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A REVIEW ARTICLE ON CONCEPT OF *MARANA* PROCESS AND IT`S RELEVANCE TO THE CONCEPT OF NANOTECHNOLOGY

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ABSTRACT

Rasa shastra, an off shoot of *ayurveda* that dates back to the medieval period, mainly deals with the therapeutic use of metals and minerals called *rasaushadhis* (herbo-mineral-metallic compounds). *Parada* (mercury) is the main ingredient in this ancient science, while the other drugs are used as its subordinate. With the development of a pharmaceutical technique for converting metals and minerals into *bhasmas*, the internal administration of all metals and minerals became possible. *Rasashastra* is a traditional branch of pharmaceutics and therapies that deals with the use of metals and minerals for human health. *Rasashastra* used various techniques such as *shodhana*, *marana*, *jarana*, *satvapatana* (extraction), *kupipakva rasayana*, etc. to convert the metal into a nontoxic and bioassimilable form. The *marana* technique consists of five distinct steps: *shodhana*, *bhavana* (levigation with herbal juices), pelletization, *sharava samputikarana* (application of a specific heating pattern), and *puta* (application of a specific heating pattern). *Puta* is repeated until the desired characteristics of *bhasma* are achieved, such as *varitartva* (floating of *bhasma* on a calm surface of water), *rekhpurnatva* (occupying the inter ridge space on the finger pad skin), and *niruttha* (not to recover its original elemental metallic form). *Marana* is a term used to describe a complex chemical composition that converts an elemental, toxic, and non-bio-compatible metal and mineral into nano-sized organic complexes that are

nontoxic and biocompatible. When a metal, mineral, or gem is converted into nano-sized structures or nanoparticles, its physicochemical properties change. In *ayurveda*, many concepts like the one given above are present, which were introduced thousands of years ago. This paper is about such concepts, and it focuses mainly on the synthesis of nanoparticles in ancient times and the properties of nanoparticles useful in medicine.

KEYWORDS: *Marana*, *Puta*, Nanoparticles, *Bhasma*, Nanotechnology.

INTRODUCTION

Recent advances in nanoscale products and nanomaterials research have dominated the global market. Nanotechnology refers to the science and engineering involved in the creation, manufacture, assembly, processing, and application of materials that are in the nanometer range. *Panchmabhutas* created all living and nonliving things on this earth, according to *ayurveda*. The same genesis theory promoted the use of nonliving things for the benefits of living thing, as shown by the following quote: "*nanaaushdhibhutam jagat kinchit dravyaamasti"*. However, any nonliving thing is not beneficial to living cells until it is converted into an assimilable and nontoxic form. Different raw materials (herbal, metal, and mineral origin), different tools, different techniques, and different techniques were used to use nonliving things for benefits of living things in *rasashastra* and *bhaishajya Kalpana ancient* discipline of pharmaceutics. Metals and minerals present in the environment have a beneficial and harmful effect on the living organisms present in this universe, particularly in the form of carbon and magnesium.

By introducing physiological changes in naturally occurring metal and mineral, biological benefits can be achieved. The physicochemical properties of the drug, in terms of particle size, shape, and chemical form, are in close proximity to various biological activities. In *ayurveda,* terms such as *laghutva* (lightness), *rekhpurnata* (fineness), *arasa* (tastelessness), *shigravyapti* (quick absorption), and *mrutani lohani rasibhavanti* (good bio-viability) are used to describe the physicochemical and biological properties of the medicine used.

Nanotechnology is the most advanced scientific technology of the 21st century. The term nanotechnology comes from a greek word "nanos," which means dwarf. It is a new way to take drugs. It aims to produce devices and dosages in the range of 1 to 100 nm that can be increased to 1000 nm. Nanotechnology uses nanoparticles with a large surface area to reach the intended location due to their small size. To overcome the limitations of using herbal

drugs, nanotechnology and herbal science are combined. The development of a novel drug delivery system for herbal medicines includes a nano dose, which aids in increasing the bio-solubility and bioavailability, preventing toxicity, and long-distance delivery. Such novel drug delivery schemes have a site specific action and a predetermined rate.

