

Rasasindura: A Comprehensive Review of Classical Pharmaceutical Preparation, Analytical Characterization and Therapeutic Potential

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Abstract

Background: *Rasasindura* is a classical *Kupipakwa Rasayana* formulation of *Rasashastra* prepared from purified *Parada* (mercury) and *Gandhaka* (sulphur). It is traditionally described as a *Yogavahi*, *Rasayana*, and *Balya* drug and is widely indicated in chronic and systemic disorders. Recent scientific investigations have focused on its physicochemical characteristics, safety, and therapeutic potential.

Aim: To review the classical concepts, pharmaceutical preparation, analytical characterization, therapeutic applications, and toxicological aspects of *Rasasindura* in the light of contemporary scientific evidence.

Materials and Methods: Classical Ayurvedic texts, *Rasashastra* literature, and published scientific studies on *Rasasindura* were reviewed to critically analyse its composition, pharmaceutical preparation, analytical characteristics, therapeutic applications, pharmacological activities, and safety profile.

Results and Discussion: Classical literature describes *Rasasindura* as a *Kupipakwa Rasayana* prepared through *Shodhana*, *Kajjali* formation, and controlled heating procedures. Modern analytical studies have shown that *Rasasindura* predominantly consists of crystalline α -mercuric sulphide (α -HgS) particles with nanoscale dimensions, high structural stability, and low solubility. Experimental investigations suggest that pharmaceutical processing significantly alters the physicochemical properties and biological behaviour of mercury. Available studies indicate potential therapeutic benefits and a toxicity profile distinct from elemental mercury; however, variations in manufacturing procedures and limited high-quality pharmacological, toxicological, and clinical evidence restrict definitive conclusions.

Conclusion: *Rasasindura* represents a unique integration of traditional Ayurvedic pharmaceuticals and modern material science. While existing evidence supports its distinctive physicochemical characteristics and potential therapeutic utility, further well-designed pharmacological, toxicological, and clinical studies are required to establish its safety, efficacy, and mechanism of action according to contemporary scientific standards.

Keywords: Ayurvedic herbo-mineral formulation; *Kupipakwa Rasayana*; Mercury sulphide; Nanomedicine; *Rasashastra*; *Rasasindura*

1. Introduction

Rasashastra is a specialized branch of Ayurveda dealing with the processing and therapeutic utilization of metals, minerals and herbo-mineral formulations. Among the various mercurial preparations, *Rasasindura* occupies a unique position due to its wide therapeutic applicability and classical importance.

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Rasasindura belongs to the category of *Kupipakwa Rasayana*, a group of formulations prepared by subjecting *Kajjali* to controlled heating in a specially designed glass bottle (*Kacha Kupi*) placed in a *Valuka Yantra*. [1] Classical Ayurvedic physicians considered *Kupipakwa* preparations highly potent and effective in chronic and difficult-to-treat diseases. The pharmaceutical process involves several critical steps including *Shodhana* of *Parada* and *Gandhaka*, *Kajjali* preparation, *Bhavana* and controlled heating through *Mridu*, *Madhyama* and *Tivra Agni*. [2], [3]

1.1. Historical Background

The development of mercurial formulations represents a major advancement in Ayurvedic pharmaceuticals. *Rasasindura* is described in various *Rasashastra* classics including:

- *Rasa Tarangini*
- *Rasaratna Samuccaya*
- *Ayurveda Prakasha*

These texts emphasize the importance of purification, trituration and controlled heating in transforming mercury into a therapeutically useful form.

2. Materials and Methods

2.1. Review Methodology and Literature Review

A literature review was conducted using classical Ayurvedic texts, *Rasashastra* treatises, and published scientific studies on *Rasasindura*. Relevant information was collected from sources such as *Rasa Tarangini*, *Rasaratna Samuccaya*, *Ayurveda Prakasha*, PubMed, Google Scholar, and other peer-reviewed databases. Literature related to the composition, pharmaceutical preparation, analytical characterization, therapeutic applications, and safety profile of *Rasasindura* was reviewed and critically analysed.

2.2. Ingredients of Rasasindura

2.2.1. Parada (Mercury)

Parada is considered the principal ingredient of *Rasasindura*. Classical texts describe it as *Yogavahi*, meaning it enhances the action of co-administered drugs and *Sarvarogahara* (broad-spectrum therapeutic agent). [4]

2.2.2. Gandhaka (Sulphur)

Purified sulphur is mixed with purified mercury to prepare *Kajjali*. *Gandhaka* facilitates the conversion of elemental mercury into mercuric sulphide during the heating process.

2.2.3. Bhavana Dravyas

Various plant materials such as *Vatankura Swarasa* are used for *Bhavana*. These substances are believed to improve processing efficiency and therapeutic efficacy. [5]

2.3. Pharmaceutical Preparation of Rasasindura

2.3.1. Shodhana of Parada

Purification of mercury is performed to remove physical and chemical impurities. Classical procedures include *Mardana* with herbal materials and washing techniques.

