.33
Tin (Sn)	-	-	1.15

Table 11: Elemental Analysis of Naga Bhasma

Elements (Mass %)	Sample 1	Sample 2
Lead (Pb)	40.26	65.14
Iron (Fe)	7.69	-
Calcium (Ca)	1.45	1.13
Potassium (K)	7.14	-
Oxygen (O)	10.89	10.58
Chlorine (Cl)	0.80	-
Tin (Sn)	1.77	8.71
Arsenic (As)	-	4.96
Zinc (Zn)	-	2.23

Particle Size Assessment Naga Bhasma - Sample 1

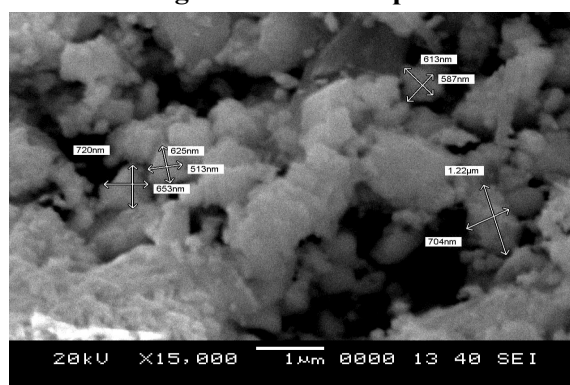


Figure 9: Naga Bhasma Sample 1

Naga Bhasma – Sample 2

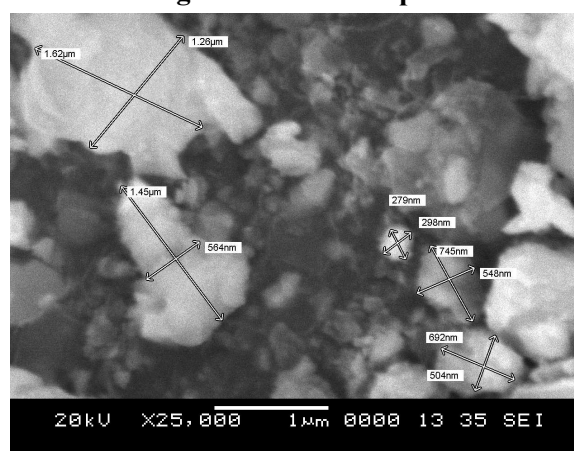


Figure 10: Naga Bhasma Sample 2

Discussion

In the treatises of *Rasashastra*, especially earlier books like *RasendraMangala*, *Rasarnava* used *Naga* for the purpose of *Dhatuwaada* and *Dehavada*, later from *Rasendra Chudamani* onwards detailed reference about *Shodana*, Marana Properties and indications of *Naga* can be seen. The Word '*PootiLoha*' indicates that when it is heated or melted it emits bad smell but practically it is not seen. Probably it may indicate the quick tarnishing to dull greyish colour when exposed to atmosphere by forming a complex mixture of compounds depending on the conditions. The colour of the compounds can vary. The tarnish layer can contain significant amounts of carbonates and hydroxycarbonates or the scum which is formed over the surface of molten *Naga* when being heated.

In *samanya shodhana* five liquid media were used out of which 3 liquid media were acidic, 1 was basic and 1 was neutral in nature respectively. The alternate heating and quenching in these acidic and basic liquid media may cause the removal of acid and alkali soluble impurities from the metal. Change in the pH of *takra* from 4.09 (acidic) to 4.13, change in the pH of *gomutra* from 7.93 to 9.14 and change in the pH of *aranala* from 3.48 (acidic) to 5.30 all signifies the removal of alkaline impurities, whereas change in the pH of *kulaththa kwatha* from 6.92 to 6.66 indicates the removal of acidic impurities.

Naga Bhasma (Sample 1)

Visesha Shodana of Naga was done in Nirgundipatra swarasa mixed with Nirgundimula, Haridra and Renuka churna. Shodana was done in Katu Rasa dravya i.e Nirgundi swarasa, which may be effective due to the pharmacological effects of Katu rasa such as agni deepaka, lekhana, sroto vilayana etc. As the definition itself says that Visesha Shodana is done to induce therapeutic property to the drug, hence it may be useful. Marana of Naga was carried out by amalgamation with Parada which helps in dissociation of metal. During heating on the 1st day a bright yellow colour powder was formed which signifies the oxidation process of lead resulting into the formation of Lead Oxide. Gradually when the heating continued the colour changed from yellow to dull red on day 7 and then finally red colour on day 18. The red colour of the Naga Bhasma signifies further oxidation of Lead Oxide to Tri Lead Tetra Oxide.

