

Pharmaceutical Standardization of Naga Bhasma

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ABSTRACT : Standard operating procedures (SOPs) should to be designed, implemented and set for all Ayurvedic drugs one by one for globalization Ayurveda. In this study, an attempt has been made to introduce SOPs for preparation of Naga Bhasma. Naga Bhasma was prepared three times by adopting two different methods. In the first method Parada and Gandhaka were taken as media, while the second method consists of Ashwattha (*Ficus religiosa*) and Manahshila (Realgar) as media. The percentage increase in the Naga Bhasma prepared by first method was 5.03%, while in case of Naga Bhasma prepared by second method was 6.09%. Raw drugs, in process materials and the final products were analyzed physico-chemically and comparison was drawn to lay down pharmacopoeial standards. The average percentage purity of Naga decreased from 97.38% to 81.44% after Shodhana. The percentage of (Pb) lead in Naga Bhasma was 28.29% and 30.80% respectively in first and second methods. Both the Bhasmas were in PbS form chemically with other elements in traces.

Key words : Shodhana, Marana, Standard Operating Procedure, Validation.

INTRODUCTION

A direct hindrance in the standardization of Ayurvedic drugs is the absence of standard parameters with which to compare a drug. Such parameters have to be designed, implemented and set for all the drugs one by one. This can be achieved by first validating the processes and then setting a standard operating procedure (SOPs) for every process of drug manufacture.

Standardization has to be considered at level of three phases; Standardization of crude drugs, pharmaceutical processes and finished product. Standardization of crude drugs is needed for achieving genuine raw drugs, which affects the safety, purity and quality of the medicine. Validation is the appropriate word in context of process, which includes validation regarding apparatus, temperature pattern, fuel, time duration, and procedure. Standardization of finished product is necessary to confirm batch to batch uniformity. It includes classical and modern physico-chemical parameters as well as shelf life studies.

The external use of Naga is described in Charaka Samhita¹ for the treatment of Kushtha. Though wide utility has been mentioned, the preparation of Naga Bhasma has always been a practical problem in the present time and improperly prepared Naga Bhasma causes various diseases like Kushtha, Gulma, Ruja, Meha, Pandu, Jwara, Tridoshaprakopa² Roga, Mrityu³, Kshaya, Kamala⁴, Kilasa, Sandhishula, Pakshavadha, Anaha, Amsashotha, Avabahuka, Shula⁵,

Kandu, Anilasada⁶ etc. in the body. To remove the unwanted effects of Naga, various texts^{7, 8, 9, 10} advised to take Swarna Bhasma, Haritaki, and Sita internally for 3 days. Rasataranginikara mentioned Vishatinduka as an antidote for Nagadosha⁵. Rasahridayatantra¹¹ told to take Gomutra, Kutki and Karavellaka Shifa as a remedy for Nagadi Kalankita Rasa (Rasajirna).

Naga, portrayed in chemistry as Lead, occupies 0.0013% of earth's crust. Now-a-days, it is used in paints, lead-acid batteries, pesticides, typesetting, etc. Toxicity of lead occurs mostly through industrial and environmental exposure. It affects almost all systems in the body and gives rise to symptoms such as lead colic, lead encephalopathy etc^{12,13}. So the present study was undertaken to lay down standard operating procedure to prepare Naga Bhasma by two different methods. In the first method Parada and Gandhaka were taken as media, while the second method consists of Ashwattha and Manahshila as media.

In the present study, each unit operative procedure was considered as an independent processing to develop SOPs for Naga Bhasma, so attempt was made to validate each step. The pharmaceutical proforma was prepared and every minute fact and observation regarding these processes were recorded. More popular and more accepted the method, its validation is all the more important and necessary. So most popular methods were suggested and to lay down pharmacopoeial standards for the Bhasma preparations, two samples of Naga Bhasma were prepared.

The aim of the study was to develop standard manufacturing procedures for preparation of Naga Bhasma.

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MATERIAL AND METHODS

Procurement and authentication of Raw materials :

Raw Naga, Tila Taila, Takra, Gomutra, Kanji, Kulattha seeds, Parada, Gandhaka, Manahshila, Ashwattha Twaka, Churnodaka and Nimbu Swarasa were used as raw materials. Lead was considered as Naga for their similar characteristics and was collected from Pharmacy, Gujarat Ayurved University, Jamnagar and authenticated as per classical texts^{2,14,15} mentioned. The processing of Naga Bhasma is shown in table no.1.

