BHASMA AND NANO MEDICINE

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ABSTRACT

The Metals and Minerals are heavy, nonabsorbable and toxic substances. Metals are used as medicines in Ayurveda since from Samhita period in the fine powder form named as 'Ayaskriti'¹. Latter with the development of 'Marana' technique (7th Cent AD) the Metals and Minerals are converted in to very very fine and absorbable, therapeutically most effective and least or Nontoxic form of Medicines known as 'Bhasma'². According to Ayurvedic concept the change in the qualities is due to 'Samskara' done through Shodhana, Bhavana, Putapaka procedures by which particle size of Metals and Minerals are reduced to finer and finer form of Bhasma.

The Bhasma particles when analyzed microscopically through SEM and TEM fall under the range of Nanoparticles of contemporary science.

Nano technology based on Nano science is the technology of 21st century due to its wide range of application in Medicines, Automobiles, Computers, Clothes, communications, cosmetics, sports goods etc. In nano science the materials of very small dimension in the range of 1 to 100nm are studied. When atleast one of the dimensions of any type of materials is reduced below 100nm it's mechanical, thermal, optical, magnetic and other properties change at some size characteristic of that material.

In this paper I have explained basic principle of change of properties of substances at their Nano level. The Mukta shukti bhasma & Swarna Bhasma when analysed through SEM they are in Nano particle size. Thus bhasma can be considered as Nano Medicine of Ayurveda. It is an attempt to understand and apply basics of Nanotechnology in Ayurvedic Pharmaceutics.

Keywords; Bhasma, Marana, Particle size, Nanotechnology, Nanomedicine.

INTRODUCTION

The metals are used in Samhita period (600to1000 BC) in the form of fine powder named as Ayaskrati. The use of Ayaskrati for internal use was limited as its fineness was not suitable enough to make it free from toxic effects.

The development of Rasashastra (7th century AD) has revauioutionised Ayurvedic system of medicine. Many new pharmaceutical techniques are developed like Shodana, jarana & marana by which metals& minerals are converted in to very very fine, absorbable, therapeutically most effective& least or non toxic form of medicines Known as Bhasmas.

Bhasma are defined as powder form of a substance obtained by Calcination⁵.

What is the Importance of Bhasma?

Bhasma: Potent in small dose, without specific taste and quick acting

How Bhasma can have all the above properties? It all depends upon the technique of Bhasmikarana. The minerals and metals in their grass form are not at all useful as medicine, but when their form changes from macro to microscopic form (Bhasma) they will exhibit wide range of therapeutic properties.

If we observe the different stages in the preparation of Bhasma it can be noted that at every stage effort is made to bring down the particle size finer and finer.

Stages of Marana

I) Addition of Maraka gana Drugs

II) Bhavana

III) Putapaka

Addition of Marana Drugs

The quality of Bhasma is categorized as³,

- Shresta Bhasma (Best Quality Bhasma) – Marana done by Rasa and Rasa Bhasma like hingula, kajjali and rasa

sindhora. These are considered best, because here Maraka gana drugs greatly help in the disintegration of metal and mineral particles quickly as Mercury is supposed to make amalgamation with any metal and disintegrate or disperse their particles to finest subdivisions.

- Madhyama Bhasma – Marana done with Herbal drugs of acidic and basic nature.
- Kanishta Bhasma- Marana done with Gandhaka and its compounds like haratala, manashila etc.
- Durguna Bhasma- Marana done by arilohas.

Bhavana

It helps to make the Metal and Mineral particles to become more and more fine and change into organo metallic compounds.

Putapaka

Application of specific quantity of heat for repeated times also makes the Metals and Minerals more and more brittle, so that they are disintegrating into finer and finer particles.

Bhasma Pariksha

In the Rasashastra the assessment of good quality Bhasma is told by following tests⁴.

