



Research Article

ESTABLISHMENT OF STANDARD PHARMACEUTICAL PARAMETERS FOR MAHASETU RASA: A CLASSICAL HERBO-MINERAL FORMULATION

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ABSTRACT

Mahasetu Rasa, a classical *Kupipakwa Rasayana* preparation described in *Rasa Kamdhenu*, requires systematic purification (*Shodhana*) of *Parada*, *Vanga*, and *Gandhaka*, followed by *Kajjali* formation and heating in an Electric Muffle Furnace. The present study aimed to standardize its pharmaceutical preparation and evaluate the final product using modern analytical techniques. Pharmaceutical observations confirmed the successful detoxification of raw materials. **Materials and Methods:** Raw materials were purified by traditional methods: *Parada* with *Churnodaka* and garlic paste, *Vanga* via *Samanya* and *Vishesh Shodhana* in various media, and *Gandhaka* by repeated *Dhalana* with ghee and cow's milk. *Kajjali* was prepared by amalgamation and trituration, and *Mahasetu Rasa* was heated upto 550°C in EMF. **Results:** Purified materials exhibited expected detoxification and physical changes. *Kajjali* showed classical properties. Pharmaceutical observations confirmed the successful detoxification of raw materials, yield was after *Shodhana*, *Shuddha Vanga* (Sn) - 90.8%, *Shuddha Gandhaka* (S) - 88.08%, *Shuddha Parada* (Hg) - 88.40%, *Kajjali* - 98.66%, *Kupipakwa* yielded MSR1 - 38.5%, MSR2 - 40.06, MSR3 - 39.1% final product after 26 hrs of heating and completion. **Conclusion:** The standardized method ensures reproducible preparation of *Mahasetu Rasa* through effective purification, controlled sublimation and fixation using EMF heating, thereby producing a safe and uniform product suitable for both clinical and research applications.

INTRODUCTION

Ayurveda describes metals and minerals as potent therapeutic agents when processed through rigorous purification and incineration procedures. *Kupipakwa Rasayana* is a specialized method in *Rasashastra* wherein formulations are prepared inside sealed glass bottles under controlled heating. *Mahasetu Rasa* (MSR), mentioned in *Rasa Kamdhenu*^[1], is prepared through sequential *Shodhana* of *Parada*, *Vanga*, and *Gandhaka*, followed by *Kajjali* preparation and the *Kupipakwa* process.

Mahasetu Ras has not been prepared yet due to the lack of a defined procedure, as well as the absence of information regarding the *Agni* (heating) standard and duration. Its description was also found in *Raschandanshu*^[2] and *Rasendra Chintamani*^[3], but even there, the *Agni* (heating) standard is not mentioned. Since it is similar to *Suvarna Vanga*, its *Agni* standard has been kept the same as that of *Suvarna Vanga*^[4].

Materials and methods:

Materials: *Parad*, *Gandhak*, *Vanga* was purchased from locally from Phophalia, Jodhpur.

Cow milk, cow ghee, *Gomutra* (cow's urine), horse gram, sesame oil, buttermilk (*Takra*), collected locally.

Kulatha kwath, *Churnodaka* (lime water), *Kanji*, prepared in departmental lab of R.S. & B.K, PGIA, Jodhpur.

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Methods: The pharmaceutical study of *Mahasetu Rasa* involves a systematic sequence of steps. It begins with the *Shodhana* of raw materials, which is an essential process in *Rasashastra* to remove impurities and enhance the therapeutic potential of the ingredients. The *Shodhana* procedure includes the purification of *Parada*, *Vanga*, and *Gandhaka* using classical methods. After the purification, the next step is the preparation of *Kajjali*, which is obtained by proper trituration of purified *Parada* and *Gandhaka* until a fine, black, and lustrous powder is formed. This *Kajjali* serves as the base for further formulation. Finally, the preparation of *Mahasetu Rasa* in an EMF is carried out, following controlled heating patterns to achieve the desired pharmaceutical product.

Shodhan of row material

Shodhan of Parada

Purification of *Parada* was carried out according to the reference of *Rasa Tarangini*^[5].

- *Churnodaka*^[6] was prepared by dissolving 5g of purified lime in 1.2L water, settled for 9 h, and filtered, yielding 1.17L of alkaline solution (pH ~11). For trituration, 250g impure mercury was ground with 50ml fresh *Churnodaka* daily for 8 days (3 h/day). During this, globules fractured and re-coalesced, and pH of *Churnodaka* dropped from 11 → 9. After washing and drying, the weight was 250.2 g.
- Subsequently, mercury was trituated with 250g garlic paste and 125g *Saindhava Lavana* for 12–16 h, turning from yellow-green to black, indicating chemical interaction. About 4L hot water was used to separate mercury globules, which were collected, filtered, and stored.