2.3.2. Shodhana of Gandhaka

Sulphur is purified using methods such as melting and filtration through cloth into milk or ghee. [6]

2.3.3. Kajjali Nirmana

Equal quantities of purified mercury and sulphur are trituated until a smooth, lustreless black powder known as *Kajjali* is formed.

Kajjali Siddhi Lakshanas include:

- *Nishchandra* (absence of metallic shine)
- *Rekhapurnata*
- *Varitaratva* (in some preparations)
- Smooth black appearance

2.3.4. *Bhavana*

Bhavana is administered using suitable liquid media. Repeated *Bhavana* helps achieve homogeneity and facilitates pharmaceutical transformation.

2.3.5. *Kupipakwa Procedure*

Kajjali is filled into a *Kacha Kupa* and subjected to gradual heating.

2.3.6. *Mridu Agni*

Initial mild heating removes moisture and volatile impurities.[7]

2.3.7. *Madhyama Agni*

Intermediate heating initiates chemical reactions between mercury and sulphur.[8]

2.3.8. *Tivra Agni*

High temperature promotes formation of *Rasasindura* and sublimation at the neck of the bottle.

The final product accumulates at the neck region of the bottle and is collected after cooling. [9]

2.4. Probable Chemistry of *Rasasindura*

The pharmaceutical transformation occurring during *Kupipakwa* preparation has attracted scientific interest.

- During heating:
- Mercury reacts with sulphur.
- Mercuric sulphide (HgS) is formed.
- Crystalline transformation occurs.
- Nanometre-sized particles may be generated.

Modern investigations indicate that properly prepared *Rasasindura* mainly contains α -HgS (cinnabar phase) rather than free elemental mercury. This transformation is considered important in determining its biological behaviour and safety.[10]

2.5. Analytical Characterization

2.5.1. *X-Ray Diffraction (XRD)*

XRD studies demonstrate the presence of crystalline α -HgS in *Rasasindura*.

2.5.2. *Scanning Electron Microscopy (SEM)*

SEM studies reveal fine particles with nanoscale dimensions and agglomerated morphology.

2.5.3. *X-Ray Fluorescence (XRF)*

XRF analysis confirms mercury and sulphur as major elemental constituents.

2.5.4. *Particle Size Analysis*

Several studies report nanoparticle-sized fractions in *Rasasindura*, which may influence bioavailability and pharmacological activity.

2.6. Therapeutic Applications

Classically *Rasasindura* is indicated in:

- *Jwara*
- *Kasa*
- *Shwasa*
- *Rajayakshma*
- *Pandu*
- *Prameha*

It is also used as an ingredient in several compound formulations due to its *Yogavahi* property.

2.7. Toxicological Considerations

The use of mercury-containing medicines remains controversial. Modern toxicology generally associates mercury exposure with adverse health effects. However, Ayurvedic pharmaceuticals proposes that proper *Shodhana* and *Kupipakwa* processing alter the physicochemical nature of mercury.

Scientific studies have shown that *Rasasindura* predominantly contains mercury in sulphide form (HgS), which differs significantly from elemental mercury and organic mercury compounds in terms of bioavailability and toxicity. Nevertheless, standardization and quality control remain essential. [11]

2.8. Recent Scientific Evidence

Recent investigations have evaluated *Rasasindura* using advanced analytical techniques such as:

- SEM
- XRD
- XRF
- SAED
- XAFS

These studies demonstrated that *Rasasindura* is largely composed of crystalline α -HgS nanoparticles and contains minimal free elemental mercury when prepared according to classical procedures.[12]

3. Results

The reviewed literature indicates that *Rasasindura* is a classical *Kupipakwa Rasayana* prepared through a systematic pharmaceutical process involving *Shodhana* of *Parada* and *Gandhaka*, *Kajjali* formation, *Bhavana*, and controlled heating in a *Kacha Kupi*. Classical *Rasashastra* texts consistently describe *Rasasindura* as a potent *Yogavahi* and *Rasayana* formulation with therapeutic utility in disorders such as *Jwara*, *Kasa*, *Shwasa*, *Rajayakshma*, *Pandu*, and *Prameha*.

Modern analytical studies have demonstrated that properly prepared *Rasasindura* predominantly consists of crystalline α -mercuric sulphide (α -HgS). Characterization using XRD, SEM, XRF, TEM, SAED, and XAFS has revealed a crystalline structure, high chemical stability, and the presence of particles ranging from micro- to nano-scale dimensions. Experimental studies further suggest that classical pharmaceutical processing significantly alters the physicochemical properties of mercury, resulting in a form distinct from elemental mercury. Available toxicological investigations indicate relatively low solubility and bioavailability of α -HgS compared with other forms of mercury, although comprehensive clinical evidence remains limited.

