ISSN: 2322 - 0902 (P)
ISSN: 2322 - 0910 (O)

International Journal of Ayurveda and Pharma Research

Research Article

PHARMACEUTICO-ANALYTICAL STUDY OF *NAGA BHASMA* BY USING RASATARANGINI REFERENCE

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Article info

Article History:
Received: 21-10-2023
Accepted: 08-11-2023
Published: 10-12-2023

KEYWORDS:
Naga Shodhana, Marana, Bhasma, Marak Dravya, Varitar, Rekhapurnatva, Unnam.

ABSTRACT

Naga bhasma is one of the herbo-metallic preparations used in Ayurveda. In this study an effort has been made to establish standards for *Naga bhasma* prepared by using classical ref. described in Rasatarangini with classical format, *Shodhana, Jarana, Bhavana* & *Marana*. In *Samanya & Vishesha 'Shodhana' (*purification process) removes heavy metals other than lead, apart from making it soft and acquiescent for trituration. *Jarana* process is pre-procedure of *Marana* for all *Puti loha*. For *putapka* of *Putiloha* without *Jarana* process it difficult to convert the *Bhasma* because these metal have low melting point. *Manashila* is *Ariloha* of *Naga*. *Ariloha* is used as *Maraka Dravya* for preparation of *Bhasma* which acts as supporting agent to help the efficacy of *Bhasma*. Black coloured *Naga Bhasma* was obtained after 10 *Puta* by using classical *Puta*. Prepared *Naga bhasma* subjected to tests mentioned in Ayurvedic texts *Varitar, Rekhapurnatva*, & *Unnam*, tests and physico-chemical analysis such as pH Value, Total Ash, Loss on drying and acid insoluble ash.

INTRODUCTION

Bhasma are the metallic preparations in which the metal is incinerated with various juices, decoction of herbal ingredients frequently used in Ayurveda to treat various diseased conditions since centuries without developing any major adverse effects. *Bhasma* are prepared in a well described, generalized classical format, *Shodhana, Jarana, Bhavana* & *Marana*. Generally the term *Jarana,* in *Rasashastra* is concerned with *Parad*. It is one of the eighteen *Sanskaras* of *Parad*. However, this term is also used for the intermediate step performed during the *Marana* of *Putilohas* viz. *Naga, Vanga* and *Yashada.*

On the basis of media, these *Marana* procedures can be classified into 4 groups, which are *RasaBhasma* (Mercurials), *Mulika* (plant-products), *Gandhakadi* (sulphur) & *Arilauha* sequentially in decreasing order of superiority[1]. *Ari* means enemy. The metal which kills the metallic properties of any other metal is considered to be *Ariloha*. *Manashila* is used as *Maraka Dravya* for preparation of *Naga Bhasma* which acts as main active ingredients or as an auxiliary agent to assist the efficacy of *Naga Bhasma*. It reacts with remnant, unreacted lead oxide (PbO) transforming it to lead sulphide (PbS) which is the least toxic form of lead.[2]

The use of *Naga* is described in *Charaka Samhita* in *Trapvadi lepa* for the treatment of *Kushtha, Pancha lauha*, *Kustha roga chikistha*. The use of *Naga* in *Sushruta samhita* also in *Trapwadi lepa* for the treatment of *Kustha*, a variety of *Shilajatu*, used for *Kaphaja Arbuda*. The Ayurvedic application of *Naga Bhasma* is described in *Pandu, krimi, Prameha, Amavata, Raktapradara, Rakta arsa, Vrikka shopha, Hasatapadavikara, Pakshyaghata*. The Pharmacological activity of *Naga Bhasma* is used for Hyperglycemia, *Amavata, Gulma, Grahani, Atisaranasaka, Vajikarana, Vrisya, Balya*, Hypoglycemic activity, testicular regenerative capacity, good *Rasayana*. Toxicity of lead occurs commonly through manufacturing and ecological exposure. It affect almost all system in the body and gives rise to symptoms such as lead stomach pain, lead encephalopathy etc. [3] So, the objectives of this study are to determine SOP in the preparation of *Naga Bhasma*, evaluate the consistent findings of *Shodhana* & *Marana*, and define physico-chemical properties of respective stage of pharmaceutical

