Comprehensive Evaluation Of Time And Temperature Variations In The Beejavarta And Shuddhavarta Phases Of Abhraka Satvapatana: Introducing A Magnetic Test Method For Precise Identification Of Abhraka Satva Nanoparticles

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Ayurveda, Beejavarta, Satvapatana, Satva, Shuddhavarta.

Abstract

Background:
Satvapatana is a pivotal pharmaceutical process in Rasashastra aimed at isolating Satva, the therapeutically active metallic essence, from minerals through controlled high-intensity heating. Unlike metallurgical refining, which emphasizes purity for industrial applications, Satvapatana prioritizes medicinal efficacy, minimal dosage, and enhanced bioavailability. Classical treatises describe visual indicators, such as Bijavarta (a red swirling flame) and Suddhavarta (a stable white flame), to demarcate process phases; yet, systematic correlation with modern thermal parameters remains inadequately defined.

Methods:
Suddha Dhanyabhraka was prepared through classical Nirvapana and Dhanya procedures, followed by the formation of a Golaka (pellet). The Golaka were subjected to high-temperature processing in a custom-designed Koṣṭhi, employing a combination of wood, coal, cow dung cakes, and mine coal as fuels. Real-time temperature was monitored using a calibrated thermocouple, while Bijavarta and Suddhavarta phases were visually documented. Satva yield was measured, and a novel magnetic test was introduced to differentiate metallic Abhraka Satva from non-metallic residues.

Results:
Bijavarta manifested at ~1150 °C after 90 min of sustained heating, marked by a swirling red flame. Suddhavarta was recorded at ~1350 °C after an additional 60 min, characterized by a stable white flame and complete Golaka melting. From 920 g of Golaka, 210 g of Abhraka Satva was obtained, yielding 21.5%. The

	procedure necessitated prolonged high-temperature maintenance with substantial fuel utilization. **Conclusion:** This study establishes reproducible correlations between traditional process indicators and defined thermal parameters in Abhraka Satvapatana. The novel magnetic test provided reliable validation for Satva identification, thereby bridging classical pharmaceutics with modern scientific evaluation and strengthening standardization in Ayurvedic mineral processing.

Introduction

Rasasastra, a specialized branch of Ayurvedic pharmaceutical science, primarily focuses on the processing and therapeutic application of mercury, metals, and minerals. Its core objective is to develop formulations with enhanced efficacy, requiring minimal dosages for maximum therapeutic benefit.(1) Among the many procedures in Rasasastra, Satvapatana holds significant importance as it enables the extraction of Satva-the therapeutically active metallic essence-from raw ores and minerals.As Described in Rasaratna Samuccaya, mineral substances of either metallic or animal origin are combined and triturated with substances from Kṣāra Varga (alkaline group), Āmla Varga (sour group), and Dravaka Varga (solvents such as Gunja, Madhu, Guḍa, Ghṛta, Tankana, and Guggulu). This mixture is enclosed in a sealed crucible and subjected to intense heat within a Koṣṭhi (furnace). Under such conditions, the metallic essence separates from the impurities and is collected as Satva (essence), which is considered the most potent therapeutic fraction of the compound.(2)

Various classical texts outline the medicinal and alchemical applications of different Satvas. For instance, Abhraka Satva is employed in Caraṇa and Jaraṇa (processes related to incineration and calcination),(3) and is considered crucial in stabilizing mercury (Pākṣacchedana-rendering mercury thermo-stable).(3) Similarly, Makṣika Satva is used in Dehavada (promotion of longevity and disease-free state) and Lohavada (alchemical transformation of metals),(4) while Tuvari Satva is utilized in the Bandhana (binding) of Rasa and Upārasa and in facilitating the process of Kramana (mercurial movement).(5)

Ayurvedic classics also assert that the Satva Bhasma of a mineral is therapeutically ten times more potent than the conventional Bhasma of the same substance.(6) Thus, Satvas not only hold immense value in mercury processing but also offer substantial therapeutic benefits when properly purified (Sodhana), softened (Mṛdukaraṇa), and incinerated (Māraṇa). Despite the importance of Satvpatana, classical texts often lack explicit details regarding critical operational parameters, such as the duration and intensity of heating, the quantity of fuel required, the temperature range, and the expected yield percentage. This absence may be attributed to variations in material type and practitioner expertise. However, classical indicators such as Bijavarta(7) (the swirling red flame marking the onset of extraction), Suddhavarta (a stable white flame denoting completion), and the color and texture of the extracted Satva serve as essential markers to guide the process.(8) Furthermore, post-extraction validation of Satva has largely remained qualitative, relying on color, texture, and practitioner expertise, without incorporation of objective tests.

This lack of scientific standardization limits reproducibility and poses a challenge for global acceptance of Rasasastra-based medicines. To date, no published study has provided a detailed account of Abhraka Satvapatana with systematic evaluation of operational parameters such as heating duration, thermal ranges of classical indicators, yield percentage, and fuel requirements. Similarly, there has been no attempt to establish simple, reliable, and objective validation methods for confirming Abhraka Satva post-extraction.

Therefore, the present study was undertaken to systematically evaluate the time and temperature ranges corresponding to classical markers (Bijavarta and Suddhavarta) during the Satvapatana of Abhraka, to quantify the yield, assess the fuel and duration requirements, and to introduce a novel magnetic test as a reliable method for post-process validation of Abhraka Satva.

Material and methods

Procurement of Raw Material
Raw Abhraka (mica) and other associated medicinal ingredients required for the study were procured from the local market of Raipur, Chhattisgarh. The materials included classical Rasashastra ingredients necessary for the preparation of Abhraka Sattva.