Samanya Shodhana, Vishesh Shodhana of Naga was carried out as per the reference of Rasaratnasamuchchaya (5/13) and Rasatarangini (19/10) respectively by applying Dhalana principle. One kg ashuddha Naga was taken for Samanya shodhana in Tila Taila, Takra, Gomutra, Kanji, Kulattha Kwatha and each time liquid medias were taken equal to the Naga (Gravimetrically). For Vishesh Shodhana, Churnodaka was used as liquid media. Naga, Tila Taila, Kulattha were procured from Pharmacy, Gujarat Ayurved University, Jamnagar. Gomutra was collected from local cow shed.

Procedure : Kanji, Kulattha Kwatha, Takra and Churnodaka were prepared as per the references of Vigyanabodhini-Tika of Rasaratnasamuchchaya¹⁶ commented by Dr. D.A.Kulkarni, Sharangadhara Samhita¹⁷, Sushruta Sutra¹⁸ and Rasatarangini⁵ respectively.

Ashuddha Naga was heated in an iron laddle and after melting, it was poured in each liquid media for 7 times. Each time fresh liquid media was used. Vishesh Shodhana was carried out after Samanya Shodhana. The observations and results are shown in table no 2.

Precautions : Physical injury was avoided during quenching due to bumping of molten Naga. Protection from smoke of media (mainly Tila Taila) during heating process was taken by wearing goggles and mask. Tip of the thermocouple was handled carefully when red hot as it may break. Analysis of all samples (liquid media) was done immediately after the process as they are liable to get spoilt.

Validation of Naga Bhasma by Pishti Method :

Process validation of Parada Shodhana :

The first method of shodhana of Parada was done as per classical reference of Rasatarangini (5/27-30). Ashuddha Parada 500 g, Sudha 500 g, Nistusha Lashuna 256 g and Saindhava lavana 128 g were taken as ingredients during this practical study.

Procedure : Parada was triturated with Sudha for 3 days (total 9 hrs). On 4th day, it was filtered through a cloth and procured Parada was triturated with Nistusha Lashuna Kalka and Saindhava Lavana till Kalka became black. Then it was washed with hot water and filtered through a cloth. Parada was weighed and packed in a glass bottle.

Observations : After trituration with Sudha, almost all Parada was mixed with it and colour of the mixture was gray. Some part of Parada was scattered throughout the mixture. White Lashuna Kalka was changed to black within 2 hrs of trituration.

Results : 248 g, 252g and 50.4% yield, weight loss and % of loss of Parada were found during practical study respectively.

2nd method : During 1st practical of shodhana of Parada 50.4% loss was observed, so 2nd method was carried out by slightly modifying the reference of Rasatarangini(5/27-30). Ashuddha Parada 538 g, Nistusha Lashuna 538 g and Saindhava lavana 269 g were taken as ingredients during this practical study.

Procedure : Here the procedure was slightly changed and Parada was triturated only with Nistusha Lashuna Kalka and Saindhava lavana, to protect the loss of Parada. First the paste of Nistusha Lashuna Kalka was prepared and Saindhava Lavana was added to it followed by Parada. Then trituration process was carried out for three hours. After completing the trituration process, it was washed with hot water till complete removing the Kalka Dravya and finally filtered with double folded cloth.

Observations : White Lashuna Kalka was changed to black colour within 2 hrs. of trituration. Majority of the Parada was mixed with Kalka Dravya and some part was converted into globule form after complete 3 hours of trituration.

Precautions : Before adding Parada, the paste of Lashuna and Saindhava was properly prepared. Trituration process was done carefully to protect the splitting of Parada from the Khalva Yantra. Washing process was done carefully with hot water to protect the loss of Parada by Jalagati. Finally filter through the double folded cloth to remove the remaining particles of Kalka Dravya.

Results : The yield, weight loss and % of loss of Parada were found as 525.8 g, 12.2 g and 2.27 % respectively during practical study.

Process validation of Gandhaka Shodhana :

The Gandhaka shodhana was carried out as per the reference of Rasatarangini 8/7-12 (modified).

Gandhaka: 2 kg x 7 batches= 14kg, Godugdha: 4 L x 3 times x 7 batches = 84 L (Gravimetrically double amount to the Gandhaka each time), Goghrita: 250g x 3 times x 7 batches = 5250 gm were taken as ingredient during practical study.

Procedure : Powdered Gandhaka was heated with Goghrita over Mandagni. After melting, it was poured into Godugdha, which was placed in a steel vessel, through the Goghrita smeared cloth. A solid mass with some granular part of Gandhaka was taken out and washed with hot water. The procedure was repeated thrice. After drying it was powdered, weighed and kept in a glass jar.

