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UNVEILING BHASMA KALPANA AS ANCIENT NANO- MEDICINE: A REVIEW OF AYURVEDIC HERBO - MINERAL THERAPIES

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ABSTRACT

Ayurveda has wonderful concept of *Bhasma Kalpana* which has intrigued researchers due to its unique and ancient nanotechnological approach to creating herbo-mineral medicines. Bhasmas is one of the herbo-mineral preparations that have been described under Rasashastra in Ayurveda, the ancient science of life. *They* are formulations made from metals and minerals which undergo a series of intricate pharmaceutical processes such as Shodhana (purification), Bhavana levigation, and Marana-calcination. These compounds are known for their complexity. Contemporary analytical methods support the notion that Bhasmas display traits resembling artificial nanoparticles, such as finer particles, larger surface area and crystal structure, and better bioavailability. The pharmacological value of their use in treating chronic diseases like diabetes, arthritis, and cancer is further demonstrated by their usefulness.[3,4] Traditional techniques of Bhasmas, preparation, their physicochemical properties, and how these methods are related to contemporary nanomedicine principles can be examined. This paper focuses on the potential of combining ancient Ayurvedic practices with contemporary nanoscience to develop safe and innovative therapeutic approaches.

KEYWORDS: Examples of these are Bhasma Kalpana, Nano-Medicine, Rasashastra, Ayurveda, and other related fields.

1. INTRODUCTION

The domain of Rasashastra, a branch of Ayurveda, outlines specialized pharmaceutical procedures to detoxify and convert these raw materials into potent, safe, and assimilable products known as Bhasmas.

They are known for their small size, higher potency and bioavailability.[1,3] Significant similarities can be showcased with the development of nanotechnology, between Bhasmas and synthetic nanoparticles.[4,5]

Ayurvedic texts like Rasa Tarangini, *Rasa Ratna Samuchchaya*, and *Ayurveda Prakasha have* detail methods for preparing Swarna (gold), Rajata (silver), Tamra (copper) and other Bhasmas. These are mentioned as therapeutic agents which are capable of penetrating minute channels (*srotas*), acting on cellular and sub-cellular levels — a description remarkably similar to how nanoparticles operate.

With the advancement of nanoscience, researchers have begun comparing these traditional preparations to engineered nanomedicines.

2. HISTORICAL PERSPECTIVE OF BHASMA KALPANA

Bhasma is an ancient concept mentioned in classical Ayurvedic texts like Charak Samhita, Rasratna Samuchchaya. Samhitas have description about purification of Bhasmas like Shodhana, Marana before any therapeutic use, which makes it safe to use. Acharya Nagarjuna, considered the father of Indian alchemy, was one of the earliest proponents of metal-based medicines. He described the effects of particle size, purification process, and the role of *Bhavana* in activating pharmacological potential — concepts now showcase similarity to nanopharmaceutical design.

3. METHODOLOGY OF BHASMA PREPARATION AND ITS NANOTECHNOLOGICAL ASPECTS

3.1 Shodhana (Purification)

Primary step where the base metal/mineral is detoxified using herbal decoctions, cow's urine, lime juice, or milk. From a modern point of view, this step involves reduction of metallic ions into stable compounds, possibly forming early nano-complexes.

3.2 Bhavana (Wet Trituration)

This step involves grinding the purified substance with plant extracts. This process facilitates complexation with phytochemicals like flavonoids, tannins, etc aiding in nanoparticle capping and stabilization.

3.3 Marana (Calcination)

This process involves repeated incineration process using closed earthen crucibles (*Sharava Samputa*) at high temperatures. Calcination helps achieve nano-sized particles, elimination of toxic elements, and transformation into oxide or sulfide forms.

3.4 Amritikarana and Putapaka

These are further refinement steps unique to certain Bhasmas (e.g., Swarna and Tamra) that improve bio-assimilation and reduce residual toxicity, closely resembling post-synthesis surface modification of nanoparticles.

4. MODERN CHARACTERIZATION TECHNIQUES FOR BHASMAS

To validate Bhasma as a nano-medicine, modern characterization tools have been used:

Technique	Purpose
SEM (Scanning Electron Microscopy)	Morphology and size distribution
TEM (Transmission Electron Microscopy)	High-resolution nanoparticle visualization
XRD (X-ray Diffraction)	Crystalline structure analysis
FTIR (Fourier Transform Infrared Spectroscopy)	Functional group identification
ICP-MS (Inductively Coupled Plasma Mass Spectrometry)	Trace metal analysis and toxicity
Zeta Potential	Particle surface charge and colloidal stability

Studies have shown Swarna Bhasma particles in the range of 5–50 nm and Yashada Bhasma in 40–70 nm range. The presence of oxides and organo-metallic complexes in these preparations further supports their safety and efficacy.

5. NANO-MEDICINE VS. BHASMA KALPANA: A COMPARATIVE VIEW

Parameter	Bhasma	Modern Nanomedicine
Size	10–100 nm (avg.)	1–100 nm
Carrier	Natural plant media	Polymers, lipids
Process	Calcination + Biochemical Levigation	Physical or chemical synthesis
Surface Modification	Phytochemicals during Bhavana	PEGylation, ligand binding

Targeting	Passive via *srotas* theory	Active and passive targeting
Toxicity	Minimal if properly prepared	Risk of cytotoxicity if not well-defined

This comparative analysis shows that Bhasma Kalpana is a rudimentary yet effective form of nanotechnology practiced for centuries in India.

6. NANOTECHNOLOGICAL ASPECTS OF BHASMA

Under 100 nm, Bhasmas have been scientifically characterized as nano- crystalline structures.[2] The nanostructure is confirmed by modern means such as SEM, TEM and XRD, thus they are classified under nanomedicine.[7] The use of herbal media in Bhavana facilitates particle stability and surface modification.[3,11]

7. PHARMACOLOGICAL PROPERTIES

Bhasmas such as Swarna, Abhraka, and Tamra have been shown to possess anti-inflammatory, immunomodulatory, effects. Their high surface area and bioavailability enhance the therapeutic effects.[4] However, research has shown that.

8. SAFETY AND STANDARDIZATION

Although Bhasmas made with improperly prepared materials can be toxic, they are safe to use for extended periods of time when using purified process and classical methods.[6,12]

9. COMPARISON WITH MODERN NANOMEDICINE

Nano-sized, high reactivity, and targeted effects are evident in both Bhasmas and modern nanomedicines. Bhasmas are more biocompatible when they are processed with herbal extracts.[3,5,9] Their slow-release and site-specific effects are comparable to modern drug-delivery systems.'".

10. FUTURE PROSPECTS AND RESEARCH DIRECTIONS

- **Clinical Trials:** Large-scale double-blind studies to establish efficacy and safety
- **Nano-formulation Research:** Combining Bhasma with modern nanocarriers for targeted therapy
- **Toxicology Studies:** Chronic and acute toxicity profiling using OECD guidelines
- **Phytochemical Interaction Studies:** Role of Bhavana dravyas in modifying nanoparticle behavior
- **Global Recognition:** Collaborations with international research bodies to standardize and validate Bhasmas

11. CONCLUSION

The use of Bhasma Kalpan demonstrates significant therapeutic potential in traditional nanoscience. New biocompatible nanomedicines could be developed by blending Ayurvedic processing with modern technology.[4,7] Safety profiling, pharmacokinetics, and clinical validation for global acceptance should be the main focus of future research.

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