



ISSN 2456-3110

Vol 5 · Issue 4

July-Aug 2020

Journal of
**Ayurveda and Integrated
Medical Sciences**

www.jaims.in

JAIMS

An International Journal for Researches in Ayurveda and Allied Sciences



Charaka
Publications

Indexed

Concept & utility of Nanotechnology in the standardization of *Rasadravya*

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ABSTRACT

The ancient application of nanomedicine in the form of Ayurvedic *Bhasma* throws a light on the safer usage of present nanomedicine for a living being and the environment. The use of nanoparticulate metals in therapeutics has been a common practice in Ayurveda. All *Bhasma* have some common properties such as *Rasayana* (immunomodulation & anti-aging quality), *Yogavahi* (target drug delivery), *Alpamatra* (prescribed in minute doses), *Shigravyapi* (spreads quickly and fast acting) and *Agnideepana* (increases metabolism at cellular level and acts as catalyst). *Bhasma* can be employed for selective/ targeted/controlled drug delivery as they are biocompatible, nontoxic, and nonantigenic in nature. *Bhasma* is biologically produced nanoparticles with quick and targeted action. E.g Gold nanoparticles in *Swarna Bhasma*. Ayurvedic *Bhasma* is considered very safe and economical in comparison to contemporary metal based nanomedicines. The benefits of nanomedicines are indubitable and unstoppable, nevertheless, and safety- related studies should also be carried out rigorously and planned in order to provide guidelines for safer manufacturing practices, keeping care of ecology, and environment. Hence, Ayurvedic *Bhasma* may hold strong relevance in the emerging era of nanomedicine and can serve as an excellent template for the development of nanomedicine for an efficient therapeutic cure.

Key words: *Nanomedicine, Bhasma, Rasayana, Nontoxic.*

INTRODUCTION

The use of nanoparticulate metals in therapeutics has been a common practice in Ayurveda. The present attempt is to revisit the Ayurvedic *Bhasma* concept as organometallic ethno-nanomedicine in the surging area of nanomedicine.^[1] *Bhasma*, literally meaning ash, is unique Ayurvedic herbo-mineral-metallic

compounds in the size of nanodimensions (usually 5-50nm, as established by modern microscopic techniques). There are the products of classical Indian alchemy, the 'Ayurveda Rasa Shastra,' used for treating diverse chronic ailments.^[2] The essence of metal / mineral based drugs is that they function best when converted from their original metal / mineral state to oxide state. The manufacturing process is very systematic and elaborates, called '*Bhasmikarana*' which converts the metal from its original state to a form with higher oxidation state, and eliminates the toxic nature of metal. During *Bhasmikarana*, metals / minerals are subjected to various processes of *Shodhana* (purification) and incineration before internal administration and converting them in to biocompatible, bio-assimilable, absorbable and suitable form for the human body. All *Bhasma* have some common properties such as *Rasayana* (immunomodulation and anti-aging quality), *Yogavahi* (target drug delivery), *Agnideepana* (increases

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Submission Date: 09/07/2020 Accepted Date: 12/08/2020

Access this article online

Quick Response Code



Website: www.jaims.in

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metabolism at cellular level and acts as catalyst). According to modern point of view Nanotechnology - "Nano", the word 'Nano' is derived from Greek word 'Dwarf' means a "billionth". A nanometer is billionth of a meter or one thousandth of a millimeter (mm) about 1/80,000 of the diameter of a human hair. The term Nanotechnology was coined by Prof. Norio Taniguchi, Tokyo Science University in 1974. Nanotechnology or "nanotech" is the study of the controlling of matter on an atomic and molecular scale. Generally nanotechnology deals with structures sized between 1 to 100 nanometer in at least one dimension, and involve developing materials or devices within that size.^{[3],[4]}

Important of *Bhasma* and Nano Medicine

Bhasmas: *Bhasma* is a Ayurvedic metallic/mineral preparation, treated with herbal juice or decoction and exposed for certain quantum of heat as per *Putra* system of Ayurveda, which itself is well known in Indian subcontinent since 7th century AD and widely recommended for the treatment of many disease conditions.