Results

Table 3: Percentage of loss of vanga after Vishesh shodhana

Dhalana media	Wt. of Vanga	Wt. of Vanga Obtained	Loss of Vanga After Dhalana	% Loss
Churnodaka	473	454	19	4.02%

Table 4: Total loss and yield during Shodhana process

Initial wt. before Shodhana	Final wt. after complete Shodhana	Total wt. loss	% yield
500gm	454gm	46gm	90.8%

Shodhana of Gandhaka

Method- Dhalana and Galana

Processor:

Purification of *Gandhaka*^[11] was carried out using the *Dhalana* method, where powdered *Gandhaka* was melted with *Goghrita* and quenched in boiling cow's milk (*Godugdha*) through a ghee-smeared cloth. The procedure was repeated three times.

- Final yield was 221g (88.4%), with minor losses due to adhesion, handling, and volatilization. The purified mercury showed improved luster and color, confirming effective removal of physical and oxidized impurities

A. *Shodhan of Vang: Vang shodhan* was done in two steps

- Samanya shodhan*^[7]
- Vishesh shodhan*^[8]

Samanya shodhan

Method- Dhalana

Processor: The *Samanya Shodhana*^[7] of *Vanga* was performed by repeated (*Dhalana*) melting and quenching in different media-*Tila Taila*, *Takra*, *Gomutra*, *Kanji*^[9], and *Kulattha Kwatha*^[10]- seven times each. Temperature, pH, and weight were recorded throughout.

Results:

Table 2: Total loss after Samanya sodhan

Initial wt.	Final wt.	Total wt. loss	% loss
500gm	473gm	27gm	5.4%

Vishesha Shodhana of Vanga – it was done according to *Ras tarangini*^[8]

Method- Dhalana

Processor: *Vishesha Shodhana* was performed by repeated *Dhalana* (melting and quenching) of *Samanya Shodhit Vanga* in freshly prepared *Churnodaka* (lime water, pH~11) seven times using a *Pithar Yantra*. *Churnodaka* was made by mixing purified lime (*Sudha*) with water, allowing it to settle, and filtering to obtain a clear alkaline solution.

Result**Table 5: Physical Changes in Gandhaka**

Parameter	Before <i>Shodhana</i> (Impure)	After <i>Shodhana</i> (Purified)
Color	Dark yellow, crystalline	Bright yellow, granular
Texture	Hard, rocky	Grainy, soft, smooth
Odor	Characteristic sulphur odor	Characteristic sulphur odor

Table 6: Show % yield

Initial Weight (g)	Final Weight loss	Weight loss(g)	% yield
1200 g	1057 g	143	88.08%

Preparation of Kajjali^[12]

The preparation of *Kajjali* involves three major steps:

Step I - Dhatupishti Nirmana**Step II - Trituration of Dhatupishti with Saindhava Lavana and Nimbu Swarasa.****Step III - Addition of Shuddha Gandhaka.**

Step I- Dhatupishti Nirmana: *Shuddha Parada* 150gm and *Shuddha Vanga* 300gm were used for the initial amalgamation. *Shuddha Vanga* was melted and immediately poured into a *Khalva* containing *Shuddha Parada*. Continuous trituration was performed for four hours, resulting in a smooth, homogenous metallic-white amalgam, indicating proper amalgamation. Care was taken to use purified ingredients, handle mercury safely in a well-ventilated area, pour molten *Vanga* immediately to prevent premature solidification, and maintain consistent trituration with personal protective equipment.

Step II- Trituration with Saindhava Lavana and Nimbu Swarasa: The greyish amalgam obtained from Step I was further trituated with *Saindhava Lavana* and *Nimbu Swarasa* for a total of eight hours. During this process, the *Nimbu Swarasa* initially turned black and was repeatedly removed using a suction syringe until the black discoloration disappeared completely. Continuous grinding led the mixture to change into a

uniform silver-grey color. The product was then washed thoroughly with lukewarm water and dried under sunlight for two days. Minor weight gain was observed due to traces of *Nimbu Swarasa* and *Saindhava Lavana* mixing with *Dhatu Pishti*.

