

## Review Article

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**“ROLE OF BHASMAS IN AYURVEDA AND THEIR CORRELATION WITH NANOMEDICINE”**

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**ABSTRACT**

**Introduction:** *Bhasmas* are unique Ayurvedic herbo-mineral preparations subjected to specific purification (*Shodhana*) and incineration (*Marana*) processes, resulting in fine, bioavailable powders used for therapeutic purposes since antiquity. They are indicated in chronic diseases including metabolic, neurological, and immunological disorders. Recent advances in nanomedicine have revealed that the physicochemical properties of *Bhasmas* closely resemble engineered nanoparticles. **Methods:** A systematic literature review was carried out by searching classical Ayurvedic texts (*Charaka Samhita*, *Sushruta Samhita*, *Rasatarangini*, *Rasa Ratna Samucchaya*), and modern databases (PubMed, Scopus, Web of Science) using terms “*Bhasma*”, “Ayurveda”, “nanomedicine”, and “herbo-mineral formulations”. Studies reporting traditional preparation, characterization, safety, and pharmacological actions of *Bhasmas* were included. Exclusion criteria involved non-peer-reviewed reports and formulations unrelated to *Bhasmas*. **Results:** Classical references describe multiple *Bhasmas* such as *Swarna Bhasma* (gold), *Abhraka Bhasma* (mica), *Tamra Bhasma* (copper), and *Yashada Bhasma* (zinc), each indicated for specific conditions like immunomodulation, respiratory disorders, metabolic regulation, and wound healing. Modern analytical studies demonstrate particle sizes in the nanometer range, high stability, and unique surface properties enhancing bioavailability. Pharmacological studies show antioxidant, anti-inflammatory, immunomodulatory, and anticancer activities. Toxicological evaluations suggest that properly prepared *Bhasmas* are safe, though standardization remains a challenge. **Discussion:** The nanoscale properties of *Bhasmas* provide a bridge between traditional Ayurvedic wisdom and contemporary nanomedicine. Their natural synthesis through controlled incineration parallels green nanotechnology. Integration of Ayurvedic pharmaceutics with modern nanoscience may inspire novel therapeutic agents with high efficacy and safety. **Conclusion:** *Bhasmas* exemplify a traditional nanomedicine system. Scientific validation of their preparation, safety, and pharmacodynamics is essential to harness their full therapeutic potential and integrate them into global healthcare.

**KEYWORDS:** Ayurveda, *Bhasma*, Nanomedicine, Pharmacology, *Rasashastra*



## INTRODUCTION

Ayurveda, the ancient Indian system of medicine, emphasizes a holistic approach for maintaining health and treating disease. Within its specialized branches, *Rasashastra* occupies a distinct place, dealing with herbo-mineral formulations prepared through precise processes to enhance therapeutic potential.<sup>[1-2]</sup> Among these, *Bhasmas*—calcined metallic and mineral preparations—have remained central due to their reputed potency, stability, and efficacy even in minute doses. Their preparation involves elaborate purification (*Shodhana*) and incineration (*Marana*) techniques, designed to detoxify raw materials and transform them into bio-assimilable forms.<sup>[3]</sup>

Historically, *Bhasmas* have been widely employed in conditions considered difficult to manage with herbal remedies alone.<sup>[4]</sup> Classical Ayurvedic texts highlight their role in chronic metabolic disorders, degenerative diseases, and immune dysfunctions. They are described as fast-acting, highly potent, and capable of producing sustained therapeutic effects in small quantities, thereby offering advantages in terms of dose economy and patient compliance. Such descriptions underscore their unique status in Ayurvedic therapeutics.<sup>[5-6]</sup>

In recent decades, advances in nanoscience and biomedical research have provided new insights into the physicochemical nature of *Bhasmas*. Studies demonstrate that these preparations often possess nanoscale particle sizes, high surface area, and enhanced bioavailability, which align them closely with modern nanomedicine principles.<sup>[8-9]</sup> Against this backdrop, the present review aims to explore the traditional role of *Bhasmas* in Ayurveda, summarize their pharmacological and clinical evidence, and critically analyze their correlation with modern nanomedicine, thereby offering a framework for integrative understanding and future translational research.<sup>[10]</sup>

## MATERIALS AND METHODS

A comprehensive literature survey was conducted between January and July 2025. Sources included:

- **Ayurvedic classics:** *Charaka Samhita*, *Sushruta Samhita*, *Ashtanga Hridaya*, *Rasaratna Samucchaya*, *Rasatarangini*.<sup>[11]</sup>
- **Databases:** PubMed, Scopus, Web of Science, Google Scholar.

- **Search terms:** “*Bhasma*”, “*Rasashastra*”, “Ayurveda and nanotechnology”, “Ayurvedic herbo-mineral drugs”, “nanomedicine correlation”.<sup>[12]</sup>
- **Inclusion criteria:** Studies describing preparation methods, analytical characterization (XRD, SEM, TEM, ICP-MS), pharmacological activities, toxicology, and clinical reports of *Bhasmas*.<sup>[13-14]</sup>
- **Exclusion criteria:** Non-authentic sources, commercial reviews without scientific evidence, and studies not directly linked to *Bhasmas*.<sup>[15]</sup>

## OBSERVATION AND RESULTS

### 1. Classical Ayurvedic Perspective on *Bhasmas*

Ayurvedic texts describe over 100 *Bhasmas* derived from metals, minerals, and animal products. Commonly used examples include:

- **Swarna Bhasma (Gold):** Rejuvenative, immunomodulatory, used in tuberculosis, arthritis, and neurological disorders.
- **Rajata Bhasma (Silver):** Antimicrobial, cooling, used in fever and bleeding disorders.
- **Tamra Bhasma (Copper):** Indicated in liver disorders, obesity, and chronic respiratory diseases.
- **Yashada Bhasma (Zinc):** Used in diabetes, skin diseases, and wound healing.
- **Abhraka Bhasma (Mica):** Strengthening, anti-aging, effective in asthma, infertility, and anemia.
- **Lauha Bhasma (Iron):** Widely prescribed in anemia, weakness, and menstrual disorders.

