Journal of Advances and Scholarly Researches in Allied Education
Vol. 16, Issue No. 6.1, May-2019 (Special Issue), ISSN 2230-7540

Green Synthesis of Metal Nanoparticles from Medicinal Plants and Their Applications

Chinnasamy P. M.[1]* Elayaperumal R.[2]

[1] Assistant Professor, Dhanalakshmi Srinivasan College of Arts and Science for Women, Perambalur, Tamil Nadu, India

[2] Assistant Professor, Dhanalakshmi Srinivasan College of Arts and Science for Women, Perambalur, Tamil Nadu, India

ABSTRACT

Currently, metal nanoparticles have varied uses for different medical, pharmaceutical, and agricultural applications. Nan biotechnology, combined with green chemistry, has great potential for the development of novel and necessary products that benefit human health, environment, and industries. Green chemistry has an important role due to its contribution to unconventional synthesis methods of gold and silver nanoparticles from plant extracts, which have exhibited antimicrobial potential, among other outstanding properties. Biodiversity-rich countries need to collect and convert knowledge from biological resources into processes, compounds, methods, and tools, which need to be achieved along with sustainable use and exploitation of biological diversity. Therefore, this paper describes the relevant reported green synthesis of gold and silver nanoparticles from plant extracts and their capacity as antimicrobial agents within the agricultural field for fighting against bacterial and fungal pathogens that can cause plant, waterborne, and food borne diseases. Moreover, this work makes a brief review of nanoparticles' contribution to water treatment and the development of "environmentally-friendly" nanofertilizers, nanopesticides, and nanoherbicides, as well as presenting the harmful effects of nanoparticles accumulation in plants and soils.

Keywords – *Green Synthesis; Technology; Nanoparticles*

INTRODUCTION

A small preamble of the thesis which is relevant to our research work is demonstrated in this chapter. The section 1.1 deals about the introduction of nanotechnology, synthesis, characterization and applications of nanoparticles and literature survey of nanoparticles. Section 1.2 conceals green synthesis method, introduction of medicinal plants like Justicia adhatoda; Polyanthus embilica and Piper nigrum are discussed in the segment. Section 1.3 explains the catalytic and anticancer activity of nanoparticles and literature survey are also given.

Nanotechnology

The nanotechnology is one of the enthusiastic field in modern materials science. Nanotechnology is based on synthesise of nonmaterial's (1-100 nm) and its applications in various fields especially for industrial revolution. Norio Taniguchi has first used the term "nanotechnology" in 1974. The word "Nano" (Greek word: "dwarf") means extremely small. The famous researcher "Glister" made a new history in material science, he named the material as "Microcrystalline". The word "nanocrystalline" comes from it. In 4th century peoples were also used the nanoparticles like a Lycurgus cup (gold/silver alloy nanoparticles) as shown in Fig.1.1. In 1857, Michael Faraday has carried out the first study in minefield by the synthesis of gold nanoparticle and its optical properties. Nan materials can be used in various fields as sensors, agricultural, nanostructure materials, biomedical field etc.,. At present, there are 800 consumer products on market exploiting based on nanotechnology [8]. Presently, millions of tones of nonmaterial's are fashioned per annumin worldwide and the production will possibly increase in future.

Fig: 1.1 Lycurgus cup (when light pass through the sections of glass containing Au-Ag alloyed nanoparticles it becomes brilliant red).

Types of nonmaterial's

Nan materials can be divided into two groups i) Organic based material (made of carbon atom-fullerenes, nanotubes etc.,) and ii) Inorganic based materials include metal oxides such as iron oxide, zinc oxide, titanium dioxide, cerium oxide, etc., metals (silver, gold, copper, iron, etc.,) and quantum dots (cadmium selenide and cadmium sulfide).

Natural nanoparticles

Natural nanoparticles are found in aquatic surface and ground water, biological systems (DNA and complex nanostructure proteins), Rock weathering, volcanoes, fires and sea spray are also accountable for fabricating nano-sized components, by the way of microbial activity and chemical hydrolysis.

