WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.084
Volume 9, Issue 8, 953-958. Review Article ISSN 2277– 7105

NANOTECHNOLOGY IN AYURVEDIC MEDICINE W.S.R. TO CLASSICAL BHASMA

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Article Received on
05 June 2020,

Revised on 25 June 2020,
Accepted on 15 July 2020,

DOI: 10.20959/wjpr20208-18204

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ABSTRACT

Metals are used as medicine in Ayurveda since *Samhita* period in the fine powder form named as *'Ayaskriti'*. With the development of *marana* technique the metals and minerals are converted into very fine and absorbable form of medicines known as *bhasma*. The process of *Bhasmikaran* helps converting the metal at zero valent state to a higher oxidation state and the toxic effects of the metals are not only nullified but are transformed into biologically active nanoparticles. Nanotechnology is the newly emerging science in the medical field. Nanoscale objects have at least one dimension that measures between 1 and 999 nanometers. Nano drug delivery systems can reduce the drug consumption and side-effects by lowering the deposition of the active agent in the non targeted sites. This review gives compiled discussion of classical *Bhasma* and Nanotechnology.

KEYWORDS: *Bhasma, Ayaskriti, marana, Bhasmikaran,* Nanotechnology.

INTRODUCTION

Metals are used as medicine in Ayurveda since *Samhita* period in the fine powder form named as *'Ayaskriti'*. The use of *Ayaskriti* for internal use was limited as its fineness was not suitable enough to make it free from toxic effects. With the development of *Rasashastra*, many new pharmaceutical techniques like *shodhan*, *jarana* and *marana* were evolved by which metals and minerals could get converted into very fine, absorbable, therapeutically most effective and least or non toxic form of medicines known as *bhasmas*.[1] The main

concept of *Rasashastra* lies in the transformation of base lower metals into noble higher metals and to use them for strengthening the body tissues and to maintain them as fresh.[2] *Bhasma* literally meaning ash is a mineral preparation that is made from precious metals and their naturally occurring salts.[3] *Bhasmikarana* is a systematic and step-wise procedure that involves purification followed by repeated, controlled and prolonged heating of metals/minerals with suitable ingredients (of organic liquid media).[4] In *Bhasmikarana,* metals are processed with herbs, and organo-metallic/organo-mineral complexes are formed (having improved stability and functionality), that help in assimilation and selective/targeted/controlled drug delivery into the human body.[4]

BHASMA PARIKSHA

The good quality of *Bhasma* is assessed by tests like *Visishta Varnotpatti*(Specific colour), *Rekhapurnatva/Mrutaloha* (Fineness to enter finger ridges), *Varitaratva* (Lightness to float in water), *Unam* (*Dhaanya* floats over *varitara* bhasma), *Gatarasatva* (Tasteless), *Nischandratva* (Lustreless), *Anjanabhatva* (Smoothness), *Apunarbhavatva* (Permanence), *Niruthatva* (Irreversibility).[3][5][6][7]

ADVANTAGES OF *BHASMA*

- ✓ Potent in small dose
- ✓ Does not have any specific taste
- ✓ They can act quickly
- ✓ Available as very fine particles (nano size)
- ✓ Have good stability as compared to other dosage forms.[2]

COMMON PROPERTIES OF *BHASMA*

All *Bhasma* have some common properties such as *Rasayana* (immunomodulation and anti-aging quality), *Yogavahi* (target drug delivery), *Alpamatra* (prescribed in minute doses), *Rasibhava* (readily absorbable, adaptable, assimilable, and nontoxic), *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.[8]

NANOTECHNOLOGY

Nanotechnology is the study of extremely small structures. The prefix “nano” is a Greek word which means “dwarf”. The word “nano” means very small or miniature size.

Nanotechnology deals with materials in the size of 0.1 to 100 nm.[9] The Nanoscale is the place where the properties of most common things are determined just above the scale of an atom. Nanoscale objects have at least one dimension that measures between 1 and 999 nanometers.[9] When the dimension of any type of material is reduced below approximately 100 nm its mechanical, thermal, optical, magnetic and other properties change at some size. Thus within the same material one can get different properties. As the size of sphere changes from 1m to 1nm the surface area to volume ratio increases by a factor of 10^{-9} which will again act as a key for catalyzing the medicine.[2][1] The two major approaches to get nano materials are –

- bottom up
- top down

Bottom up produce components which are made of single molecules, and covalent forces hold them together that are far stronger than the forces that hold together macro-scale components. Enormous amount of information could be stored in devices built from the bottom up. Top manufacturing involves the construction of parts through methods such as cutting, carving and molding and due to limitations in these processes highly advanced nano devices are yet to be manufactured.[9]

The development of nanotechnology is made possible through the marked development in analysis techniques with the help of specialized microscopes like Scanning Electron Microscope (SEM), Atomic Force Microscope (AFM),Transmission Electron Microscope (TEM), Cryo TEM, Fast-freeze fracture, Fluorescence optical Microscopy, Quasi-elastic light scattering, Energy dispersive X-ray Analysis (EDAX), Inductively Coupled Plasma (ICP), Atomic absorption Spectroscopy (AAS), X-ray induced photoelectron spectroscopy (XPS), etc.[10][11]