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https://doi.org/10.47070/ijapr.v11i11.3022

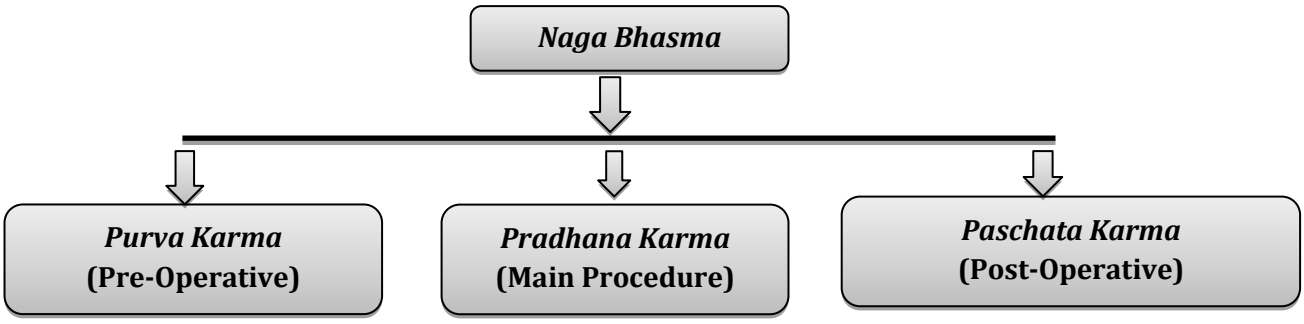
processing and evaluation of physical & chemical test parameters according to classics as well as modern science by using classical *Puta* method.

MATERIAL AND METHODS

Procurement and authentication of Raw materials

The prime objective of pharmaceutical research is to produce a safe, effective and quality drug. The quality of the pharmaceutical product depends not only on the care taken in its preparation, but also in confirming that the genuine raw materials have been used and the material has been correctly processed. Raw Naga, *Tila Taila, Takra, Gomutra, Kanji, Kulattha seeds, Manashila, Ashwattha Twaka, Churnodaka* and *Nimbu Swarasa* were used as raw ingredients. Lead was considered as Naga for their similar characteristics and was collected from local market and *Goshala* Nagpur and authenticated as per classical transcripts cited.

Takra, Kanji, Kulattha Kwatha, Aadraka Swarasa and *Churnodaka* were prepared as per the references of Sushruta Samhita, Sutrasthana: 45/85, Rasayansara 1/1-6, Sharangdhara Samhita Madhyama Khanda: 2/1 & 1/2, Rasatarangini (11/216-218) respectively. The *Naga Bhasma* was prepared through the following Pharmaceutical processing.



1. Preparation of *Takra, Kanji, Kulattha Kwatha, Churnodaka & Aadraka Swarasa*
2. *Shodhana* of *Manshila*.
3. *Samanya* & *Vishesha Shodhana* of *Naga Dhatu*
4. *Jarana* of *Naga Dhatu*

Preparation of *Naga Bhasma*

Bhasma Pareeksha (testing of bhasma through Ayurvedic parameters), organoleptic and Physico-chemical test

Shodhana of Manashila[4]

Reference: Rasa Ratna Samuchhaya 11/114

Principle: *Bhavana*

Duration: 7days

Equipment: Weighing machine, *Khalwayantra*, Stainless steel vessels, measuring vessel, plate etc.

Materials: 1. *Ashuddha Manashila*: 300g

2. *Aadraka Swarasa*: Q.S.

Procedure: *Ashuddha Manashila* was triturated with *Aadraka Swarasa* and this similar procedure of *Bhavana* was repeated 7 times with fresh *Swarasa* each time and dried properly.

