

Rasibhavanti Lohani Mritani Survandite Verse Resembles As Nanotechnology- A Critical Study

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Abstract: Ayurveda, one of the ancient systems of medicine, holds a vast domain of traditional knowledge within himself. It is considered as the science of life and has been practiced in India since times immemorial. The system frequently employs unique metallic preparations known as Bhasma for the treatment of various ailments. The essence of these metals based drugs is that they function best when converted from their original metals to metal oxide forms. A very systematic and elaborate step-wise procedure known as 'Bhasmikarana' converts the metal from its zero valent state to a form with higher oxidation state, which is crucial from the point of view that during this process the toxic nature of the metal and its oxide is fully destroyed while rendering the metal oxide with high medicinal value. The mentioned Verse is in the text like Rasendra mangal, Rasarnava, Ras Ratna Samuchchaya, Ras Ratnakar, The verse signifies that the absorption & assimilation of different types of Bhasma of minerals / metals / sub metals & Sindoor kalpana for internal administration in human body. Reduction in the particle size is the motto of using in the form of Bhasma or Nano medicine. The finer the particle size of bhasma allows better rate of assimilation and absorption. This is an critical attempt to understand and apply the basis of Ayurvedic concept of Bhasma and the concept of Nanotechnology.

Keywords: Rasibhavan, Bhasma, Sindoor kalpana, Nano technology.

I. Introduction

Ayurveda has its existence from prevedic period. A review of available literature indicates that this system of medicine might have been in vogue even prior to Vedas as we find references to various disease¹ and uses of herbs² for medicinal purposes even before the period. Rasa chikitsa was considered to be the most effective and time saving therapy³. The preparation used under Rasa chikitsa being palatable, were preferred over other formulations for oral administration. Further this preparation have the advantage of being effective in smaller dose in compare to the herbal formulations⁴. In Rasa shastra the metals and minerals are also termed as Dhatus and Updhatus because of their specific role in biological system that is this can sustain body tissue by supplementing some of the essential elements to the tissues, whose deficiency causes many disease in the body. These are palatable, were preferred over other formulations for oral administration. i.e. bhasmas have superior level of efficacy in comparison to other Ayurvedic dosage forms. Thus it can be said that on account of the above mentioned qualities and properties, the use of drugs of metal and minerals origin has become more frequent than the use of drug of herbal origin. However in Ayurveda, Bhasma of different metals are in wide clinical uses⁵. In ancient text Rasibhavan means the perfect bhasma form of metal /minerals must passed through the receptor during mode of administration in order to facilitate the pharmacological action of the same drug in human body. The literal meaning of nano is a billion (10^{-9}) part of some units scale.

II. Material And Methods-

However to prepare a perfect bhasma the metal / sub metal /minerals undergone processes which are defined as below -

Shodhana

Historically the Shodhana concept was in existence at the time of Charaka samhita as Shauch⁶, it is described one of the fundamental considered necessary for the Gudantaradhaana (alteration or addition of

properties in the drugs). This concept was further developed after the development of Rasa (Metals and Minerals) therapy in the field of Ayurveda medicine, i.e. from 8th century A. D. and onwards.

The concept of using nanometal particle is prevailing since Charaka samhita. For a metallic preparation of Lauhadi Rasayana, iron is used to heat up until red hot and quenched in some liquid media immediately until flakes of iron become in fine powder form & in Sushruta Ayaskriti kalpana also.

The Shodhana treatment also helps in impregnation of some organic material in the inorganic drugs for making the drugs as organo-metallic compounds¹⁰ and to make it more acceptable to the body. Pharmaceutically, Shodhna also helps conversion of material in a state suitable for the further pharmaceutical processing like Marana, Amritikarana⁷ etc. The types of the process of Shodhana may be selective depending on the nature of raw material. Some special techniques are described below.

Changes during Shodhana

Tension is increased in material by the application of heat, causing linear expansion. After heating immediate cooling in liquid media leads to decrease in tension & increase in compression force. Repetition in heating & cooling causes disruption in compression tension equilibrium, leads to increase brittleness, reduction in hardness, gradually by heating treatment (puta) reduction in particle size can be obtained finally⁸.

