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# Authentication of *Suvarna makshik* and an Approach towards Standardization of *Suvarna makshik bhasma* by Sophisticated Techniques

**Suchita M. Sheth*[1], Kanchan Damodhar Raut[2]**

[1]Associate Professor,

[2]Assistant Professor

Department of *Rasashastra* and *Bhaishajya Kalpana*, Smt. Kamladevi Gauridutt Mittal *Punarvasu* (KGMP) Ayurvedic College, Charni Road, Mumbai, Maharashtra

***Author Correspondence:** smsheth1972@gmail.com

**Abstract**

*Suvarna makshik* (SM) is extensively described in *Rasa shastra materia medica* and is traditionally utilized for various conditions. It is deemed an *updhatu* of *Suvarna* and can be used as a substitute for *Suvarna*, offering additional benefits due to its content of important metals such as iron, copper, and sulphur. However, due to its rare availability, SM is frequently substituted by iron pyrite, which significantly reduces its efficacy. This study was undertaken to establish the authenticity of genuine raw material SM by employing ancient tests of *grahyagrahyatva* and modern techniques like Inductively Coupled Plasma Spectrometry with AES (ICP-AES), Charcoal test, HNO3 test, HCl test, and Namburi Phased Spot Test (NPST). The sample procured from Copper mines in Khetri, Rajasthan (*SM Kh*), proved to be the most authentic raw material. Subsequently, *bhasma* preparation was carried out following the concept of "*Lohanam maranam shreshtham*…". Four different methods were used: *Rasa marit* (SMH), *Gandhak marit* (SMS1/4), *Arilauha marit* (SMSE), and *Vanaspati marit* (SMV). Quality control tests, including ancient parameters like *nischandratva* and *varitar*, were utilized, followed by sophisticated analysis using ICP-AES and NPST. The ICP-AES analysis of the finished drugs indicated that the percentage of Copper, the active principle in SM *bhasma*, was highest in the *Rasa marit* sample (9.95%), thus validating ancient texts suggesting that *Rasa marit bhasma* is the best among all.

**Keywords**

*Suvarna makshik bhasma*, Inductively Coupled Plasma spectrometry with AES, NPST.

## Introduction

*Rasa shastra materia medica* details many therapeutic applications of *Suvarna maksika* (SM) *bhasma*, including its use in *Pandu* (anaemia), *Anidra* (insomnia), *Apasmara* (convulsions), and *kushtha* (skin diseases), besides acting as a potent *rasayana* and *vrushya* drug. SM is a Copper Iron sulphide, which imparts a very specific target organ action. It is considered an *updhatu* of *Suvarna* and is enriched with Copper, Iron, and Sulphur. Therapeutically, sulphides are proven to be less toxic than oxides, and the absorption, assimilation, and excretion of drugs are considered more potent in the media of Sulphur.

However, the efficacy of SM *bhasma* is often not achieved as described in ancient treatises because authentic raw drug material is often not used. SM, a complex compound, is frequently mistaken by pharmaceutical companies for *Vimal* or *Raupya makshik*, which are forms of Iron pyrite. To minimize variability and check adulteration, a thorough survey and standardization were necessary to find a genuine raw SM sample.

**Materials and Methods**

**Raw Drug Standardization**

A survey was conducted in the local market, various institutes, and pharmaceutical companies for the availability of SM. Samples were collected from three sources for study: Local market (*SM Al*), Private dealer from Kolkata (*SM Ko*), and Copper mines from Khetri, Rajasthan (*SM Kh*).

**Ancient Tests (*Grahyagrahyatva*):** Criteria were used as guidelines before proceeding to *shodhan*.

- Sample *SM Kh* passed all six criteria, including *Swarnabh* (golden tinge), *Nishkona* (no angles), *Guru* (heavy), *Krishnatam vikirett* (leaves black impression when rubbed on palm), *Neelachhavi* (bluish tinge), and *Kashe kanakvad* (golden impression when rubbed on touch stone).
- Sample *SM Kh* passed all ancient tests, confirming it as genuine.

