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Research Article

PHARMACEUTICAL STANDARDIZATION OF NAGA BHASMA (INCINERATED LEAD) PREPARED BY USING HERBAL MEDIA

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Abstract

In the wake of the present surge of increased global, curiosity regarding safety and efficacy of various metallic and mineral preparations in Rasashastra, there is an imminent need to pay attention towards standardization of each preparation. Naga bhasma (incinerated lead) is one of Ayurvedic incinerated metallic preparation claimed to possess some extraordinary property. Some recently published research work emphasized its antidiabetic and aphrodisiac property. Different media has been found mentioned for preparation of Naga bhasma but till date no work has been published regarding pharmaceutical standardization of Naga bhasma prepared by using herbal media. Pharmaceutical standardization is necessary for batch to batch consistency, reproducibility and for good manufacturing practices. In present study an attempt has been made to establish standards for Naga bhasma prepared by using Vasa (*Adhatoda vasica* Nees.) as herbal media. Present study was planned to standardize Naga bhasma prepared by using Vasa as herbal media. Prepared Naga bhasma subjected to tests mentioned in Ayurvedic texts Varitar, Rekhapurnatva, Niruttha, Apunarbhava tests and physico-chemical analysis such as pH Value, Total Ash, Loss on drying and acid insoluble ash. Twenty eight days are required to prepare Naga bhasma with 3.76% weight loss. Jarana is the principal step in Naga bhasma preparation as it assist maximum surface of Naga for further chemical reaction.

Key words: Pharmaceutical standardization; Lead; Naga bhasma; Vasa; Electric muffle furnace.

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INTRODUCTION

Kashthaushadhis (herbal medicines) and Rasaushadhis (herbo-metallic medicines) are two main groups of medicines used in Ayurveda, the former is devoid of any metals and minerals and is purely herbal product and can be considered as safest of medicines, and later consists of metal and minerals in the form of Bhasma (incinerated form of metals and minerals). These metallic preparations occupies significant seat in Ayurvedic pharmacopoeia. Both types of medicines are used in Ayurveda from centuries till now. Thus Ayurveda is one of the comprehensive systems of medicine which uses processed natural products which can be of herbal, metallic, mineral and animal origin. Considering the developments in the science, it always become mandatory to match and compare the benefits of the age old remedies by following the existing protocols or strategies.

Hence, Ayurveda needs to undergo hardcore scientific validation in the current scenario. There have been questions raised about quality standardization and often about the safety of Ayurvedic medicines in recent past.[1][2] Particularly, Rasoushadhies which uses certain heavy metals and even poisonous herbs have become main target of safety related issues. If, the products passes through different steps of standardization by following Ayurvedic and modern parameters and other relevant conventional drug development procedures; the formulations will get more and more authenticated and widely accepted. Standardization implies application of suitable methods and processes by which optimum conditions are ensured for obtaining predictable results.

Standardization of Rasaushadhis can be defined with the number of processes, involved in the production of a drug. The standard protocols mentioned in the classics,[3] which may be applied to the present manufacturing scientific pharmaceutical ambience, such as quality of raw materials[4] to be taken for the process. The process standardization protocols are like temperature, time space, instruments and heating devices etc. along with purification protocols like number of Bhavana (trituration),[5] Swedana (steam heating)[6] etc. and the finished drug protocol[7] viz. colour, fineness etc. Validation[8] of the method of preparation is to be done by manufacturing the same product by similar method and instrumentation, for any number of times, with standard raw material getting output of same product with specification of parameters.

Bhasma are the incinerated metallic preparations frequently used in Ayurveda to treat various ailments. Naga bhasma (incinerated Lead) is one of the well known preparation indicated in the treatment of various systemic diseases specially Prameha (diabetes), and is familiar as Pramehakarikeshari[9] i.e. one of the best drug for diabetes. Earlier scholars have conducted characterization study on commercial samples of Naga bhasma and reported that Naga bhasma is complex mixtures of PbO,Pb_3O_4 and presence of carbonate group $(CO_3)_2$ in all samples.[10] In another study Naga bhasma was prepared by using Haratala (Orpiment) as media and thestudy reported that Naga bhasma is in PbS form chemically with other elements like Ca, Si, Fe, Al, K, As, Mg, Ni, Mn, Cd, Zn in trace amount.[11] A recent study elaborated standardization of Naga bhasma prepared by using Parada (mercury) and Gandhaka (sulphur) as media. Till date no work has been carried out regarding the standardization of Naga bhasma prepared by using Vasa (*Adhatoda vasica* Nees.) as herbal media. Thus in present study an attempt has been made to standardize Naga bhasma prepared by Jarana (open pan frying) with Vasa stem followed by levigation with Vasa kwatha (decoction of Vasa) and repeated incineration cycles.