Properties of *Bhasmas*^[5]

- *Rasayana* - Immunomodulation & Anti aging
- *Yogavahi* - Targeted drug delivery
- *Rasibhava* - Readily absorbable, Adoptable, Assimilable & non-toxic
- *Shegravyapi* - Spreads quickly & fast acting
- *Agnideepana* - *Bhasma* increases metabolism at cellular level & acts as catalyst

Nano Medicine: One of the most interesting capabilities in nanomedicine is the functionalization of NPs. Fictionalization involves altering properties of a nanoparticle through chemical or physical modifications that are applied to achieve a desired effect.^[6] This process can provide local or directed delivery, prolong drug effect and facilitate transport in to target cells. Some other properties are given below.

- Nanoparticles can cross the blood brain barrier; Micro particles can't.

- Cells tend to not recognize, nanoparticles as a threat
- Slip through cell junctions

Types of Nano Particles: (Used in Drug delivery)

- Nan suspensions and nanocrystals, Solid lipid nanoparticles
- Polymeric nanoparticles, Polymeric micelles
- Magnetic Nanoparticles, Carbon Nan tubes, Liposome's, Nan shells, Ceramic Nanoparticles.
- Nano pores, Nano wires, Quantum dots, Ferro fluids

Application of Nanotechnology in the field of Medicine

Nanotechnology, when used with biology or medicine, is referred to as Nan biotechnology or Nanomedicine. Nanotechnology provides the field of medicine with promising hopes for assistance in diagnostic and treatment technologies as well as improving quality of life. Nanomaterials can be applied in nanomedicine for medical purposes in three different areas: diagnosis (nanodiagnosis), controlled drug delivery (nanotherapy) and regenerative medicine. Humans have the potential to live healthier lives in the near future due to the innovations of nanotechnology.

Some of these innovations include

- Better drug delivery system with minimal side effects
- Disease diagnosis
- Prevention and treatment of disease
- Tissue Reconstruction
- Medical Tools

These attributes of *Bhasmas* are comparable with the action of NPs in the body

Nanoparticles (NPs) are biodegradable, Biocompatible, and non-antigenic in nature. NPs in general can be used to provide

selective/Targeted/Controlled delivery of drugs to specific site of action in the body even across the blood brain barrier. *Bhasmas* are the nanocrystalline materials. In terms of nanotechnology, nanocrystalline materials are solids composed of crystallites with size less than 100 nm in at least one dimension, it requires mechanical milling. Ayurvedic concepts of *Mardana* and *Bhavana* to reduce particle size are an ultimate result of these processes.

Detection of Nano particles in *Bhasma*:^[7]

Methodologies used to test NPs are

- Environmental Electron microscopy
- Scanning electron microscopy(SEM)
- Transmission electron microscopy(TEM)
- Confocal laser scanning microscopy
- Flourescence Optical microscopy
- Energy dispersive x-ray analysis(EDAX)

The process of Nanoparticle testing in Ayurvedic Products involves five steps:

- 1) One needs to establish the presence of Nano particles in the test sample.
- 2) The second factor is the chemical composition, and the task is to ascertain whether the composition is homogeneous.
- 3) The third test is on the state of the nanoparticles, as to whether they are crystalline or amorphous and the nature of defects in the sample.
- 4) The sample has to be biologically tested to check their bioactivity.
- 5) Finally the convergence of all these factors in the mechanism of action for a particular application needs to be tested as well.