Observation: After completion of *Bhavana*, *Manashila* became reddish bright, *Slakshna churna* with smell of *Aadraka* and remarkable constant increase in weight was noted.

Results: Initial Weight of *Ashuddha Manashila*: 300gm

Final weight of *Shuddha Manashila*: 312gm

Weight gain: 12g weight gain: 4%

Samanya shodhana* of *Naga Dhatu[5]

Reference: Rasa Ratna Samuchhaya, 5/13

Principle: *Dhalana* (melting, followed by quenching)

Media: *Tila Taila* (sesame oil), *Takra* (butter milk), *Gomutra* (cow urine), *Kanji* (sour gruel), *Kulattha Kwatha* (decoction of seeds Dolichos biflorus)

Duration: 7 days

Equipment: Weighing machine, *Pithara Yantra*, stainless steel vessels, iron ladle, measuring vessel, pyrometer, and gas stove etc.

Materials: Raw *Naga*: 500g

Media: 1000ml X 7 *Nirvapa* X 7 times =49000ml

Procedure: Raw *Naga* taken for *Shodhana* was confirmed for Ayurvedic *Grahya* parameters like quick melting, heavy, have bright black surface and gives black line on rubbing over white paper. *Samanya shodhana* was carried out by seven times quenching of melted *Naga* in each media. Each time new liquid media was taken.

Vishesha Shodhana* of *Naga Dhatu[6]

Reference: Rasatarangini 19/10

Principle: *Dhalana* (melting, followed by quenching)

Duration: 1 day

Equipment: Weighing machine, iron pan, iron ladle, stainless steel vessels, measuring vessel, pyrometer, gas stove, etc.

Materials: *Samanya Shodhita Naga*: 355.81g

Media: *Churnodaka*: Q.S.

Procedure: *Vishesha shodhana* was done by seven times quenching of melted *Naga* in *Churnodaka*.

Table 1: Observation in *Naga* during *Samanya Shodhana* and *Vishesha Shodhana*

S.No.		In *Taila*	In *Takra*	In *Gomutra*	In *Kanji*	In *Kulattha Kwatha*	In *Churnodaka*
1.	Colour	Blackish silver colour	Blackish silver colour	Light yellow	Light yellow and lustrous	More shining silvery	Blackish shine with whitish
2.	Texture	Little part in a granular form & coarse form	Some part Coarse form	Some part coarse form, brittleness increases	More brittle	More in coarse form	More in coarse form
3.	Time required for melting	4.50min	4.15min	3.30min	3.45 min	4.10 min	4.15min
4.	Wt of *Naga* before *Dhalana* (7times) (g)	500	464.77	436.64	407.08	380.93	355.81
5.	Wt of *Naga* after *Dhalana* (7times) (g)	464.77	436.64	407.08	380.93	355.81	332.65

Results: Initial weight of *Naga*: 500g

Final weight of *Naga* after *Samanya* and *Vishesha shodhana*: 332.65g

Total Amount of *Naga* Lost: 167.35g

% of loss: 33.47%

***Jarana* of *Naga Dhatu*[7]**

Reference: Rasatarangini (19/11-14)

Principle: *Avapa*

Duration: 5 hours

Equipment: Weighing machine, iron pan, iron ladle with a long handle, gas stove, *Sharava* (earthen lid), stainless steel spatula, pyrometer etc.

Ingredients: *Vishesha Shodhita Naga*-1 part: 250g

Medium: *Ashwattha Tvak Churna*- 1part: 250g

Procedure: *Shuddha Naga* (purified lead) was heated in an iron pan. After complete melting, *Naga* was strongly rubbed with *Ashwattha Tvak Churna* at a regular interval. After 2 hrs *Naga* was converted in to yellow powder. Powdered metal was collected in the center of the iron pan and covered with the *Sharava* (earthen lid) and maximum amount of heat was given till the bottom of vessel became red hot. Heating stopped after 3 hrs. On next day, powder was collected. This process followed by *Prakshalana* of *Naga Dhatu*. The *Prakshalana* was repeated until the pH of decanted water become neutral i.e., around 7.

