

Standardising Manufacturing Process of Swarnamakshika Bhasma

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ABSTRACT

Rasashastra, Indian Alchemy involves various processes of transformation to make metals and minerals more assimilable in the body. A careful survey of original texts on *Rasashastra* shows that subject covers the entire field of inorganic pharmaceutical preparation like metallic, non-metallic and organo-metallic compounds of Ayurvedic Material Media. *Shodhana*, *Marana*, *Amruthikarana* etc. of the substance are done with some special processes and thereafter can be used therapeutically. *Swarnamakshika* is one of the *Maharasa Varga Dravya* which is said as *Rasendra Prana*. It acts as *Rasayana* and *Vrishya* and has importance in both *Lohavada* and *Dehavada*. In the present study, raw *Swarnamakshika* is subjected to *Shodhana* with *Saindhava lavana* and *Nimbu Swarasa* using *Bharjana* process. *Marana* of *Swarnamakshika* is carried out with *Gandhaka* as *Maraka Dravya* and subjecting to *Varaha puta*. Standard Operating Procedure (SOP) aim to achieve efficiency, quality output and uniformity of performance. In the present study, *Swarnamakshika Bhasma* was prepared and analysed using various physical parameters and modern analytical instruments like XRD, FTIR, SEM-EDS, N.P.S.T. and Particle size analyser.

KEYWORDS: *Rasashastra*, *Marana*, *Swarnamakshika Bhasma*, *SOP*

INTRODUCTION

Rasadavyas have been familiar to mankind since very long time. They can be used therapeutically only after *samskaras* like *Shodhana*, *Marana*, *Satwapatana*, *Amrithikarana* etc. These *samskaras* play an important role in changing the inherent properties of a *Dravya*.¹ The primary aim of this is to convert the *sthula rupa* of the raw drug to *Sukshma rupa* to confirm its bioavailability. *Shodhana* is a *samskara*, which essentially brings out modifications and potentiation of properties along with purification. *Marana* is a process in which *Rasadavya* is killed, so that it loses all its physical properties and are converted into *Bhasma* by applying required quantum of heat after grinding with herbal extracts.²

Swarnamakshika is a kind of mineral substance having *peeta varna* like *Swarna*. *Makshika* categorised under *Maharasa Varga Dravya* whose detailed description is available in almost all the textbooks of *Rasashastra*. *Bhasma* of *Swarnamakshika* is *Tridoshaghna* and has *Vrishya*,

Rasayana, *Yogavahi*, *Vishadoshahara* etc. effect when administered internally.

To establish the efficacy along with safety of *Rasoushadhis*, care must be taken throughout the whole process to prepare the medicine. This study was carried out to standardize the *Marana* procedure of *Swarnamakshika* and convert it into *Bhasma* which is a unique dosage form described in *Rasashastra*.

METHODOLOGY

Raw materials were collected after authoritative identification through *grahya - agrahya lakshanas*.

1. *Swarnamakshika Shodhana* by *Bharjana* method.³

Homogenous mixture of 1000 gms of *Swarnamakshika churna* and 350gms of *Saindhava lavana* was taken in an iron vessel. *Nimbuka swarasa* added to it and mixed properly. Then this iron vessel was kept on a gas stove for heating. The mixture was then continuously stirred with the help of *darvi* throughout the procedure. Heating was stopped when

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the bottom of the iron vessel attained red hot. The mixture was washed thoroughly with hot water for two times and kept spread for drying on a clean cloth.

Observations:

- The color of homogenous mixture of *Swarnamakshika churna* and *Saindhava lavana* was greyish black. When *Nimbuka swarasa* added to it, the color turned to slight greenish and the mixture became paste like.
- Soon after five minutes of heating bubbles started appearing in the mixture. And the mixture became more liquid in nature than before.
- After fifteen minutes of heating the mixture became sticky and attained semisolid state. And the color of the mixture was blackish gray.
- Sulphur smell noticed after 15 minutes of heating.
- With the course of time of heating the mixture was turned into red from blackish gray.
- After 1 hour 45 minutes of heating the bottom of the iron vessel became red hot.