Step III- Addition of Shuddha Gandhaka: *Shuddha Gandhaka* was gradually added to the trituated *Dhatu Pishti*, and the mixture was ground continuously. The color progressed from grey to metallic black, then to ink black over 40 hours, showing classical properties of *Rekhaupurna*, *Varitara*, and *Nishchandravta*. After completion, the total weight of *Kajjali* obtained was 1335g from 453g *Dhatu Pishti* and 900g *Shuddha Gandhaka*, with a minor weight loss of 1.33% due to spillage, adhesion to the *Khalva*, and minimal ghee loss during trituration. The final *Kajjali* satisfied all classical criteria, indicating successful preparation.

Preparation of Mahasetu Ras

Procedure: Five steps were involved in *Mahasetu rasa Kupipakwa* preparation.

Filling of *Kajjali* in *Kanchkupi*, application of heat by EMF, corking of *Kupi*, breaking of *Kanchkupi*, collection of final product.

Ingredients

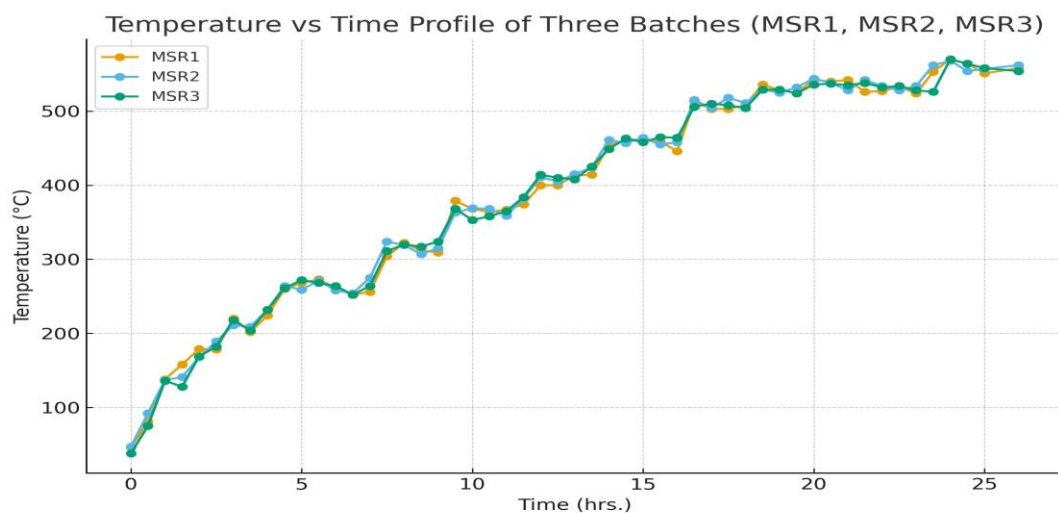
Kajjali – 300 gm

Table 7: Heating patterns and observation of MSR

Stage of Process	Time (hrs.)	Readings MSR1(°C)	Readings MSR2(°C)	Readings MSR3(°C)	Observation
Stage of mild temperature	00:00	46°C	47°C	38°C	Furnace switched on
	00:30	81°C	92°C	75°C	No changes were seen
	01:00	138°C	137°C	136°C	No changes were seen
	01:30	158°C	141°C	145°C	<i>Kajjali</i> started melting in thin line around surface of <i>Kupi</i> .
	02:00	179°C	168°C	169°C	White fumes coming out with characteristic smell of SO ₂ .
	02:30	178°C	189°C	182°C	White fumes seen and <i>Kajjali</i> partially melted.
	03:00	220°C	211°C	218°C	<i>Kajjali</i> was melted completely and some bubbles seen at <i>Kajjali</i> .