Observations and Results : Average time taken to melt the Gandhaka was 30 minutes. Crystalline dark yellow Gandhaka turned granular and dull yellow after Shodhana. Average 97 g, 4.85% decrease in weight and percentage Gandhaka after Shodhana respectively was found.

Precautions : Powder form of Gandhaka was heated over Mandagni. Cloth was slightly smeared with Ghee. Godugdha was hot during the quenching of melted Gandhaka. After each quenching, Gandhaka was thoroughly washed with hot water.

Process validation of preparation of Naga Bhasma:

Naga Bhasma was prepared as per the reference of Rasatarangini Tarang (19/26-33). The ingredients taken in this study are shown in table no. 3.

Procedure : Shuddha Naga was heated in an iron ladle. After melting, it was poured in Shuddha Parada which was placed in mortar. Immediately trituration was carried out resulting in the formation of Nagapishti. It was washed with Nimbu Swarasa and dried. Shuddha Gandhaka was added to it and triturated till the formation of Kajjali. Bhavana was given with Nimbu Swarasa and prepared Chakrikas. The Chakrikas were dried and kept in Sharava (earthen saucer) then Samputikarana was done and dried. It was subjected for Laghuputa (50 cow-dung cakes; 5 kg in wt). On the next day the material was collected and ground. Total three Puta were given to complete preparation of Bhasma.

Observations and Results : Table no. 4 & 5.

Precautions : For bhavana of Kajjali with Nimburasa 6 hrs. were required Chakrika and cloth-smeared saucers were dried properly. The pit was filled by cow dung cakes up to 2/3rd part (30 in no.), then the saucer was kept followed by remaining 1/3rd of (20 in no.) cakes and ignited from the bottom. Weight and temperature were recorded carefully.

Validation of Single Procedure of Preparation of Naga Bhasma by Jarana Method :

Process validation of Manahshila Shodhana :

Shodhana of Manahshila was carried out as per the reference of Rasatarangini (11/19). One kg ashuddha Manahshila and Churnodaka (Gravimetrically double amount to the Manahshila each time) were taken as ingredients.

Procedure : Finely powdered Manahshila was dipped in Churnodaka for 3 days. Churnodaka was changed every day. On 4th day, it was separated by decantation, dried, powdered and packed in polythene bag.

Observations and Results : Brick red Manahshila turned dull red after Shodhana. Slight weight loss of Manahshila in the form of fine particles floating on Churnodaka was seen during decantation. Average 16.1g, 1.61% decrease in weight and percentage was observed respectively after Shodhana of Manahshila.

Process validation of Naga Jarana (Jeerna Naga):

Naga Jarana was done as per the reference of Rasatarangini (19/11-14). The ingredients used during practical are shown in table no 6.

Procedure : Shuddha Naga was heated in an iron pan and after melting, Ashwattha-twak-churna (ATC) was added (apprx. 10-15 g) and triturated with iron ladle. After completion of its burning (5 min.), same amount was again added and the procedure was repeated till Naga got converted into powder form. Then jarita Naga powder was collected in centre, covered with earthen saucer and strong heat was applied uptill red hot stage (2hrs). On next day, Jarita Naga powder was collected and sieved through 120 no. mesh. The product was washed thrice with distilled water. The improper Jarita Naga powders, not passing through the 120 no. mesh, was again subjected to the same procedure for three times.

Observations and Results : The average 12.10% decrease in weight of Naga after ATC Jarana was observed. The details of Observations and Results are shown in table no.7.

Precautions : ATC was added after complete melting of the Naga. ATC was again added after complete burning of the previous ATC. Continuous trituration was done. After complete conversion into powder form, it was covered with earthen saucer and provided strong heat to check the completion.

Process validation of preparation of Naga Bhasma by Putapaka method :

The preparation of Naga Bhasma by Putapaka method was done as per the reference of Rasatarangini (19/15-18). The ingredients used during practical are shown in table no.6.

Procedure : Shuddha Manahshila was added to the Jarita Naga and triturated with Nimbursara for 6 hrs. followed by Chakrikakarana. After proper drying, Chakrika were collected in an earthen saucer, covered by another earthen saucer and the junction was sealed by mud smeared cloth and allowed for complete drying. Then it was subjected for Laghuputa (50 cow-dung cakes). On the next day the material was collected and ground. The process was repeated three times.

Observations and Results : Black, fine powder, 120.7g and 234.5 g increase in weight as compared to shuddha Naga and Jarita Naga respectively. The other observations and results are shown in table no.8. The comparative results of Naga Bhasma prepared by two methods are shown in table no.9.