CONCEPT OF *MARANA* PROCESS

Before introducing the metals and minerals to the body, they are burned. *Marana* is a term used to describe this technique. After *marana*, the shattered metal will not be able to be restored to its metallic state. Since the metal cannot be assimilated in its original form, it must be given a shape that is as small as possible to be absorbed by the body's adipose tissue. *Marana* is the best option for this. The metal loses all of its physical properties and has a therapeutic value as well. Therefore, the metals that are processed in this manner have no harmful or toxic effects. For a safe therapeutic use, however, the dosage, the vehicle, and other factors should also be taken into account. Before using for therapeutic purposes, only a few minerals, such as *vaikranta*, *makshika*, and *abhraka*, must pass through the *marana*. Although there is no specific name for the *marana* technique, it can be referred to as *samanya marana* or *vishesha marana*. *Samanya marana* is a group technique for all metals, while *vishesha marana* is a individual technique for a particular metal. The *vishesha marana* for *lauha* can also be broken into separate sections.

STEPS OF *MARANA* PROCESS

Step 1: *Shodhana* of Metal and Minerals

This is the first and most crucial step in the *marana* process. *Shodhana* is a technique that involves many steps with the intention of removing impure and toxic substances from drugs, to enhance the properties of the drug, or to make it more suitable for further processing. Different forms of *shodhana* are used in the preparation of *shoshana* (drying), *bharjana* (roasting/frying), *bhavana* (wet trituration), *nirvapa* (quenching), etc. With different purposes. For example, improper intake of *shodhita* iron leads to seven health problems in the body, such as heaviness *(jadyata*), nausea (*hrulasa*), etc. But during process of *shodhan* quenching of the iron in the different media like Sesame oil leads to reduction in the particle size of iron and may converted into the martensite form which is hard and brittle. Repeated heating of iron in *Samanya* and *Vishesh Shodhana* leads to microcracks on the surface of iron. These microcracks not only helpful to incorporate nanostructure feature but also to improve reactivity with herbal constitutes. *Shodhana* of iron removes oxides of Fe+3 by

forming complexation with the herbal and animal products. Thus the *shodhana* of iron leads to removing of the ill effects of iron and to bring the physiochemical changes useful for the further processing.

Types of *Shodhana*

Two types of *Shodhana* are described in our *Rasagranthas*

1. *Samanya Shodhana*
2. *Vishesha Shodhana*

1. *Samanya shodhana*: It is used as general procedure for *Shodhana* of all drugs of a particular group, in other words these drugs should be purified individually through the same *Shodhana* procedure. With the help of *Samanya Shodhana* general impurities can be removed. e.g., *Samanya Shodhana* of *Dhatu varga*.

2. *Vishesha Shodhana*: It is used as specific procedure for particular drug material individually, not for a group. After performing *Samanya Shodhana*, *Vishesha Shodhana* has to be applied for deriving some special *Gunas* i.e. qualities. Each drug of the *Rasa varga* may have different types of impurities. Which can different from one to another and it may be removed by *Vishesh Shodhana*.

Step 2: *Bhavana* (Trituration of Metal and Minerals with herbal juices)

The *shodhita* material is triturated with specific herbal juices until it forms a doughy mass that is soft and easily converted into *varti* (roll) form without breaking or cracking after drying. *Acharyas* was also advised not to use only water instead of *marana dravy*a or a specific herbal juice to form a doughy mass and convert it into *chakrika* (pellets). It appears that herbal juice in a specific amount and trituration for a specific duration plays a significant role in *bhasma* formation. Sometimes bhavana therapies are performed as part of *shodhana*, with the intention of removing the toxic material from the drug. As part of the *marana* process, we must also repeat the *bhavana* technique. We must use *maraka dravya* during the *bhavana* as part of the *marana* technique. The *shodhana* and *marana* method uses the same herbal drugs as in *kasis*.

