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GREEN SYNTHESIS OF NANOPARTICLES

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ABSTRACT

The nanotechnology and biomedical sciences open the possibility for a wide variety of biological research topics and medical uses at the molecular and cellular level. The biosynthesis of nanoparticles has been proposed as a cost-effective and environmentally friendly alternative to chemical and physical methods. Plant-mediated synthesis of nanoparticles is a green chemistry approach that connects nanotechnology with plants. Novel methods of ideally synthesizing NPs are thus thought that are formed at ambient temperatures, neutral pH, low costs and environmentally friendly fashion. Keeping these goals in view nanomaterials have been synthesized using various routes. Among the biological alternatives, plants and plant extracts seem to be the best option. Plants are nature's "chemical factories". They are cost efficient and require low maintenance. The advantages and disadvantages of nanotechnology can be easily enumerated. This study attempts to review the diversity of the field, starting with the history of nanotechnology, the properties of the nanoparticle, various strategies of synthesis, the many advantages and disadvantages of different methods and its application.

Keywords*:* - Green Synthesis, Nanoparticles, Eco-friendly

INTRODUCTIOIN:

Nanoparticles (NPs) having one of the dimension ranges of 1–100 nm act as a bridge between bulk Materials and atomic or molecular structures. They possess remarkable and owing their small sizes, large surface free dangling bonds and higher reactivity bulk. Since the Nineteenth century scientists have been well aware of the ability of biological entities to reduce metal Precursors but the mechanisms are still unexplored. The progress of efficient green synthesis utilizing Natural reducing, capping and stabilizing agents without the use of toxic, expensive chemicals and High energy consumption have attracted researchers towards biological method. Rapid industrialization, urbanization and population explosion are resulting in deterioration of earth Atmosphere and a huge amount of hazardous and unwanted substances are being released. It is now high time to learn about the secrets that are present in the nature and its natural products which lead to advancements in the synthesis processes of NPs. Furthermore, PS are widely applied to human contact areas and there is a growing need to develop processes for synthesis that do not use harsh toxic chemicals. Therefore, green/biological synthesis of NPs is possible alternative to chemical and physical methods.

NPsMay be synthesized following physicochemical methods. However, these methods are capital extensive with many problems including Use of toxic solvents, generation of hazardous byproducts and the imperfection of the surface structure. Chemical methods are generally Composed by more than one chemical species or Molecules that could increase the particle reactivity and toxicity and might harm human health and the Environment due to the composition ambiguity and Lack of predictability.

REVIEW OF LITERATURE[1,2]:

Recently, many studies have proven that the plant extracts act as a potential precursor for the synthesis of the nanomaterials in non-hazardous ways. The plants are used successfully in the synthesis of several greener nanoparticles such as cobalt, copper, silver, gold, palladium, platinum, zinc oxide and magnetite. During the past decade, it has been demonstrated that many biological systems, including plants and algae, diatoms, bacteria, yeast, fungi, and human cells can transform inorganic metal ions into metal nanoparticles by the reductive capacities of the proteins and metabolites present in these organisms. Synthesis of metallic nanoparticles using biological entities has great interest due to their unusual optical, chemical properties. Several plants have successfully used for efficient and rapid extracellular synthesis of gold and silver nanoparticles. Geranium (*Pelargonium graveolens*), leaf extracts of lemongrass (*Cymbopogon flexuosus*), *Cinnamommum camphora*, neem (*Azadirachta*

indica), Aloe vera, tamarind (*Tamarindus indica*) and fruit extract of *Emblica officinalis* have proven potential in reducing Au (III) ions to form gold nanoparticles Au (0) and silver nitrate to form silver nanoparticles Ag (0). Biomasses of wheat (Triticum aestivum) and oat (*Avena sativa*), alfalfa (*Medicago sativa*), native and chemically modified hop biomass and remnant water collected from soaked Bengal gram bean (*Cicer arietinum*) have also been used for gold nanoparticles synthesis. Alfalfa (*Medicago sativa*), *Chilopsis linearis* and Sesbania seedlings showed synthesis of gold nanoparticles inside living plant parts. However, alfalfa (*Medicago sativa*) sprouts and *Brassica juncea* germinating seeds are used for silver an environmentally acceptable ‘‘green chemistry’’ procedures, probably involving organisms ranging from bacteria to fungi and even plants .75

HISTORY:

The birth of matter at the nanoscale has created much excitement to researchers and promises to transform many aspects of materials sciences in the 21st century and beyond. The word “Nano” is derived from Greek word Dwarf, means “a billionth”. A Nanometer is billionth of a meter, which is 250 millionth of an inch, about 1/80,000 of the diameter of a human hair or 10 times of the diameter of hydrogen atom. The term ‘Nanotechnology’ was coined by Prof. Norio Taniguchi, Tokyo Science University in 1974 to describe the precision manufacture of materials with nanometers tolerances and was unknowingly appropriated by Drexler in his 1986 book ‘Engines of creation: The Coming Era of Nanotechnology. Although, in general, nanoparticles are considered a discovery of modern science, they actually have a very long history. Nanoparticles were used by artisans as far back as the ninth century in Mesopotamia for generating a glittering effect on the surface of pots. Even these days, potteries from the middle age and Renaissance often retain a different gold- or copper-colored metallic glitter. This luster is caused by a metallic film that was applied to the transparent surface of a glazing. The brightness can still be visible if the film has resisted atmospheric oxidation and other weathering. The luster originated within the film itself, which contained silver and copper nanoparticles dispersed homogeneously in glassy matrix of the ceramic glaze. These nanoparticles were created by the artisans by adding silver and copper salts and oxides together with vinegar, ochre, and clay on the surface of previously-glazed pottery. The object was then placed into a kiln and heated to about 600 °C in a reducing atmosphere. In the heat the glaze would soften, causing the copper and silver ions to migrate into the outer layers of the glaze. There is the reducing atmosphere reduced the ions back to metals, which then came together forming the nanoparticles that give the colour and

optical effects. Luster technique showed that ancient craftsmen had a rather sophisticated empirical knowledge of the materials. The technique originated in the Muslim world. As Muslims were not allowed to use gold in artistic representations, they sought a way to create a similar effect without using real gold. The solution they found was using luster.

NANO-SCIENCE:

It has long been known that the plants are able to reduce metal ions both on their surface and in various organs and tissues remote from the ion penetration site. The field of nanotechnology mainly encompasses with biology, physics, chemistry and material sciences and it develops novel therapeutic nano sized materials for biomedical and pharmaceutical applications. Nanoparticle has multifunctional characteristics and very interesting applications in various fields such as medicine, nutrition and energy. The biogenic syntheses of the mono dispersed nanoparticles with specific sizes and shapes have been a challenge in biomaterial science. Also, it has made remarkable advantages in the pharmacological industry to cure various bacterial and viral diseases. Nanomedicine makes a huge impact in health care sector in treating various chronic diseases. Hence, environment friendly synthesis of nanoparticles is considered as building blocks of the forthcoming generations to control various diseases. Additionally, nanoparticles have broad applications in agriculture industry and plant sciences. For instance, the nanoparticle using bio processing technology converts the agricultural and food wastes into energy and useful by-products. Based on that, the review focused on biosynthesized metallic nanoparticles from plant derivatives and its application in the medical and commercial sectors including waste water treatment, cosmetics and food industry and also their advantages and disadvantages in many fields. One limitation in moving from bench to bedside with the nanoparticle diagnostic and therapeutic approaches in mainstream medicine has been concern about the potential toxicity of the nanomaterials. Some nanoparticles are especially likely to accumulate in bodily tissues. For instance, unmodified copper or silver nanoparticles can exhibit toxicity risks. Surface modifications of nanoparticles can create agents with very distinct chemical and/or biological properties from the “same” nanoparticles with unmodified surfaces.

GREEN SYNTHESIS:

Nature has devised various processes for the synthesis of nano and micro length scaled inorganic materials which have contributed in the development of relatively new and largely unexplored area of research based on the biosynthesis of the nanomaterials. Synthesis using bio-organisms is compatible with the green chemistry principles. “Green synthesis” of

nanoparticles makes use of environmentally friendly, non-toxic and safe reagents. Nanoparticles synthesized using biological techniques or green technology have diverse natures, with greater stability and appropriate dimensions since they are synthesized using a one-step procedure. Nanoparticles can be synthesized using a variety of methods including chemical, physical, biological, and hybrid technique, laser desorption, lithographic techniques, sputter deposition, layer by layer growth, molecular beam epitasis and Similarly, chemical methods are used to synthesize NPs by electro deposition, sol–gel process, chemical solution deposition, chemical vapor deposition soft chemical method, Langmuir Blodgett method, catalytic route, hydrolysis co-precipitation method and wet chemical method. Chemical and Physical methods have been using high radiation and highly concentrated reductants and stabilizing agents that are harmful for the environmental and to human health. Hence, biological synthesis of nanoparticles is a single step bio-reduction method and less energy is used to synthesize eco-friendly [4-5].