To lay down Pharmacopoeial standards for Naga Bhasma, raw Naga, in process material and final product (Naga Bhasma) were analyzed physico-chemically and the comparison of final products has been drawn. The result shows that 97.38%, 81.44% purity in raw Naga and shuddha Naga was observed respectively. The melting point of shuddha Naga was found 327°C. Results of organoleptic & physico-chemical characters of Naga Bhasm are shown in table no. 10 & 11.

TABLE NO. 1 : STEPS IN THE PREPARATION OF NAGA BHASMA :

Steps	1 st Method - I	2 nd Method
Shodhana	Samanya Shodhana Vishesa Shodhana	Samanya Shodhana Vishesa Shodhana
Marana	Bhavana and Putapaka	Jarana Bhavana and Putapaka

TABLE NO. 2 : AVERAGE TIME TAKEN TO MELT AND AVERAGE WEIGHT LOSS AFTER SHODHANA :

Media	Avg. Time (min.)	Avg. wt. (g)	Avg.wt.↑/↓ (g)	Avg. % wt. ↑/↓ (%)
Tila Taila	4.28	1014.06	14.06 ↑	1.41 % ↑
Takra	4.24	993.29	06.71 ↓	0.67 % ↓
Gomutra	7.07	966.00	34.00 ↓	3.40 % ↓
Kanji	7.50	953.89	46.11 ↓	4.61 % ↓
Kulattha Kwatha	10.05	926.89	73.11 ↓	7.31 % ↓
Churnodaka	8.29	902.03	97.97 ↓	9.80 % ↓

↑: Increase, ↓: Decrease.

TABLE NO. 3 : INGREDIENTS FOR NAGA MARANA (1ST METHOD) :

Batch code	Ingredients	Quantity		
		1 st Puta	2 nd Puta	3 rd Puta
1 st batch	Shuddha Naga	927.0 g	1 st Puta Marita	2 nd Puta Marita
	Shuddha Parada	232.0 g	Naga- 1107.6 g	Naga- 1064.0 g
	Shuddha Gandhak	1854 g	2215.2 g	2128.0 g
	Nimbursara	2 L (washing), 1000 ml (Bhavna)	----- 940 ml	----- 890 ml
2 nd batch	Shuddha Naga	914.4 g	1 st Puta Marita	2 nd Puta Marita
	Shuddha Parada	229.0 g	Naga- 1070.2 g	Naga- 1057.6 g
	Shuddha Gandhak	1828 g	2140.4 g	2115.2 g
	Nimbursara	2 L (washing), 1000 ml (Bhavna)	----- 930 ml	----- 900 ml
3 rd batch	Shuddha Naga	912.2 g	1 st Puta Marita	2 nd Puta Marita
	Shuddha Parada	229.0 g	Naga- 996.8 g	Naga- 1001.6 g
	Shuddha Gandhak	1824 g	1994 g	2003.2 g
	Nimbursara	2 L (washing), 1000 ml (Bhavna)	----- 900 ml	----- 850 ml

TABLE NO. 4 : SPECIFIC OBSERVATIONS AND RESULTS OF NAGA BHASMA PREPARATION (1ST METHOD) AFTER EACH PUTA :

Batch	Put a No.	Weight of Bhasma (g)	Colour of Bhasma	Chakrika consistency	Chandrika
1 st batch	1	1107.6	Black	Powder form	++
	2	1064.0	Black	Powder form	+
	3	1125.0	Black	Powder form	—
2 nd batch	1	1070.2	Black	Powder form	+
	2	1057.6	Black	Powder form	—
	3	1035.4	Black	Powder form	—
3 rd batch	1	996.8	Black	Powder form	++
	2	1001.6	Black	Powder form	+
	3	990.6	Black	Powder form	—

++ = profuse Chandrika, + = slight Chandrika, — = Chandrika absent.

TABLE NO. 5 : PERCENTAGE CHANGE IN NAGA BHASMA (1ST METHOD) :

Weight (g)	1 st batch	2 nd batch	3 rd batch
Initial	927.0	914.4	912.2
Final	1125.0	1035.4	990.6
% change	21.36 % ↑	13.24 % ↑	8.60 % ↑

↑: Increase.