MATERIAL AND METHODS

Material

Present pharmaceutical study is designed to standardize classical method of Naga bhasma preparation by employing electric muffle furnace for heating instead of classical Puta system of heating. For this purpose raw lead was obtained from Ayurvedic pharmacy, I.P.G.T. & R.A., Gujarat Ayurved University, Jamnagar. Til taila (seasame oil), Horse gram for decoction (Kulattha kwatha) and Gomutra (cow urine) were procured from local market and from Goshala, Jamnagar respectively. Kanji (sour gruil) and Takra (clarified butter milk) were prepared as per classical reference from Parada Vidyaniya[12] and Sushurata Sutra[13] respectively. Vasa stems for Naga Jarana (open pan frying) and Vasa leaves for levigation were collected from botanical garden, I.P.G.T. & R.A., Gujarat Ayurved University, Jamnagar.

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Methods

Three batches of Naga each 1 kg were taken for the study. Naga bhasma was prepared by following steps

1. Purva Karma (pre-operative procedure) includes Samanya shodhana (general purification), Vishesha shodhana (special purification) of naga and Jarana of naga.

2. Pradhana Karna (Main procedure) includes naga Marana (incineration).

3. Paschat Karma (Post operative procedure) comprises of Bhasma Pareeksha (testing of bhasma through Ayurvedic parameters), organoleptic and Physico-chemical test.

Same procedures were repeated for all three batches.

1. Purva Karma

Samanya shodhana of Naga

Material required: Raw Naga (3 kg), Til taila (18 L), Takra (18 L), Kanji (18 L), Gomutra (18 L) and Kulattha kwatha (18 L).

Procedure: Raw Naga taken for shodhana (purificatory procedures) was tested for Ayurvedic grahya (acceptable) parameters like quick melting, heavy, have bright black surface and gives black line on rubbing over white paper. The raw Naga was 99.80 % pure. (Table 1) Samanya shodhana was carried out by three times quenching of melted Naga in Til taila, Takra, Kanji, Gomutra and Kulattha kwatha respectively.[14] Each time new liquid media was taken. For 1 kg Naga 2 L liquid media was taken. (Figure 1 & 2)

Vishesh shodhana

Material required: Samanya shodhita Naga (2737 g), Churnodaka (lime water, 42 L).

Procedure: Vishesha shodhana was done by seven times quenching of melted Naga in Churnodaka.[15] (Figure 3)

Jarana of Naga

Material required: Vishesha shodhita Naga (2795 g), Vasa stems (3 pieces, each approx 4 feet long and average 6 cm in diameter).

Procedure: Shuddha Naga (purified lead) was heated in an iron pan. After complete melting Naga was strongly rubbed with Vasa stem. After 2 hrs Naga was converted in to yellow powder. Then powdered Naga was collected in centre, covered with earthen saucer and strong heat was given for 3 hrs till all powder become red hot. Heating stopped after 3 hrs. On next day, powder was collected.[16] (Figure 4)