Anthropogenic nanoparticles

Anthropogenic (incidental or adventitious) nanoparticles have subsisted since the earlier days of evolution. Anthropogenic emissions of inorganic nonmaterial's have more than two fold the size of natural nanoparticles. Nan materials were preferred as ultrafine particles in the air (It comes

from diesel and gasoline-fuelled vehicles and combustion sources), colloids in soil (clays, organic matter and other minerals) and colloids in water (fulvic acids, proteins, hydrous iron and manganese oxide).

ORGANIC BASED MATERIALS

Carbon based nonmaterials

Carbon based nonmaterial's are having several application like optics, electronics and biomedicine.

Fullerenes

Fullerenes molecules contain 60 carbon atoms (C60) and also used in medical field (Fig.1.2). However, the researchers are focusing on preliminary studies on HIV-protease inhibition, DNA photo cleavage, neuron-protection and apoptosis [15].

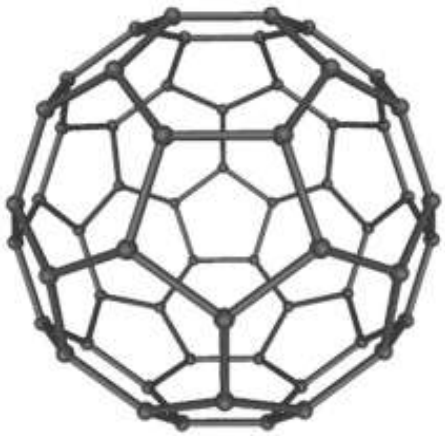

Fig.1.2.Structure of Fullerene

Carbon nanotubes

Carbon nanotubes (CNTs), single-walled (SWCNT) or multi-walled (MWCNT) are having a diameter of 1-10 nm. CNTs are robust, though flexible one; it has been used in manufacturing industry (i.e. Aircrafts, sports equipment, etc.,), electron field emitters, nanoprobes in AFM, microelectrodes in electrochemical reactions and potential hydrogen storage devices.

INORGANIC BASED MATERIALS

Metal oxide nanoparticles

Iron oxide nanoparticles naturally exist in environment which is having low toxicity and also have magnetic properties. Zinc oxide nanoparticles (semiconductors) are potential in electronic devices, chemical sensors, solar cells and antimicrobials. Titanium dioxide has vital application in the field of photo catalytic activity and photocells due to its stability, low cost and etc.

METAL NANOPARTICLES

Zero-valent iron nanoparticles

The main application of zero-valent iron nanoparticles are in bioremediation technologies owing to their size to degrade and adsorb organic pollutants.

Silver nanoparticles

Silver is a safe inorganic non-harmful component. Silver nanoparticles are utilized as a medication for around 650 kinds of illnesses against microorganisms. The colloidal type of silver is utilized as a medication for bacterial infection in open injuries, gauzes, readiness of salves, wound dressings, prophylactic and water disinfectant. Silver nanoparticles (AgNPs) is a seriously fascinating material, this is because of its wide applications in different fields as catalysis slight film development herbicide identification nanotechnology photograph catalysis, optics, antimicrobials anticancer investigations and biomaterial creation. Silver nanoparticles are least expensive material, subsequently it is utilized as merchandise (for example plastics, garments, creams and cleansers) and furthermore builds their market interest because of their antimicrobial property. Silver nanoparticles embedded into socks, to lessen the smell it can drain from hostile to fouling film in water filtration Further, it is utilized for the treatment of debased ground water. An investigation on harmful impact of silver nanoparticles was analyzed on Zebra fish, because of its quick advancement and clear body structure. The biocompatibility and harmfulness of silver nanoparticles were uncovered by analyzing silver nanoparticle inside the incipient organisms at each stage. The anomalies were seen in Zebra fish were emphatically relies on the measurement of silver nanoparticles Silver nanoparticles are acceptable anti-infection and additive and accordingly it can without much of a stretch conta ct with people. It makes more interest to consider the impact that silver nanoparticles could have on individuals.

Importance of silver nanoparticles

- Purification and quality management of air, imaging, biosensing and drug delivery system.
- It is used as a coating for solar energy absorption, batteries, optical receptors, catalysts, biolabelling, and antimicrobials.
- Silver nanoparticles are used in high sensitivity, bimolecular detection, diagnostics, antimicrobials, therapeutics and catalysis.
- It has some potential application like biological implants (like heart valves) wound dressings, surgical instruments and bone prostheses.