TABLE NO. 6 : INGREDIENTS FOR NAGA MARANA BY 2ND METHOD :

Batch code	Ingredients	Quantity		
		1 st Puta	2 nd Puta	3 rd Puta
1 st batch	Shuddha Naga	946.0 g	1 st Puta Marita Naga- 798.0 g	2 nd Puta Marita Naga- 816.0 g
	Ashwattha-twak-churna	946.0 g		
	Shuddha Manahshila	768.4 g	798.0 g	816.0 g
	Nimburasa (for Bhavana)	580 ml	550 ml	550 ml
2 nd batch	Shuddha Naga	954.8 g	1 st Puta Marita Naga- 1009 g	2 nd Puta Marita Naga- 1100 g
	Ashwattha-twak-churna	954.8 g		
	Shuddha Manahshila	860.0 g	1009 g	1100 g
	Nimburasa (for Bhavana)	650 ml	600 ml	550 ml
3 rd batch	Shuddha Naga	889.4 g	1 st Puta Marita Naga- 969.4 g	2 nd Puta Marita Naga- 1040.2 g
	Ashwattha-twak-churna	889.4 g		
	Shuddha Manahshila	840.0 g	969.4 g	1040 g
	Nimburasa (for Bhavana)	600 ml	550 ml	500 ml

TABLE NO. 7 : WEIGHT OF NAGA BHASMA AFTER JARANA :

Batch	Initial wt. (g)	Jarana No.	Wt. of Bhasma (g)	Final wt. (g)	Change in wt. (g)	Percentage of change (%)	Colour of Bhasma
1 st batch	895.2	1	649.6	804.2	91.0 ↓	10.17 % ↓	Reddish yellow
		2	40.0				
		3	114.6				
2 nd batch	864.8	1	682.6	886.2	21.4 ↑	2.47 % ↑	Yellowish
		2	147.6				
		3	56.0				
3 rd batch	889.0	1	675.6	839.8	49.2 ↓	5.53 % ↓	Yellowish
		2	112.4				
		3	51.8				

↑: Increase; ↓: Decrease.

TABLE NO. 8 : WEIGHT OF NAGA BHASMA(2ND METHOD) AFTER EACH PUTA :

Batch	Puta No.	Weight of Bhasma (g)	Colour of Bhasma	Chakrika consistency	Chandrika
1 st batch	1	798.0	Black	Brittle	++
	2	816.0	Black	Brittle	+
	3	887.4	Black	Brittle	—
2 nd batch	1	1009.0	Black	Medium hard	+
	2	1100.0	Black	Medium hard	+
	3	1167.6	Black	Medium hard	—
3 rd batch	1	969.4	Black	Medium hard	++
	2	1040.2	Black	brittle	+
	3	1127.8	Black	brittle	—

++ = profuse Chandrika, + = slight Chandrika, — = Chandrika absent.

TABLE NO. 9 : COMPARISON OF RESULTS OF NAGABHASMA PREPARED BY TWO DIFFERENT METHODS :

Parameters	Naga Bhasma (1 st method)	Naga Bhasma (2 nd method)
Avg. wt. of raw Naga (g)	1000.0	1000.0
Avg. wt. of Shuddha Naga (g)	919.53	940.20
Avg. wt. of Naga Bhasma (g)	1050.33	1060.93
Avg. increase in wt. (g)	50.33 ↑	60.93 ↑
% of increase in wt. (%)	05.03 ↑	06.09 ↑

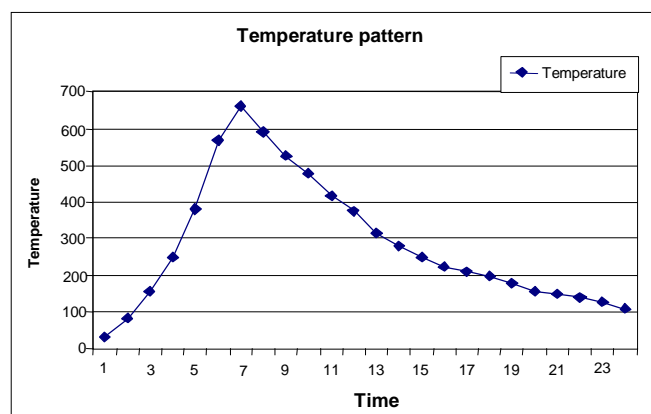
↑ = increase.