Authentication of Raw Material
The raw material samples were initially identified as Abhraka based on classical Rasashastra organoleptic criteria and textual references. To ensure authenticity, the material- selected as optimal by an expert Ayurvedic panel-was further authenticated by geologists as the Biotite variety of mica. This characterization was performed at the Department of Metallurgy, National Institute of Technology (NIT), Raipur, Chhattisgarh. In addition, the sample underwent advanced analytical evaluation, including Scanning Electron Microscopy coupled with Energy Dispersive X-ray spectroscopy (SEM-EDX), at a certified analytical facility.(Figure 1)

Pharmaceutical Processing
The pharmaceutical preparation of Abhraka Sattva was carried out in the Department of Rasa Shastra and Bhaishajya Kalpana, Government Ayurveda College, Raipur. The entire process was conducted in three sequential stages, following classical references and in accordance with standard protocols outlined in authoritative Ayurvedic texts. The process involved the traditional Shodhana (purification), Dhanyabhraka Nirmana (incineration), and Satvapatana (extraction of essence) procedures, ensuring safety, potency, and therapeutic efficacy.

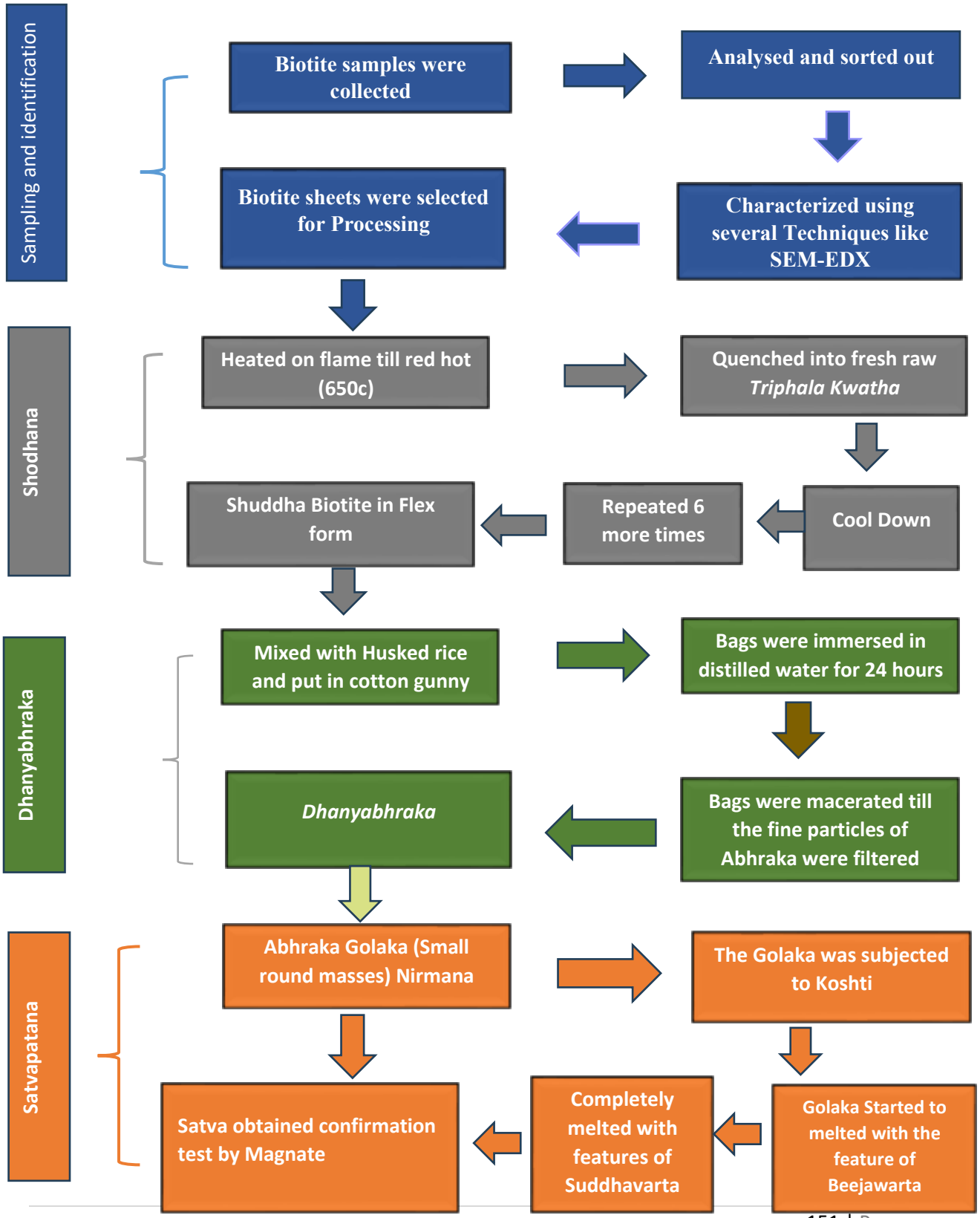
Sodhana of Abharaka:
The process began with Ashuddha Abhraka (impure mica), which was subjected to intense heating in a charcoal burner until it reached a red-hot state. On average, it required approximately 80 minutes to attain this stage, with the temperature at red heat recorded at around 1000 °C. Immediately upon reaching this temperature, the Abhraka was quenched (Nirvapana) in Triphala Kvatha, used as the liquid medium and contained in a stainless steel vessel.
This cycle of heating to red-hot followed by quenching in Triphala Kvātha was repeated a total of seven times,(9) (Table no.1) (Figure 2)

Dhanyabhraka Preparation:
For Dhanyabhraka preparation, Shodhita Abhraka was bundled in a jute bag with 1/4th quantity of rice (Sali Dhanya) and soaked in Kanji for 72 h. The bundle was then rubbed and squeezed in the liquid so that only fine mica particles passed through the bag. The supernatant was decanted, and the fine sediment collected and dried under sunlight to yield Dhanyabhraka(10) (Figure 3)

Preparation of Abhraka Golaka (small round masses)
The preparation of Abhraka Golaka (small round masses) was undertaken by combining Shuddha Abhraka, Tankana Bhasma, and Musli Swarasa (Chlorophytum borivilianum juice) in a Kharala (mortar). The mixture was subjected to continuous Mardana (trituration) for approximately four hours until uniform spherical masses were obtained (Figure 4). This process ensured thorough homogenization of the ingredients, providing the requisite consistency and compactness necessary for the subsequent Abhraka Satvapatana procedure.