Synthesis of Nano-materials

Synthesis of nanoparticles to have a better control over particles size distribution, morphology, purity, quantity and quality.^[8]

Traditional vs. Modern methodology

Traditional (Ayurvedic)	Modern (Biosynthetic)
<ul style="list-style-type: none"> ▪ “Top-Down”: Size reduction from bulk materials. ▪ “Top-Down” routes are included in the typical solid-state processing of the materials. This route is based with the buik material and makes it smaller, thus breaking up larger particles by the use of physical processes like crushing, milling or grinding. ▪ Usually this route is not suitable for preparing uniformly shaped materials, and it is very difficult to realize very small particles even with high energy consumption. ▪ The biggest problem with top-down approach is the imperfection of the surface structure. ▪ Very elaborate and time Consuming. Efficacy is proven. 	<ul style="list-style-type: none"> ▪ “Bottom-Up”: Material synthesis from atomic level. ▪ “Bottom-Up” approach refers to the build-up of a material from the bottom: atom-by-atom, molecule-by-molecule or cluster-by-cluster. ▪ This route is more often used for preparing most of the nano-scale materials with the ability to generate a uniform size, shape and distribution. ▪ Main use in electronic and Biotechnological applications. ▪ Used in medicine Medicinal use as diagnostic /therapeutics.

Standardization

In terms of particle size, Nanoparticles will aid in determining standardization. Apart from *Bhasma Siddhi Lakshanas*, presence of nanoparticles in the *Bhasma* has to be tested and parameter has to be fixed in order to standardize the *Bhasma* in terms of nanoparticles. Each *Bhasma* has to be placed in a particular nanometer range. E.g. *Swarna Bhasma* and Gold nanoparticles.^[9]

- Gold in traditional Indian Ayurvedic medicine as *Swarna Bhasmas* (gold ash) has been characterized as globular particles of gold with average size between 56 to 57 nanometre (nm).

Also, *Swarna Bhasma* and gold nanoparticles (NPs) prepared by modern method are quite comparable with respect to transmission electronic microscopy (TEM).

DISCUSSION

Nanotechnology is the science of functional systems at the molecular scale. This covers both current work and concepts that are more advanced. Nanotechnology refers to the projected ability to construct items from the bottom up, using techniques and tools being developed today to make complete, high performance products. Nanotechnology is already broadening the medical tools, knowledge, and therapies currently available to clinicians. Nanomedicine, the application of nanotechnology in medicine, draws on the natural scale of biological phenomena to produce precise solutions for disease prevention, diagnosis and treatment. Nanotechnology researchers are working on a number of different therapeutics where a nano particle can encapsulate or otherwise help to deliver medication directly to cancer cells and minimize the risk of damage to healthy tissue. This has the potential to change the way doctors treat cancer and dramatically reduce the toxic effects of chemotherapy. Research in the use of nanotechnology for regenerative medicine spans several application areas, including bone and neural tissue engineering. For instance, novel materials can be engineered to mimic the crystal mineral structure of human bone or used as a restorative resin for dental applications. Nanomedicine researchers are looking at ways that nanotechnology can improve vaccines, including vaccine delivery without the use of needles. Animal derivatives such as horns, shells, feathers, metallic and nonmetallic minerals are normally administered as *Bhasma*.

CONCLUSION

Nanotechnology is truly a new revolutionary technology, having its application in various fields. Nanotechnology provides the field of medicine with promising hopes for assistance in diagnostic and treatment technologies as well as improving quality of life. *Bhasmas* are the best examples for Nanotechnology in Ayurveda, as these are comparable with the action of Nanoparticles. Traditional method of Ayurvedic *Bhasma* preparation involves “top down” approach of Nanoparticle synthesis. Standardization of *Bhasmas* has to be done on the basis of Particle size using Nanotechnology.

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How to cite this article: Dr. Pallabi Mahanta, Dr. Suvarna P. Nidagundi, Dr. M. V. Sobagin. Concept & utility of Nanotechnology in the standardization of Rasadravya. *J Ayurveda Integr Med Sci* 2020;4:235-238.

Source of Support: Nil, **Conflict of Interest:** None declared.