	03:30	218°C	226°C	220°C	<i>Kajjali</i> consistency seen like black sludge, fumes and SO ₂ smell increased.
	04:00	224°C	232°C	232°C	Lite yellowish white fumes were observed.
	04:30	260°C	264°C	261°C	Fumes increased bottom seen blurry due to fumes.
	05:00	268°C	263°C	272°C	Yellow fumes were observed Neck of <i>Kupi</i> .
	05:30	273°C	271°C	268°C	<i>Kajjali</i> was boiled and reached approx. 2/3 of <i>Kupi</i> height.
	06:00	270°C	268°C	274°C	Fumes converted yellow to yellowish – white.
	06:30	272°C	264°C	272°C	yellowish -white fumes completely disappeared and dance yellow fumes was observed.
Stage of medium temperature	07:00	286°C	275°C	280°C	<i>Kajjali</i> was settled down.
	07:30	304°C	324°C	311°C	Fumes increased.
	08:00	322°C	319°C	320°C	Bottom of <i>Kupi</i> completely disappeared.
	08:30	312°C	307°C	317°C	Red hot <i>Shalaka sanchalan</i> started.
	09:00	319°C	315°C	324°C	yellow flames seen at <i>Salaka sanchalan</i> .
	09:30	369°C	363°C	368°C	Flames reached upto 1-2 inches with red hot <i>Shalaka sanchalan</i> .
	10:00	368°C	369°C	363°C	Fumes were denser.
	10:30	364°C	368°C	368°C	Flame hight reached 3 inches with red hot <i>Shalaka sanchalan</i> .
	11:00	367°C	374°C	365°C	Light yellow-blue flame observed when red hot <i>Shalaka</i> inserted in neck of <i>Kupi</i> .
	11:30	374°C	382°C	384°C	Flames height decreased.
	12:00	400°C	411°C	414°C	Fumes was decreased.
	12:30	400°C	405°C	410°C	When red hot <i>Shalaka sanchan</i> done flame height reached at 1-2 inches.
	13:00	413°C	415°C	408°C	Yellow fumes were denser.
	13:30	421°C	424°C	425°C	Same above 13 th hrs observation was continued.
	14:00	454°C	461°C	449°C	Same observation was continued
	14:30	461°C	457°C	463°C	Yellow-blue flame reached at 2-3 inches during red hot <i>Shalaka sanchalan</i> .
	15:00	462°C	464°C	458°C	Yellow-blue flame was observed same as last.
	15:30	459°C	455°C	465°C	Same observation was observed.
	16:00	466°C	468°C	464°C	Flames decrease when red hot <i>Shalaka</i> inserted in neck of <i>Kupi</i> .
	16:30	487°C	472°C	484°C	Fumes density decreased.
	17:00	503°C	504°C	510°C	Some white fume was seen with yellow fumes
	17:30	503°C	518°C	508°C	Blue flame was observed without <i>Shalaka sanchalan</i> .
	18:00	508°C	511°C	504°C	During <i>Shalaka sanchalan</i> reddish-yellow flames was observed.

18:30	536°C	529°C	529°C	Blue flame decreased
19:00	538°C	535°C	532°C	At <i>Shalaka sanchalan</i> flames reached 4-5 inches.
19:30	545°C	532°C	534°C	Strong smell of SO ₂ was observed.
20:00	542°C	544°C	536°C	Blue flames again increased.
20:30	540°C	538°C	537°C	Same observations were observed.
21:00	542°C	538°C	535°C	Blue flame was decreased
21:30	536°C	542°C	538°C	During red hot <i>Shalaka sanchalan</i> a few flames was visible.
22:00	537°C	534°C	532°C	Fumes decreased
22:30	533°C	538°C	534°C	Blue flames were disappeared only seen with <i>Shalaka sanchalan</i> .
23:00	534°C	534°C	538°C	Same as above
23:30	553°C	562°C	526°C	Still whit fumes were observed.
24:00	570°C	568°C	570°C	flames completely disappeared during <i>Shalaka sanchalan</i> but some white fumes visible in the <i>Kupi</i> .
24:30	564°C	554°C	564°C	Fumes also disappeared
25:00	551°C	557°C	558°C	Copper coin test and sheet <i>Shalaka</i> test was positive corking done.
26:00	558°C	562°C	554°C	After 1 hour of corking EMF was switched off.



Results

Table 8: Result of Mahasetu rasa

EMF batch	Initial Wt. (gm)	Final Product Wt. (gm)	% Yield	Duration of Procedure in hrs.	Material Loss in gm	% Loss
MSR1	300	115.5	38.5	26	184.5	61.5%
MSR2	300	120.2	40.06	26	179.8	59.93%
MSR3	300	117.4	39.1	26	182.6	60.87%

RAW MATERIA



Ashuddha vanga



Ashuddha gandhaka



Ashuddhaa parada



Shuddha vanga



shuddha gandhaka



shuddha parada



Preparation of dhatupisti

Preparation of mahasetu ras



1. kajjali



2. white fumes



3. kajjali started melting



4. yellow fumes



5. yellow flame with shalaka



6. copper coint test posetive



6.mahasetu ras at bottom of kupi



7. powder of Mahasetu Ras

DISCUSSION

The pharmaceutical observations obtained in this study reaffirm the classical principles of *Rasashastra* while simultaneously validating them with a systematic scientific approach. The detoxification of *Parada*, *Vanga*, and *Gandhaka* resulted in substantial physical and chemical transformation, indicating the removal of toxic principles and enhancement of pharmaceutical suitability. The weight loss of raw materials during *Shodhana*-11.6% in mercury, 9.2% in tin, and 11.9% in sulphur-was within the reported pharmacologically standards, and can be attributed to removal of physical impurities, evaporation of volatile components, and leaching of undesired toxicants into the media. These changes were corroborated by macroscopic observations such as increased brightness of *Parada* and *Vanga*, as well as structural changes in *Gandhaka* from crystalline hard lumps to granular, smooth-textured particles, which align with the expected end point of classical purification.