4. Discussion

The findings of the present review highlight the scientific significance of the classical pharmaceutical principles described in *Rasashastra*. The processes of *Shodhana*, *Kajjali* preparation, *Bhavana*, and *Kupipakwa* heating are not merely traditional procedures but appear to induce substantial physicochemical transformations in the raw materials. Modern analytical evidence suggests that these procedures convert elemental mercury and sulphur into a stable crystalline form of mercuric sulphide, thereby altering its biological behaviour.

The identification of α -HgS as the principal constituent of *Rasasindura* provides a possible explanation for its therapeutic use and safety profile described in classical literature. The nano- and micro-scale particle size reported in several studies may contribute to enhanced bioavailability and pharmacological activity. Furthermore, the *Yogavahi* property attributed to *Rasasindura* in Ayurveda may warrant investigation using modern pharmacological approaches.

Despite encouraging analytical findings, the available evidence is primarily limited to pharmaceutical and laboratory-based studies. Well-designed pharmacological investigations, toxicity assessments, and controlled clinical trials are still required to establish the safety, efficacy, mechanism of action, and therapeutic relevance of *Rasasindura* according to contemporary scientific standards. Standardization of preparation methods and quality control parameters will also be essential for ensuring reproducibility and wider scientific acceptance.

5. Conclusion

Rasasindura represents one of the most sophisticated pharmaceutical achievements of *Rasashastra*. Classical preparation involves systematic purification, *Kajjali* formation, *Bhavana* and controlled *Kupipakwa* processing. Modern analytical investigations suggest that properly prepared *Rasasindura* consists predominantly of crystalline α -HgS nanoparticles. Although emerging scientific evidence supports its unique physicochemical characteristics, further studies are required to establish comprehensive safety and therapeutic efficacy.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

References

- [1] Shukla V, et al. Pharmaceutico-analytical study of Samaguna, Dwiguna and Shadguna Bali Jarita Rasa Sindura. Ayu. 2018.
- [2] Sharma S. Rasatarangini. Edited by Kashinath Shastri. 11th ed. New Delhi: Motilal Banarsidass; 1979. Taranga 6, Verses 162–167. p. 136.
- [3] Bhojar MS, Lagad CE, Wadodkar DS. Preparation of Rasasindura by modified portable Valukayantra vis-a-vis traditional method. Int J Res Ayurveda Pharm. 2013;4(1):54-58. doi:10.7897/2277-4343.04124.
- [4] Vagbhata. Rasa Ratna Samuccaya. Edited by Vaidyaraj Shankarlal Harishankar. Mumbai: Khemraj Shrikrishnadas Prakashan; 2019. Chapter 1.
- [5] Sharma S. Rasatarangini. Edited by Kashinath Shastri. 11th ed. New Delhi: Motilal Banarsidass; 1979. Taranga 6, Verses 162–167. p. 136.
- [6] Gunaratna TANR, et al. Comparison of traditional and laboratory methods of sulphur processing. J Ayurveda Integr Med. 2023;14(4):100751. doi: 10.1016/j.jaim.2023.100751.
- [7] Gokarn RA, Rajput DS, Yadav P, Galib, Patgiri BJ, Prajapati PK. Pharmaceutical standardization of Svarna Vanga. Ayu. 2013;33(2):97-102. doi:10.4103/0257-7941.139046
- [8] Gokarn RA, Rajput DS, Patgiri BJ. Pharmaceutical standardization of Samaguna Bali Jarita Rasasindura prepared by conventional and modified method. Anc Sci Life. 2012;31(3):123-128. doi:10.4103/0257-7941.103191
- [9] Gokarn RA, Gokarn SR, Hiremath SG. Process standardization and characterization of Rajata Sindura. Ayu. 2014;35(1):63-70. doi:10.4103/0974-8520.141940.
- [10] Khandekar S, et al. Ayurvedic processing of α -HgS gives novel physicochemistry and distinct toxicokinetics in zebrafish. Chemosphere. 2020; 251:126295. doi: 10.1016/j.chemosphere.2020.126295. PMID: 32143074
- [11] Biswas S, Bellare J. Ayurvedic processing of α -HgS gives novel physicochemistry and distinct toxicokinetics in zebrafish. Chemosphere. 2020; 251:126295. doi: 10.1016/j.chemosphere.2020.126295. PMID: 32143074.
- [12] Ramanan N, Lahiri D, Rajput P, Varma RC, Arun A, Muraleedharan TS, et al. Investigating structural aspects to understand the putative/claimed non-toxicity of the Hg-based Ayurvedic drug Rasasindura using XAFS. J Synchrotron Radiat. 2015;22(5):1233-1241. doi:10.1107/S1600577515012473. PMID: 26289275.