TABLE NO. 10 : ORGANOLEPTIC CHARACTERS OF NAGA BHASMA :

Parameters	Naga Bhasma (1 st method)	Naga Bhasma (2 nd method)
Shabda	No metallic sound	No metallic sound
Sparsha	No course particles	No course particles
Rupa	Jet Black	Black
Rasa	Tasteless	Tasteless
Gandha	Not specific	Not specific

TABLE NO. 11 : PHYSICO-CHEMICAL CHARACTERS OF NAGA BHASMA :

Parameters	Samples	
	Naga Bhasma (1 st method)	Naga Bhasma (2 nd method)
Loss on drying (%)	0.78	0.80
Ash value (%)	99.0	99.0
Acid insoluble ash (%)	49.5	42.0
Water soluble extract (%)	0.32	0.19
CS ₂ soluble extract (%)	0.002	0.00
Phase identification (XRD)	PbS	PbS
Particle size (VMD) (µm)	120	57.4
Element content (ICP method) (%)	Pb 28.297	30.804
	Hg Not detected	Not detected

GRAPH NO. 1 : TEMPERATURE PATTERN OF LAGHUPUTA WITH 50 COW-DUNG CAKES (5 KG IN WT.) :

DISCUSSION

Present study was aimed at standardization of preparation method of Naga Bhasma. It was prepared by adopting two methods described by Rasatarangini, 1st method by using Parada and Gandhaka as a media and the 2nd method by using Ashwattha and Manahshila as a media. The 97.38% chemically pure Naga was procured from the Pharmacy, Gujarat Ayurved University, Jamnagar. The 99.99% pure Naga is available in the market, but at the time of cutting of lead plates, part of Naga which came into contact with the heat got converted into its oxide form, rendering the Naga 97.38% pure.

Takra (butter milk) was prepared with the reference of Sushruta Sutra (45/85). It is acidic in nature and used for Samanya Shodhana of Naga. As Naga Bhasma was intended to use on Madhumeha which is Meda and Kaphapradhana Vataja disorder, butter was separated from Takra, to impart Ruksha quality to Naga through Samskara (Dhalana).

Kanji and Arnal are used as synonyms. So for Samanya Shodhana, Kanji was prepared by following the Vigyanabodhini-Tika commented by Dr. D.A.Kulkarni

over Rasaratna Samuchchaya. It is also an acidic medium. Preparation of Kanji is a type of acidic fermentation during which carbohydrates (rice acts as a main source of carbohydrates) are reduced to organic acids. In this process, CO₂ is released after fermentation stops, the release of CO₂ also stops. Absence of effervescence, positive match stick and Lime water tests indicate that the fermentation is also completed. pH of the Kanji is observed to be in between 2.5 to 3.0 which may be taken as a standard parameter along with other parameters like yellowish colour, sour acidic taste and typical sour odour.

Kulattha Kwatha was prepared by general reference of Kwatha preparation mentioned in Sharangadhara Samhita. It is an acidic medium and is used for Samanya Shodhana of Naga. It may impart Tikshna and Bhedana properties to Naga, which in turn may break the Samprapti of the disease.

Naga was heated and after melting it was poured for 7 times in Tila Taila, Takra, Gomutra, Kanji and Kulattha Kwatha in order. The order of quenching is changed by various Acharyas, so the exact reason behind the particular sequence is not explainable.

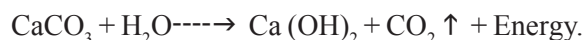
During quenching it was observed that 1 L of the media was sufficient for complete immersion of 1 kg Naga. The amount depends upon the diameter of the vessel in which Naga is to be quenched.

Naga acquired silver luster after each quenching. This may be because impurities of Naga may get attracted towards the chemical components present in the media forming a bond with them. Thus they may get separated. So each time new liquid media should be taken. Liquid media may also impart certain qualities like Sukshma etc. which improve the quality of Bhasma. Intense heating and sudden dipping may cause change in physical as well as chemical properties of Naga making it suitable for Bhasma formation.

Gradual increase in melting time is seen while quenching in various liquid media. This may be due to the reason that during successive quenching; some part of Naga gets converted into powder form (PbO). This powdered Naga absorbs the liquid media during quenching. The liquid media forms a layer around the metallic Naga. When this Naga is heated again, liquid media evaporates first which cause delay in rise of temperature. While heating, powder form of Naga settles at the bottom of the Darvi. So there is delay in heat transfer from Darvi to metallic lead causing delay in rise of temperature.

Some scholars opine that there is increase in melting point of Naga, but analytical study proves that there is no increase in the melting point. Although Naga, which gets converted into powder form (PbO) during Shodhana, has melting point 888°C.

Churnodaka was prepared by following the method of Rasatarangini which is an alkaline medium and used for Vishesh Shodhana of Naga. The reaction is exothermic and can be shown as follows-



Various references of Vishesh Shodhana of Naga are available. This particular reference was selected because Churnodaka is Kaphahara in Guna (Khativat), and may impart its Kaphahara property to Naga which may help to keep the disease under control. Average time taken to melt the Naga was observed to be 8.29 min. during its Vishesh Shodhana.

