

“MARANA (INCINERATION) PROCEDURES AND THEIR PHARMACEUTICAL SIGNIFICANCE: A SCIENTIFIC REVIEW”

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ABSTRACT

Introduction: Marana, or incineration, is a critical pharmaceutical procedure in Rasa Shastra (the Ayurvedic branch dealing with metals and minerals). It involves repeated calcination and processing of purified substances to transform them into fine, stable, and bioassimilable forms known as *Bhasma*. The significance of Marana lies in reducing toxicity, enhancing therapeutic activity, and ensuring long-term stability of formulations. **Methods:** This review was conducted through a systematic search of Ayurvedic classical texts (*Rasatarangini*, *Rasa Ratna Samuccaya*, *Ayurveda Prakasha*, and *Charaka Samhita*), along with modern research databases including PubMed, Scopus, and Web of Science. Search terms included “Marana,” “Bhasma preparation,” “Ayurveda metallurgy,” “incineration Ayurveda,” and “Ayurvedic pharmaceuticals.” Inclusion criteria were studies and texts detailing Marana techniques, pharmaceutical transformations, and clinical applications, while anecdotal or non-authentic sources were excluded. **Results:** Traditional Marana procedures involve repeated heating, quenching, and grinding cycles with herbal juices, ensuring complete transformation of metals and minerals. Techniques such as *Puti* (calcination in closed containers with cow dung cakes) or modern electrical furnaces yield micro- and nano-sized particles with altered physicochemical properties. Analytical methods including X-ray diffraction (XRD), scanning electron microscopy (SEM), and Fourier-transform infrared spectroscopy (FTIR) confirm particle size reduction, phase transformation, and enhanced stability. Preclinical and clinical studies demonstrate that Bhasmas prepared through Marana exhibit improved bioavailability and reduced toxicity compared to raw substances. **Discussion:** Marana reflects a convergence of traditional pharmaceutical wisdom and modern material science. While its therapeutic relevance is supported by growing evidence, gaps remain in standardization, toxicological profiling, and global acceptance. **Conclusion:** Marana is not merely a ritualistic practice but a scientifically valid pharmaceutical technique that transforms toxic raw substances into safe, effective, and stable medicines. Integrating classical insights with modern analytical validation will strengthen its role in global integrative medicine.

KEYWORDS: Ayurveda, Bhasma, Incineration, Marana, Rasa Shastra

INTRODUCTION

The preparation of herbo-mineral and metallic formulations is a hallmark of Rasa Shastra, an important branch of Ayurveda. Among its pharmaceutical techniques, *Marana* (incineration) occupies a central position^[1-2]. This process transforms purified metals and minerals into *Bhasmas*, which are fine powders intended for therapeutic use. Ancient scholars emphasized that without *Marana*, raw metals remain toxic and unfit for human consumption^[3-4].

Historically, *Marana* evolved through systematic experimentation documented in texts such as *Rasa Ratna Samuccaya*, *Rasatarangini*, and *Ayurveda Prakasha*^[5-6]. These works describe different types of *Putra* (calcination methods), the role of herbal juices, and the use of specialized instruments to achieve safe and bioassimilable preparations. Through repeated incineration and trituration, particle size reduction and chemical transformation occur, making metals biologically compatible^[7-8].

The present review aims to critically examine *Marana* from both classical and modern scientific perspectives. Specifically, the objectives are: (i) to describe the procedures and rationale of *Marana* as detailed in classical texts, (ii) to explore the pharmaceutical significance of *Marana* in detoxification, transformation, and stabilization of metals, and (iii) to evaluate modern research that validates these processes using contemporary analytical and pharmacological tools^[9-10].

MATERIALS AND METHODS

This review followed a structured literature search. Primary sources included classical Ayurvedic texts such as *Rasa Ratna Samuccaya*, *Rasatarangini*, *Ayurveda Prakasha*, and relevant sections of *Charaka* and *Sushruta Samhita*. Secondary sources included commentaries, pharmacopeial references, and authoritative Ayurvedic compendia. Electronic databases searched were PubMed, Scopus, and Web of Science, using keywords: “*Marana*,” “*Ayurveda incineration*,” “*Bhasma preparation*,” “*metallic Ayurveda drugs*,” and “*Ayurvedic pharmaceuticals*.”^[11-12]

Inclusion criteria: Classical references to *Marana* procedures; experimental and analytical studies on *Bhasma* preparation; preclinical and clinical safety evaluations; and modern validation studies^[13].

Exclusion criteria: Non-peer-reviewed articles, anecdotal reports, and sources lacking scientific or

classical authenticity^[14].

A total of 98 sources were screened, and 48 were included in the final review. Data were thematically organized into historical evolution, pharmaceutical techniques, analytical validation, pharmacological evidence, and clinical relevance^[15].

OBSERVATION AND RESULTS

1. Classical Understanding of Marana

Marana is defined as the process of repeated incineration and trituration to transform purified metals and minerals into *Bhasma*. Ancient scholars emphasized that *Marana* converts heavy, insoluble, and toxic raw materials into light, assimilable, and therapeutically active powders. The concept is rooted in the principle of *Samskara* (transformation), where external processing enhances therapeutic potential.

2. Types of Putra (Incineration Methods)

Different *Putra* methods were developed to regulate heating intensity:

- **Gaja Putra:** Large-scale calcination using about 1,000 cow dung cakes.
- **Varaha Putra:** Medium intensity heating with 400 cow dung cakes.
- **Kukkut Putra:** Small-scale heating with 50 cow dung cakes.
- **Modern Putra:** Use of muffle furnaces or electrical incinerators replicating classical conditions.