Observation: Addition of *AshwatthaTvak Churna* and constant rubbing resulted into yellow coloured *Naga* powder.

Table 2: Observation during *Jarana* of *Naga*

Wt. of *Shuddha Naga*(g)	Wt. of *AshwatthaTvak Churna*	Duration	Wt. of *Jarita Naga* (g)	Wt. Increase in %
250	250	3 hr 30 min	306.23	22.49

ii. *Prakshalana* of *Jarita Naga*

OBSERVATIONS

The amount of water for the *Prakshalana* of *Jarita Naga* was not found in the classical texts. Hence 4 times of water was taken to ensure the proper dilution of the *Jarita Naga* in the water.

Table 3: pH of water of *Jarita Naga* and wt. of *Naga* after *Prakshalana*

Wt. of *Naga* before *Kshalana* (g)	1st Wash	2nd Wash	3rd Wash	4th Wash	Wt. of *Naga* after *Kshalana* (g)	Wt. decrease in %
306.23	11.5	9.8	8.6	7.2	254.59	8.50

Preparation of *Naga Bhasma*[8]

Reference: Rasatarangini19/14-15

Principle: *Bhavana* and *Putapaka* (Incineration)

Equipment: Weighing machine, *Khalwayantra, Gaja Puta*, cow dung cakes, knife, spoon, *Sharava*, mud smeared cloth, pyrometer etc.

Ingredients: *Jarita Naga* (1 part): 200g *Shuddha Manashila* (1part in 1st *Puta* then it reduced 1/20th part in remaining *Puta*): 200g *Ashwattha Twaka churna*: Q.S.

Medium: *Nimbu Swarasa* :Q.S

Procedure

1. *Jarita Naga, Shuddha Manashila* and freshly prepared *Nimbu Swarasa* was taken in clean *Khalwayantra* and triturated properly, till formation of smooth mass followed by *Chakrikarana*.
2. After complete drying of *Chakrikas*, it was taken in a *Sharava* (earthen lid) and covered with another inverted *Sharava*.
3. Then, space between the two *Sharava* was sealed properly with the help of cotton cloth and *Multani mitti* and allowed to dry.
4. The *Sharava* was placed in *Puta* and incinerated and temperature was recorded with help of pyrometer.
5. *Puta* was allowed to cool down on its own, after that *Sharava* was opened carefully.
6. The change in appearance and weight of *Chakrikas* was observed.
7. This procedure was repeated for 10 times until *Naga Bhasma* was obtained.

OBSERVATIONS

After each *Puta*, the color of *Chakrikas* was changed from greenish to black, lusterless, soft in texture.

Table 4: Observation during *Naga Marana*

Puta	Total wt.=*Jarita Naga + Shuddha Manshila* (g)	*Bhavana Drava-Nimbu Swarasa* (ml)	Wt. of *Chakrikas* Before *Puta* (Dry *Chakrikas*-g)	Wt. of *Chakrikas* After *Puta* (g)	Cow Dung Cakes (No.)	Cow Dung Cakes (Wt.) Kg	Max Temp. (0C)	Time reqd. to attain the Max. Temp. (minutes)	Colour of *Chakrikas* after *Puta*	Hardness/ Softness of *Chakrikas*	Wt. loss after *Puta* (g)	%Wt. loss
1st	200+200=400	100	425.45	221.22	15	3.6	560	15	Greyish	Soft	204.23	48.0
2nd	221.22+11.06 =232.28	70	258.81	229.69	15	3.6	500	18	Greyish	Hard	29.12	12.23
3rd	229.69+11.48 =241.17	70	265.92	233.36	13	3.25	450	12	Black	Hard	32.56	12.24
4th	233.36+11.66 =245.02	70	266.25	226.99	13	3.25	520	13	Black	Hard	39.26	14.74
5th	226.99+11.34 =238.33	60	258.47	220.62	13	3.25	550	14	Black	Soft	37.85	14.64
6th	220.62+11.03 =231.65	50	252.18	206.95	12	3	450	12	Black	Soft	45.23	17.93
7th	206.95+10.34 =217.29	40	237.42	194.56	12	3	460	12	Black	Soft	42.86	18.05
8th	194.56+9.72 =204.28	40	224.73	184.28	10	2.5	420	10	Black	Soft	40.45	17.91
9th	184.28+9.36 =196.64	30	217.79	176.56	10	2.5	400	13	Black	Soft	41.23	18.93
10th	176.56+8.82 =185.38	30	207.61	169.46	10	2.5	430	10	Black	Soft	38.15	18.37