Step 3: *Chakrika Nirmana* (Pellatisation)

The doughy mass is then converted into *chakrika* (pellets) and dried. The prepared pellets must be flat in shape and weigh no more than 10 to 20 grams. Moist pellets exposed to *puta*

formations result in an abnormal color of *bhasma*, which becomes hard. Pellets with a flat shape encourage uniform and homogenous heating because they have more surface area and less thickness.

Step 4: *Sharava Samputikarana*

Dry flat pellets were kept on the flat surface of earthen saucers and covered with another earthen saucer. The joint of both earthen saucers is closed with mud smeared cloth and allowed to dry. This specific arrangement was denoted as *Puta Yantra* by ancient scholars. Some ancient scholar mentioned not to close the joint of two earthen saucers only for those *puta* which contains gaseous material like sulphar, arsenic.

Step 5: *Puta* (Application of specific heat Pattern)

Puta yantra is a specific heating pattern for a specific duration. The *puta* is the most important step in marana's process. *Putas* are classified into several forms based on the heat source, direct and indirect application of heat, the fuel source, and of course its own dimension. *Agniputa* is further divided into the different types of *agniputa* by variation in the temperature pattern due to different size of pits and number of cow dung cakes. Ancient scholars used different *puta* for the different materials, such as *gaja puta* for iron. For the preparation of quality *bhasma* of *abhrak*, *tamra*, and *lauha*, some scholar recommended first *puta* of maximum temperature, followed by *puta* of lower temperature. In the *swarana*, *rajat*, and naga *bhasma* preparation, the reverse method of applying *puta* was described.

Step 6: Trituration: The pellets were analyzed for their consistency and all pellets were then turned into fine powder by trituration.

Step 7: Repeat the above procedure until the desired physico-chemico-biological changes are made in the material in which the *marana* is performed.

A. Physical changes – The lightness, fineness, softness, and smoothness characteristics of *bhasma* were demonstrated by performing tests.

B. Chemical changes – The following test, confirms the formation of a particular compound and its structure, as well as the absence of any original elemental or other undesirable substance.

C. Biological changes – According to the following properties, biological changes are mainly

dependent on physiological changes.

CONCEPT OF NANOTECHNOLOGY

Nanotechnology refers to the science and engineering involved in the creation, manufacture, assembly, characterization, and application of materials that are in the range of a few to several hundred nano meters. Nano meter is a billionth (10-9) of a meter, so the term "nano" means a billionth of a meter. Since one can control their molecular synthesis and assembly, nanoengineered substrates are designed to have specific and controlled bulk chemical and physical properties.

Nanotechnology is not a single emerging scientific discipline, but rather a grouping of traditional sciences such as chemistry, physics, engineering, and biology. To further develop this novel technology, a team of experts from all these disciplines is required. There are two main methods of synthesis and assembly of nanomaterials: the "top down" and "bottom up" approach. Top-down techniques begin with the macroscopic object or group of materials and then incorporate smaller-scale details into them. The methods employed in this approach aim to make smaller devices by using larger ones to guide their assembly. Bottom-up approaches, on the other hand, begin by designing and synthesizing custom-made molecules that have the ability to self-assemble or self-organize into higher-order mesoscale and microscale structures. In simpler terms, these methods aim to convert smaller parts into more complex assemblies. Nanotechnology has the ability to produce many new materials and devices with a wide variety of applications. Nanoengineered materials and devices that can interact with the cells and tissues or perform biologically specific functions can be used in a new clinical context or treatment scheme, as we can say in the field of medicine and biology.

Ayurveda formulations include herbs, minerals, metals, and animals that are processed pharmaceutically to have therapeutic properties. Medical plants were mainly used for the preparation of remedial agents in *charaka* and *sushruta* at the time. *Nagarjuna*, an indian alchemist, introduced the use of metals and minerals as medicinal agents in the 8th century ad. *Rasashastra* is a branch of ayurveda that deals with herbo-mettalic preparations. *Rasashastra* and *bhaishajya kalpana* are ancient pharmaceutical sciences that use different raw materials (herbal, metal, and mineral origin), different equipment, different techniques, and different techniques to use nonliving things for benefits of living things. Metals and minerals present in the environment have a beneficial and harmful effect on the living organisms present in this universe, particularly in the form of carbon and magnesium.