These gradations allowed precise control of temperature and duration, critical for achieving proper incineration without under- or over-processing.

3. Role of Bhavana (Trituration with Herbal Media)

Herbal juices and decoctions used during trituration impart pharmacological properties, reduce particle size, and facilitate complete oxidation or sulfide formation. For example:

- *Lemon juice* is used in *Lauha Bhasma* (iron) preparation.
- *Aloe vera juice* is applied in *Swarna Bhasma* (gold).
- *Arka Ksheera* (calotropis milk) is used in *Tamra Bhasma* (copper).

These organic media act as reducing or stabilizing agents, enhancing assimilation.

4. Pharmaceutical Transformations

Analytical studies reveal that *Marana* produces significant changes:

- Metals convert into oxides, sulfides, or carbonates.
- Particle size reduces to micro- and nano-levels.
- Surface area and solubility increase, improving bioavailability.

For instance, Lauha Bhasma primarily contains Fe₂O₃ and Fe₃O₄ nanoparticles, while Swarna Bhasma has crystalline gold nanoparticles coated with organic residues.

5. Modern Analytical Validation

- **SEM/TEM:** Shows nano- to micro-sized particles.
- **XRD:** Confirms phase transformations (e.g., metallic iron to iron oxide).
- **FTIR:** Detects organic functional groups from herbal media.
- **ICP-MS:** Quantifies elemental composition and safety.

These techniques validate the ancient claims that Marana detoxifies and transforms metals into safe therapeutic forms.

6. Pharmacological and Clinical Studies

Several studies highlight the pharmacological benefits of Bhasmas:

- *Lauha Bhasma:* Effective in anemia management without hepatotoxicity.
- *Swarna Bhasma:* Exhibits immunomodulatory and neuroprotective effects.
- *Rasasindura:* Shows cardioprotective and antioxidant properties.

Clinical trials, though limited, suggest safety and efficacy when formulations are prepared with proper Marana procedures.

7. Challenges and Concerns

Despite evidence, challenges remain:

- Lack of uniform standards for Marana procedures.
- Risk of toxicity with improperly prepared products.
- Limited large-scale clinical trials.

These issues highlight the need for standardized protocols and integration with modern pharmaceuticals.

DISCUSSION

Marana is a unique pharmaceutical innovation of Ayurveda, blending metallurgical knowledge with therapeutic application. Unlike crude metallic intake, which poses toxicity risks, Marana

transforms substances into bio assimilable nano- and micro-forms. This resonates with modern nanotechnology, where particle size and surface modifications alter biological activity^[16].

Scientific studies corroborate classical claims. SEM and XRD analyses confirm structural transformation and particle size reduction, validating the rationale behind repeated incineration. Herbal media used in Bhavana act as reducing, stabilizing, and biocompatibility agents, paralleling modern concepts of green synthesis of nanoparticles. Thus, Marana can be viewed as an early precursor of nanomedicine^[17].

Pharmacological studies further strengthen its significance. For instance, Lauha Bhasma improves hemoglobin levels and iron absorption without the gastrointestinal side effects of conventional iron salts. Swarna Bhasma has demonstrated antioxidant, immunomodulatory, and cognitive-enhancing properties. These findings highlight the therapeutic relevance of Marana-based formulations^[18].

Nonetheless, several gaps persist. Variability in traditional procedures, lack of uniform heating conditions, and poor-quality control result in inconsistent products. Reports of heavy metal toxicity from improperly prepared formulations undermine global trust in Ayurvedic herbo-mineral drugs. Large-scale toxicological studies and randomized controlled clinical trials are urgently required. Furthermore, harmonization of traditional methods with modern Good Manufacturing Practices (GMP) and pharmacopeial standards is necessary for international acceptance^[19].

Looking ahead, Marana offers immense potential in integrative medicine. Its methodologies could inspire new approaches in material science, nanopharmacology, and drug delivery. Future research should focus on mechanistic understanding of chemical transformations, bio-distribution studies, and comparative trials with modern medicines. Bridging tradition with evidence-based science will ensure the sustainable development of Marana pharmaceuticals in the modern era^[20].

CONCLUSION

Marana, the incineration process central to Rasa Shastra, exemplifies the profound pharmaceutical wisdom of Ayurveda. By repeated cycles of incineration and trituration with herbal media, raw metals and minerals are transformed into safe, stable, and bioavailable Bhasmas. This transformation not

only reduces toxicity but also enhances therapeutic potential, making these formulations relevant for chronic and lifestyle-related disorders.

Modern scientific validation has confirmed the classical claims of Marana. Analytical studies reveal significant structural and chemical transformations, including formation of oxides, sulfides, and nanoparticles. Pharmacological research demonstrates therapeutic benefits in anemia, immunomodulation, and chronic disease management. These findings highlight Marana's enduring relevance in integrative medicine.

However, critical challenges remain in standardization, reproducibility, and global acceptance. Instances of toxicity from poorly prepared formulations underscore the importance of adhering to classical protocols and modern regulatory standards. Large-scale toxicological and clinical studies are necessary to fully validate safety and efficacy.

In conclusion, Marana is not a ritualistic practice but a scientifically meaningful pharmaceutical process with immense therapeutic potential. Its integration with modern analytical techniques, quality control measures, and evidence-based clinical validation will strengthen its acceptance globally. Future directions should focus on harmonizing ancient wisdom with cutting-edge research, positioning Marana as a valuable contributor to modern pharmaceuticals and nanomedicine.

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