

Review Article

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“HISTORICAL EVOLUTION OF RASA SHAstra: FROM NAGARJUNA TO MODERN ERA”

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ABSTRACT

Introduction: Rasa Shastra, the branch of Ayurveda dealing with minerals, metals, and herbo-mineral preparations, has played a transformative role in the evolution of Indian medicine. Its roots trace back to the early alchemical practices of Nagarjuna, a pioneer of Rasayana Tantra, and continue to influence contemporary Ayurvedic pharmaceutics. Despite its long tradition, Rasa Shastra is often debated for its safety, scientific validation, and integration with modern pharmacology. **Methods:** A comprehensive literature review was conducted using classical Ayurvedic texts (Charaka Samhita, Sushruta Samhita, Rasaratnakara, Rasarnava, and Rasashastra treatises), published peer-reviewed journals (PubMed, Scopus, Web of Science), and modern pharmacological studies. Inclusion criteria involved historical, pharmacological, and clinical studies on Rasa Shastra formulations, while irrelevant or non-authentic sources were excluded.

Results: The review highlights Nagarjuna’s pioneering role in systematizing the use of mercury and other metals, followed by the medieval expansion of Rasashastra texts between the 8th–13th centuries CE. It also outlines the refinement of Shodhana (purification) and Marana (calcination) techniques, ensuring safety and bioavailability of formulations. In the colonial and modern era, Rasa Shastra was criticized for toxicity concerns but later regained relevance due to advanced analytical tools such as XRD, SEM, ICP-MS, and pharmacological validation of formulations like Rasasindura and Swarna Bhasma. **Discussion:** While Rasa Shastra demonstrates profound therapeutic utility, challenges remain in standardization, safety validation, and clinical integration. Modern pharmaceutics and nanotechnology offer avenues for bridging tradition with evidence-based science. **Conclusion:** From its roots in alchemy to its contemporary position in integrative medicine, Rasa Shastra has demonstrated resilience and adaptability. Its future lies in harmonizing traditional wisdom with modern scientific rigor for safe, effective, and globally acceptable therapeutics.

KEYWORDS: Alchemy, Ayurveda, Bhasma, Nagarjuna, Rasa Shastra

INTRODUCTION

Rasa Shastra, a specialized branch of Ayurveda, focuses on the therapeutic application of metals, minerals, and their herbo-mineral formulations^[1-2]. Its philosophy is based on the concept that properly processed substances can transform into powerful remedies for chronic and otherwise incurable diseases. Historically, it emerged from Indian alchemical traditions, with a dual focus on spiritual transformation and prolongation of life^[3-4].

The historical evolution of Rasa Shastra can be traced to the pioneering works of Acharya Nagarjuna (7th–8th century CE)^[5], who is credited with systematizing alchemical processes and therapeutic applications of mercury. Subsequent medieval scholars enriched the field with numerous treatises such as *Rasaratnakara*, *Rasarnava*, and *Rasatarangini*. These works laid the foundation for advanced pharmaceutical techniques, including *Shodhana* (purification) and *Marana* (calcination), which ensured the safety and therapeutic potency of Rasa Dravyas^[6-8].

The present review aims to critically analyze the historical development of Rasa Shastra from the Nagarjuna era to modern times, with special emphasis on pharmacological validation, safety concerns, and integrative perspectives. The objectives are: (i) to explore its historical origins and growth, (ii) to assess its contributions to Ayurvedic therapeutics, and (iii) to examine the contemporary relevance of Rasa Shastra in evidence-based medicine^[9-10].

MATERIALS AND METHODS

A comprehensive literature review was conducted using a systematic approach. Primary sources included Ayurvedic classics such as *Charaka Samhita*, *Sushruta Samhita*, *Rasaratnakara*, *Rasarnava*, *Rasatarangini*, and *Ayurveda Prakasha*. Secondary sources included commentaries and published research on Ayurvedic pharmaceuticals. Modern evidence was sourced from databases including PubMed, Scopus, Web of Science, and Google Scholar using keywords such as “Rasa Shastra,” “Ayurvedic herbo-mineral formulations,” “Nagarjuna alchemy,” “Bhasma pharmacology,” and “Ayurvedic metallic safety.”^[11-12]

Inclusion criteria: Studies discussing historical evolution, preparation methods, pharmacological validation, clinical trials, and safety assessment of Rasa Shastra formulations^[13].

Exclusion criteria: Non-peer-reviewed articles, anecdotal reports without scientific basis, and redundant studies^[14].

A total of 112 sources were screened, out of which 52 (classical and modern) were included for detailed analysis. Both qualitative and thematic analysis approaches were employed, focusing on historical progression, pharmaceutics, safety, and modern applications^[15].

OBSERVATION AND RESULTS

1. Historical Background and Nagarjuna's Contribution

Rasa Shastra emerged during India's alchemical renaissance, with Nagarjuna being a central figure credited for pioneering mercury-based preparations. His works on Rasayana Tantra documented processes of *Parada* (mercury) purification, amalgamation, and therapeutic application. The initial focus of Rasa Shastra was on alchemical immortality and transformation, later evolving into therapeutic domains.

2. Medieval Expansion (8th–13th Century CE)

Between the 8th and 13th centuries, Rasa Shastra experienced exponential growth. Texts such as *Rasarnava* and *Rasaratnakara* codified systematic procedures for preparing *Bhasma* (calcined ash of metals/minerals). The concept of *Shodhana* (purification) became critical, involving herbal media like cow's urine, Triphala decoction, and lemon juice. These methods not only detoxified but also enhanced the bioavailability of metals.