RESULT

Initial weight of *Shuddha Naga* + *Shuddha Manshila*: 200 g+294.81g=494.81g

Final weight of *Naga Bhasma*: 185.38g

Total Loss: 312.43g

% of loss: 63.14 %

Paschat Karma

After 3rd *Puta Rekhapurntva* (when *Bhasma* is rubbed in between the index finger and thumb. It should enter into the lines of the finger), after 5th *puta,* softness was observed, *Varitaratva* (it is floating character of *Bhasma* on stagnant water surface) and *Unnam* (a grain of rice is to be kept carefully on the layer of floated *Bhasma,* observe whether the grain floats or sinks) was obtained in 10th *Puta*.

Observations and Result of Analytical Study

Table 5: Testing Ayurvedic & Modern parameters of *Naga Bhasma*

S.No.	Ayurvedic Parameters	Results	S. No.	Modern Parameters- (Organoleptic characters)	Results
1.	***Shabda***	*Nishabda*	1.	**Appearance**	Black, powder form
2.	***Sparsha***	*Mridu*	2.	**Taste**	Tasteless
3.	***Rupa***	*Sukshma, Shlakshna, Krishnabha*	3.	**Odour**	Not significant
4.	***Rasa***	*Niswadu*	4.	**Touch**	Soft
5.	***Gandha***	*Nirgandhi*			
6.	***Bhasma pariksha***	*Rekhapurnavta, Varitara, Unnam pariksha* passed			

Table 6: **Testing Analytical parameters of *Naga Bhasma***

S.No.	Test Name	Results
1.	Total ash content	82%
2.	Acid Insoluble Matter	9.80%
3.	Loss on drying@105^{o}C	7.2%
4.	pH	7.5
5.	Water soluble extractive	21.16%

DISCUSSION

Shodhana* of *Manashila

The process of *Manashila shodhana* was done with ref.R.R.S.3/95-96, *Manashila* was mentioned as *Ariloha* of *Naga* metal as per ref. So, it is generally used as a *Maraka dravya* for *Naga* (lead) in present study. The weight of *Manashila* was found increased after *Shodhana* process due to addition of solid contents (starch content) of *Adraka Swarasa*. There are several positive factors associated with *Adraka Swarasa.* Phytochelatins are heavy metal-binding peptides that play an important role in detoxification of heavy metals by chelation. Ginger contains two important Sulphur-based amino acids called cysteine and methionine which act as phytochelatins and can render arsenic in *Shuddha Manashila* nontoxic [9].

Samanya* and *Vishesha Shodhana* in *Naga

Samanya and *Vishesha Shodhana* were done by *Dhalana* process. During quenching in sesame oil, *Naga* caught fire pungent smell, hissing sound and black fumes were observed after each quenching. Flame was noticed after quenching in *Takra* as well. Hence flame, black fumes after 1st quenching in sesame oil and *Takra* are likely due to burning of residual oil and ghee respectively. When this *Naga,* was heated again, liquid media evaporates first which cause delay in rise of temperature. 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 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*. Finally blackish silvery shine *Shuddha Naga* were obtained [10].