Procedure for Sattvapatana (Extraction of Abhraka Satva)
Following the preparation of Golaka (pellets) from Śuddha Dhanyabhraka, a traditional Koṣṭhi (closed heating chamber) was constructed. The Golaka was placed within the chamber and subjected to intense heat generated using firewood, coal, cow dung cakes, and mine coal, with continuous airflow provided by a blower. After approximately 90 minutes, the temperature reached around 1120 °C, at which point initial signs of Bījāvarta (swirling motion indicating partial melting) were observed. Continued heating raised the temperature to approximately 1350 °C, leading to complete melting of the Golaka and the appearance of Śuddhavarta (stable swirling motion), indicating readiness for Sattvāpātana (metallic

essence extraction). This temperature was maintained for an additional 30 minutes. The setup was then left to self-cool overnight. The following morning, Abhraka Satva was identified and separated from the residual ash and slagha based on visual inspection and magnetic confirmation of metallic properties. A total of 210 g of Abhraka Satva was recovered from 920 g of Abhraka Golaka.(11) [Figure 5] [Table 2]



Flowchart of Various Processes of Preparation of Abhraka Satvapatana

Table 1. Observations made during Samanya Shodhana Abharakla

Sr. No.	Wt. of Abhraka before Nirvapana (gm)	Duration of Heating (min.)	Temp. (˚C)	Wt. of Abhraka after Nirvapana(gm)	Quantity of media before Nirvapana(l)	Quantity of media after Nirvapana(l)	Gain/loss in (%)
1.	1020	100 min	1030^0 C	1050	2 lit	1.8 lit	2.9% gain
2.	1050	95 min	1020^0 C	1010	2 lit	1.6 lit	3.8% loss↓
3.	1010	97 min	1040^0 C	1030	2 lit	1.7 lit	1.9% gain
4.	1030	85 min	1010^0 C	980	2 lit	1.8 lit	4.8% ↓
5.	980	80 min	970^0C	950	2 lit	1.7 lit	3.0 % ↓
6.	950	75 min	980^0C	930	2 lit	1.7 lit	2.1 % ↓
7.	930	87 min	950^0C	915	2 lit	1.5 lit	1.6 % ↓
Average	**995.7**	**88 min**	**1000^0 C**	**980.7**	**2 lit**	**1.6 lit**	**3.5% ↓**

Table 2. Observations made during Abhraka Satvapatana

Time	Temperature (°C)	Observation
12:02 pm	110	Heating was started
12:30 pm	690	Golaka was dry & black fumes started coming out
1:00 pm	1013	Golaka was red hot & yellowish fumes started coming out
1:30 pm	1150	Golaka started melting & red flames of fire started to appear (Beejavarta) characterized by dynamic and rich flame colours. These colours range across a spectrum, predominantly featuring deep blues
2:00 pm	1320	Golaka was completely melted
2:30 pm	1350	white flames of fire appear (Suddhavarta) The colors are more subdued yet distinct, primarily showcasing deep reds, clear whites, and bluer tones, signifying the enhanced purity of Abhraka Satvapatna components
3:00 pm	1310	After Shuddhavarta rest for self-cooling
After whole night of self-cooling Satva with slugh identified from ash, and further physical confirmation was done by a magnate.		

Results

Characterization of Shuddha Abhraka by Scanning Electron Microscopy

The scanning electron micrograph (500× magnification) (Figure 8) displayed a typical lamellar and flaky structure, consistent with the natural morphology of mica. However, signs of micro-fracturing, delamination, and irregularities in surface texture were observed.