Naga Bhasma (Sample 2)

Visesha shodhana of Naga was done in Churnodaka, the probable reason for selecting churnodaka is, it being alkaline in nature will help in removing the acidic impurities present in the samanya shodhita Naga. For the Marana of Naga, fine sheets of Naga were prepared by continuous hammering which signifies the Malleability property present in the Naga even after the Shodana. 50 cow dung cakes were used for the Puta and it was observed that the maximum temperature reached 512^oC which was more than the melting point of Naga (326^oC), due to which some part of the Naga remained in the metallic form. The metallic form was separated from the powder form and was melted, made into thin sheets and was subjected to puta (with the paste of shuddha Manashila applied over it) with 30 cow dung cakes and the maximum temperature recorded was around 252^oC. Within 2 puta the whole of it got converted into powder form. Such 7 puta were required for the preparation of Naga Bhasma.

Table 12: Differences in both the procedures of Marana

Sl. No.	Sample 1	Sample 2
1	Method adopted - Jarana	Method adopted - puta
2	Time duration required for the procedure - 21 days.	Time duration required for the procedure - 23 days
3	Final quantity - 52% loss	Final quantity - 7% gain
4	Red coloured Bhasma	Dull black coloured Bhasma

Analytical Study

3 samples of Naga were purchased and analysed for grahya lakshnas. All the samples possessed the grahya lakshanas in it. Further all the samples were subjected to SEM EDAX for the estimation of Lead percentage. The sample procured

from Bangalore was found to have the highest percentage of lead in it (97.36%) compared to Udupi sample (69.01%) and Hyderabad (59.69%), hence Naga procured from Bangalore was used for the study. In the bhasma pariksha, Varitara and Unnama- were positive which indicated Naga Bhasma was so light in weight that it couldn't break the surface tension of water and had specific gravity less than that of water.

- *Rekhapurnatva* - Indicates the fineness of the Bhasma.
- *Nischandratva* - Absence of metallic lustre in the Bhasma indicates the absence of the metallic particles.
- *Avami* and *Nisvadu* - Both the samples of the Bhasma when placed over the tongue didn't produce any nausea and were tasteless which indicates absence of Naga in the metallic form.
- *Dantagre kacha kacha* - Indicates the fineness and softness of the particles.
- *Niruttha* - No gain in the weight of the Silver indicates complete absence of metallic particles.
- *Apunarbhava* - The *Mitra Panchaka* reduces the melting point of the drug. When the drug is heated with *Mitra Panchaka* if the Bhasma contains metallic particles, it will attain its original state. Metal did not regain its original form which indicates the absence of metallic particles.

Modern Analytical Parameters

The total ash, water soluble ash and acid insoluble ash contents have been widely used as one of the indices to illustrate the quality as well as purity of the medicine. The ash value is related to the inorganic material in the drug. The actual value depends upon the three factors, firstly the inorganic material naturally present in the drug, secondly addition by the processes and thirdly upon possible subsequent contaminations. The total ash method is designed to measure the total amount of materials remaining after the ignition. This includes both physiological ash which is derived from the drug itself and non-physiological ash which is the residue of the media used during the procedure.

Acid insoluble ash is the residue obtained after boiling the total ash with dilute hydrochloric acid, and igniting the remaining insoluble matter. This measures the amount of silica present as sand. Water soluble ash is the difference in the weight between the total ash and the residue after the treatment of total ash with water.

Naga Bhasma sample 2 is completely inorganic in nature as it contains 100% ash compared to Naga Bhasma sample 1 wherein it contains 96.27%.

The percentage of acid insoluble ash is more in the Naga bhasma sample 2 i.e. 75.09 % compared to that of sample 1 i.e. 23.21%. It could be due to the addition of sand from the *sharava* and *mulatani mitti* used for *Sandhibandhana*. The % of water soluble ash was nil in sample 2 whereas in sample 1 it was 11.28%. It could be due to the presence of water soluble part in the *Kshara* added during the procedure. The pH of the sample 2 is 6.27 which is nearly neutral

whereas the pH of the sample 1 is 9.8 which is alkaline. It indicates that the sample 2 with the neutral pH is fit for therapeutic purpose.

The % of Lead in impure Lead was 97.36% whereas in *Naga bhasma* sample 1 it is 37.93% which is less than *Naga Bhasma* sample 2 wherein it is 70.81%. Here the probable reason for the decrease in the quantity of lead in sample 1 could be because of the procedure which was conducted in an open environment that will lead to maximum oxidation.

X-RD analysis of both the samples of *Bhasma* shows that they are crystalline in nature.

Namburi phased spot test is done for the qualitative assessment of the drug wherein a chemical reaction takes place between the sample solution and the chemical paper used because of which a particular colour pattern is formed. NPST of both the samples of *Naga Bhasma* were nearly equal to the standards as mentioned in the books.