SYNTHESIS OF NANO-PARTICLES IN *AYURVEDA*

Ayurveda is a well-known and well-established ancient indian science. *Ayurveda's* literal meaning is "science of life." It is one of the oldest forms of medicine. Nanotechnology, on the other hand, is the future of science. It is considered to be the most significant technological breakthrough since the industrial revolution. This cutting-edge technology promises to re-engineer the man-made world.

Nanotechnology has spawned a slew of promising commercial products, from machines to drugs. Though *ayurveda* is ancient and nanotechnology has recently emerged, there is a connection between the two. However, it has been observed that the principles of nanotechnology are incorporated in thousand-year-old ayurveda. Nanotechnology has evolved over time, according to *ayurvedic bhasma*. *Bhasma* is a powder form of a substance that is formed by calcination. Metals and minerals are converted into very fine, absorbable, most effective, and least or nontoxic forms of drugs in *ayurveda* (*shodhana*, *jarana*, *marana*). Nanoparticles synthesized by nanotechnology have also some properties such as nano-size, bioavailability, specific target action, and less toxicity, making them a useful tool in the drug delivery system.

NANOPARTICLES IN MEDICINE

Nanotechnology is a promising emerging field of medicine with potential therapeutic benefits. When it comes to using a particular drug for treatment, one must consider drug targeting or a drug delivery method. Nanotechnology, according to recent research, plays a vital role in the drug delivery system. Because of their relatively small size, nanoparticles have a self-targeting ability. Self-targeting means they can target a specific pathological area without the attachment of a specific ligand. These nanoparticles are either nanospheres or nano-capsules. They are able to absorb or encapsulate a drug, protecting it against enzymatic or chemical degradation. In the drug delivery system, there is another new concept known as nano-carrier. Nano-carrier is a nanomaterial used as transport module for another substance like a drug. Various novel drug delivery systems, such as liposomes, ethosomes, nanoparticles and phytosomes have the ability to deliver herbal drugs.

Nanotechnology applications have improved bioavailability and bioactivity of phytomedicine by reducing the size of the particles, surface modification, attaching or embedding the phytomedicine with different micro or nanomaterials. By traversing the boundaries, such as the blood brain barrier, nanomaterials enhance the pharmacokinetic profile and diffusion of

drugs into various organs. Nanomedicine is the use of nanotechnology for diagnosis, monitoring, and control of biological systems. The term nano-phytomedicine is derived from *ayurveda*. Nano-phytomedicines are made from active phytoconstituents or standardized extracts. These drugs increase the safety and bioavailability of the injected drugs. These drugs have no side effects and side effects, as they are negligible.

A nanosized herbal drug containing veteh root, seawort, cassia twig, and liquorice root has been shown to be effective in lung, bone, liver, and skin cancers. This method of administration is effective in destroying cancerous cells without harming healthy cells. Nanoparticles are also used in cosmetics. Nanoparticles in sunscreen lotion have been used by many people to shield themselves from harmful uv rays and skin cancer. The combination of nanotechnology and traditional herbal medicine makes for a very useful tool in the development of future herbal products with a higher bioavailability profile and less toxicology. In the new age of nanomedicine, ayurvedic herbal remedies and *ayurvedic bhasma* are of utmost importance. It could be a model for the future nanomedicine application.