Gold nanoparticles

Gold is a biocompatible respectable metal and colloidal type of gold was misused as a drinkable sol is practiced remedial properties for some sicknesses in ancient time. The Chinese were combined the red colloidal gold utilized as the "medication of life span". It is classified "Swarnabhasma" in India and it is utilized for renewal during mature age by Ayurvedic

medication Gold nanoparticles are assuming a basic part in nanobiotechnology as biomedicine and its optical properties. Gold nanoparticles have shown cytotoxicity, it is utilized as a stage in the fields like immunostaining, biodiagnostics, cell imaging, drug/DNA conveyance, bio detecting and electron magnifying instrument markers. Gold nanoparticle as an ideal material to explore this is because of biocompatible and it is a delicate corrosive it can emphatically tie with delicate bases.

Gold nanoparticles (AuNPs) is as significant in exploration zone owing their remarkable, tunable Surface Plasmon Resonance (SPR) and their applications in medication conveyance, tumor imaging, photograph warm cure, catalysis and ID of microbes. Substance dormancy and forestalling surface oxidation are the fundamental explanations behind AuNPs are displaying bunches of utilizations. has been accounted for guarantee AuNPs are non-poisonous. As increasingly more of the gold molecules, the arrangement happen to supersaturated and gold consistently starts to accelerate as sub-nanometer particles. The surviving from the gold molecules joined to the current particles and the arrangement is mixed vigorously the particles will get genuinely uniform in size. To forestall the collection, some sort of settling specialist is generally added. Gold nanoparticles shows up at various shapes like circles, wires, tubes, bars, hexagonal, plate, cubic and three-sided shape, Gold nanoparticles are utilized as a biomedical gadget for disease specialists this is because of its various focal points in the clinical field. The gold nanoparticles can undoubtedly discover the disease in a base amount of tissue or cells. At that point they can undoubtedly go into the cells and associate with DNA, compounds, proteins and cell receptors.

Copper

Copper nanoparticles are more impressive consideration due to their biocidal properties like as treatment of wounds, along these lines; it is utilized in swathe arrangements just as fantastic physical and compound properties. Moreover, copper nanoparticle displays a significant Localized Surface Plasmon Resonance (LSPR) in obvious district like Ag and Au nanoparticles Copper nanoparticles are extremely beautiful materials in view of their high warm conductivity. Copper nanoparticles have more noteworthy surface zone, minimal effort, antibacterial, and synergist action, optical and attractive properties like gold, silver or palladium. By and by a significant issue is ascending in their arrangement, protection and restricting their use of copper nanoparticles this is expected their inclination to oxidize in air. To forestall the issue, decreasing, covering or securing specialists or latent media (Argon and Nitrogen) were utilized in prior laborers. It is utilized in mechanical field like gas sensors, reactant measure, superconductors, high temperature superconductors, sun powered cells and so forth, The CuNPs utilized as an intense heterogeneous recyclable impetus in dangerous squanders and harmful water contaminations. It is additionally utilized as a material because of their optical, electrical, biomedical, reactant, antifungal and antibacterial. Copper nanoparticles are an effective antimicrobial movement this is expected to exceptionally harmful to microorganism and furthermore non-poisonous to creature cells.

Optical property

As of late, the analysts are generally centered on metallic nanoparticles this is because of their hued colloidal arrangements. Mie was the main man to clarify about the red shade of gold

nanoparticles by addressing Maxwell's condition for associating an electromagnetic light wave with metallic circles (in 1908). The shade of the metallic nanoparticles have sane excitation of all "free" electrons in the conduction band, is generally imperative to an in-stage swaying is known as Surface Plasmon Resonance (SPR). In this way, shade of the metallic nanoparticles may adjust with their size inferable from SPR appeared in Fig.1.3.

Fig 1.3. Optical properties of nanoparticles

Magnetic property

Attractive properties of nonmaterials clearly vary from the mass materials. Ferromagnetic particles are precarious when the molecule size diminishes into lower size, gives increment is the surface zone and energy, it gives adequate energy for spaces and furthermore it gets paramagnetic. Nonetheless, this is unique in relation to the ordinary paramagnetic and subsequently it is eluded as too paramagnetic. Attractive nonmaterial's are having impressive consideration because of their application like as immobilization of proteins, catalysts, bioseparation, biosensors, drug conveyance and invulnerable examines.