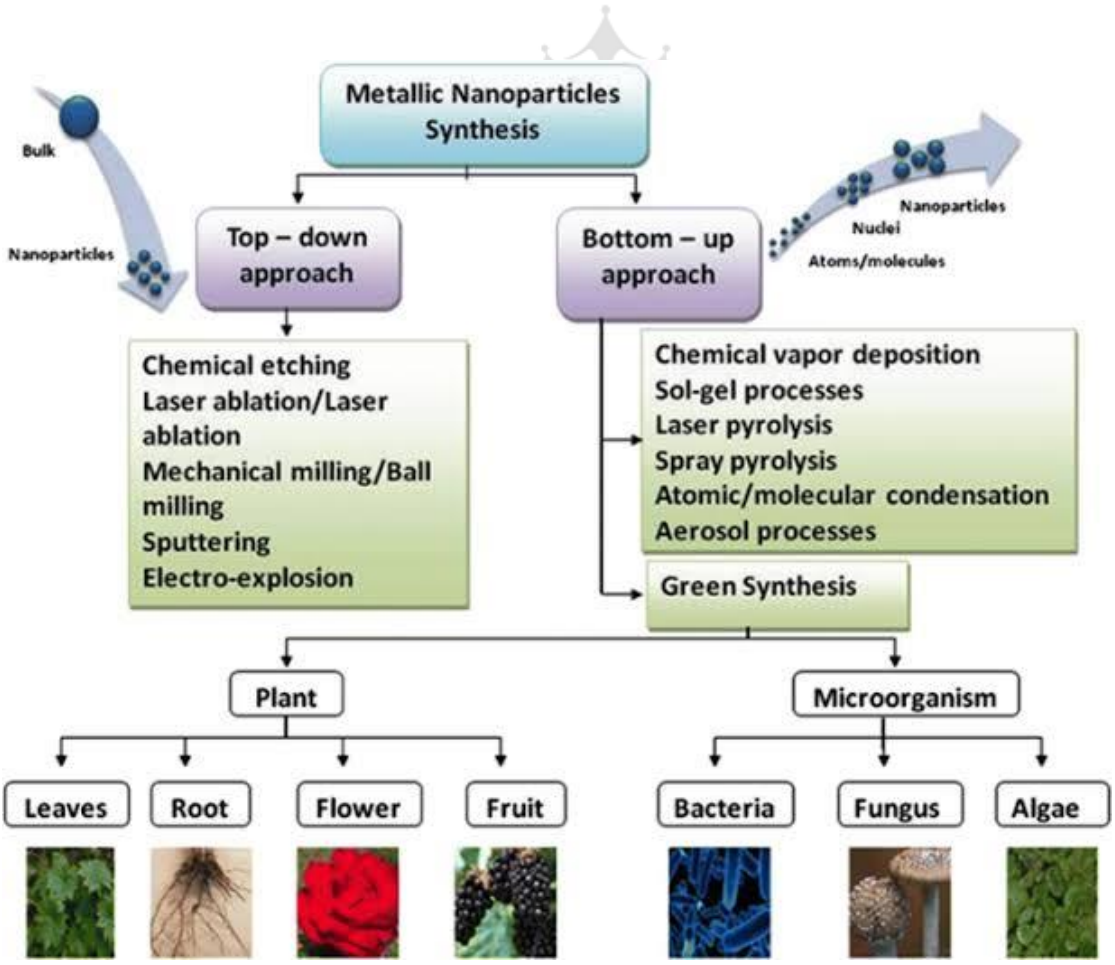

Fig. 1. Synthesis of Green Nanoparticles

In general, green nano-biotechnology means synthesizing nanoparticles or the nanomaterials using biological routes such as those involving microorganisms, plants, and viruses or their by products, such as proteins and lipids, with the help of various biotechnological tools. Nanoparticles made by green technology are far superior to those manufactured with physical and chemical methods based on various aspects. For example, green techniques eliminate the use of expensive chemicals, consume less energy, and generate environmentally benign products and by products. The 12 principles of green chemistry have now become a reference guide for researchers, scientists, chemical technologists, and chemists around the world for developing less hazardous chemical products and by products. Accordingly, green nanobiotechnology is a promising alternate route for synthesis of biocompatible stable nanoparticles. The general procedure using plants to produce metallic nanoparticles employs the dried biomass of the plants and metallic salt, as bio reducing agent and precursor, respectively. The medicinal and preservative characteristics of silver have been known for over 2,000 years. Biological-based synthesis of nanoparticles utilizes a bottom-up approach in which synthesis occurs with the help of reducing and stabilizing agents. Three main steps are followed for the synthesis of nanoparticles using a biological system: the choice of solvent medium use, the choice of an ecofriendly and environmentally benign reducing agent, and the choice of a nontoxic material as a capping agent is to stabilize the synthesized nanoparticles.