2. *Gandhaka shodhana by kurmaputa method.*⁴

Earthen pot was smeared with Ghrita and 1.5 liters of fresh cow's milk was poured, & its mouth was covered with a single layer of white cotton cloth and tied properly with a thread. *Gandhaka* was spread over the cloth uniformly and covered with loha *Sharava*. *Loha Sharava* was covered with 11 cow dung cakes and fire was set with camphor. After *SwangaSheeta* the pot was removed out from the pit, cloth tied over the mouth was removed. Granules of *Shodhita Gandhaka* which were immersed in milk were separated, washed with hot water thoroughly and dried under shade. This procedure was repeated for 2 more times by using fresh cow's milk. Total 10kgs of *Gandhaka shodhana* was carried out using this method in 20 batches.

Observations:

- After *Shodhana* colour of the milk turned to yellowish white.
- Smell of the milk was of mild sulphur.
- All mud particles and dust present in *Gandhaka* were separated out over the cloth during the first procedure.
- *Shodhita Gandhaka* was of pale yellow colour & shiny.
- *Shodhita Gandhaka* was in granular form and few were streak-like, fully immersed in the milk. Few minute granules were seen floating on the milk.

3. *Marana of Swarnamakshika.*⁵

It was carried out in different stages viz:

A. *Bhavana with Nimbu swarasa.:*

600gms of *Shodhita Swarnamakshika* was taken in *Khalvayantra*. Equal quantity of fine powder of *Shodhita Gandhaka* mixed with *Shodhita Swarnamakshika* for first 10 *putas*. After that Half quantity of *Shodhita Gandhaka* was added for each *puta*. This mixture was triturated with sufficient quantity of *Nimbu Swarasa* for 6 hours. Trituration was done until whole mass attains a viscous and semisolid state.

B. Preparation of *Chakrikas*.

After attaining appropriate consistency, *Chakrikas* were prepared of size 3-4cm Diameter, 2-2.5mm thickness and dried completely.

C. *Sharava Samputa formation.*

Two concave earthen *Sharava* of equal size were taken. Dried *Chakrikas* were kept in earthen *sharava* and arranged in two layers. Another *sharava* was placed over it to make *samputa*. Gap between two *sharavas* was properly sealed with one layer of Multani mitti smeared thread and then with seven layers of multani mitti lepita vastra or cloth.

D. *Varaha Puta:*

Size and Shape: *Varaha puta* was given by using the pit of following dimensions. Height -43cm (22 angula), Depth- 43cm (22 angula), Width - 43cm (22 angula).

Fuel: Cow dung cakes weighing 12 kg.

2/3rd part of the pit was filled with 72 cow dungs weighing 8 kgs and *sharava samputa* was placed over it. Thermocouple of the pyrometer was placed horizontally from the side of the pit at the junction between lower 2/3rd upper 1/3rd of the cow dung cakes. Remaining 1/3rd portion of pit was filled with 24 cowdung cakes weighing 4 kgs. To facilitate easy catching of the fire, camphor balls were placed on four corners of the *puta* and cow dung cakes were ignited. The temperature was recorded with the help of Thermocouple with pyrometer. After self-cooling *sharava samputa* was taken out of pit and opened cautiously and *Swarnamakshika bhasma* was collected and weighed.

Observations:

- The maximum temperature was recorded 850 °C.
- Total time taken for burning of cow dung cakes was 4 hrs and for completes self-cooling 20hours.
- Sulphur fumes were observed after 1 hour.
- All *Bhasma siddhi lakshanas* attained after 20 *varaha putas*.

*Amritikarana of Swarnamakshika.*⁶

There is no direct reference available for *Swarnamakshika Bhasma - Amritikarana* in the

classics. As *Swarnamakshika* contains *Tamra* as one of the constituents, the *Amritikarana* methods adopted for *Tamra Bhasma* can be implemented. In the present study, 1 part of *Swarnamakshika Bhasma* and $\frac{1}{2}$ part of *Shodhita Gandhaka* was taken in *khalvayantra* and *bhavana* given with *Nimbu swarasa*. After attainment of proper consistency, a bolus was formed weighing 700gms.