Technique of Shodhana -

a) **Achushana (Absorption)**- Oily content of certain toxic material is minimized through different absorption means.e.g. Bhallataka shodhana.

b) **Abhisheka(Sprinkling)**- The material is heated strongly and liquid media is sprinkled on it. E.g. Mandoora shodhana.

c) **Swedana (Boiling under liquid bath)**:-In this type, the drug which is indicated for swedana is kept in between pottali and liquid media in a dolayantra& heat is applied for given amount of time.

d) **Mardana**:- The impure drug is triturated or rubbed in a stone mortar and pestle for a particular time by the help of swarasa, decoction or any liquid media.

e) **Patana(sublimation)**:-In this type, the drug especially parada is triturated with the mercurial drugs given in the recepies. And then urdhava, adhaha and tiryakapatana are done through the particular apparatus.

f) **Dhalana (Melting and Quenching)**:-^(R.R.S.8/43)The solid drug is 1st liquefied by giving heat & then it is poured into another liquid media.

g) **Avapa** :-First the solid drug is liquefied in a pot and prakshepa drugs are slowly added into it and stirred.

h) **Nirvapa(Heating and quenching)** :-Very solid drugs as dhatu, ratnas, uparatnas etc. 1st are heated to red hot, then heated drug is dipped into the juice or decoction of herbal drugs. This is done repeatedly so that slowly that solid drug gets dissociated, malleable and then can be triturated easily.

i) **Suryatapana** :-the drugs are dipped in the juices or decoctions & are kept in sunlight.viz. shilajeetshodhana.

j) **Pralepa** :-1st fine metal sheets are prepared. Then the drugs by which pralepana has to be done are triturated to paste like is prepared and it is applied over the metal sheet, dried and puta is given.

k) **Shoshana** :-the drug is kept in the pan & heat is given to the pan. So that the watery portion gets evaporated. Now days dessicator, hot air oven are used for this process.

l) **Bharjana (torrification)** :-the drugs are fried with an open iron fry method.

m) **Prakshalana(Washing)** :-in this type the drugs are kept in hot water for some time and washed thoroughly.

n) **Nirmajjana(Dipping)**- The material is kept immersed in the prescribed liquid for specific period.e.g. Vatsnabha shodhana

o) **Nirjalikarana(Evaporation of water)**- Whole water content of the material is evaporated by heating. e.g. Tankan shodhana

p) **Galana (Melting and Straining)**- The solid material first by heating and filtered through cloth. e.g. Gandhak shodhana

q) **Parishravana(Straining)**- The solid material dissolved in suitable liquid media and separated from insoluble impurities through straining. e.g. Navsadar shodhana.

r) **Prithakkarana(separation)** – Physical impurities are removed manually. E.g. Guggllu shodhana

s) **Vilayana(Elutriation)**- The material is firstly dissolved in prescribed liquid media and left as such for some time then the upper part of the liquid containing the soluble drug material is decanted into another pot leaving behind the impurities in the bottom of first pot. E.g. Shilajatu shodhana.

JARANA (An Intermediary process)-

Jarana is an intermediary process which is adopted as a preparatory stage of Marana of Putilohas in which some suitable media is burnt along with the molten metals and get these exhausted, finally converting the same into powder form.Putiloha can not be directly subjected to Puta in their metallic form due to their very low melting point i.e. 325^oc and 232^oc of Naga and Vanga respectively. Eventhough if they will be subjected to Puta

directly in metallic form the free metals melts and collects together in the centre of the saucer but does not transform into Bhasma properly.

Hence in the case of Putiloha, this type of drawback is corrected by the use of Jarana process. The purified metal is to be heated in the open fry pan melting it by using like Apamarga panchanga, Gandhaka, Asvattha Twak Churna, Chinchu Twak Churna, and Kshara etc. are to be added repeatedly in the small pinches followed by stirring with Lauha Darvi or any herbal stem. This process is to be continued until the whole molten metal is converted into powder form. In this way, the desired media like Apamargapanchanga, Kshara etc. are getting exhausted in the metal and metal is reduced to ash form. For a particular Putiloha, this Jarana process is termed as Naga Jarana, Vanga Jarana etc. Hence, Jarana is important process before Putiloha Marana. It is the intermediary process between the Shodhana and Marana.