The classical reference selected for Parada Shodhana contained Sudha, Lashuna and Saindhava Lavana. It was observed that when Parada was triturated with Sudha, it was converted to powder form which may be referred as Grey powder. It is difficult to procure whole amount of Parada by Vastra-Galana (filtration through cloth) process as mentioned in classics. The 50.4% loss was observed in this process. Extraction of Parada from this compound needs heat so that Parada could be regained (after condensing the mercury vapours). The process is extremely dangerous as mercury vapours are highly toxic and easily get absorbed through respiratory tract.

To overcome the loss, in second batch, Parada was directly triturated with Nistusha Lashuna Kalka and Saindhava. In this process, Parada-Dosha may also get eliminated and same sample has been used for present study.

The Shodhana of Gandhaka was slightly modified. In the classical reference, equal amount of Ghrita is mentioned while in AFI part-I (quoting the reference of Rasamritam) no Ghrita is mentioned for Shodhana of Gandhaka. Taking this into consideration, only sufficient amount of Ghrita (250 g for 2 kg of Gandhaka each time) was taken for melting of Gandhaka. After each Dhalana, Gandhaka was thoroughly washed with hot water to remove fat contents of milk and Ghee. Each time, fresh Godugdha was taken to facilitate detoxification of Gandhaka.

Rasa Tarangini opined that Churnodaka should be administered (orally) to counteract side-effects due

to ingestion of Malla (an Arsenic compound). That means it reduces toxicity of Arsenic compounds. Manahshila is also an Arsenic compound. Besides this, it may enhance the Kaphahara property of Manahshila which is useful for the treatment of Madhumeha. So this peculiar method was selected. Manahshila was powdered to allow maximum area of contact with Churnodaka. This helps Churnodaka to decrease the toxicity of Manahshila. Churnodaka was changed each day. This reduces the side effects of Manahshila to greater extent.

Mercury forms amalgam very quickly with melted lead. The method mentioned in text is - melt the Naga, pour the Parada in melted Naga, put the mixture quickly into the mortar and triturate. Practically there is a risk of formation of mercury vapours, if the temperature of molten Naga increases. So Parada was placed in mortar and molten Naga was added to it followed by vigorous trituration. In the classical reference, the ratio of Naga: Parada is given as 1:1/4. It was observed that, this amount of Parada is not sufficient to form a good amalgam. After Pishti formation, it was washed with Nimbu Swarasa as per classical reference of 'Amla Jala', till the Pishti glows. Nimbu Swarasa became black in colour after washing. This may be due to carbon and/or Kshara of Shodhana Dravyas, especially Kulattha Kwatha.

Various Putas and Yantras have been suggested for Marana of Naga right from Karishagni¹⁹ upto Gajaputa²⁰, Damaru-Yantra-Patana²¹ and Utthapana¹⁴. For Putapaka, as per classical reference, Laghuputa was selected. Not a single Rasagrantha has mentioned the dimensions or the number of Upalas in relation to Laghuputa. The range of Laghuputa starts from Karishagni / Kukkutaputa up to Varahaputa according to the opinion of various Acharyas. To find out the controversy about Laghuputa, here as per trial and error method, 50 Upalas (5kg) for 3 Sharavas containing Naga along with its Marana Dravya was considered as Laghuputa. The dimension of this Puta was affixed as 56cm x 56cm x 28cm.

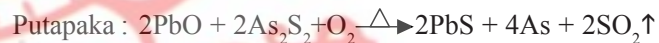
Maximum temperature of Laghuputa [50 Upalas (5kg)] was observed 660°C (Graph-1). It remained above 550°C for 10 min. followed by gradual decrease. Complete combustion of the same material liberates same amount of energy, but the difference in temperature may be due to loss of energy in to the surroundings or it may be due to error in the instrument. Following chemical reaction takes place in this method :



It comprised of two parts viz. Jarana and Putapaka. After Jarana process, the product was washed with distilled water thrice to remove Kshara content of the product. Elimination of Kshara was confirmed by reduced pH of water used for successive washing. In the Jarana process, repeated Jarana resulted in slight fading of colour. This may be due to presence of water insoluble part of ash of Ashwattha-Twak-Churna (ATC).