The elemental analysis of *Naga Bhasma* shows the presence of elements like Lead (Pb), Iron (Fe), Calcium (Ca), Potassium (K), Oxygen (O), Chlorine (Cl), Sulphur (S) in sample 1. The quantity of Iron estimated through AAS and SEM are 6.28 % and 7.69% respectively. The probable reason for the presence of iron may be due to the preparation of the *Bhasma* in an iron vessel and some part might have been present in the *kshara* (ash) of the different drugs which were added during the procedure. Presence of oxygen is due to the oxidation and elements like Calcium (Ca), Potassium (K), Chlorine (Cl) might be from the *kshara* added during the preparation. The element Sulphur (S) was present in the raw drug. Sample 2 contained elements like Lead (Pb), Calcium (Ca), Oxygen (O), Sulphur (S), Arsenic (As), Zinc (Zn). The quantity of Arsenic estimated through AAS and SEM are 2.18% and 4.96%. The probable reason for the presence of Arsenic is due to the addition of *Manashila* during the preparation of *Naga Bhasma*. Other elements like Calcium (Ca), Zinc (Zn) might have been present in *Tambulapatra* which was used as a *Bhavana dravya* (Liquid media for trituration). The element Sulphur (S) was present in the Raw Lead.

The particle size assessment of sample 1 shows particle size ranging from 382nm – 1.72 micro meter whereas the particle size assessment of sample 2 shows particle size ranging from 372nm – 1.62 micro meter. This indicates that the continuation of the procedure may reduce the maximum particles of the *Bhasma* to nano size.

Conclusion

Duration required for the Marana of Naga through *Jarana* method is 21 days and for that of *Putra* method is 23 days. The colour of *Naga Bhasma* prepared through *Jarana* method is red and *Putra* method is dull black. *Naga bhasma* prepared by *Putra* method is completely inorganic in nature as it contains 100% ash whereas in *Jarita* method 96.27% are inorganic materials with traces of organic materials

which signify the presence of carbon. The % of Lead in *Naga Bhasma* prepared through the *Jarana* method was 37.93 and in *Putra* method was 70.81. *Naga Bhasma* prepared by *Jarana* method contains trace elements like iron, Calcium, Potassium, Oxygen, Chlorine and Sulphur whereas that prepared by *Putra* method contains trace elements like Calcium, Oxygen, Sulphur, Arsenic and Zinc. pH of *Naga Bhasma* prepared by *Jarana* method was 9.8 and that prepared by *Putapaka* method was 6.27. *Naga Bhasma* prepared by *Jarana* and *Putra* method are crystalline in nature. Colour pattern obtained by the NPST shows that *Naga Bhasma* prepared by *Jarana* and *Putra* method are standard. Hence to conclude, *Naga Bhasma* prepared by *Putra* method was more convenient and cost effective based on the labour work, number of drugs used and the pH of the sample. Further Studies like toxicity, experimental and clinical studies can be carried out.

Reference

1. Vagbhata. *Rasa Ratna Samucchaya*. Reprint edition, New Delhi; Meharchand Lakshmandas Publications; 2007. 93p.
2. Vagbhata. *Rasa Ratna Samucchaya*. Reprint edition, New Delhi; Meharchand Lakshmandas Publications; 2007. 126p.
3. Vagbhata. *Rasa Ratna Samucchaya*. Reprint edition, New Delhi; Meharchand Lakshmandas Publications; 2007. 127p.
4. Sharma Sadanand. *Rasa Tarangini*. Reprint edition, New Delhi; Motilal Banarsidas; 2012. 458p.
5. Sri Madhava. *Ayurveda Prakasha*. 4th edition. Varanasi; Chwokambha Vishva Bharati ; 1994. 383p.
6. Vagbhata. *Rasa Ratna Samucchaya*. Reprint edition, New Delhi; Meharchand Lakshmandas Publications; 2007. 212p.
7. Vagbhata. *Rasa Ratna Samucchaya*. Reprint edition, New Delhi; Meharchand Lakshmandas Publications; 2007. 213p.
8. Sri Madhava. *Ayurveda Prakasha*. 4th edition. Varanasi; Chwokambha Vishva Bharati ; 1994. 285p.
9. Sri Madhava. *Ayurveda Prakasha*. 4th edition. Varanasi; Chwokambha Vishva Bharati ; 1994. 373p.
10. Sri Madhava. *Ayurveda Prakasha*. 4th edition. Varanasi; Chwokambha Vishva Bharati ; 1994. 285p.
11. Sri Madhava. *Ayurveda Prakasha*. 4th edition. Varanasi; Chwokambha Vishva Bharati ; 1994. 285p.
12. Vagbhata. *Rasa Ratna Samucchaya*. Reprint edition, New Delhi; Meharchand Lakshmandas Publications; 2007. 213p.
13. Vagbhata. *Rasa Ratna Samucchaya*. Reprint edition, New Delhi; Meharchand Lakshmandas Publications; 2007. 212p.