Figure 1 – 12: Pharmaceutical procedures of Naga bhasma


Fig.1: Raw Naga


Fig.2:Naga shodhana


Fig.3: Vishesha Shodhita Naga


Fig.4: Naga Jarana

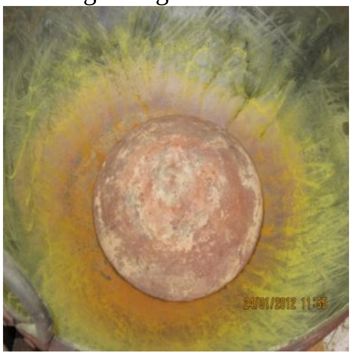
Fig.5: Completion of Naga Jarana

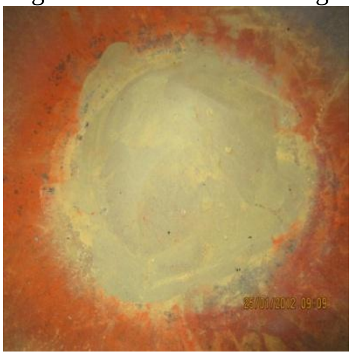
Fig.6: Jarita Naga


Fig.7: Preparation of decoction of Vasa


Fig.8: Bhavana to Naga


Fig.9: Incineration in EMF

Fig.10: Pellets of Naga after 7th puta batch 1

Fig.11: Pellets of Naga after 7th puta batch 2

Fig.12: Pellets of Naga after 7th puta batch 3

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2. Pradhan Karma - Naga Marana

Material: Jarita Naga (500 g for each batch, 3 batches), Vasa Kwatha (100 ml for each batch freshly prepared before each puta)[16]

Procedure: Vasa kwatha was added in Jarita Naga and levigated for 3 hours, till formation of smooth mass followed by chakrikarana (preparing small pellets). These chakrika were allowed to complete dry in sunlight. After complete drying these pellets were collected in earthen saucer and covered with another earthen saucer. The junction of earthen saucer was sealed by mud smeared cloth and allowed for complete drying. For incineration electric muffle furnace (EMF) was used instead of traditional puta. The saucers were placed in EMF and subjected for incineration. (Figure 7, 8 & 9) On next day the saucers were collected, incinerated pellets were removed and again levigated with fresh Vasa kwatha followed by chakrikarana and incineration. This procedure was repeated for seven times for each batch.

OBSERVATION AND RESULTS

During Samanya shodhana of Naga flame caught from second time of quenching in Tila taila. Pungent smell, hissing sound and a rush of black fumes were observed after quenching and iron ladle turned yellow in colour. Before first quenching in Takra, flam coughed in melted Naga due to presence of Tila Taila. No significant change in test and odour of all liquid media were observed after quenching. Some part of Naga was converted into yellowish powder form after each quenching. Melting time of Naga was gradually increased after shodhana in each media. Shining of Naga was decreased after quenching in Kanji and Gomutra, while it was significantly decreased and blackish ash was observed floating over melted Naga after shodhana in Kulattha kwatha. Average time taken for melting of Naga in Tila taila, Takra, Kanji, Gomutra, and Kulattha kwatha were 5.5, 6.67, 6.73, 7.09, and 8.51 min respectively. (Table 2 and 3) pH of all liquid media showed slight increase except the pH value of Gomutra which was unchanged. (Table 4)

Observation and result of vishesha shodana

Hissing sound was heard while pouring of melted Naga. Slight shinning was appeared after shodhana in Churnodaka. Average time taken for melting of Naga in Churnodaka was 8.46 min. Detail of Weight of Naga before and after Samanya and Vishesha Shodhana is given in table 4 and 5.

Observation and result of naga jarana

Black fumes were found coming while Naga Jarana. Up to 4 inches Vasa stem was burned till Naga become yellow powder i.e. in 2 hrs. (Figure 5) On the next day Yellow powder of Naga was obtained with slight reddish particles. (Figure 6) Average 0.72 % weight gain was observed after Jarana. (Table 6 & 7)

Observation and result of marana

Before 1st puta Naga chakrika were yellowish, soft and easily breakable and after puta, chakrika were slight hard, having slight redness at the circumference and mixed yellowish redness at the centre. Soft in touch and no friction of metallic particle experienced at the time of powdering chakrikas. No metallic particles of Utthapita Naga (regained particle of Lead) were observed. Before 2nd puta, colour of chakrika was pink red and after 2nd puta it becomes redder. Hardness increased although chakrika were easily breakable. No metallic particles of Utthapita Naga were observed. Redness of chakrika increased after 3rd puta. chakrika were soft in touch, easily breakable and not have any shining at the cut surface. Sindoorvarna (reddish colour) chakrika obtained after 4th puta. Chakrika were soft in touch, easily breakable and not have any shining at the cut surface but the cut surface was also sindoorvarna. Sindoorvarnatva increased after 5th puta.