- Varitara
- Rekhapurnatwa
- Lochanaanjana Sannibha
- Apunarbhava

By the above explanation it becomes clear that reduction of the particle size is given importance in the preparation as well as assessment of good quality Bhasma. In the context of Mrataloha, it is said that the Bhasma after administration should attain 'Rasibhava State' in the body. I.e. it should attain such a fine microscopic form that it should be absorbed in the body at cellular level to show therapeutic effectiveness in different diseases.

The change in the qualities of metals and minerals, when they are converted into Bhasma form can also be analyzed in terms of Samskara (Samskaro hi Gunantaradanam).

Nanotechnology

Nanotechnology based on Nanoscience is the technology of 21st century; the terms Nanotechnology & Nanoscience are often used synonymously. The literal meaning of 'nano' is 'dwarf' or an abnormally short person. However in scientific language it is a billionth (10^{-9}) part of some unit scale, example nano meter or nano second means 10^{-9} meters or 10^{-9} seconds respectively. i.e. in one meter making 1000,000,000 parts and picking up one part is one nano meter. Nano particles are 1 crore times smaller than a hair. Further nano particles can be made understood by comparison of different objects as in the **Table 1**.

In 1875 Michael Faraday synthesized stable gold colloidal particles of nano size (magenta red colour solution) is the milestone in nano science.

Nano Technology is thus the technology of materials dealing with very small dimension materials usually in the range of 1-100nm¹⁰. When at least one of the dimensions of any type of material is reduced below ≈ 100 nm, its mechanical, thermal, optical, magnetic and other properties change at some size characteristic of that material. Thus within the same material one can get a range of properties.

Example: Consider Cds semiconductor whose Normal Color is Red. Through the below chart we can observe that as size of Cds changes to different nano levels, the color also changes accordingly¹¹. We can see the details in **Table 2**.

Also the Melting Point decreases as the particle size decreases.

Why Nano particles are special? Why are the properties different? We can see the specialty in **Figure 1**. By reducing the size of the sphere from 1m to 1nm, the surface area to volume ratio increases by a factor of 10^9 . Also in **Figure 2** we can understand the size and property relationship of nano particles. 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.

Therefore by changing the particle size of a material one can achieve a range of properties which are used in the different fields.

The development of nano technology is made possible through the marked development in analysis techniques with the help of specialized microscopes like⁶

- Transmission Electron Microscope (TEM)
- Scanning Tunnelling Microscope (STM)
- Atomic Force Microscope (AFM)

Nanobiology

The key molecules in biology such as DNA, Enzymes, Receptors, Antigens, Antibodies and O₂ carriers can be included in the dimension of nanometers. Thus it is clear that all fundamental process in biology is taking place in the dimension of 1-100nm. To understand this fundamental life process 'Bio-Nanohybrid' Systems are fabricated. This can be done by two ways.

Nano particles have either a positive or a negative charge on their surface depending on the synthetic methodology adopted for their preparation.

A majority of biomolecules have electrostatic charge due to the presence of acidic and basic function group. Thus

electrostatic self assembly of biomolecules around the nanoparticle can be used to fabricate Nano-biohybrid system. Another protocol used for the fabrication of assemblies is the immobilization of biomolecules above the surface of inorganic nano particles by using covalent bonding with the aid of an anchor molecule⁷. (**Figure 3**)

Biological functions take place in nanometer sized objects. Therefore inorganic nanoparticles can be integrated in to biological molecules such that one can understand, control and manipulate biological process.

Uses

- Molecular Detection
- Targeted Drug Dilevery
- Biological imaging

Nanomedicines

As Drug Carriers

Nano materials are finding there way in the form of drug carriers because of large surface area of materials and small size by which easily transported in to cells and nuclei and specificity to the target can be achieved as desired. This is achieved by 3 ways i.e. 1) Nanospheres 2) Nano capsules 3) Nano pores⁸ (**Figure 4**).

Drugs can be encapsulated in Nanocapsules and targeted towards desired parts of a body. Drug can then be fast or slowly delivered, as desired, by opening the capsule using some external stimulus like magnetic field or infrared light or under some physiological conditions. The action of the nano particle drug system can be seen in the following forms.