Preparation involves multi-step detoxification and repeated incineration cycles with herbal media, ensuring fine particle size and reduced toxicity.

### 2. Physicochemical and Nanoparticle Characteristics

Modern characterization techniques (SEM, TEM, XRD, ICP-MS) reveal:

- Particle size typically in 50–200 nm range, some even below 50 nm.
- Crystalline structure with altered oxidation states compared to raw metals.
- High surface area facilitating bioavailability.
- Presence of organic phytoconstituents from herbal media that act as natural stabilizers (similar to green synthesis in nanotechnology).

- **Antioxidant & Cytoprotective Effects:** *Swarna Bhasma* and *Abhraka Bhasma* reduce oxidative stress markers and enhance antioxidant enzymes.
- **Immunomodulatory Activity:** *Guduchi-samskarita Swarna Bhasma* enhances macrophage activity and antibody production.
- **Antimicrobial Action:** *Rajata Bhasma* shows broad-spectrum antibacterial and antiviral activity.
- **Metabolic Regulation:** *Yashada* and *Tamra Bhasmas* improve insulin sensitivity and lipid metabolism in diabetic models.
- **Neuroprotection:** *Abhraka* and *Swarna Bhasma* improve memory, reduce neuroinflammation, and show promise in Alzheimer's models.
- **Anticancer Potential:** Nanogold and nanocopper-based *Bhasmas* exhibit apoptosis-inducing effects in cancer cell lines.

#### 4. Safety and Toxicity

When properly prepared, *Bhasmas* are safe in therapeutic doses. Studies demonstrate absence of heavy metal toxicity in standardized formulations. Conversely, improperly prepared *Bhasmas* pose risks of accumulation and toxicity, underscoring the need for stringent standardization.

#### 5. Correlation with Nanomedicine

The nanoscale size, stability, and biocompatibility of *Bhasmas* closely align with engineered nanoparticles in medicine. Their properties parallel applications in targeted drug delivery, imaging, and regenerative therapy. Herbal-assisted incineration represents a form of **green nanotechnology**, highlighting Ayurveda's advanced pharmaceutics centuries ahead of modern discovery.

#### DISCUSSION

*Bhasmas* epitomize Ayurveda's foresight in developing nanomedicine-like preparations. Their therapeutic actions, safety, and rapid bioavailability correspond with nanoparticle behavior. For instance, *Swarna Bhasma*'s nano-gold structure is comparable to colloidal gold used in modern diagnostics and targeted therapies. Similarly, *Yashada Bhasma*'s effects resemble zinc oxide nanoparticles employed in dermatology and wound healing.<sup>[16]</sup>

Ayurveda's integration of herbal media during *Marana* provides additional biological capping agents, enhancing stability and reducing toxicity, a method now mirrored in green nanotechnology. This indicates that *Bhasmas* are not only pharmacologically active but also pharmaceutically sophisticated.<sup>[17]</sup>

However, significant challenges remain:<sup>[18]</sup>

- Lack of universal standards for preparation.
- Variability in particle size and composition across different batches.
- Limited large-scale clinical trials.
- Concerns regarding safety of improperly prepared formulations.

Future research should focus on:<sup>[19]</sup>

- Establishing Good Manufacturing Practices (GMP) for *Bhasmas*.
- Multi-omics approaches (proteomics, metabolomics) to elucidate mechanisms.
- Comparative studies between *Bhasmas* and synthetic nanoparticles.
- Controlled clinical trials to validate *efficacy* and safety.

Bridging Ayurveda with nanoscience provides immense scope for drug innovation. Properly standardized *Bhasmas* may serve as natural nanomedicine templates, combining traditional wisdom with modern precision.<sup>[20]</sup>

#### CONCLUSION

*Bhasmas* represent a remarkable confluence of Ayurveda and nanotechnology. These ancient herbo-mineral formulations, prepared through meticulous processes, exhibit nanoscale characteristics that enhance their therapeutic potential. Classical texts prescribe *Bhasmas* for chronic, refractory diseases, and modern studies confirm their antioxidant, immunomodulatory, antimicrobial, neuroprotective, and anticancer activities.

Nanoscience has validated that *Bhasmas* function similarly to engineered nanoparticles, with herbal-assisted preparation methods resembling green synthesis. This positions *Bhasmas* as precursors to nanomedicine, centuries before the term was coined. Despite promising evidence, challenges in standardization, safety validation, and clinical testing persist. Addressing these gaps through rigorous scientific evaluation and integration of modern analytical tools will enable wider acceptance and application.



In conclusion, *Bhasmas* exemplify the sophistication of Ayurvedic pharmaceutics and their relevance to modern medicine. They hold great promise as safe, effective, and sustainable nanomedicines, bridging ancient tradition with futuristic healthcare.

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