Two *Surana kandas* one weighing about 810gms and another 760gms was selected and a cavity is created using a knife, inside this cavity bolus of *Swarnamakshika Bhasma* placed and the cavity is again covered with another *Surana kanda* and the *sandhibandana* was done with 7 layers of Multani mitti lepita vastra. After drying it was subjected to *Gajaputa*. Vanopalas used is 31kg.

Observations:

- The maximum temperature recorded was 752⁰C.
- Mild Sulphur odour was observed.

- The colour of Bolus was greyish black.

Lohitikarana Of Swarnamakshika⁷

The process is done to regain the colour of *bhasma* which is lost in the process of *Amritikarana*. In process the *bhasma* is given *bhavana* with *Raktavarga dravyas* and subjected to 2-3 *Gajaputas*. In the present study, to 680gms of *Amrithikrita Swarnamakshika Bhasma* 200ml of *Manjishtha Kashaya* is added and *bhavana* was done until *subhavita lakshanas* are seen. *Chakrikas* were prepared and dried. After drying of *chakrikas* they were placed in two *earthen sharavas* and *sandhibandhana* was done. When it gets dried, it was subjected to 2 *Gajaputas*.

Observations:

- The maximum temperature recorded was 806⁰C.
- Sulphur odour was observed.
- The colour of *chakrikas* were reddish brown.

RESULTS

1. Pharmaceutical Study Results

Table No.01: Showing results of Swarnamakshika Shodhana

Quantity of Swarnamakshika taken	Quantity of Swarnamakshika obtained	Loss	Yield %
1000gms	960gms	40gms	96%

Table No.02: Showing results of Gandhaka Shodhana

Batch	Quantity of Gandhaka taken	Quantity of Gandhaka obtained	Loss	Yield %
I	500gms	400gms	100gms	80%
II	500gms	405gms	95gms	81%
III	500gms	442gms	58gms	88.4%
IV	500gms	440gms	60gms	88%
V	500gms	350gms	150gms	70%
VI	500gms	360gms	140gms	72%
VII	500gms	410gms	90gms	82%
VIII	500gms	380gms	120gms	76%
IX	500gms	400gms	100gms	80%
X	500gms	450gms	50gms	90%
XI	500gms	435gms	75gms	87%
XII	500gms	430gms	70gms	86%
XIII	500gms	365gms	135gms	73%
XIV	500gms	400gms	100gms	80%
XV	500gms	400gms	100gms	80%
XVI	500gms	400gms	100gms	80%
XVII	500gms	440gms	60gms	88%
XVIII	500gms	400gms	100gms	80%
IX	500gms	440gms	60gms	88%
XX	500gms	400gms	100gms	80%

Table No.03: Showing results of Swarnamakshika Marana

Quantity of Swarnamakshika taken for Marana	Quantity of Swarnamakshika obtained after 20 puta	Loss	Yield %
600gms	410gms	190gms	68.333%

Table No.04: Showing results of Swarnamakshika Amrithikarana

Quantity of Swarnamakshika before Amrithikarana	Quantity of Swarnamakshika after Amrithikarana	Loss	Yield %
700gms	680gms	20gms	97.1%

Table No.05: Showing results of Swarnamakshika Lohitkarana

Quantity of Swarnamakshika before Lohitkarana	Quantity of Swarnamakshika after Lohitkarana	Loss	Yield %
680gms	400gms	280gms	58.82%

2. Analytical Study Results

Table No.06: Showing classical parameters of Lohitikrita Swarnamakshika Bhasma

	<i>Rekha purnata</i>	<i>Varitartva</i>	<i>Amla dadhi pareeksha</i>	<i>Nishchandratva</i>
2 nd puta	Negative	Negative	Negative	Negative
5 th puta	Negative	Negative	Positive	Negative
10 th puta	Negative	Negative	Positive	Negative
11 th puta	Positive	Negative	Positive	Negative
15 th puta	Positive	Negative	Positive	Negative
20 th puta	Positive	Partially positive	Positive	Positive

Table No.07: Showing organoleptic characters of Lohitikrita Swarnamakshika Bhasma