**Modern Tests:**

1. **Inductively Coupled Plasma Spectrometry with AES (ICP-AES):** According to Indian pharmacopoeial standards, SM, equated to Chalcopyrite, is a sulphide mineral composed of Iron, Copper, and Sulphur. The elemental analysis showed that *SM Kh* had the maximum amount of Copper (20.72%), Iron (45.93%), and Sulphur (31.3%). This Copper content was in compliance with pharmacopoeial standards, whereas the other two samples showed negligible or very low amounts of Copper (0.84% and 0.95%).
2. **Chemical tests:** The Copper mine sample (*SM Kh*) passed all required tests, including the Charcoal test (fuses to magnetic black globule), HCl test (tints flame with blue flash), and HNO3 test (solution is green).
3. **Namburi Phased Spot Test (NPST):** NPST analysis showed an orange brown ring at the center of the *SM Kh* samples, suggestive of the presence of Copper as per NPST standards. The patterns of the other two samples were not in compliance with standard plates.

Based on both ancient (*grahyagrahyatva*) and modern tests, the sample collected from Copper mines at Khetri, Rajasthan, was

selected as the genuine SM for further processing.

***Suvarna makshik* Processing (*Shodhan* and *Maran*)**

The processing included *shodhan* (purification) and *maran* (incineration).

1. **Simple Purification (*Samanya shodhan*):** *Ashodhit* SM was heated in a *darvi* until red, and then plunged into five sequential liquid media (*nirvap*): *til taila*, *takra*, *gomutra*, *kanji*, and *kulath kwath*. Seven cycles of *nirvap* were carried out.
2. **Special Purification (*Vishesh shodhan*):** Coarse powder of SM and *saindhav* were heated in a *kadai* until red hot, and *matulunga swaras* was added and stirred. This procedure was repeated three times.

***Maran* (Incineration) of SM:** *Marana* was carried out exclusively according to the concept of "*Lohanam maranam shreshtham…*". *Eranda taila* was used as a universal drug for the *bhavana* process (trituration with liquid media) in the last three methods.

- ***Rasa marit*** (SMH): SM + *hingool*.
- ***Gandhak marit*** (SMS1/4): SM + ¼th *gandhak*.
- ***Ariloha marit*** (SMSE): SM + equal *gandhak*. *Gandhak* was selected as the *arilauha* because it is known as *Shulbari* (enemy of *tamra*), and *tamra* (copper) is the major constituent of SM.
- ***Vanaspati marit*** (SMV): Powdered *shuddha* SM was heated, *kadalikanda swaras* was added, evaporated, and *errand taila* was added and burnt completely. A specially designed instrument, the *surankanda samputa*, was used for proper *marana*.

The sealed and dried *samputa* were subjected to the *gajaputa* system of heating, using 20 kg of charcoal for each *puta*. A minimum of seven *putas* were administered to attain desired quality parameters.

**Standardization of *Suvarna makshik bhasma***

**Ancient Quality Control Tests**

The prepared *bhasmas* were analyzed using methods mentioned in *Ayurvedic* texts:

1. ***Nishchandrata***: The *bhasma* was observed under a magnifying glass for any luster; **no luster was found**.
2. ***Varitaram***: The particles of the *bhasma* sprinkled over still water were observed to be **floating on the surface**.
3. ***Rekhapurnatva***: The *bhasma* rubbed between the thumb and index finger **entered into the lines of the finger** and was not easily washed away.

**Modern Analytical Tests (Finished Drug Standardization)**

1. **ICP-AES (Composition):** The Copper percentage in all four *bhasmas* ranged from 8.96% to 9.95%, which is considered sufficient for desired effects. Copper percentage was **highest in the *Rasa marit* sample (SMH) at 9.95%**.
2. **Heavy Metal Analysis:** Trace amounts of Arsenic were detected via ICP-AES, ranging from 0.0015% (*SM V*) to 0.0339% (*SM H*). These trace amounts were considered not harmful and safe for internal administration.
3. **Physico-chemical Tests:**

- **Ash value:** Values were highest in *Hingool marit bhasma* (SMH) at 98.30%.
- **Acid insoluble Ash:** Values were highest in ¼ *Gandhak marit bhasma* (SMS1/4) at 80.01% and lowest in *Vanaspati marit bhasma* (SMV) at 66.84%.
- **Loss on drying (L.O.D.):** L.O.D. was maximum in *Vanaspati marit bhasma* (4.08%).