Jarana* of *Shuddha Naga

Jarana process is mainly applied for *Putilohas* and *Vanga*, *Naga* are included under *Puti Loha*. *Putilohas* cannot be subjected to *Puta* in their metallic form because of their low melting point. Hence a preparatory method that is *Jarana* was mentioned in classics to convert the *Putiloha* into its powder form and to obtained more stability on fire. An overall review of the herbal drugs used for *Putiloha Jarana* indicates that most of them contain *Kshara* (alkaline matter). Alkali is said to be best oxidizing agent for metals. *Kshara* may be working as a catalyst and convert the metal into powder form. By its *Bhedana* (penetration property) *Kshara* may help in making the metal softer and brittle. After process, yellowish coloured powder of *Naga* was obtained.

Preparation of *Naga Bhasma*

Naga Bhasma was prepared according to ref R.T.19/14-15. Using *Jarita Naga*, *Shuddha Manashila* and *Nimbu Swarasa. Nimbu Swarasa* is used as *Bhavana dravya,* which forms 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 nanoparticles. According to ref. *Shuddha Manashila* was taken in 1 part in 1st *Puta*, Maximum quantity of *Naga chakrika* converted into black coloured and lot of crystals of arsenic got deposited on inner side of upper *Sharava* and on the upper layer of *chakrika*. In consequent *Puta*, only 1/20th part of *Manashila* was added as that of material obtained after each incineration cycle. After second *Puta, chakrika* were hard, black in colour with some metallic particles (*Utthapita Naga*) observed deposited on inner side of upper *Sharava* and on the upper layer of *Chakrika*. After 5th *Puta, Chakrikas* were soft in touch, easily breakable and without shining at the cut surface. After 10th *Puta* it passed *Bhasma Pariksha* like *Rekhapurnatva*, *Varitar* and *Unnam*. After *Marana*, black coloured of *Naga Bhasma* was obtained.

In Marana, arsenical compounds are intentionally added to Ayurvedic formulations as main active ingredients or as auxiliary agent to assist the efficacy of herbal drug. Temperature during *Marana* probably facilitates conversion of arsenic sulphide (As_2S_2) to arsenic oxide (As_2O_3) and thus conversion of PbO to PbS. The boiling point of arsenic oxide (As_2O_3) is about 465°C and hence would have vaporized during the incineration cycle where PbS is known to react with PbO when heated, leading to formation of metallic lead and sulphur dioxide. An addition of realgar during each incineration cycle may probably be aimed at suppressing the above reaction. The addition of realgar in excess quantity reacts with any unreacted PbO transforming the same to PbS. This ensures that the intermediates do not contain elemental lead. These finding denotes the importance of *Manashila* in the preparation of *Naga Bhasma* which assist the formation of PbS and ensure the safety aspect of *Naga Bhasma* because intermediate compound PbO is more toxic as compared to lead sulphide.[11]

Analytical Study

On organoleptic evaluation of *Naga Bhasma* showed smoothness with no perceptible coarse powder, having tasteless property and no specific odour, produced no perceptible sound during chewing. Sound and touch indicate physical properties like smoothness, softness, and fineness of *Bhasma*. *Naga Bhasma* was black in colour. Specific colour of the *Bhasma* indicates formation of particular metallic compounds, because each chemical compound possess particular colour. Tastelessness of *Bhasma* indicates transformation of the particular metallic taste to tasteless compound i.e.; a new entity resulted due to unique pharmaceutical processing. *Varitara, Rekhapurnata* and *Unama* test indicate lightness and micro fineness of the *Bhasma*. Analytical study brings the standard for the quality drug and helps to explain the pharmacokinetics and pharmacodynamics of a drug. Here analytical study was carried out with final product to know the physico-chemical changes and effect of different pharmaceutical processing. The L.O.D. value of *Naga Bhasma* was 7.2% because it also contains organic substances as its ingredients which absorb moisture. The pH value which was 7.5 shows slightly alkaline nature. *Naga Bhasma* was evaluated for ash value and it was found 82% w/w because it also contains organic substances as its ingredients. Acid insoluble Ash value was 9.80% which facilitates the easy absorption of drug.