Physical test	Observation
Colour	A. Reddish brown
Odour	B. Odourless
Taste	C. Tasteless
Touch	D. Fine

Table No.08: Showing results Physical Tests of Lohitikrita Swarnamakshika Bhasma

	LSMB
p ^H Value	6.0
Ash Value	124±2.17
Acid Insoluble Ash	53.44±0.02
Water Soluble Ash	57.33±0.01
Loss on drying at 105 ^o C	0.98±0.01

Table No.09: Showing results of XRD Study of Lohitikrita Swarnamakshika Bhasma

2-Theta	d
27.08	3.290
28.528	3.126
33.83	2.647
35.481	2.528
39.25	2.293
43.18	2.093
47.44	1.915
48.648	1.870
49.034	1.856
57.12	1.611
62.66	1.4814
79.54	1.204

Table No.10: Showing SEM EDS results of Lohitikrita Swarnamakshika Bhasma

Sl no	Element	Weight %	Atomic %
1	O	34.73	61.98
2	S	14.20	12.64
3	Fe	41.03	20.97
4	Cu	8.59	3.86
5	As	1.45	0.55

Table No. 11: Showing results of FTIR of Lohitikrita Swarnamakshika Bhasma

Sample peaks Cm^{-1}	Bond	Functional groups
3786.46	O-H (free)	phenols
3657.06	O-H (stretching)	Alcohol
3434.74	N-H (stretching)	Primary amine
2920.28	O-H (strong)	Carboxylic acid
2851.49	N-H (stretching)	Amine salt
2051.56	C=C=N (stretching)	Ketenimine
1634.93	C=C (Stretching)	Cyclic alkene
1463.33, 1384.26	C-H (bending)	Alkane
1089.85	C-F	Fluro compound
874.56	C=C	Alkene
620.84	C-Br	Bromide
596.68	C-Cl	Chloride

Table No.12: Showing results Parcticle size analysis of Lohitikrita Swarnamakshika Bhasma

Mean diameter(nm)	816.4
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Table No.13: Showing N.P.S.T. Result of Lohitikrita Swarnamakshika Bhasma

Sample	I phase(0-5min)	II Phase(5-20min)	III Phase (20 min-1hrs)
LSMB	Deep blue central drop was masked by the presence of brownish particles due to presence of brown coloured <i>Bhasma</i> . Deep blue colour was visible in the brim of brown spot. Blue periphery expanded with light blue periphery on time.	Deep blue central solid spot with very light blue periphery formed and around this, visible serrated blue and a green margin encircle was seen	Deep blue colored central spot with white ring at the periphery.

DISCUSSION

1. Swarnamakshika Shodhana by Bharjana:

- In this method of *Shodhana*, the *Nimbu swarasa* and *Saindhava lavana* were used for *Shodhana* by *Bharjana* method.
- Here the *Swarnamakshika* was fried with these two drugs in presence of oxygen. By addition of these two drugs there may be a chance of formation of Hydrochloric acid in minute quantity and by heating the impurities like carbonates etc. may be get destroyed.
- By continuous stirring and heating the arsenic impurities may get evaporated resulting in detoxification of *Swarnamakshika*.
- *Nimbu swarasa* may give some organic qualities to *Swarnamakshika* resulting in its potentiation. And water-soluble impurities formed as a result of chemical reaction may get dissolved in water and removed when the *Swarnamakshika* was washed with the hot water after completion of *Bharjana* process.
- The color of *Swarnamakshika churna* changed to brownish at the end of procedure. This might due to formation of iron oxide as the *Bharjana* was done in the presence of oxygen. There was 60gms of weight loss in this procedure, which might be due to adherence of *Swarnamakshika* to an iron

vessel and also there may be a possibility of weight loss while washing with hot water.

2. Gandhaka Shodhana:

Gandhaka Shodhana was done by *Kurmaputa* method, using milk as a media

Melting of Gandhaka:

- Sulphur can melt at two different temperatures
- If heated rapidly, it melts at 112.8°C
- But if heated slowly it will melt only at 118.6°C

In this case Sulphur is melted by steady rise of temperature i.e., by the second way. At this temperature, sulphur melts to form a light-yellow liquid. At this point the S_8 molecules are separating. In this form the atoms are covalently bonded (sharing electrons with one another) to form rings of eight. These rings slide easily over one another but can't connect or tangle, which is why the liquid is not viscous. When this light-yellow molten sulphur is poured into milk it solidifies as crystalline sulphur.