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Table 1: Purity of Naga before shodhana

Element	Sn %	Sb %	Bi%	Cu %	As %	Ag %	Zn %	Cd %	Ni %
Value	0.131	0.432	0.130	0.033	0.0023	0.0036	0.0004	0.0007	<0.0001
Element	**Ca %**	**Al %**	**Au %**	**Fe %**	**Na %**	**P %**	**S %**	**Pb %**	
Value	0.0003	<0.0001	<0.0002	<0.0001	0.0002	0.0068	<0.0015	99.80	

Table 2: Average time taken for quenching of Naga during Samanya and Vishesha Shodhana (min)

Batch	Til Taila			Takra			Kanji		
	1st Q	2nd Q	3rd Q	1st Q	2nd Q	3rd Q	1st Q	2nd Q	3rd Q
1	10	5.10	5.05	12.05	6.12	5.25	10.15	6.20	6.10
2	5.15	4.50	5.15	5.10	5.14	5.10	6.40	6.35	6.45
3	5.10	5.10	4.35	6.05	5.45	5.30	6.25	6.30	6.45
Average	6.75	4.9	4.85	7.73	5.57	5.21	7.6	6.28	6.33
Average in each media		5.5			6.67			6.73	

*Q=Quenching

Table 3: Average time taken for quenching of Naga during Samanya and Vishesh Shodhana (min)

Batch	Gomutra			Kulattha kwatha			Churnodaka						
	1st Q	2nd Q	3rd Q	1st Q	2nd Q	3rd Q	1st Q	2nd Q	3rd Q	4th Q	5th Q	6th Q	7th Q
1	11.00	6.50	6.45	13.00	7.36	8.00	14	7.45	8.23	8.35	9.00	8.45	8.58
2	7.00	6.40	6.45	8.10	8.12	8.35	9.05	9.10	8.85	9.15	9.10	8.90	9.2
3	6.50	6.55	7.00	7.55	8.05	8.15	8.40	8.5	9.10	8.40	8.55	8.45	9.0
Average	8.16	6.48	6.63	9.55	7.84	8.16	7.15	8.35	8.72	8.63	8.88	8.6	8.92
Average in each media		7.09			8.51					8.46			

Table 4: Average pH value of media utilized for shodhana

Liquid Media	pH before shodhana	pH after shodhana
Til taila	6.66	6.09
Takra	5.08	5.79
Kanji	3	3.33
Gomutra	7.5	7.5
Kulattha Kwatha	5.2	5.73
Churnodaka	10.75	10.91

Table 5: Weight of Naga before and after Samanya and Vishesha Shodhana

Batch no.	Tila Taila			Takra			Kanji		
	BS (g)	AS(g)	% change	BS	AS(g)	% change	BS	AS	% change
I	1000	1000	0	1000	979	0.9↓	979	970	0.91↓
1I	1000	1009	0.9 ↑	1009	930	0.93↓	930	910	0.21↓
III	1000	1069	6.9↑	1069	994	0.92↓	994	972	1.20↓
Average	1000	1026	2.6↑	1026	967.66	0.91↓	967.66	950.66	0.77↓

*BS=Before shodhana, AS=After shodhana, ↑= weight gain, ↓=weight loss

Table 6: Weight of Naga before and after Samanya and Vishesha Shodhana

Batch no.	Wt. of Naga before and after shodhana								
	Go-mutra			Kulattha Kwatha			Churnodak		
	BS	AS	% change	BS	AS	% change	BS	AS	% change
I	970	946	2.47↓	946	940	0.52↓	940	935	0.53↓
1I	910	887	2.52↓	887	876	1.24↓	876	872	0.45↓
III	972	963	0.92↓	963	921	4.06↓	921	988	0.72↓
Average	950.66	932	1.97↓	932	912.33	1.94↓	912.33	931.66	0.56↓

Table 7: Observations during Naga Jarana

Sr. no.	Duration (hrs. / min.)	Observations
	00.00	Process started
1.	00.15	Melting is started
2.	00.30	Naga completely melted, trituration with Vasa dand (stem) started.
3.	00.45	Melted Naga is converted in to the powder form
4.	01.00	Approx 25 % Naga is converted in to the powder.
5.	01.15	Approx 50 % Naga is converted in to the powder
6.	01.30	Approx 75 % Naga is converted in to the powder and colour of powder is greenish orange.
7.	01.45	All Naga is converted in to the powder form.
8.	02.00	Some powder is started to floating in air.
9.	02.15	Same as above
10.	02.30	Same as above
11.	02.45	Same as above
12.	03.00	Yellowish orange color appeared. A sharava kept over powdered Naga and Tivragni given for three hours and then allowed for complete cooling.

