

# RASAYANA FORMULATIONS IN RASA SHASTRA: ANCIENT CONCEPTS AND MODERN EVIDENCE

Dr. Anupama<sup>1</sup>, Dr. Rajni Bhardwaj<sup>2</sup>

<sup>1</sup> Ph.D. Scholar, Rasa Shastra evam Bhaishajya Kalpana, Desh Bhagat Ayurvedic College & Hospital, Punjab, India

<sup>2</sup> Associate Professor, Rasa Shastra evam Bhaishajya Kalpana, Desh Bhagat Ayurvedic College & Hospital, Punjab, India

## ABSTRACT

*Background:* Rasayana, one of Ayurveda's core disciplines, aims to promote longevity, disease resistance, and healthy ageing. Rasa Shastra expands this pharmacopeia with potent herbo-mineral Rasayana formulations such as Swarna Bhasma, Abhraka Bhasma, Gandhaka Rasayana, Makardhwaja, and Rasasindura. *Objective:* To synthesize classical Ayurvedic concepts of Rasayana with contemporary analytical, preclinical, and clinical evidence, highlighting safety, mechanisms, and gaps. *Methods:* Narrative study of contemporary literature and classical treatises indexed in PubMed, ScienceDirect, and DOAJ, with an emphasis on toxicity, analytical characterization, and human investigations on the main Rasa-Rasayana. *Results:* Modern studies report that (i) Swarna Bhasma largely comprises elemental gold with crystalline nanoscale features; (ii) Abhraka Bhasma demonstrates distinct mineralogical profiles with emerging data on genotoxicity endpoints; (iii) Rasasindura is predominantly  $\alpha$ -HgS with low solubility and distinct physicochemical signatures; (iv) Makardhwaja shows acceptable sub-chronic safety in rodent models at therapeutic multiples; and (v) Gandhaka Rasayana has early clinical signals in specific indications, with pediatric protocols underway. *Conclusions:* Classical Rasayana goals align with modern findings on immunomodulation, antioxidant effects, and improved bioavailability via nano-/sub-micron structuring. Stronger standardized trials and harmonized safety frameworks are needed to translate Rasayana into evidence-based integrative care.

**Keywords:** Rasayana; Rasa Shastra; Bhasma; Swarna Bhasma; Abhraka Bhasma; Rasasindura; Gandhaka Rasayana; Makardhwaja; Ayurveda; nanomedicine

## INTRODUCTION

Enhancing *Ayushya*, *Bala*, *Medha*, and *Vyadhikshamatva* is the goal of *Rasayana*, the *Ayurvedic* science of rejuvenation. *Rasa Shastra* subsequently organized herbo-mineral *Rasayana* made by *Shodhana* and *Marana*, while the classical compendia *Caraka Samhita*, *Sushruta Samhita*, and *Ashtanga Hridaya* describe botanical, nutritional, and behavioral *Rasayana*. These processes intend to transform raw metals/minerals into therapeutically suitable, *Sukshma*, and stable forms. Contemporary science now interrogates these claims through crystallography, microscopy, elemental analysis, and biological testing.

## METHODOLOGY

A narrative search of PubMed and ScienceDirect up to August 2025 was undertaken using terms such as "Swarna Bhasma," "Abhraka Bhasma," "Rasasindura," "Gandhaka Rasayana," and "Makardhwaja," combined with "XRD," "TEM/SEM," "toxicity," and "clinical trial." Classical references were sourced

from standard *Sanskrit* editions and English translations. Priority was given to analytical characterization, in vivo safety studies, and human data, i.e., trials, protocols, or controlled studies.

### CLASSICAL FOUNDATIONS OF RASAYANA IN RASA SHAstra

- *Ojovardhana*, *Vyadhikshamatva*, and *Medhya* are the three main goals of classical *Rasayana*, which are extensively discussed along with rejuvenating formulations and practices. According to *Rasa Shastra* literature, which combines metals and minerals with botanical media, appropriate *Shodhana* lowers toxicity while *Marana* produces stable, absorbable *Bhasma* that has *Rasayana* qualities.