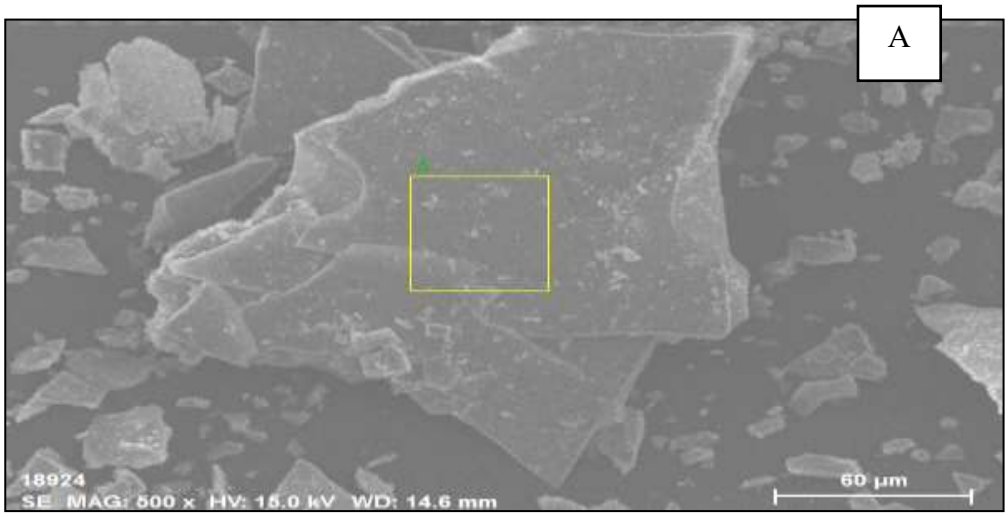
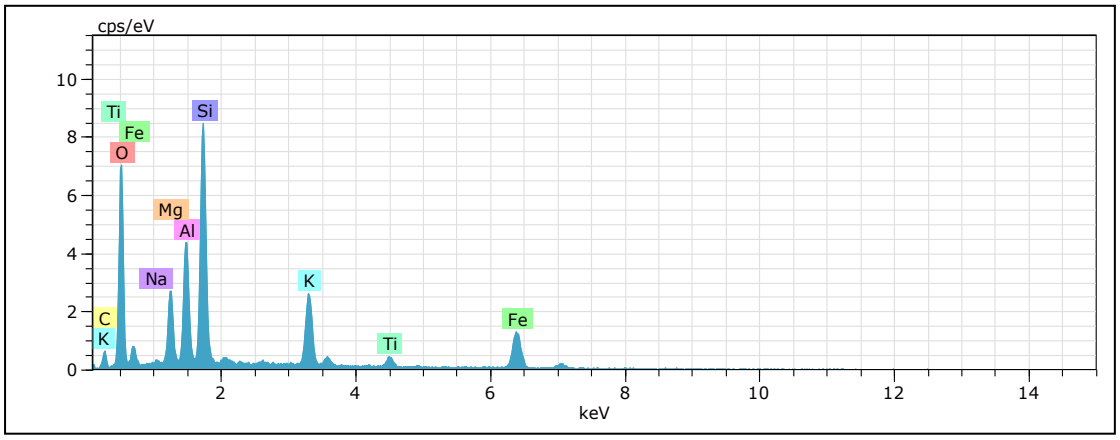


Figure 8. SEM Analysis of Shuddha Abharaka A.displayed a typical lamellar and flaky structure

Characterization of Shuddha Abhraka by Energy Dispersive X-ray (SEM-EDX)

The Energy Dispersive X-ray Spectroscopy (EDS) performed on Region 5 of the SEM image revealed the presence of multiple elements, predominantly oxygen (35.94 wt%), iron (20.26 wt%), silicon (14.85 wt%), potassium (7.95 wt%), aluminium (7.30 wt%), and carbon (6.87 wt%). Other minor constituents included magnesium (4.57 wt%), titanium (2.04 wt%), and sodium (0.23 wt%).(Table 9)

Characterization of Abhraka Satvapatana by Scanning Electron Microscopy (SEM)



The surface morphology of Abhraka Satvapatana was examined using Scanning Electron Microscopy (SEM) at 500× magnification (Figure 9). The micrograph reveals a characteristic lamellar and flaky structure with sharp edges and large, plate-like particles, consistent with the morphology of thermally processed mica minerals. The layered appearance is indicative of the inherent phyllosilicate structure of Abhraka.

Characterization of Abhraka Satvapatana by Energy Dispersive X-ray (EDX)

The region marked as Spot 5 was selected for Energy Dispersive X-ray (EDX) analysis to determine the elemental distribution in the selected area. The EDX results (as presented in Table 5) showed a significant enrichment of iron (28.33 wt%), followed by oxygen (27.26 wt%), silicon (14.40 wt%), potassium (10.11 wt%), and aluminium (6.91 wt%). Trace elements such as magnesium (3.79 wt%), titanium (2.91 wt%), and carbon (6.29 wt%) were also detected.[Table3]