Nano Particle - Drug Systems⁹: Oral Administration, Nasal Administration and Occular Administration

Diagnostic Applications

Gold nanoparticles, quantum dots, magnetic nano particles are used to detect the early stage of cancer. These nanoparticles are bounded to biomarkers and research attempts are made to read the state of biomarkers of different types of cancers. The use of nanosystems for reading the state of biomarkers becomes important because of the high surface area offered by the nano particle surface.

To Image certain parts of body like in dentistry, bones etc, nanophaspsers are being used. Some nanotechnology based tests are being developed which appear to extremely simple, specific and fast in detection of viruses, E coli, DNA proteins antibodies etc.

Therapeutic applications

A great revolution is taking place also in biotechnology and medical field due to Nanotechnology. Initial test of various drug delivery systems, cancer or tumor therapies or detection have been successful in using nanotechnology. Nanoparticles, as they are very small, are easy to inject and targeted towards specific portion in a body. In recent years gold nanorods which have strong scattering and absorption property in the infrared are used successfully to detect and destroy cancer cells without affecting the healthy cells. This is possible because healthy cells required twice the laser power as compared cancer cells destruction. It is quite important as it would avoid killing of healthy cells unlike in chemotherapy. Thus by using low power for imaging and destroying cancer cells no side effects due to destruction of healthy tissues can occur. This is key concept in curing cancer by nanoparticles.

Table 1

Objects	Dimension
10 Hydrogen atoms placed in one line touching each other	1 nm
Cadmium Sulphide nano particles	1-10 nm
Virus	20-250 nm
Height of a Man	1.65 m (1.65 x 10 ⁹ nm)
Height of Himalaya Mountain	8,848 m (8,848 x 10 ⁹ nm)
Diameter of the Earth	1,28,000 km (1,28,000 x 10 ¹² nm)
Diameter of the Sun	13,93,000km (1.65 x 10 ¹² nm)

Table 2

Size	Color
10nm	Red
4nm	Orange
3nm	Yellow
2nm	White

Figure 1.
Surface Area to Volume Ratio Figure 2
Surface atoms to inner atoms RatioSurface atoms / Inner atoms

Figure 3.
Covalent Bonding

Figure 4.
Nanoparticles Vs Drugs

Figure 5.

Applications of Nanotech in Medical field

Figure 6.

SEM Image of Muktha sukthi bhasma

Graph 1.

Raw Muktha sukthi Particle size

Graph 2.

Muktha sukthi bhasma Particle size

There is considerable nano technology based research going on to help diabetic and HIV affected patients. Scientists are working to develop better body implants than available. So far by using nanotechnology. We can see the applications of Nanotech in Medical field in **Figure 5**.

Particle Size Analysis of Different Bhasmas

Swarna Bhasma (Gold ash) particles when evaluated through various tools and techniques like AFM (Atomic Forced Microscope), TEM (transmission Electron Microscope), SEM- EDS (Scanning Electron microscope and Energy Dispersive Spectroscopy) it was find that the size of particle are about **56 nm**¹²

There is marked reduction in the particle size of Raw drug mukta shukti to mukta shukti bhasma.(See **Graph 1** and **Graph 2**)

Bhasma in accordance of classical expectation are Mukdashukti bhasma (**Figure 6**), Abhrak bhasma, Tamra bhasma and Louha bhasma. X-ray diffraction, TEM and particle size analysis revealed that these bhasma are in nanometer dimension.

‘By these studies we can consider bhasma as nanomedicine and are free from toxicity in therapeutic doses’.

CONCLUSION

The Nano is the newly used word but in Ayurveda in the form of Bhasma, the Nano particle of metals& minerals are being used as an effective medicine. It is the need of the moment for Ayurveda to conduct the researches to extend the use of our Nano medicines (BHASMA) in various aspects like detection& diagnosis of the diseases to make them more effective in serving the society.

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