Table 8: Weight of Naga before and after Jarana

Batch no.	Weight of Naga before and after Jarana		
	Before Jarana (g)	After Jarana (Kg)	% gain
Batch-I	940	945	0.53↑
Batch-II	876	882	0.68↑
Batch-III	921	930	0.97↑
	Average		0.72↑

Table 9: Temperature given during puta and weight changes in Naga Batch 1 (NB1)

No. of Puta	Wt. of Chakrikas		Max. Temp. (^{0}C)	Time required for attain the max. Temp.	Colour of Chakrika after puta	Hardness/ Softness of Chakrika	Wt. of loss after Puta (g)	% wt loss
	Before Puta (g) (after Bhavana)	After Puta (g)						
1st	512	496	500	30 min	Yellowish Red	Soft	16	3.12
2nd	505	494	550	35 min	Yellowish Red +	Soft	9	1.78
3rd	504	493	600	38 min	Yellowish Red ++	Soft	11	2.18
4th	498	490.4	560	35 min	Sindoorvarna	Soft	7.6	1.52
5th	492	481.6	600	40 min	Sindoorvarna	Slight hard	10.4	2.11
6th	491.4	480	550	32 min	Sindoorvarna	Soft	11.4	2.31
7th	486	477.4	600	40 min	Sindoorvarna	Soft	8.6	1.76

Chakrika were soft in touch, easily breakable and not have any shining at the cut surface. Similar characters were observed after 6th and 7th puta except that bhasma was finer and sindoorvarna increased. (Figure 10, 11 & 12) Batch to batch detail of temperature and weight changes in Naga are given in Table 8, 9 and 10.

Paschat Karma

Up to 3rd puta bhasma didn't passed Varitar (floating on water) and Rekhapurnatva (should enter into the lines of the finger and should not glitter) test but from 4th to 6th puta both the characters were found increased and after 7th puta Naga bhasma completely passed Varitara and Rekhapurnatva test. Further to confirm accomplishment of bhasma Apunarbhav and Niruttha tests were done. Later organoleptic character and physico-chemical analysis were done which are given in table 11 to 15.

DISCUSSION

Selection of raw material

There are two types of Naga mentioned in Ayurvedic classics viz. Kumara & Samala,[17] but their differential characteristics and superiority regarding therapeutic utility is not mentioned anywhere, hence both the types are used for bhasma preparation. Raw Naga was observed to fulfill Ayurvedic parameters and also tested for percent purity then selected for this study. Raw Naga was in the form of metallic plate. Naga has very low melting point (327.46 °C) hence there is need to make it into pieces for shodhana. Fresh Vasa stems are considered better for Jarana hence were collected freshly before starting Jarana process.

Selection of quantity

Rasaratna Samuchchaya mentioned the quantity has to be taken for shodhana as minimum is 5 pala (one pala equal to 48 g) to maximum of 13 pala i.e. the quantity used for heating and quenching.[18] Although to facilitate standardization procedure it was decided to take 1 kg each batch. After Jarana, some weight changes were observed, hence for Marana procedure only 500 g Jarita Naga was taken to facilitate in creating equal batches. The quantity of liquid media for shodhana should be enough to complete immersion of metal. Generally it is taken equal to the weight of metal but author found that it is not sufficient to significantly increase brittleness of metal. Some author advised the quantity of liquid media should be taken eight times to that of metal.[19] More the quantity of liquid media more will be brittleness in the shodhita metal and thus easier for the onward procedure of bhasma preparation. Although in terms of cost and large scale preparation of bhasma it is not economic to take eight times liquid media. In present study it was also not comfortable due to capacity of available instruments, hence each liquid media were taken double to the weight of Naga (gravimetrically).