APPLICATIONS OF NANOTECHNOLOGY

The different fields that find potential applications of nanotechnology are – Health and medicine, Electronics, Transportation, Energy and environment and Space exploration.[9]

In Health and medicine, nano drug delivery systems can reduce the drug consumption and side-effects by lowering the deposition of the active agent in the non targeted sites. By interacting with biological molecules at nano scale, nanotechnology broadens the field of research and application. Interactions of nano devices with bio molecules can be understood

both in extracellular medium and inside the human cells.[9] These nanoparticles are having diagnostic and therapeutic application in Cancer.[1] It also have important role in tuberculosis treatment, operative dentistry, ophthalmology, surgery, tissue engineering, antibiotic resistance, immune response and nano pharmaceuticals. For the delivery of CNS therapeutics, various nano carriers such as dendrimers, nano gels, nano emulsions, liposomes, polymeric nano particles, solid lipid nano particles and nano suspensions have been studied.[9]

CLASSICAL *BHASMA* AND NANOTECHNOLOGY CORRELATION

Bhasmas are obtained by repeated calcinations and incineration of liquid products by special process. During incineration metals are converted into its mixed oxides. Zero valiant metal state is converted to metal oxides of higher oxidation state, by this *Bhasmikarana* process. Toxic nature of the resulting metal oxide is completely destroyed while medicinal properties are introduced in this process.[2] Since *Bhasmas* are nanoparticles, they have large surface area, smaller size and uniform shape. So their internalization to the cell and consequent effects is occurring quickly. Thus the pharmacological efficiency of *bhasma* lies in the reduced particle size which is achieved by increasing the number of *puta* process (incineration).[2] The increase in the surface area to volume ratio increases the dominance of quantum effects and increases the dominance of the surface of a particle over that of those of interior. Thus high surface area is the key for catalyzing the medicine.[1]

Swarna bhasma and gold nanoparticles prepared by modern method are quite comparable with respect to TEM analysis. A further study has shown *Swarna bhasma* principally constituted of globular gold particle of 56-57 nm and devoid of any other heavy metal or organic material by its screening through AAS and Infrared Spectroscopy (IS). Nanosized gold particles (27±3nm) have been proven to be effective in ameliorating symptoms of mycobacterial, collagen and pristine-induced arthritis models. It put to rest, the concerns about presence of heavy metals in Ayurvedic preparations, which otherwise clouds popular use of Ayurvedic medicines abroad.[10] Observations of few tests like *Rekhapurnatva,Varitaratva* for the engineered nanoparticles of ZnO, and TiO_2 indicated that the engineered nanoparticles yielded similar results like *Bhasma* (unpublished data).[3] *Bhasma* in accordance of classical expectation having nanometer dimension are *Muktashukti bhasma, Abhrak bhasma, Tamra bhasma, Louha bhasma, Yashad bhasma, Vanga bhasma, Swarna makshik bhasma*.[1][4][8] The elements like Gold, Silver, Copper have been engineered into nanoparticles.[12][13][14][15]

DISCUSSION

Bhasmikarana converts a compound into ashes. It is distinct from the approaches used for manufacturing engineered nanoparticles. It is an elaborate process, which converts the metal into its specifically desired chemical compound eliminating the toxicity of the metal, making it compatible for human medicinal purpose.[3] The process is also aimed to reduce the particle size and thus converting metals to *bhasma* nanoparticles, which are biocompatible, bio-assimilable, absorbable and suitable form for the human body.[4]

It has been reported that manufacturing methods of *bhasma* are in tune with nanotechnology of modern era and *Bhasmas* are nearer to the nano crystalline materials, similar in physico-chemical properties except that *Bhasma* is prepared in the presence of various plant products like juices, concoctions, etc. A majority of biomolecules have electrostatic charge due to the presence of acidic and basic function group. The engineered nanoparticles are found to be highly reactive due to the free electrons present on their surface, hence these can be very sensitive to the environmental factors such as pH, temperature, electrolytes, and solvent, and have tendency to aggregate. The use of plant extracts may provide capping of reactive nanoparticles and thus make *bhasma* biocompatible, safe, and effective when manufacturing norms are properly followed.[3][1][16]

It is also noteworthy that Ayurvedic *Bhasma* is considered very safe and economical in comparison to contemporary metal based nano medicines.[8] Ayurvedic pharmaceutics are receiving a new thrust through a reappraisal of *bhasma* preparations as novel nanotechnological applications.[10] The method of manufacturing of *bhasma* can be modified or improved for better quality and nano property. Official guidelines have to be set regarding: standardization, toxicity, and safety studies, mass productive issues, labeling rules, clinical studies and others.[17]

CONCLUSION

All the engineered nanoparticles are not meant for human use the way *bhasma* preparations were meant. *Bhasma* are biologically produced nanoparticles with quick and targeted action. The benefits of nano medicines 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.

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