Importance Of Jarana:-

In short, the importances of Jarana are as follows:

- i) To obtain powder form of Putiloha. This is more Agnisthayi form (stable in heat) of a metal.
- ii) A suitable form for the further processing.
- iii) Less chance of regaining the original metallic form.
- iv) Few of the Jarana processes are adopted as complete Marana process and derived Bhasma by Jarana can be prescribed for therapeutic purpose also. Viz. swarnamakshik.

Marana

It is next step in conversion of metal / mineral in the fine ash (Bhasma) form, suitable for systemic absorption in human body. To achieve this, the drug of metal and mineral origin is the first added with some marana drugs and then it is subjected to bhavana and then to heating through a fixed heating pattern known as putpaka⁹. This total procedure several times till the metals / mineral attains the quality of Bhasma.

Different types of putas are developed for the heat treatment of different metal and mineral drugs. Puta are selected on the basis of heat tolerance capacity of particular metal and mineral. Selection of suitable puta for conversion of metal and mineral into ash form is desirable for better results. These putas having variable dimension are able to provide different grade of temperature to the material which is under the process of putpaka. For most of the putas cow dung is used as fuel.

Bhasma Pariksha^{10,11}

Physical characteristics:-

- i. Colour (Varna): Every bhasma has specific colour according to their parent substance and in general mostly bhasmas are red, white or pale in colour even after that specific colour of each bhasma has mentioned in our text.
- ii. Lusterless (Nishchandratvam): When bhasma is observed under fresh sun light and if luster is present in bhasma than it indicates for further marana process, because bhasma must be lustreless for therapeutic aspect.
- iii. Lightness and Fineness (Varitara & Unnama): Bhasma floats on stagnant water surface. This test is based on law of surface tension. Properly incinerated Bhasma need to float on water surface & it is also mentioned that bhasma is so fine that it could not split the surface tension of water by putting a single rice over it.
- iv. Lochananjana sannibhama (Tactile sensation): This also indicates the fineness of bhasma. In which some portion of bhasma is used in the eyes as Anjana, if any irritation is felt in the eyes the bhasma should be subjected to more putas. Tactile sensation can be absorbed and assimilated in the body without producing any irritation to mucous membrane of gastrointestinal tract. (JSIR – Journal of scientific & industrial research)
- v. Particle size: Prepared Bhasma should be in powder form. Particle of Bhasma should be like pollen grain of ketaki rajah.
- vi. Rekhapurnatvam: It again indicates the fineness of bhasma, when the particle size of bhasma attains such state that they could enter the furrows of finger, it is presumed that may also be absorbed in GIT system.

Chemical characteristics

- i. Apunarbhava: It means incapability to regain original metallic form. For this test, Bhasma is mixed with equal quantity of mitra panchaka dravyas, this can help to reduce the size of particle then sealed in earthen pots and heated with similar grade of heat. Thereafter particular Bhasma is observed on self-cooling.
- ii. Niruttha: Niruttha is to test inability to regain metallic form of metallic Bhasma. In this test Bhasma is mixed with a fixed weight of silver leaf and kept in sealed earthen pots, then similar grade of heat is applied and after self cooling, the weight of silver is taken. Increase in weight of silver leaf indicates improperly prepared Bhasma.
- iii. Gatarasatwam:- After the complete marana process, generally the bhasmas are without any taste. To taste this is portion of bhasma should be placed over the tongue to detect its taste if any.

Nanotechnology¹²

Nanotechnology is thus the technology of material dealing with very small dimension material usually in the range of 1-100 nm. Nano technology is used for nano automobiles engineering , nano cosmetics, nano medicines. 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. i.e. in one meter making 1000,000,000 parts and picking up one part is one nano meter. Nano particle are one crore times smaller than the hair . Modern pharmaceutical science this also referred to ancient Ayurvedic preparation medicine as kajjali -bhasma etc. The latest technology developed now in 21st century is NANOTECHNOLOGY. In 1875 Michel faraday synthesized stable gold colloidal particle of nano size (magenta red colour solution) is the milestone of nano science.