Mechanical property

The mechanical properties of nonmaterial’s increase with decreasing the particle size. One dimensional nanowire structure are more interesting in research area. The improved mechanical strength of nimrods or nanowires owes their high internal perfection of nanowires.

Application of nonmaterial’s

Synthesized nanoparticles are used in paints, cosmetics, self-cleaning, car tyres, printing inks (Fig.1.4.)

Human health: Imaging, drug delivery, cancer therapeutics.

Defense: Light weight materials, energetic materials, armour composites

Energy: Improved efficiency, hydrogen storage, catalysis

Agriculture: Secure packaging, increased crop yields, chemical/biological detection

Environment: Reduced air emissions, water filteration, remediation and water treatment.

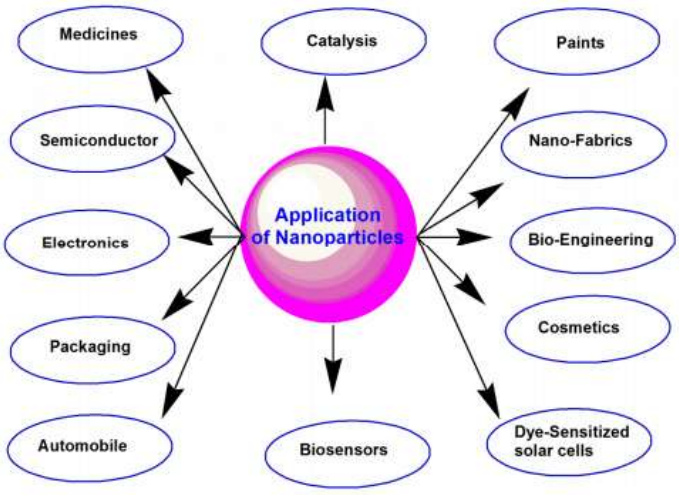

Fig.1.4. Schematic diagram of application of nanoparticles

CONCLUSIONS

Green science is a creative and developing asset in the quest for all the more harmless to the ecosystem measures. Utilizing plant separates for the combination of metal NPs is an as of late developing zone of revenue because of its advantage in contrast with the conventional physicochemical techniques. AuNPs and AgNPs created by green combination have expected applications in horticulture and agro industry, particularly as antimicrobial specialists of specific microorganisms for which their adequacy has been experimentally demonstrated. Albeit late investigations propose that ecological groupings of AuNPs and AgNPs influence microbial biomass with low effect on their variety, further exploration should be tended to decide the impacts they could deliver to the dirt, plants, and the climate, all in all, because of long haul openness. Thusly, neighborhood and public administrative foundations should build up rules and checking techniques for better utilization of these nanotechnological progresses.

REFERENCES

[1] ASTM E2456-06, Standard terminology relating to nanotechnology, (2012).

[2] M.N. Moore (2006). Environ. Int., 32, pp. 967-976.

[3] N. Taniguchi (1974). Proc. Intl. Conf. Prod. Eng., pp. 18-23.

[4] H. Glieter (1989). Prog. Mat. Sci., 33, pp. 223-315.

[5] J. Turkevich (1985). Gold Bull., 18, pp. 86-91.

[6] M. Faraday (1857). Philos. Trans. R. Soc., 147, pp. 145-181.

[7] M.A. Albert, C.W. Evans, C.L., Ratson (2006). Green chem., 8, pp. 417-432.

[8] W. Wilson (2009). A proj. Woodrow Wilson Int. Center for Scholars.

[9] Y. Ju-Nam, J.R. Lead (2008). Sci. Total Environ., 400, pp. 396-414.

[10] J.R. Lead, D. Muirhead, C.T. Gibson (2005). Environ. Sci. Technol., 39, pp. 6930-6936.

[11] M.F. Hochella (2002). Geochim. Cosmochim. Acta, 66, pp. 735-743.

[12] N.S. Wigginton, K.L. Haus, M.F. Hochella (2007). J. Environ. Monit., 9, pp. 1306-1316.

[13] M. Farre, K. Gajda-Schrantz, L. Kantiani (2009). Anal. Bioanal. Chem., 393, pp. 81-95.