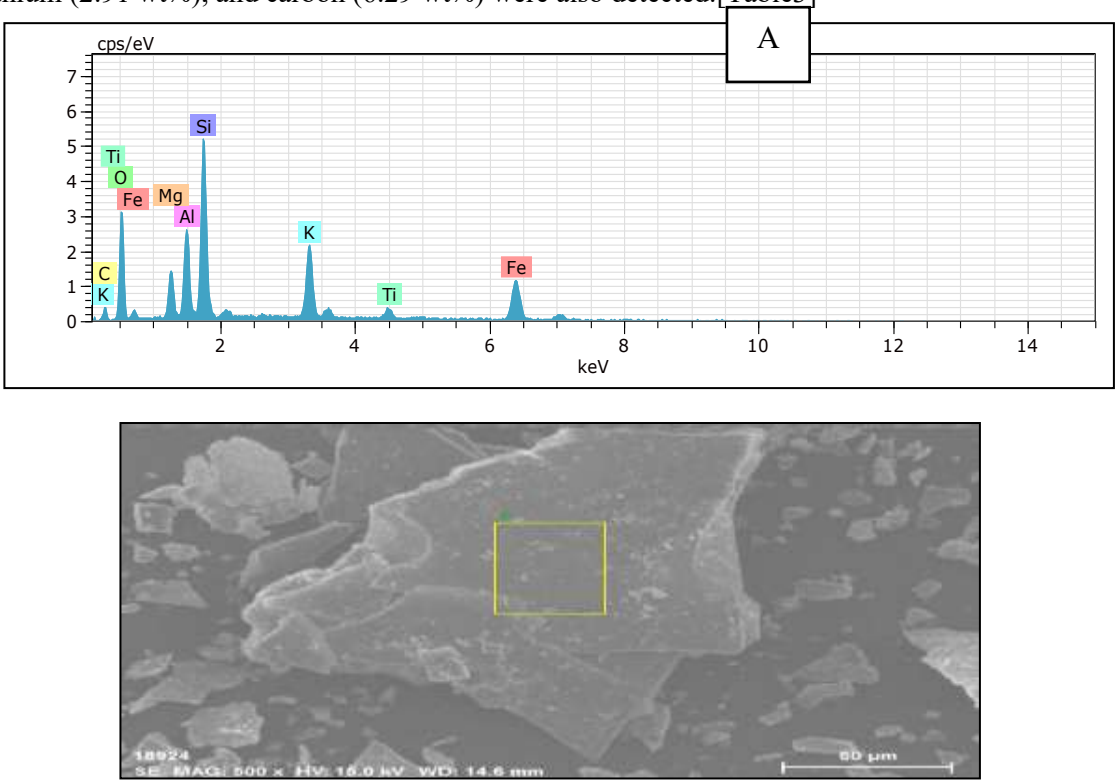


Figure 9. SEM Analysis of Abharaka Satvapatana A.displayed a typical lamellar and flaky structure with sharp edges and large

Table 3. Energy Dispersive X-ray Spectroscopy (EDS) elemental composition of the Abhraka Satvapatana.

Element	Atomic No.	Series	Unn. C(wt. %)	Norm. C(wt. %)	Atom. C(at. %)	1 σ(wt. %)
Fe	26	K-series	22.03	28.33	12.75	0.80
O	8	K-series	21.21	27.26	42.82	3.44
Si	14	K-series	11.20	14.40	12.89	0.52
K	19	K-series	7.86	10.11	6.50	0.30
Al	13	K-series	5.37	6.91	6.43	0.30
C	6	K-series	4.89	6.29	13.16	1.46
Mg	12	K-series	2.95	3.79	3.92	0.21
Ti	22	K-series	2.27	2.91	1.53	0.14
Total	—	—	77.79	100.00	100.00	—

Note: Unn. C = unnormalized concentration; Norm. C = normalized concentration (wt.% normalized to 100%); Atom. C = atomic percentage calculated from normalized values based on atomic weights; 1 σ = one standard deviation of measurement values. All data obtained by SEM-EDS (K-series spectral lines).

Discussion

Satvapatana is one of the salient processes of Rasashastra for achieving the Satva (essence) of metals and minerals from their source by reduction, oxidation and several thermal changes. Here the yield percentage of Abhraka satva is 21.5%, which is nearly the same percentage of total metallic components of raw Abhraka (unprocessed mica) which was shown in the report of SEM-EDX and Satva Pariksha was performed from classical color and appearance of Abhraka Satva as well as magnate test was also performed for Abhraka Satva. Beejavarta and Shudhavarta are subsequently at the temperature of 1150°C and 1350°C. The total time for obtaining Beejawarta was one and a half hours of direct fire with a continuous strong heating pattern, while just after one hour of Beejawarta, the flame presented the features of Shudhhawarta. The thermal treatments of Abhraka Satvapatna at both 1150°C and 1350°C highlight the fascinating interplay between temperature and mineralogical behaviour. At 1150°C, the Bijavarta reflects the inherent complexity of the mineral's structure, resulting from varying elemental response to heat. This range of vivid colors points to an assortment of metallic constituents within the Abhraka Satvapatna, emphasizing the intricate nature of its composition. Conversely, the transition to Shuddhavarta at 1350°C indicates the transformation of the mineral towards a more purified form, showcasing the significance of temperature in effectively enhancing the quality of the substance. The more uniform and refined colors observed here represent both a chemical and physical change in the structure, producing a product that may have enhanced therapeutic properties in traditional medicinal contexts. The observed phenomenon at both temperatures not only acknowledges traditional beliefs about the significance of colors in medicinal chemistry but also aligns with modern understandings of mineral characteristics and their reactivity under varying thermal conditions. This reinforces the need for continued exploration of thermal processes in the context of medicinal applications, aiming to maximize both efficacy and safety in therapeutic use. Through such understanding, we could potentially develop new formulations and applications which leverage the beneficial properties of Abhraka Satvapatna.

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ELEMENT	WEIGHT%	ATOMIC%
C K	1.03	1.87
O K	46.88	65.23
NA K	0.29	0.28
MG K	5.05	4.56
AL K	7.61	6.18
SI K	15.85	12.37
CL L	0.32	0.20
K K	7.07	3.96
TI K	1.44	0.66
MN K	0.20	0.08
FE K	14.26	5.06
TOTAL	**100.00**	**100.00**