3. Techniques of Shodhana and Marana

Shodhana was regarded as essential for converting metals into safe therapeutic agents. *Marana* transformed metals like gold, silver, copper, iron, and mercury into fine bioavailable particles. Swarna Bhasma (gold ash), Lauha Bhasma (iron ash), and Rasasindura (red sulfide of mercury) are examples of formulations that gained clinical prominence. Advanced pharmaceutical devices such as *Dolayantra*, *Khalva Yantra*, and *Putapaka* methods were also described.

4. Colonial Era Criticism and Decline

During the British colonial period, Rasa Shastra faced skepticism due to concerns about metallic toxicity. Western medical authorities often disregarded Ayurvedic herbo-mineral drugs as unscientific. This led to a decline in their mainstream use, with Ayurveda itself relegated to a marginalized role. However, traditional practitioners continued the

use of Rasa Shastra formulations, preserving the knowledge base.

5. Modern Revival and Scientific Validation

The 20th and 21st centuries witnessed renewed interest in Rasa Shastra, fueled by advances in analytical techniques. Studies using X-ray diffraction (XRD), scanning electron microscopy (SEM), and inductively coupled plasma mass spectrometry (ICP-MS) have confirmed that *Bhasma* preparations consist of nano- and micro-particles with high stability and unique physicochemical properties. Pharmacological studies revealed antioxidant, immunomodulatory, anti-inflammatory, and adaptogenic properties of formulations like Swarna Bhasma and Rasasindura.

6. Therapeutic Applications in Modern Context

- **Swarna Bhasma:** Reported to improve immunity, cognition, and longevity.
- **Lauha Bhasma:** Widely used in the management of anemia and chronic fatigue.
- **Rasasindura:** Investigated for cardioprotective and neuroprotective effects.
- **Makardhwaja:** Popular as a Rasayana formulation for vitality.

Several clinical studies have demonstrated safety and efficacy of these formulations when prepared according to classical methods.

7. Challenges in Safety and Standardization

Despite advances, concerns about heavy metal toxicity remain. Improperly prepared or counterfeit formulations may contain unsafe levels of lead, arsenic, or mercury. Standardization, Good Manufacturing Practices (GMP), and pharmacopeial guidelines are essential to ensure safety and efficacy. Integration of modern pharmacology, toxicology, and clinical trials remains a priority.

DISCUSSION

The historical journey of Rasa Shastra demonstrates the dynamic interplay between tradition and science. Rooted in the alchemical practices of Nagarjuna, Rasa Shastra evolved into a sophisticated pharmaceutics system during the medieval era, establishing purification and calcination as essential safety steps. These processes reflect an early understanding of pharmacodynamics and pharmacokinetics, as toxic raw metals were transformed into therapeutically active, bioavailable particles^[16].

Modern analytical studies have validated these ancient practices. For example, Swarna Bhasma has

been shown to consist of gold nanoparticles, while Lauha Bhasma contains bioavailable iron oxides. Such findings corroborate the empirical knowledge of Ayurveda with contemporary nanoscience. However, controversies persist regarding safety, particularly due to reports of adulterated or improperly prepared formulations leading to metal toxicity. This highlights the critical need for rigorous standardization and regulatory frameworks^[17].

Another gap lies in the limited number of large-scale clinical trials. While animal and preliminary human studies suggest immunomodulatory, anti-inflammatory, and adaptogenic benefits, more robust randomized controlled trials (RCTs) are needed to establish clinical efficacy. Integration of Ayurveda with modern biomedicine should focus on evidence-based validation, pharmacovigilance, and interdisciplinary collaboration^[18].

Furthermore, Rasa Shastra offers valuable insights into drug delivery systems. The nano-sized particles in Bhasmas may provide novel models for targeted therapy and controlled release. This aligns with modern drug delivery research, suggesting promising opportunities for integrative approaches^[19].

Looking forward, the future of Rasa Shastra depends on three pillars: (i) strict adherence to classical preparation methods, (ii) incorporation of modern analytical validation, and (iii) bridging traditional wisdom with clinical research. Such an integrative framework could enhance global acceptance of Rasa Shastra and contribute to novel therapeutic innovations^[20].

CONCLUSION

The historical evolution of Rasa Shastra, from the pioneering contributions of Nagarjuna to its current place in modern Ayurveda, reflects a remarkable journey of resilience and adaptation. Rooted in alchemical traditions, it grew into a sophisticated discipline of pharmaceutics, introducing systematic purification and calcination methods to transform toxic raw metals into safe, therapeutically potent preparations. Classical formulations like Swarna Bhasma, Lauha Bhasma, and Rasasindura remain widely used due to their profound therapeutic effects in chronic and lifestyle-related disorders.

Despite its strengths, Rasa Shastra faces critical challenges in the modern era. Concerns about safety, toxicity, and lack of standardization have hindered its wider acceptance. However, advances in nanoscience and analytical technologies have

validated many classical claims, revealing that Bhasmas often consist of biocompatible nanoparticles. This scientific validation offers a bridge between traditional Ayurvedic practices and modern biomedical science.

The integration of rigorous safety protocols, GMP practices, and large-scale clinical trials is essential for global recognition. By embracing an evidence-based approach, Rasa Shastra can reclaim its position as a valuable contributor to integrative medicine. Ultimately, the future of Rasa Shastra lies in harmonizing its rich historical heritage with scientific validation, ensuring safe, effective, and globally relevant Ayurvedic therapeutics.

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