Previous scholars²² mentioned that repetition of the Jarana process for three times gives optimum results and no much benefit would be achieved by repeating the process further. According to modern chemistry, if lead is heated in open air, it reacts with atmospheric oxygen and forms lead oxide (PbO). In case of Jarana, Naga is heated in open air. So, final product is PbO. This is also proved by the analytical study. But, here ATC plays an important role as- burning of it may act as Puta, heat of which Naga can withstand. Similar point is concluded by Gautam DNS in his Ph.D research work²³. Due to Kashaya Rasa, ATC may potentiate the Kapha-Medohara action of Naga. The colour of PbO ranges from yellow (massicot form) to reddish yellow (litharge form)²⁴.

Bhavana Dravya was used Nimbura, period of trituration was 6 hrs. and Puta selected was also same as that of 1st method i.e. 50 Upalas (5kg). Manahshila reduces the oxide form of Naga formed in Jarana to sulphide form which is least toxic. Following chemical reaction takes place in the Marana process by 2nd method :



Arsenic was seen as white powder stucked over upper Sharava and to the walls of the pit of Puta (though very little in amount).

Colour of Bhasma was black (Kajjalaprabha). Naga Bhasma may be considered as sulphide form of lead (PbS) which is black in colour, along with traces of other elements. Naga Bhasma prepared by both methods has almost similar values in physico-chemical analysis. The particle size of Naga Bhasma prepared by second method is smaller than the other method. This may be due to repeated Agni-Samskara in the form of Jarana and Putapaka.

CONCLUSION

1. For preparation of good quality Naga Bhasma processes like. Shodhana, Jarana, Bhavana and Putapaka are very important.

2. Laghuputa of 50 Upalas (5 kg) for 1 kg Naga is found sufficient in initial stages of the Marana process.
3. Naga Bhasma is found as lead sulphide (PbS), both the prescribed methods and having particle size between 57.4-120 µm.

APPENDIX :

I. Equipment specification for Shodhana of 1 kg Naga :

- Iron ladle : Length : 89.5 cm,
Depth : 5 cm,
Diameter of body: 15 cm
Capacity : 800 ml
- Pithara Yantra : Body : Height : 30 cm,
Diameter : 17 cm;
Lid : Shape : Conical,
Diameter of the hole : 2 cm;
Capacity : 5800 ml.
- Burner : 20 cm diameter.
- S. S. vessels (2), spoon (1).

II. Equipment specification for Shodhana of 2 kg Gandhaka :

- S.S. vessel : Diam. : 20 cm,
Height : 30 cm
- Stirrer, cloth, burner with cylinder, weighing machine, etc.

III. Equipment specification for Shodhana of 1 kg Manahshila :

- S.S. vessel : Diam.: 30 cm;
Height : 15 cm
- Stirrer, cloth, burner with cylinder, weighing machine, etc.

IV. Equipment specification for Marana of 1 kg Naga by Pishti method :

- Iron ladle : same as Shodhana
- Burner : same as Shodhana
- Mortar : Depth : 11.5 cm
Length : 51 cm
Breadth : 30.5 cm
- Pestle : Length : 27 cm
Dia meter of lower surface : 8 cm

V. Equipment specification for Jarana of 1 kg Naga by Ashwattha-Twak-Churna :

- Iron pan : Diameter : 57.5 cm;
Height : 23.5 cm;
Thickness : 0.5 cm
- Iron ladle, Burner : Same as method 1.

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हिन्दी सारांश

नाग भस्म का निर्माणात्मक मानकीकरण

प्रविण ताटे, बी.जे. पटगिरी एवं पी.के. प्रजापति

आयुर्वेदिक औषधियों के वैश्वीकरण के लिये प्रमाणित निर्माण विधि को बनाना लागू करना चाहिये। प्रस्तुत अध्ययन में नाग भस्म की प्रमाणित निर्माण विधि बनाने का प्रयत्न किया गया है। नाग भस्म दो विधियों द्वारा तीन बार बनाया गया। पहली विधि में पारद तथा गन्धक तथा दूसरी में अश्वथ त्वक तथा मनःशिला का प्रयोग किया गया। पहली तथा दूसरी विधि में ५.०३% तथा ६.०९% क्रमशः वृद्धि पायी गयी। कच्ची औषधि प्रक्रिया के दौरान तथा अन्तिम उत्पाद का भौतिक-रासायनिक विश्लेषण तथा तुलना की गयी। नाग की औसत शुद्धता शोधन के बाद ९७.३८% से ८९.४४% हो गयी। नाग की मात्रा नाग भस्म में और पहली तथा दूसरी विधि में क्रमशः २८.२९% तथा ३०.८०% पायी गयी। दोनों प्रकार के भस्मों में रासायनिक रूप से PbS तथा अन्य तत्व अल्प मात्रा में पाये गये।