RELEVANCE OF *MARANA* & NANOTECHNOLOGY

Marana (Incineration/Calcination) is more important from nanotechnology point of view. *Marana* brings many physicochemical changes in a metal or mineral like reduction in particle size to make it beneficial as a therapeutic agent. *Shodhana* is the first step in the process of *Marana.* It is nothing but purification of the substance (metal/minerals). After removal of impure and toxic material from the substance, the next step is *Bhavana*. In this the purified material is triturated with specific herbal juices till doughy mass is obtained. Then the next step is *Chakrika Nirmana* also known as palletization, in which the doughy mass is converted into *Chakrika* (pellets) and kept for drying. These dry flat pellets were then stored in an earthen saucer and then covered with another earthen saucer. Both saucers' joint is covered with mud smeared cloth and allowed to dry. *Puta yantra* is a term used to describe a particular arrangement. *Puta yantra* is then subjected to *puta*. *Puta* means a specific heating pattern for a specific time period. It is a critical step in the *marana* process, and it is dependent on the source of heat, the direct/indirect application of heat, the fuel source, and its dimensions. Pellets are collected and tested for consistency after this step. The pellets are then ground into fine powder. All the above steps are repeated until the material has achieved the desired physicochemical and biological properties. This is the most common method for

synthesising nanoparticles. Nanoparticle synthesis is now carried out by radio frequency (rf) plasma technique, chemical techniques, thermolysis, pulsed laser technique, etc.

Nanoparticles synthesis using the rf plasma technique are made possible by radio frequency heating coils. On the he atom that enters the system, nanoparticles form. Different reducing agents are used in chemical processes. Nanoparticles can be made by decomposing solids with metal cations and metal organic compounds at high temperatures. This method is somewhat similar to the traditional ayurvedic method. For the synthesis of silver nanoparticles, a pulsed laser technique is used. In this technique, laser beams are used to make nanoparticles. It's strange that the ancient scientist, who has little experience, continues to burn and cool metals, rocks, and gems to remove their toxic effects. The end result was however remarkable. It was nothing but a nanotechnology. In terms of chemical composition and structure, the nanoscale particles produced by this method were completely different from the original particles. It not only increased the surface area, but it also made the drugs more able to reach the intended location quickly. These drugs had quick action and a lower dosage. In the market, there are many such drugs (*ayurvedic bhasmas*) as *heerak bhasma*, *swarna-basant-malati ras*, *tamra bhasma*, *loha bhasma*, and *rajat bhasma*. These *bhasmas* are physicochemically characterized by X-ray photoelectron spectroscopy (XPS), inductively coupled plasma (ICP), dynamic light scattering (DLS) and transmission electron microscopy (TEM).

CONCLUSION

Ayurveda and nanotechnology have a close relationship. Though nanotechnology is a new field of study, its roots and methods are rooted in thousands of years old ayurveda. When metal, minerals, and gemstones are converted into nanosized particles, *ayurveda* describes their physicochemical properties. Ancient indian scientists not only demonstrated how these nanoparticles (*rasaushadhies*) are useful, but also explained how to prepare them. The ancient methods of nanoparticle synthesis can be regarded as ancient methods of nanoparticle synthesis as shown in *ayurveda*. Nanoparticles' properties include their nanosize, specific target action, bioavailability, and less toxicity in the field of medicine. In the field of nanomedicine, nanoparticles or nanomaterials synthesized by nanotechnology have many applications.

Nanoparticles are used as a versatile tool in the drug delivery system and drug targeting. Nano-phytomedicines, herbal nano-sized anticancer drugs, nanocurcumine, and ayurveda are

some of the applications of nanotechnology combined with ayurveda. In the future, ayurveda and nanotechnology will be combined for many purposes. Any pharmaceutical product not only has a potentiating effect on the patient, but also has the ability to reduce its harmful effect on the body. The same is true of ancient pharmaceutics, including *rasashastra* and *bhaishajaya kalpana*. *Marana* is the main ingredient in the production of metal and minerals products. In short, we can describe *marana's* complicated procedure as a bionanotechnology developed by an ayurvedic scientist in the 8th century bc. *Bhasma* is biologically produced nanoparticles that have a quick and targeted action.

Nevertheless, the benefits of nanomedicine are indubitable and unstoppable, and safety-related studies should also be carried out rigorously and planned in order to provide guidelines for safer manufacturing practices while still taking into account ecology and the environment.

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