Shodhana

Seven times quenching in each liquid media is advised for samanya shodhana by some Ayurvedic classical text. However, Sharangadhara Samhita quoted that three times quenching is enough for complete shodhana of metals.[14] Economically as well as to reduce labour and duration of procedure the reference of three times quenching appeared suitable hence adopted in present work. Heating of Naga up to complete melting creates expansion in the molecules and sudden cooling after quenching in liquid media creates abrupt compression in the molecules. Repeated heating and sudden cooling help to break the bonds between molecules and thus help in increasing brittleness of metal. Some fraction of shodhana media also forms thin coating on the surface of metal which also help to impregnate organic molecules in the metal. Moreover heating of Naga in iron ladle

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Table 10: Temperature given during puta and weight changes in Naga Batch 2 (NB2)

No. of Puta	Wt. of Chakrikas: Before Puta (g) (after Bhavana)	Wt. of Chakrikas: After Puta (g)	Max. Temp. (^{0}C)	Time required for attain the max. Temp.	Colour of Chakrika after puta	Hardness/ Softness of Chakrika	Wt. of loss after Puta (g)	% wt loss
1st	513	498	500	30 min	Yellowish Red	Soft	15	2.92
2nd	507	496	550	35 min	Yellowish Red +	Soft	11	2.16
3rd	505	494	600	38 min	Yellowish Red +	Soft	11	2.17
4th	500	487.6	560	35 min	Sindoorvarna	Soft	12.4	2.48
5th	493	482.8	600	40 min	Sindoorvarna	Slight hard	11.2	2.27
6th	492	487.6	550	32 min	Sindoorvarna	Soft	4.4	0.89
7th	495	483.6	600	40 min	Sindoorvarna	Soft	11.4	2.30

Table 11: Temperature given during puta and weight changes in Naga Batch 2 (NB3)

No. of Puta	Wt. of Chakrikas: Before Puta (g) (after Bhavana)	Wt. of Chakrikas: After Puta (g)	Max. Temp. (^{0}C)	Time required for attain the max. Temp.	Colour of Chakrika after puta	Hardness/ Softness of Chakrika	Wt. of loss after Puta (g)	% wt loss
1st	511	497	500	30 min	Yellowish Red	Soft	14	2.73
2nd	506	496	550	35 min	Yellowish Red +	Soft	9	1.77
3rd	505	493.2	600	38 min	Yellowish Red +	Soft	12	2.37
4th	502	489.2	560	35 min	Sindoorvarna	Soft	12.8	2.54
5th	496	486.8	600	40 min	Sindoorvarna	Slight hard	9.2	1.85
6th	495.2	483.6	550	32 min	Sindoorvarna	Soft	11.6	2.34
7th	494	483.2	600	40 min	Sindoorvarna	Soft	10.8	2.18

Table 12: Organoleptic character of Naga bhasma

Batch	Colour	Odour	Taste	Touch	Lustre
NB1	Sindoorvarna	Odourless	Tasteless	Smooth	Lustreless
NB2	Sindoorvarna	Odourless	Tasteless	Smooth	Lustreless
NB3	Sindoorvarna	Odourless	Tasteless	Smooth	Lustreless

also creates chemical reaction between the surface of melted Naga and oxygen present in the air. This leads in the formation of lead oxide (PbO) which was found in yellowish powder form floating over the surface of melted Naga. Melting time of Naga was found increased after completing quenching in each liquid media which indicates increased heat stability of Naga. Although the difference is not significant hence no definite explanation can be provided.

Thermodynamic of shodhana

Any metal including lead if heated, at certain temperature starts to emit radiation, this is known as thermal radiation and this phenomenon means conversion of thermal energy into light is called incandescence. Lead shows thermal radiation above 205.9°C i.e. after starting its melting. Hence Naga was heated up to 400 ^{0}C while doing cycles of heating and quenching. Quenching media possesses alternate increase and decrease in pH. This may also contribute for the processing.[20]

Table 13: pH Value of Naga bhasma

Sr.no.	Batch	Obtained Value
1	NB1	7.5
2	NB2	7.5
3	NB3	7.5

Table 14: Total Ash Value of Naga bhasma

Sr.no.	Batch	Obtained Value % w/w
1	NB1	99.35
2	NB2	99.38
3	NB3	94.30

Table 15: Loss on drying value of Naga bhasma

Sr.no.	Batch	Obtained Value % w/w
1	NB1	0.15
2	NB2	0.2
3	NB3	0.15

Table 16: Acid insoluble ash value of Naga bhasma

Sr.no.	Batch	Obtained Value% w/w
1	NB1	63.36
2	NB2	63.00
3	NB3	71.00

Jarana

Strong heating up to 750 ^{0}C in open iron pan and continuous rubbing with fresh Vasa stem causes strong chemical reaction between melted Naga and oxygen present in wet Vasa stem as well as the oxygen in open air. After three hours all Naga get converted into yellowish powder which is lead oxide (PbO) with mixture of organic ash. It is difficult to decide actual nature of Jarita Naga but it can be assumed that Jarita Naga must be in organo-metallic form. Some weight gain in all batches also suggests its compound form.