What is Nano medicine-

Nano medicine is the medical application of Nano technology to the prevention and treatment of disease in human body. Nano particles are used as drug carriers for chemotherapeutics to deliver medication directly to the tumour .It offers nano coating to slow the release of Asthma medication in the lungs , allowing people in the asthma to experience longer period of relief from symptoms after using inhalants.Nanorobots in the form of respirocytes delivered 236 times more oxygen to body tissue per unit volume than natural red cells .Nano dentistry maintains oral health .It is useful in the local anaesthesia , dentition reneutrization & permanent hypersensitivity cure . Nano technology is the study of manipulating matter on an atomic and molecular scale. Generally it deals with structures sized between 1-100 nm size and involves developing materials or devices within that size.) A nm is 10 times the size of an atom.particle size is main goal to compare in between Bhasma and nano medicine.Most of biological molecules and structures have similar size of nano material , that's the reason behind for using nano material as nano medicine.It gives tremendous result in the field of medicine by using Decrease of dose needed , More rapid onset of action , enhance solubility , Increase surface area , Increases rate of dissolution , Increase bio availability .(Rasibhavana). In our Ayurvedic text the method of preparation of Bhasma is very scientific and systematic , where hard to hardest metals gets converted into as fine powder form that it fills in the finger's furrow or floats into the water i.e. containing particle of nano size .

How to produce Nanoparticles? :-

There are various conventional and noble techniques by which we can produce nanoparticles.

Mechanical grinding:

Mechanical attrition where the material is prepared not by cluster assembly but by the structural decomposition of coarser-grained structures as the result of severe plastic deformation. This has become a huge popular method to make nanocrystalline materials because of its simplicity, the relatively inexpensive equipment needed, and the applicability to the synthesis of all classes of materials. The major advantage of mechanical grinding is the possibility for easily scaling up to large quantities of material for various applications.

Wet Chemical Synthesis of Nanomaterials:

In principle we can classify the wet chemical synthesis of nanomaterials into two broad groups:

1. electrochemical etching technique . For Example porous nano silica can be prepared.
2. sol-gel method and precipitation method. The sol-gel process is designed to produce inorganic networks to form a colloidal suspension (sol) and then the sol is gelled to form a network in a continuous liquid phase (gel).

Gas Phase synthesis of nanomaterials:

In recent years, the gas-phase synthesis technology is one of the best methodologies for creating nano scale drug particles because of its effective way to modulate process parameters in order to produce nanostructure with desired product size, shape and chemical composition. The synthesis route is based on the production of small clusters aggregating to form nanoparticles through condensation. Supersaturating vapor will initiate the condensation process and homogeneous nucleation is started in the gas phase to form nanoparticles. This can be accomplished both by physical and chemical methods.

Sputtered Plasma Processing:

In this method, the material which is to be converted to nanoparticles is sputtered using rare gases such as helium gases and the target compound are allowed to agglomerate to form nanomaterial. Both direct current and radio frequency sputtering wave has been utilized to synthesize nanoparticles.

Particle precipitation aided CVD:

Particle-precipitation-aided chemical vapour deposition (PP-CVD) is a little bit modification of the traditional CVD process, where an aerosol of colloidal clusters of materials is used to prepare nanoparticles. The particles are formed in the gas phase and are deposited on a substrate.

Laser ablation:

Laser ablation has been extensively investigated for the synthesis of nano particulate films. In this technology a laser beam is impeded upon solid sample as the primary excitation source of ablation for generating nanoclusters.

III. Discussion-

It is believed that Bhasma are more powerful than any other healing system because the constituents metals and minerals don't react with the tissue of the body. These tiny particles being insoluble can enter into the blood stream and are more biocompatible as compared to any chemically produced entity, a property similar to biologically produced nano particles. Bhasmas as compared to their plant drug counterpart are stable over longer periods of time, require lower dose are easy to store and have sustainable availability. According to the classical references of Bhasma preparations; Bhasma prepared as per method and undergone some studies, it reveals that Bhasma have nano particles. This is conformation study for it. The studies are –

Swarna Bhasma prepared by the classical method described in Rasa ratna samuchhaya (for shodhana) and Sharangadara (for marana), when subjected to XRD and Transmission Electron Microscope showed that the drug is present in crystalline form with an average particle size of 56-57 nm. Nano sized gold particles have been proven to be effective anti-arthritis agent in rats. Same Physico-Chemical characterization of Yasada bhasma using XRD, DLS, TEM, Inductively Coupled Plasma (ICP), Elemental analysis with energy Dispersive X-ray analysis (EDAX), revealed that Yasada bhasma is highly oxygen deficient ZnO, containing nano particles of 10-40 nm. Rasa sindoor is also shown to contain particle size ranging from 25-50 nm.