Physical properties of nanoparticles:

Nanoparticles are unique because of their large surface area and this dominates the contributions are made by the small bulk of the material. Nanoparticles have different colors like yellow, gold and gray. The gold ones are 020048-4 melting at much lower temperatures (~300°C for 2.5nm size) than the gold slabs (1064°C). Especially silver nanoparticles have distinctive physicochemical properties, including a high electrical and thermal conductivity, surface-enhanced Raman scattering, catalytic activity and chemical stability, and nonlinear optical behavior. Absorption of solar radiation in the photovoltaic cells is much higher in nanoparticles than it is in thin films of continuous sheets of the bulk material - since the particles are smaller, they absorb greater amount of solar radiation. The advantages of using nanoparticles for the drug delivery result from their two main basic properties. First nanoparticles, because of their small size, nanoaparticles can penetrate through smaller capillaries and are taken up by cells, which allow efficient drug accumulation at the target sites. Second, the use of biodegradable materials for nanoparticle preparation allows

sustained drug release within the target site over the period of days or even weeks. But not only for drugs are nanoparticles very important. Nanotechnology can actually revolutionize a lot of electronic products, procedures, and applications. The areas that benefit by the continued development of nanotechnology when it comes to electronic products include nano diodes, nano transistors, OLED, plasma displays, quantum computers, and many more. Nanotechnology can also benefit the energy sector. Such items like batteries, fuel cells, and solar cells can be built smaller but can be made to be more effective with this technology. Another industry that can benefit from nanotechnology is the manufacturing sector that will need materials like aerogels, nanotubes, nano particles, and other similar items to produce their products with. These materials are often more durable, stronger and lighter than those that are not produced with the help of nanotechnology. There are some more advantages of nanoparticles over their production and their drug delivery process. Nanoparticles are fairly easy to prepare that's why they are used in drug after targeting the area. Due to their small size Nanoparticles penetrate small capillary and are taken up by the cell which allows for efficient drug accumulation at the target sites in the body. Using Nanoparticles in drug delivery give good control over size and give good protection of the encapsulated drug. Retention of the drug at the active site has longer clearance time. Nanoparticles increased the therapeutic efficiency as well as bioavailability. They reduced fed/fasted variability that increased drug stability. Stable dosage forms of drug which are either unstable or have unacceptably low bioavailability in non-nanoparticulate dosage form. While carrying drug with nanoparticles have no biotoxicity of the carrier. Nanoparticles are do not show any problem in large scale production and sterilization but they only avoid organic solvent. When tackling the advantages and disadvantages of nanotechnology, we will also need to point out what can be seen as the negative side of this technology: Included in the list of disadvantages of this science and its development is the possible loss of jobs in the traditional farming and manufacturing industry. Atomic weapons can now be more accessible and made to be more powerful and more destructive. These can also become more accessible with nanotechnology. Nanotechnology has increased risk to the health also, nanoparticles due to there their small size can cause inhalation problem and many other fatal diseases by just inhaling for 60 seconds in the air contain nano particles can damage lungs easily. Presently, nanotechnology is very expensive and developing it can cost you a lot of money. It is also pretty difficult to manufacture, which is probably why products made with nanotechnology are more expensive.

CONCLUSION:

Nanotechnology has raised the standard of living but at the same time, it has increased the pollution, which includes water pollution, air pollution. The pollution caused by nanotechnology is known as nano pollution. This kind of pollution is very dangerous for living organisms. The disadvantages of nanoparticles are very poorly explored. So there are only a few more of them based on drugs delivery. Producing Nanoparticles for drug delivering extensive use of polyvinyl alcohol as a detergent that create an issue on toxicity. Nanoparticles have only limited targeting abilities that's why discontinuation of therapy is not possible. Drug delivery with Nanoparticles shows cytotoxicity, alveolar inflammation. The disturbance of autonomic imbalance by nanoparticles having direct effect on heart and vascular function. Nanoparticles show particle growth, unpredictable gelation tendency, unexpected dynamic of polymeric transitions and sometimes burst release.

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