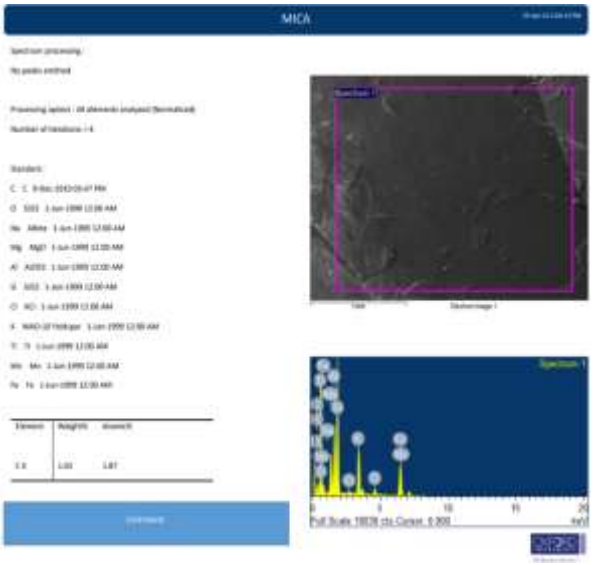
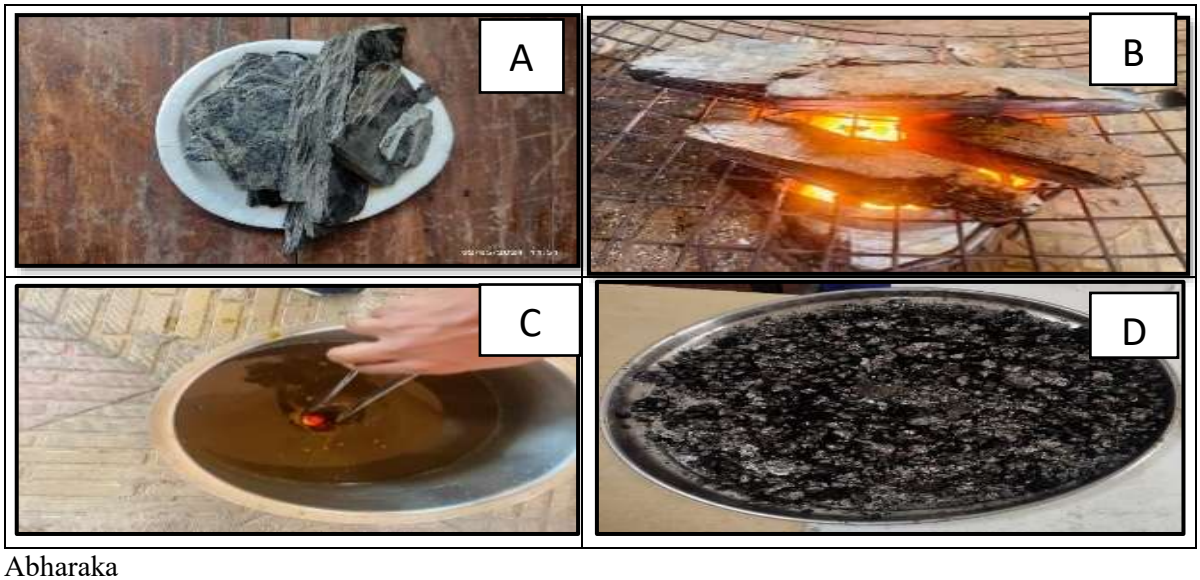


Figure 1. SEM EDX analysis of Raw Abharaka (Mica) A. SEM image of Raw Abhraka B. EDX of Raw



Abharaka

Figure 2. Abhraka Shodhana A. Raw Ashudha Abhraka B. Red hot stage C. Quenching in Triphala kwatha D. Shuddha Abhraka

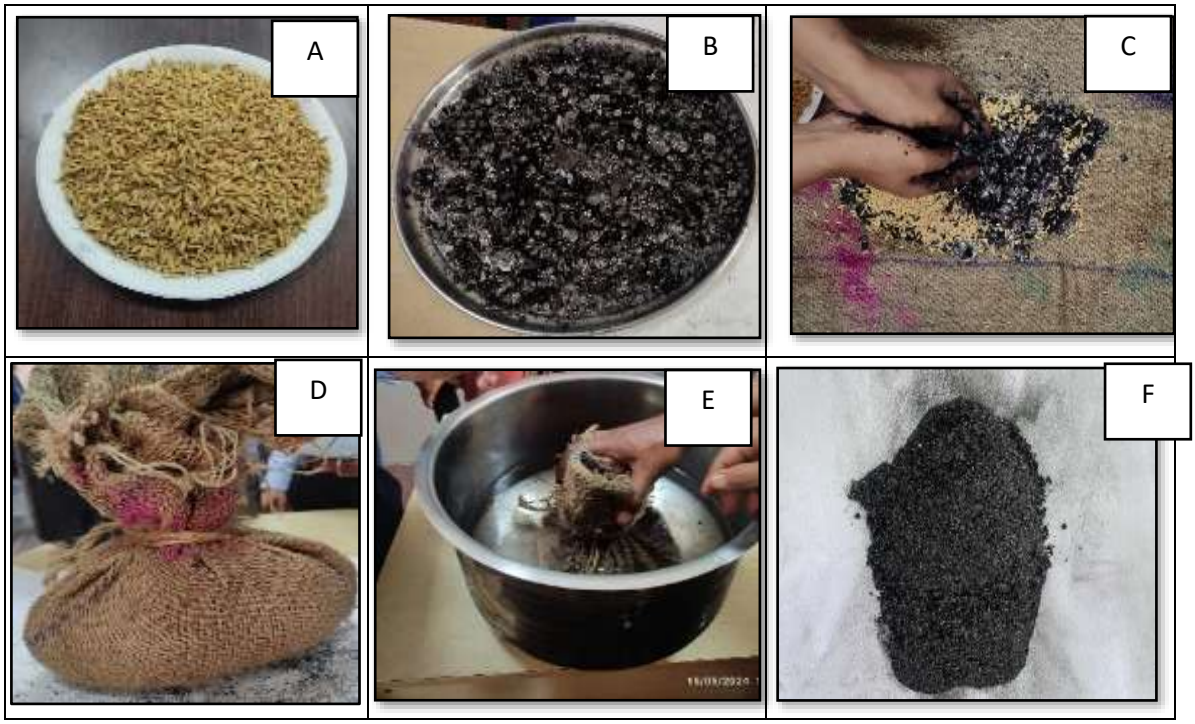


Figure 3. Dhanyaabhraka Niramana A. Shali Dhanya B. Shuddha Abhraka C. Mixed Dhanya and Shodhita bhraka D. Pottali made E. Dipped into Kanji F. Powder Abhrak