Thus, bhasmas are claimed to be biologically produced nano particles and are said to be nearer to nano crystalline materials. Nano crystalline materials can be produced by mechanical milling or mechanical alloying. (1st suggested by Koch and was validated by Fecht et al)

Nano materials are finding their way in the form of drug carriers because of large surface area of materials¹³ & 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) Nano spheres; 2) Nano capsules; 3) Nano pores. Gold nano particles, quantum dots magnetic nano particles are used to detect the early stage of cancer. These nano particles are bounded to biomarkers of different type of cancer.

Importance of particle size reduction-

According to our rasa literature, it is already mentioned that more the number of Puta are given the less particle size and more of its benefits.

In the description of Abhraka, Rasendra sar sangrah mentioned that¹⁴,

- For simple therapeutic purpose -10-100 puta
- For vitalizer property – 10-500 puta
- For immuno-modulation – 100-1000 puta

It is proven through modern medical science too. i.e.

- Smaller the particle, quicker is the cellular internalization and consequent effects.
- Drug delivery system- primary objective- drug available at the required site.
- Nano particles are proposed to be delivered to the target through rapid cellular internalization and subsequent actions upon DNA/RNA molecule and protein synthesis within the cell which modify the therapeutic actions-as per our desire and ones body requirement too!

Our assumptions about Rasashastriya drug absorption (RASIBHAVANTI) -

The bhasma absorption may be due to **Battle field theory (Khale kapota nyaya)** or inherited nature **Theory of water irrigation (Kedara kulya nyaya)**, **Kedari Kulya nyaya** states that the living body is provided with innumerable microvascular channels which carry nourishment to the respective sites in Dhatus (tissues). The cells and tissues are literally perfused with nutrient plasma but mere tissue perfusion is not enough to complete the process of nourishment. Bhasma absorption process (Rasibhavanti lohani) also carries may be through the same process. It is not possible to derive the entire benefit of bhasma simply on the basis of the quantity of intake. For all the eight factors like Prakriti, Vikruti, Saara, Sanhanan, Aharashakti, Vyayamshakti, Vaya, Bala etc which are jointly responsible for bringing about the requisite benefits of bhasma. As the effectiveness of bhasma can only be assessed from plasma. There always exist a correlation between the plasma concentration of

a drug & the therapeutic response. Thus, absorption can also be defined as the process of movement of unchanged drug from the site of administration to the site of measurement . i.e., plasma. or **Theory of Biotransformation(Vipaka vijnana)**. It reveals that if the Bhasma's particle size is in as less formed then it reached in blood stream so fast. After reviewing the two technology , it reveals that specific standardized size is chief central goal in both the technology Bhasma and Nano. Bhasma was considered to be the most effective and time saving therapy. These are palatable, were preferred over other formulations for oral administration. Further this preparation have the advantage of being effective in smaller dose then the herbal preparations . i.e. bhasmas have superior level of efficacy in comparison to other Ayurvedic dosage forms. The science of nano technology has validate this claim of ancient scholars of Ayurveda. Integrating the technology of nano science with Ayurvedic medical system can provide potent solutions for many ailments.

IV. Conclusions

The particle size in the Bhasma is 1-2 μ , which could be specified as the criterion for the final product conforming to all the traditional parameters under Bhasma pariksha. Although Bhasmas are complex materials, physicochemical analysis using modern techniques will be most attractive for the standardization of Bhasma medicines. This would definitely help in building confidence in use of such products for medication by ensuring genuinity , safety, efficacy, and batch to batch uniformity. The nano is the newly used word correlated to Ayurvedic medicine in the form of Bhasma , the nano particles of metals & minerals are being used as an effective medicine being to its easy absorbable . It is the need of the moment for Ayurveda to conduct the researches to extend the use of our nano medicine (BHASMA) in various aspects like detection & diagnosis to make them more effective in serving the society. The present study shows that Ayurvedic bhasmas may hold strong relevance in the emerging era of nanomedicine.

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