Marana -Role of Bhavana dravya

Bhavana dravya forms an herbal coat on the surface of metal particles and form a surfactant and thus facilitate the further processing. This is similar to the surfactant mediated production of nano particles.[21]

Reason for using EMF instead of classical puta

Standardization mainly aims at reproducibility. Temperature variations are observed in classical puta system of heating according to the season due to the variation of humidity, temperature as puta system is an open method where there is very possibility of loss of heat by which it require more energy to meet the loss. For standardization it is necessary to document and reproduce the temperature patterns. With EMF heating temperature pattern can be maintained according to need with precision and minimal loss of energy as it is a closed system. Chances of contamination are also less with EMF heating. These were the reason for using EMF.[22]

Changes in weight

Assessment of final weight in relation to initial weight will gives pharmacist an idea to choose quantity of initial material to procure desired quantity of finished product. Documentation of weight changes is an essential part of drug standardization. In present study slight weight gain was observed after shodhana in Tial taila which is due to adhesion of oil particles. Weight gain is Jarita Naga was due to formation of compound PbO and remnant ash of Vasa stem. Compared to initial weight of Naga, percent weight of final product in three batches was 95.48, 96.72 and 96.64 respectively.

Incineration cycles

Incineration was done in two steps viz Bhavana and incineration in EMF. Jarita Naga was triturated with decoction of Vasa for three hours i.e. till the liquid get completely absorbed in Jarita Naga. Round pellets were prepared because round shape facilitates

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Table 17: Purity of Naga after shodhana

Element	Sn %	Sb %	Bi%	Cu %	As %	Ag %	Zn %	Cd %	Ni %
Value	0.0330	0.119	<0.005	0.0013	0.0003	0.0003	0.0006	<0.0001	<0.0001

Element	Ca %	Al %	Au %	Fe %	Na %	P %	S %	Pb %
Value	0.0003	<0.0001	<0.0006	<0.0001	0.0001	0.0068	<0.0015	99.40

maximum exposure of heat during incineration. Herbal liquid used for Bhavana and continuous levigation leads in formation of coat of herbal particles over metallic surface. When it is subjected for incineration due to the presence of herbal material the superial surface of Naga particles reacts and oxides may get formed. These oxides again get reduced to their initial form and get separated from core particles. When again subjected for Bhavana then herbal media forms coat over other particles. Thus repeated incineration cycles cause repeated oxidation, reduction and separation of surface particles from core particles. This results in conversion of metal into micro and nano particles. It is found that bhasma possesses significant percentage of nano particles along with micro particles. In classical reference seven incineration cycles are mentioned enough to prepare Naga bhasma and same were required in present study.

Temperature pattern

Naga is a quick melting metal. If high temperature is given for first incineration then there is possibility that Naga will regain its metallic nature. Therefore for first three incineration cycles temperature was increased gradually followed by alternate decrease and increase in temperature.

Duration of procedure

For three batches, one day was required for shodhana in one liquid media. Thus samanya and vishesha shodhana required six days. Three days were required for Jarana of three batches. For Naga Marana, one day was needed for bhavana and drying of pellets. Incineration was done on next day. Two batches were taken simultaneously and third batch was prepared separately. Thus Marana procedure took 28 days. Total duration of procedure right from starting shodhana to obtain the final product was thirty seven days.

CONCLUSION

Pharmaceutical standardization in preparation of medicines is an essential requirement for good manufacturing practices as well as to insure the quality and quantity of final product. The preparative technology of Naga bhasma is complex, laborious and time consuming procedure. Shodhana process helps in increasing brittleness of metal. Jarana procedure plays vital role in exposing maximum surface are of Naga for bhavana and incineration cycles. For preparation of Naga bhasma gradual increasing followed by alternate increasing and decreasing pattern of temperature is necessary. Naga bhasma can be prepared in 28 days with 96.24% yield.

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