The *Kajjali* preparation process was highly significant as it represents the intermediate pharmaceutical transformation in *Kupipakwa Rasayana* formulations. The amalgamation of *Shuddha Parada* and *Shuddha Vanga* into a homogenized *Dhatu-pishti* followed by the progressive incorporation of *Gandhaka* produced a stable black *Kajjali* confirming all classical *Guna lakshanas* such as *Varitara*, *Nishchandravta*, and *Rekhapurnata*. From a mechanistic point of view, vigorous trituration and chemical interaction between metallic mercury, tin, and sulphur may have led to the initial formation of organometallic and sulphide complexes, which stabilize mercury in a non-free state and reduce its toxicity. Formation of black *Kajjali* indicates complete sulphurization of mercury preventing free mercury volatilization in subsequent heating. Thus, classical criteria for *Kajjali* can be interpreted today as surrogate markers of stabilization and detoxification.

The *Kupipakwa* process using an EMF demonstrated clear advantages over traditional heating systems such as *Valuka Yantra* or coal-based furnaces. EMF allowed controlled and reproducible heating patterns with minimal external variability. Temperature monitoring revealed a gradual rise up to 550°C, which is critical for sublimation, fixation, and the delicate balance between *Rasadravya* stabilization and volatilization. The staged observations-including smoke characteristics, flame coloration during *Shalaka sanchalan*, and consistency of *Kajjali*-closely correspond with classical descriptions found in *Rasa-shastra* treatises. Scientifically, the observed fumes align with the volatilization of sulphur dioxide and oxides of tin and mercury, while yellowish fumes may indicate sulphur derivatives undergoing

decomposition. The blue flames at higher temperatures suggest liberation of combustible vapours likely related to mercury sulphide interactions.

Loss of material during the *Kupipakwa* process (~60%) is a well-established outcome in *Kupipakwa Rasayana*. This loss occurs due to sublimation of mercury and sulphur compounds, adherence of deposits to vessel walls, and partial escape of volatile fractions. Despite this, the reproducible product yield (~39% across three batches) highlights the consistency and robustness of this standardized EMF method. Importantly, the *Kupipakwa Rasayana* process is not aimed at maximizing yield but rather producing a therapeutically safe and potent residue with desirable classical properties.

From a modern toxicological perspective, *Shodhana* reduces toxic heavy metal load and transforms raw metals into more stable mineral complexes. The controlled heating within the EMF provides uniformity in particle transformation, leading to the likely formation of nano- to submicron-sized crystalline particles, as reported in studies on different *Kupipakwa* preparations. Such transformations not only provide detoxification but also enhance bioavailability through increased surface area and stabilization of metallic sulphide complexes. The pharmaceutical standardization of *Mahasetu Rasa* thus bridges the gap between traditional descriptions and reproducible modern pharmaceutical procedures.

CONCLUSION

Shodhana effectively transformed *Parada*, *Vanga*, and *Gandhaka* into purified, stable forms with improved physical characteristics and reduced toxicity indicators, establishing their suitability for further pharmaceutical processing.

Kupipakwa heating using EMF provided controlled, reproducible, and safe processing conditions. The systematic temperature regulation minimized uncontrolled volatilization and ensured fixation of active components, producing a final residue of high quality.

Pharmaceutical yield of approximately 39% was consistent across multiple batches, demonstrating reproducibility and validating the standardization of *Mahasetu Rasa* preparation.

The observed transformations can be explained in terms of removal of toxic physical /chemical impurities, stabilization of mercury as sulphide or composite forms, and possible reduction of particle size that enhances bioavailability-all of which complement classical Ayurvedic objectives of detoxification and potentiation.

Thus, the process of preparing *Mahasetu Rasa* is now scientifically standardized. It may serve as a benchmark for future pharmaceutical research, toxicological evaluation, and eventual clinical application in *Rasashastra*. The reproducible preparation methodology not only preserves the classical essence of Ayurvedic pharmaceuticals but also aligns it with modern pharmaceutical rigor, supporting its global acceptance as a standardized herbo-mineral formulation.

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