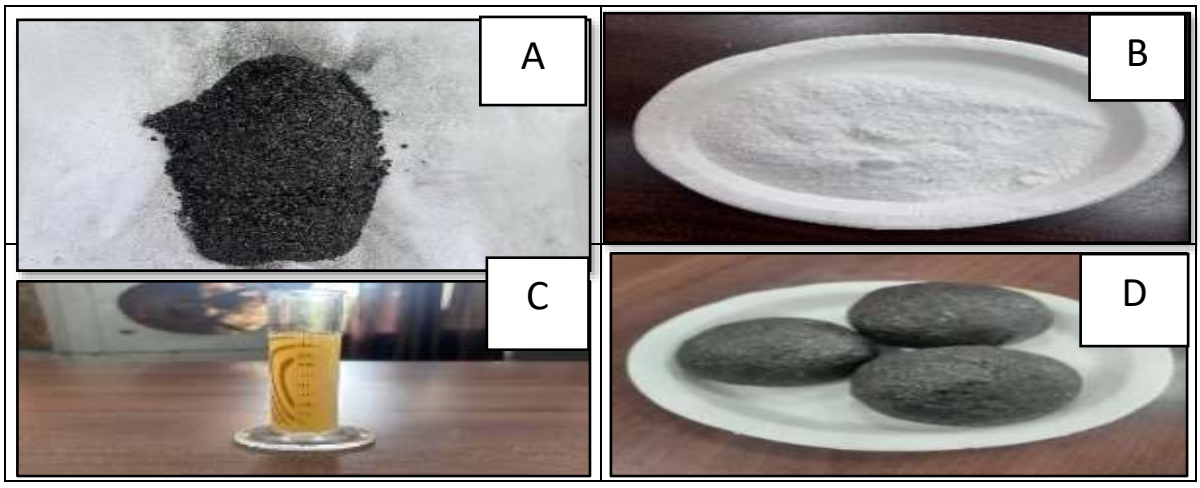


Figure 4. Preparation of Abhraka Golaka (small round masses) using A.Shuddha Abhraka, B.Tankana Bhasma, C. Musli Swarasa (Chlorophytum borivilianum juice). D. Golaka (small round masses

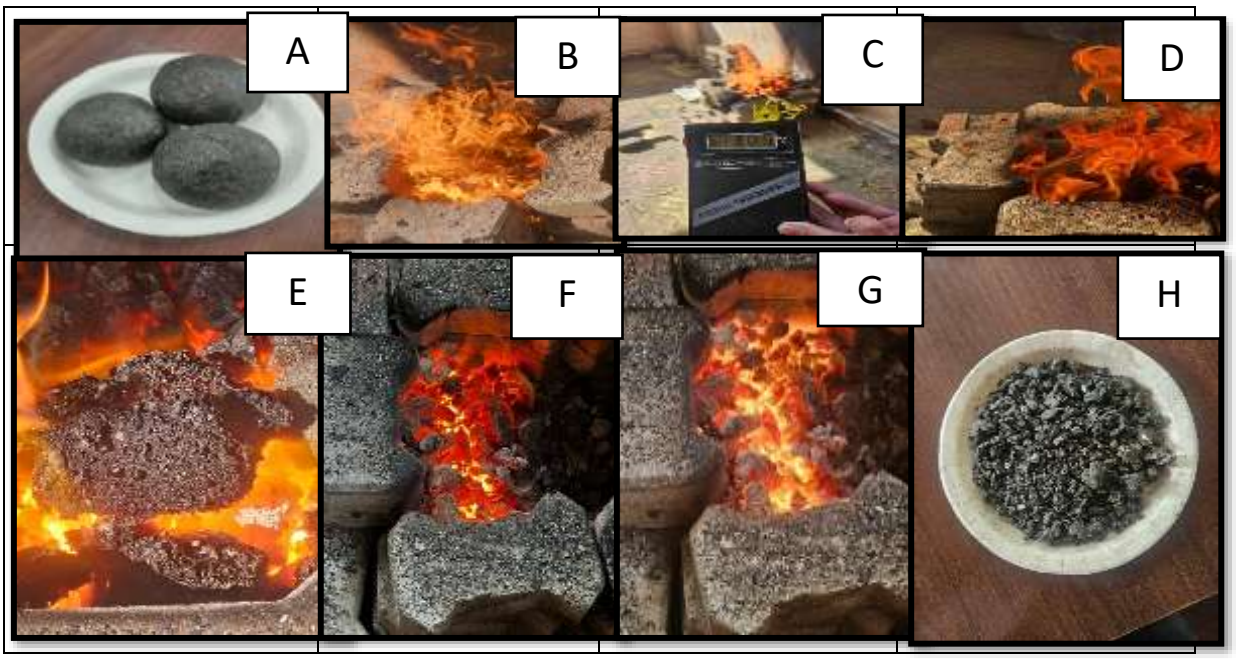


Figure 5. Satvapatana Process A. Lohanibh Satva Golaka B. Yellowish fumes C. Observe Temperature D. Beejavarta (Light red flame) E.Golaka was completely melted F,G. Suddhavarta (White Flame) H. Lohanibh Satva