Godugdha as a media

- *Guru – snigdha guna* and *sheeta veerya* of *godugdha* pacifies the *Teekshna*, *Ushnaguna* of *Gandhaka*.
- The organic sulphur present in the protein of milk might have a role in increasing bioavailability of inorganic sulphur.

- Immersing the Molten Sulphur in to milk may cause, higher porosity, lower mechanical strength, and increase in the crystal size of Sulphur.
- Since raw milk is the commonly recommended antidote for poisoning, it might help in neutralizing the sulphur poisoning.
- *Shuddha Gandhaka* was brittle and shiny, may be due to the change in crystalline structure while passing through the stage of melting.
- The impurities like mud or any other material gets separated on the cloth as these impurities do not melt or change at this temperature.

3. *Swarnamakshika Marana*:

- *Gandhaka* is an important media used for *Marana* of many metals and minerals including *Swarnamakshika*. Being *Ariloha* it is said to fasten up the *Bhasmeekarana* process.
- *Rasa Ratna samucchaya* reference explains *Marana* with *Gandhaka* in equal quantities, where *Bhasma* gets formed in 5 *Varaha Putas*.
- In *Rasa Prakasa Sudhakara* it is further explained as the *Gandhaka* should be used in equal parts to that of *Swarnamakshika* for first five *Putas*, then reduce to half parts for the next *Putas*. *Varaha Puta* is explained for *Bhasmeekarana* of *Swarnamakshika*.
- Copper and Iron when ignited with extra sulphur, sulphides are formed which predominantly are black in colour. (FeS , Cu_2S , CuS – Black). *Putas* without *Gandhaka* along with organic minerals in *Nimbu swarasa* aids in oxidation leading to formation of reddish colour.
- Sulphur act as better media in particle size reduction.

4. *Swarnamakshika Amrithikarna*

Amrithikarana was done as it contained *Tamra*, as told in classics for removal of leftover doshas. *Gajaputa* was given in this process with temperature reaching upto 752°C and time taken was 7 hrs. Some amount of sulphur evaporated along with leftover doshas.

5. *Swarnamakshika Lohitkarana*

Lohitkarana is the procedure done to regain the varna of the *Bhasma* which is lost during *Marana*. In the present study *Swarnamakshika Marana* was done using *Gandhaka* as the *Maraka Dravya* due to which the color of the *Bhasma* was black. The black colour was due to the sulphides formed in the process of *puta*. After *Lohitkarana* the colour of the *Bhasma* turned to reddish brown.

Discussion on Analytical Study

Physical Tests

- The pH value of LSMB and GPR are 6.0. The pH around 6 implies that drug solubility isn't affected by hyperacidity or alkalinity in GI system and the drug is better absorbed in the stomach.
- The total ash value indicates the presence of inorganic residues such as phosphates, carbonates and silicates present in herbal drugs. This may be due to the addition of trace elements during the process of *bhavana*.
- Acid insoluble ash signifies that a considerable amount of drug is soluble in the acidic media of stomach.
- Loss on drying at 110°C indicates very less amount of moisture content and very rare chance of bacterial and fungal growth.
- Colony forming Units were 00 in both Bacterial Count and Fungal Count tests which signifies that the samples are devoid of contamination even in non-sterile environment. This indicates that the medicine has long shelf-life and is unharmed by any environmental conditions.