**Discussion**

*Suvarna makshik* is compared to chalcopyrite in modern mineralogy, recognized as a mineral containing Copper, Iron, and Sulphur. The physical structure of chalcopyrite, characterized by tetrahedral crystals, poor cleavage, and intercrystalline fractures, explains the use of high temperatures and repeated *nirvaap* in *shodhan* and incineration in *gajaputa*.

The *maran* process was carried out adhering to the concept of "*Lauhanam maranam shreshtham*…". *Hingool* was selected for the *Rasa marit bhasma* as it is the largest mercury-producing ore. For *Vanaspati marit bhasma*, the use of a specially designed *surankanda* instrument facilitated proper *marana* and achieved expected properties, possibly resulting in *Amritikarana sanskara*.

The study successfully authenticated the genuine SM sample from Khetri, Rajasthan, which showed elemental percentages (Cu-20.72%, Fe-45.93%, S-31.3%) closely coinciding with pharmacopoeial standards. The analysis of the finished drugs using ICP-AES confirmed that the Copper percentage was maximum in *Rasa marit bhasma*. Since Copper is the active principle of SM, this finding proves the *shreshthatva* (superiority) of the *Rasa marit bhasma*.

**Conclusion**

The *grahya* SM procured from the Khetri mines, Rajasthan, is compliant with the *Ayurvedic* Pharmacopoeia of India, having 20–45% copper as supported by ICP-AES results, and is considered the standard raw sample. By employing sophisticated techniques alongside classical *Rasa shastra* quality control tests, this study standardized the SM *bhasma*. It is concluded that **Rasa *marit bhasma*** is the standard *Suvarna makshik bhasma* due to its superior quality and maximum content of Copper. Further investigation of its efficacy via clinical study is warranted.


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**Glossary of Important Terms**

| Term | Definition | Source(s) |
|---|---|---|
| ***Bhavana*** | Trichuration of the drug with liquid media. | |
| ***Puta*** | The amount of heat required to transform or convert any metal or mineral, measured in terms of number or weight. | |
| ***Nischandra*** | The presence of sparkling particles in a *bhasma* indicates a semi-finished product. | |

| | | |
|---|---|---|
| ***Varitara*** | The property of *bhasma* which floats on water. | |
| ***Apunarbhav*** | When *bhasma* and *mitrapanchak* are heated together at high temperature, it should not show any changes in physical properties. | |

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## TABLES

[Table 1]

| Sr. No. | Criteria | Sample | | |
|---|---|---|---|---|
| | | SM Al | SM Ko | SM Kh |
| 1. | Swarnabh (golden tinge) | - | + | + |
| 2. | Nishkona (no angles) | - | + | + |
| 3. | Guru (heavy) | + | + | + |
| 4. | Krishnatam vikirett (leaves black impression when rubbed on palm) | - | - | + |
| 5. | Neelachhavi (bluish tinge) | - | - | + |
| 6. | Kashe kanakvad(golden impression when rubbed on touch stone) | - | - | + |

[ Table showing grahyagrahyatva criteria]

[Table 2]

| Sr.No. | Composition in % | Sample | | |
|---|---|---|---|---|
| | | SM Al | SM Ko | SM Kh |
| 1. | Copper | 0.84 | 0.95 | 20.72 |
| 2. | Iron | 39.53 | 15.36 | 45.93 |
| 3. | Sulphur | 37.73 | 1.33 | 31.3 |

[Table showing Percentage results of ICP- AES]

[Table 3]

| Sr.No. | Sample | Charcoal test | HCl test | $HNO_3$ test |
|---|---|---|---|---|
| 1. | SM Al | + | - | - |
| 2. | SM Ko | + | + | + |
| 3. | SM Kh | + | + | + |

[Table showing results of chemical tests]

[Table 4]

| Puta No. | Total duration | Maximum temp. attained In $^0$ C | Duration of max. temp. In mins. |
|---|---|---|---|
| 1. | 19 hrs. 45 mins | 978 | 30 |
| 2. | 20 hrs. 30 mins. | 1009 | 32 |
| 3. | 21 hrs. 20 mins. | 989 | 45 |
| 4. | 20 hrs. | 994 | 40 |
| 5. | 20 hrs. 20 mins. | 958 | 35 |
| 6. | 20 hrs. 20 mins. | 960 | 42 |
| 7. | 20 hrs. 10 mins. | 975 | 45 |