### ANALYTICAL AND CLINICAL EVIDENCE OF SELECTED RASAYANA FORMULATIONS IN RASA SHAstra

Formulation	Analytical Profile	Biological/Clinical Signals	Evidence Gaps / Considerations
<b>Swarna Bhasma</b>	Primarily elemental gold; crystalline structure confirmed by XRD; particle size sub-micron to nanoscale; morphology observed by SEM/TEM.	Small particle size and large surface area may enhance bioactivity and reduce the required dose.	Lack of standardized lot-to-lot characterization; limited pharmacokinetics and dose-response human data.
<b>Abhraka Bhasma</b>	<i>Krishna-Vajra Abhraka Bhasma</i> shows layered silicate/mineral phases with nanoscale features; variability noted across marketed samples.	Preliminary genotoxicity/DNA repair studies in mice.	Need for standardization, comprehensive safety profiling, and translational data.
<b>Rasasindura</b>	Identified as $\alpha$ -HgS with low aqueous solubility and distinct crystallography; nanoscale domains reported.	Distinct form compared to organic/soluble mercury.	Requires rigorous toxicology and real-world exposure assessment.
<b>Makardhwaja</b>	Preparation-dependent; few detailed analytical reports.	90-day repeated-dose oral toxicity in Wistar rats showed no major histopathological changes; hematological profiling exists, but is variable.	Standardized product definition and bridging pharmacokinetics/toxicokinetics required for human translation.
<b>Gandhaka Rasayana</b>	Processed sulphur with <i>Bhavana Dravyas</i> , imparting additional properties.	RCT showed benefit in postoperative anorectal pain; pediatric scabies protocol (with <i>Vachadi Lepa</i> ) under study; clinical trial in Grahani Roga showed improvements.	More robust, well-designed clinical trials are needed; variable methodology.

### MECHANISTIC CONSIDERATIONS

1. Particle engineering via *Marana*: Repeated incineration/trituration yields sub-micron/nano features increasing surface reactivity and potential cellular uptake.
2. Chemical speciation and solubility: Therapeutic behavior and toxicity hinge on chemical form. E.g.,  $\alpha$ -HgS vs. soluble/organic mercury.
3. Bio-organic interfaces: *Bhavana* with herbal decoctions may functionalize particles, influencing dispersion, redox buffering, and biological signaling.

4. Immunomodulation/antioxidant effects: Classical *Rasayana* claims align with modern endpoints i.e., reduced oxidative stress, immune modulation, yet require standardized biomarkers and omics-level analyses in humans.

## SAFETY, STANDARDIZATION, AND QUALITY FRAMEWORKS

- Classical tests provide organoleptic/functional checks; pairing them with XRD, SEM/TEM, FT-IR, and ICP-MS builds a robust two-layer quality system.
- Biological safety profiles: Newer proposals outline tiered test batteries for *Bhasma* (cytotoxicity → genotoxicity → sub-chronic toxicity), urging clear product definitions and GMP-like controls.
- Variability across manufacturers: Analytical heterogeneity (especially *Abhraka Bhasma*) underscores the need for monographs, validated SOPs, and reference standards.

## CLINICAL TRANSLATION

- Early randomized/controlled data exist for *Gandhaka Rasayana*; *Makaradhwaja* has sub-chronic animal safety; *Rasasindura* and *Swarna Bhasma* have robust analytical identity evidence.
- Multi-center, adequately powered RCTs using well-defined products and CONSORT-compliant reporting; pharmacokinetic and exposure studies (including elemental speciation in blood/urine); long-term pharmacovigilance for herbo-mineral *Rasayana* in routine care; and head-to-head comparisons of classical versus modified preparation methods to define which SOPs correlate with outcomes.

## CONCLUSION

*Rasa Shastra*'s *Rasayana* pharmaceuticals, when prepared as per classical *Shodhana–Marana* and validated with modern analytics, show promising alignment with contemporary concepts of antioxidant activity, immunomodulation, and targeted delivery via engineered particulates. The field now needs cohesive quality-by-design, transparent safety profiling, and rigorous clinical trials to convert millennia-old *Rasayana* wisdom into a reproducible, global integrative standard.

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