Instrumental Analysis

- 20 values of identified peaks from sample are almost similar to the standard JCPDF numbers of Iron Oxide (Fe_2O_3) JCPDF Number – 00-039-1346, Copper Oxide, (CuO) – 48-1548 and Copper Iron Sulphide (CuFeS_2) JCPDF Number – 00-041-1404. This indicates that *Swarnamakshika Bhasma* contains Copper and Iron in its Oxides or Sulphide forms which has better bioavailability in the body.
- Elements found in the sample are Cu, Fe, As, O, S in the percentage of 8.59, 41.03, 1.45, 34.73 and 14.20 respectively. This shows that Iron is in greater proportion and the elements may be in the form of oxides and sulphides.
- FTIR showed the presence of different functional groups like Alcohol, Phenols, Alkanes, Alkenes, Aromatics, Bromide, Iodide, Chloride, Ethers, Carboxylic acids, Esters, Anhydrides, Amines, Phenyl Ring Substitution Overtones, Primary and secondary amines and amides. This shows the presence of organic compounds in the drug.
- Mean Particle size of *Lohitikrita Swarnamakshika Bhasma* is 816.4nm. The particle size has an important influence on dissolution rate. Smaller the drug particle size larger the surface area, leads to faster dissolution. Particle size reduction will result in precise drug delivery and thereby increasing the bio availability of the drug. It can

be inferred that the repeated Bhavana(trituration) and Puta (Incineration) aided in reducing the particle size of the sample.

- N.P.S.T is a modification of circular paper chromatography. N.P.S test gives a clear differentiation of individual products in a group and also product can be identified by its classical name not by the chemical name. The continual chemical reactions taking place gradually between 2 chemical substances on static media at fraction of second and also after certain interval of time are easily detected by their distinct colour changes and the pattern of spot.

CONCLUSION

- *Swarnamakshika Bhasma* is *Tridoshaghna* and has *Vrishya*, *Rasayana*, *Yogavahi*, *Vishadoshahara* etc. effect when administered internally. *Shodhana* and *Marana* is an essential step before usage, which will modify the raw drugs into safe, bio-active, therapeutic form.
- Physical tests showed *Swarnamakshika Bhasma* is reddish brown in colour with p^H of 6.0.

- NPST of *Swarnamakshika Bhasma* in 3rd phase showed a central deep blue colored spot with white colored periphery.
- Elements found in the sample are Cu, Fe, As, O, S in the percentage of 8.59, 41.03, 1.45, 34.73 and 14.20 respectively.
- 20 values of identified peaks from sample are almost similar to the standard JCPDF numbers of Iron Oxide (Fe_2O_3) JCPDF Number – 00-039-1346, Copper Oxide, (CuO) – 48-1548 and Copper Iron Sulphide ($CuFeS_2$) JCPDF Number – 00-041-1404.
- FTIR showed the presence of different functional groups like Alcohol, Phenols, Alkanes, Alkenes, Aromatics, Bromide, Iodide, Chloride, Ethers, Carboxylic acids, Esters, Anhydrides, Amines, Phenyl Ring Substitution Overtones, Primary and secondary amines and amides.
- Mean particle size of *Swarnamakshika Bhasma* is 816.4nm.
- Further experimental and clinical studies are needed to prove the effect of *Swarnamakshika Bhasma* on different diseases in which it has been indicated.

FIGURES

Raw Swarnamakshika



Mixing of Swarnamakshika



Bharjana with Nimbu swarasa



Red hot Lohapatra



Ashodhita Gandhaka



Kurmaputa for Gandhaka shodhana



Nimbu swarasa bhavana

for Marana



Chakrika Preparation



Sharava samputa



Varahaputa



Chakrika after 1st puta



Chakrika after 5th puta



Chakrika after 20th puta



Bolus for Amrithikarana



Bolus in Surana kanda



Surana kanda samputa



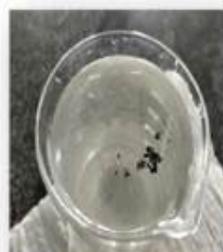
Surana Kanda after Amrithikarana



Swarnamakshika Bhasma after Lohitikarana



Varitaratva



Rekhapurnatva



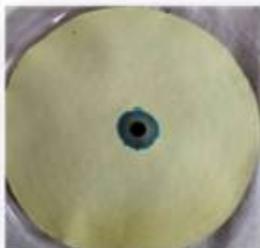
Amla dadhi Pareeksha



NPST after 5 minutes



NPST after 20 minutes



NPST after 24 hours



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