CONCLUSION

Pharmaceutical standardization is an important requirement for good manufacturing practices as well as to insure the quality and quantity of final product. To accomplish *Naga Bhasma*, which passes all the *Bhasmaparikshas*, *Naga* should be subjected to *Samanya shodhana* by *Dhalana* in *Kanji, Takra, Kulatta Kwatha, Gomutra* and *Tila taila; Vishesha shodhana* by *Dhalana* in *Churnodaka* for 7 times each media; then *Jarana* with *AshwatthaTvak Churna* and *Marana* with 10 *Puta*. For preparation of *Naga bhasma*, alternate increasing and decreasing pattern of temperature is applied.

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Cite this article as:
Shewalkar Kalyani Jeewanrao. Pharmaceutico-Analytical Study of Naga Bhasma by Using Rasatarangini Reference. International Journal of Ayurveda and Pharma Research. 2023;11(11):50-60.
https://doi.org/10.47070/ijapr.v11i11.3022
Source of support: Nil, Conflict of interest: None Declared

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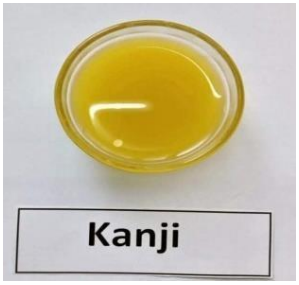
Samanya & *Vishesha Shodhana* of *Naga*

Ashuddha Naga	*Naga* heated until it became melted	Melted *Naga* quenched in different media using *Pithar yantra*

1. In *Taila* 		**4. In *Kanji*** 	
2. In *Takra* 		**5. In *Kulattha Kwatha*** 	
3. In *Gomutra* 		**6. *Churnodaka*** 	

The process of quenching was repeated seven times in each liquid media

After *Samanya* & *Vishesha Shodhana* *Shudhha Naga* was obtained

Jarana of *Shuddha Naga*

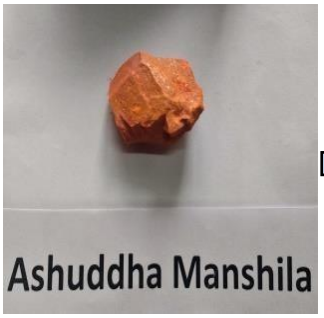


Ashwattha Twak Churna	Melting of *Shuddha Naga*	Adding the *Ashwattha Twak Churna* & Cont. and forcefully rubbing was done



Shuddha Naga converted into powder form	Powdered Naga covered with *Sharava* & *Teevra Agni* (High heat) was given	After *Prakshalana*, *Jarita Naga* was obtained

Shodhana of *Manashila*




Ashuddha Manashila	*Aadrak Swarasa*	Seven *Bhavana* were given	*Shuddha Manashila*

Naga Bhasma Nirmana

Jarita Naga

Shuddha Manashila

Nimbu Swarasa

Trituration was done

***Chakrika* formation was done**

***Ashwattha Twak Churna* was added**

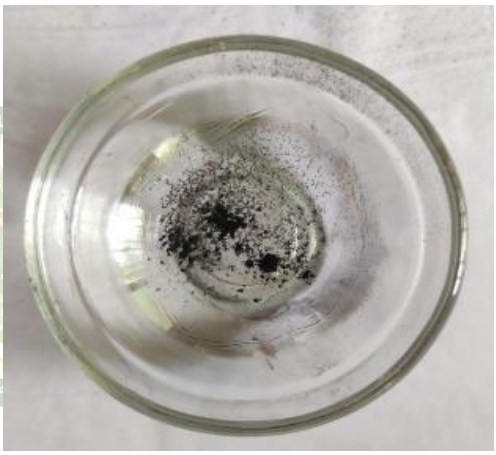
***Sharava Samputa* was done**

***Puta* was given**

After *Puta*

After 10th, *Naga Bhasma* was obtained

Bhasma Pariksha of *Naga Bhasma*

Name of *Bhasma Pariksha*	*Naga Bhasma*
1.*Rekhapuranvta*	
2. *Varitartva*	
3. *Unnam*