[Table showing details of each puta]

[Table 5]

| Bhasma | Tests | P 1 | P 2 | P 3 | P 4 | P 5 | P 6 | P 7 |
|---|---|---|---|---|---|---|---|---|
| Hingool marit | Wt (gms) B | 700 | 670 | 645 | 630 | 600 | 575 | 560 |
| | A | 680 | 652 | 638 | 610 | 585 | 566 | 540 |
| | Varna | Black | Blackish | Blackish | Brownish | Brownish | Brown | Brown |
| | Rekhapurnata | Ab. | Ab. | + | ++ | ++ | +++ | +++ |
| | Shlakshnata | + | ++ | ++ | +++ | +++ | +++ | +++ |
| | Chandrika | ++++ | ++++ | +++ | ++ | + | + | Ab. |
| | Varitaratva | Ab. | Ab. | + | ++ | ++ | ++ | +++ |
| Vanaspati marit | Wt (gms) B | 700 | 610 | 580 | 560 | 545 | 530 | 515 |
| | A | 620 | 586 | 570 | 552 | 538 | 525 | 508 |
| | Varna | Black | Black | Brownish | Brown | Brick red | Red | Red |
| | Rekhapurnata | Ab. | Ab. | ++ | ++ | +++ | +++ | ++++ |
| | Shlakshnata | + | + | ++ | +++ | +++ | +++ | ++++ |
| | Chandrika | ++++ | ++++ | +++ | +++ | ++ | + | Ab. |
| | Varitaratva | Ab. | Ab. | + | ++ | ++ | +++ | +++ |
| ¼ gandhak marit | Wt (gms) B | 700 | 680 | 660 | 635 | 620 | 595 | 570 |
| | A | 692 | 668 | 642 | 626 | 607 | 585 | 545 |
| | Varna | Black | Black | Brownish | Brownish | Brownish | Brown | Dark brown |
| | Rekhapurnata | Ab. | Ab. | + | ++ | +++ | ++++ | ++++ |
| | Shlakshnata | + | ++ | +++ | +++ | +++ | +++ | ++++ |
| | Chandrika | ++++ | +++ | +++ | ++ | ++ | + | Ab. |
| | Varitaratva | Ab. | Ab. | + | ++ | ++ | ++ | +++ |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Equal gandhak marit | Wt (gms) B<br>A<br>Varna<br>Rekhapurnata<br>Shlakshnata<br>Chandrika<br>Varitaratva | 700<br>686<br>Black<br>Ab.<br>Ab.<br>++++<br>Ab. | 680<br>671<br>Blackish<br>Ab.<br>Ab.<br>+++<br>Ab. | 665<br>648<br>Brownish<br>+<br>++<br>+++<br>Ab. | 640<br>627<br>Brownish<br>++<br>++<br>++<br>+ | 620<br>608<br>Brownish<br>+++<br>+++<br>++<br>+ | 600<br>582<br>Brown<br>++++<br>+++<br>+<br>++ | 575<br>548<br>Brown<br>++++<br>++++<br>Ab.<br>+++ |

[Table showing changes after each puta]

[Table 6]

| Sr. No. | Composition in % | Sample | | | |
|---|---|---|---|---|---|
| | | SM H | SM V | SM S1/4 | SM SE |
| 1. | Copper | 9.95 | 9.64 | 9.80 | 8.96 |
| 2. | Iron | 27.01 | 22.18 | 25.51 | 25.69 |
| 3. | Sulphur | 0.81 | 3.81 | 0.77 | 1.57 |

[Table showing percentage composition using ICP- AES]

[Table 7]

| Composition In % | Sample | | | |
|---|---|---|---|---|
| | SM H | SM V | SM S1/4 | SM SE |
| Arsenic | 0.0339 | 0.0015 | 0.0079 | 0.0039 |

[Table showing percentage composition of Arsenic using ICP- AES]

[Table 8]

| Sample | SM H | SM V | SM S1/4 | SM SE |
|---|---|---|---|---|
| % Ash | 98.30 | 94.89 | 98.97 | 97.41 |
| % Acid insoluble Ash | 77.52 | 66.84 | 80.01 | 74.96 |
| L.O.D. | 1.34 | 4.08 | 0.94 | 1.79 |

[Table showing results of physic-chemical tests]

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