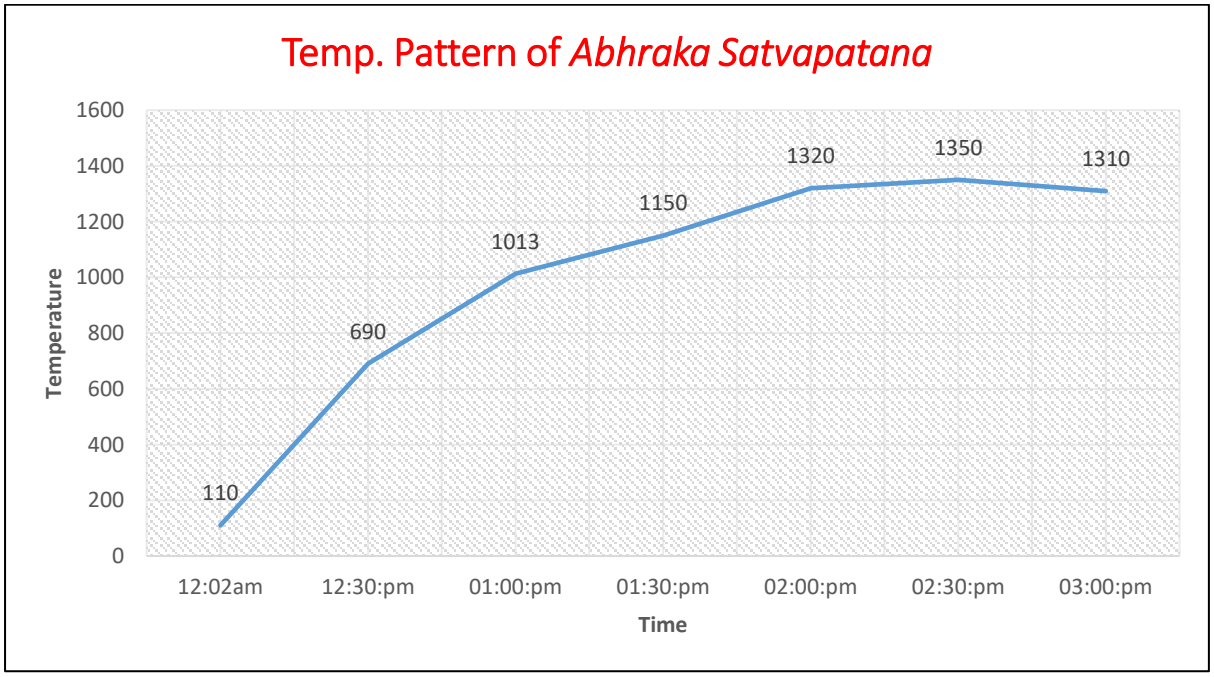


Figure 6. Graphical presentation of the Temperature pattern of Abhraka Satvapatana

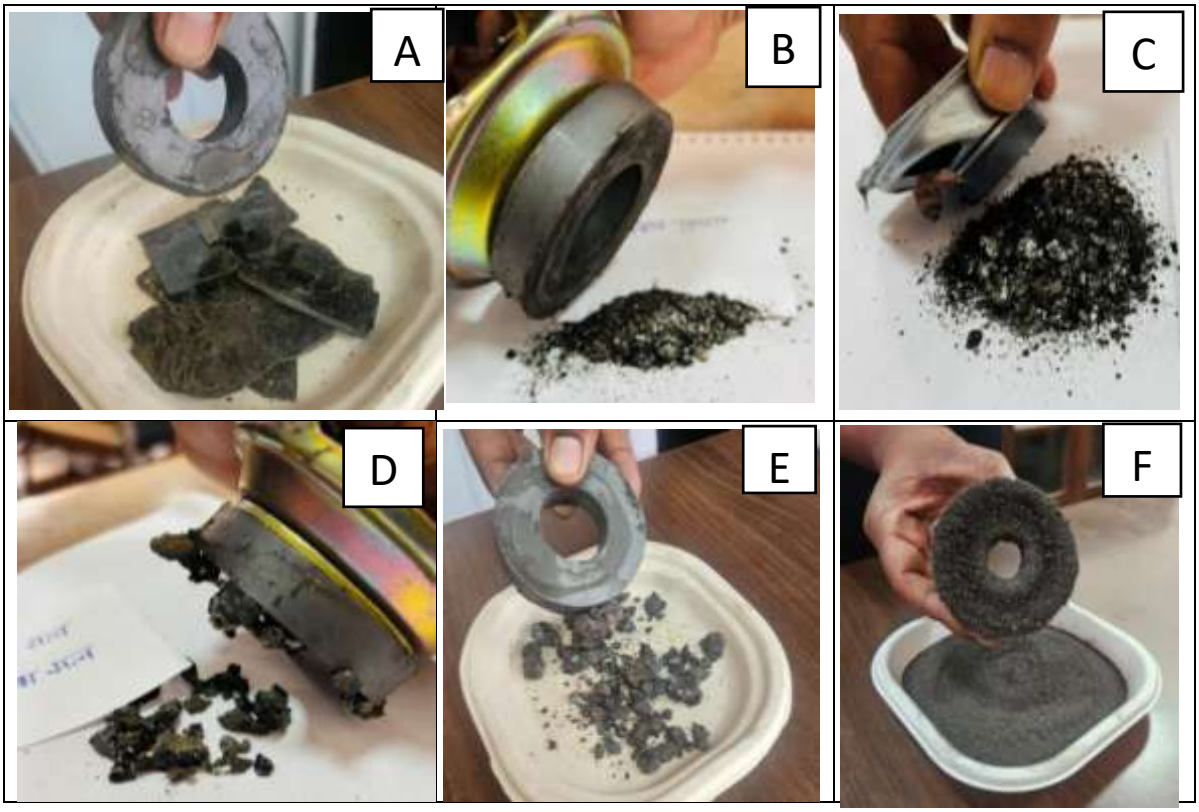


Figure 7. Satvapatana Process A. Lohanibh Satva Golaka B. Yellowish fumes C. Observe Temperature D. Beejavarta (Light red flame) E.Golaka was completely melted F,G. Suddhavarta (White Flame) H. Lohanibh Satva