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SYNTHESIS AND CHARACTERIZATION OF SILVER NANOPARTICLES FROM *MANGIFERA INDICA* AND ITS ANTIBACTERIAL ACTIVITY

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ABSTRACT

There is an increasing commercial demand for nanoparticles due to their wide applicability in various areas such as electronic,catalysis,chemistry,energy and medicine.Metallic nanoparticles are traditionally synthesized by wet chemical techniques,where the chemicals used are quiet often toxic and flammable.Silver nanoparticles are the metal of choice as they hold the promise to kill microbes effectively.The present study describes a cost effective and environment friendly technique for green synthesis of silver nanoparticles from 1mM silver nitrate solution through the extract of *Mangiferaindica*. The appearance of brown colour indicates the syntheses of nanoparticles.Nanoparticles were characterized using UV-Vis absorption spectroscopy and SEM analysis. UV-Vis spectrum of the aqueous medium containing silver nanoparticles showed absorption peak at 450nm.Further these biologically synthesized nanoparticles were found highly toxic against different multi drug resistant human pathogens.

Keywords: Silver nanoparticles, green synthesis, antibacterial activity.

INTRODUCTION

Silver nanoparticles have seen usage in the form of catalysts and micro-electronics. Due to their antibacterial properties, silver nanoparticles are extremely useful in the field of medicine. The usual chemical method for synthesizing silver nanoparticles involves the use of toxic chemicals which are expensive and are potential threat to the environment and public health. The application of nanoscale materials and structures, usually ranging from 1 to 100 nanometers (nm), is an emerging area of nanoscience and nanotechnology. Nanoparticles exhibit completely new or improved properties based on specific characteristics such as size, distribution and morphology. Nanocrystalline silver particles have found tremendous applications in the field of catalysis, micro-electronics (Jain *et.al*, 2009), biological systems (Roy &Barik, 2010) and medicine due to their antimicrobial and antibacterial effects (Kamal *et.al*, 2010). Silver nanoparticles are synthesized by the reduction of silver ions from Ag^+ to Ag^0 (Roy & Barik, 2010) using reducing agents.

Nanotechnology is gaining tremendous impetus in the present century due to its capability of modulating metals into their nanosize. Research in nanotechnology highlights the possibility of green chemistry pathways to produce technologically important nanomaterials. Nanotechnology provides the ability to engineer the properties of materials by controlling their size, and this has driven research towards a multitude of potential uses for nanomaterials. In the biological sciences, many applications for metal nanoparticles are being explored, including biosensors, labels for cells and bio-molecules, and cancer therapeutics. However, there is still need for economic, commercially viable as well environmentally clean synthesis route to synthesize silver nanoparticles.

The use of environmentally benign materials like plant leaf extract, bacteria, fungi and enzymes for the synthesis of silver nanoparticles offers numerous benefits of eco-friendliness and compatibility for pharmaceutical and other biomedical applications as they do not use toxic chemicals for the synthesis protocol. Chemical synthesis methods lead to presence of some toxic chemical absorbed on the surface that may have adverse effect in the medical applications. Green synthesis provides advancement over chemical and physical method as it is cost effective, environment friendly, easily scaled up for large scale synthesis and in this method there is no need to use high pressure, energy, temperature and toxic chemicals. Silver has long been recognized as having inhibitory effect on microbes present in medical and industrial process. The most important application of silver and silver nanoparticles is in medical industry such as topical ointments to prevent infection against burn and open wounds. This study concentrating on the antimicrobial study by using disc diffusion method and also the larvicidal activity of silver nanoparticles.Further these biologically synthesized nanoparticles were found highly toxic against different multi drug resistant human pathogens.

MATERIALS AND METHOD

PLANT MATERIAL AND PREPARATION OF THE EXTRACT

Green unripe mangoes (*Mangiferaindica*) fruits were used to make the aqueous extract. Unripe mango fruit weighing 25g were thoroughly washed in distilled water, dried, cut into fine pieces and were crushed into 100 ml sterile distilled water and filtered through Whatman No.1 filter paper (pore size 25 µm). The filtrate was further filtered through 0.6 µm sized filters. Similarly fully ripedmango fruits and green leaves were also used to prepare the extract.

SYNTHESIS OF SILVER NANOPARTICLES

1mM aqueous solution of Silver nitrate (AgNO3) was prepared and used for the synthesis of silver nanoparticles. 10 ml of papaya fruit extract was added into 90 ml of aqueous solution of 1 mM Silver nitrate for reduction into Ag+ ions and kept at room temperature for 5 hours.

UV-VIS SPECTRA ANALYSIS

UV-Vis spectroscopy is a valuable tool for the structural characterization of silver nanoparticles. The reduction of pure Ag+ ions was monitored by measuring the UV-Vis spectrum of the reaction medium at 5 hours after diluting a small aliquot of the sample into distilled water. UV-Vis spectral analysis was done by using UV-Vis spectrophotometer.

SEM ANALYSIS OF SILVER NANOPARTICLES

Scanning Electron Microscopy analysis was carried out using SEM (Jeol model JSM-5600 LV), (sputter cutting Jeol model 1200). Thin films of the sample were prepared on a carbon coated copper grid by just dropping a very small amount of the sample on the grid, extra solution was removed using a blotting paper and then the film on the SEM grid were allowed to dry by putting it under a mercury lamp for 5 min.

ANTIBACTERIAL ASSAYS

The antibacterial assays were done on human pathogenic *Escherichia coli* and *Pseudomonas aeruginosa*by standard disc diffusion method. Briefly Luria Bertani (LB) broth/agar medium was used to cultivate bacteria. Fresh overnight cultures of inoculum (100µl) of each culture were spread on to LB agar plates. Sterile paper discs of 5mm diameter (containing 50mg/litre silver nanoparticles) along with four standard antibiotic containing discs placed in each plate.

RESULTS AND DISCUSSION

It is well known that silver nanoparticles exhibit yellowish brown color in aqueous solution due to excitation of surface plasmon vibrations in silver nanoparticles. As the mango fruit extract was mixed in the aqueous solution of the silver ion complex, it started to change the color from watery to yellowish brown due to reduction of silver ion which indicated formation of silver nanoparticles. It is generally recognized that UV–Vis spectroscopy could be used to examine size- and shape-controlled nanoparticles in aqueous suspensions. Absorption spectra of silver nanoparticles formed in the reaction media has absorbance peak at 450 nm, broadening of peak indicated that the particles are polydispersed. The SEM image showing the high density silver nanoparticles synthesized by the mango extract further confirmed the development of silver nanostructures. Further the nanoparticles syntheses by green route are found highly toxic against multi drug resistant human pathogenic bacteria at a concentration of 50 ppm.Silver nanoparticles exhibited antibacterial activity against *E. coli and Pseudomonas aeruginosa*as it showed a clear inhibition zone whereas the standard antibiotics like Ampicillin, Tetracycline, Cefixime and Rifampicin does not shown any inhibition zone. Antibacterial effects of Ag nanoparticles obeyed a dual action mechanism of antibacterial activity, *i.e.,* the bactericidal effect of Ag+ and membrane-disrupting effect of the polymer subunits.

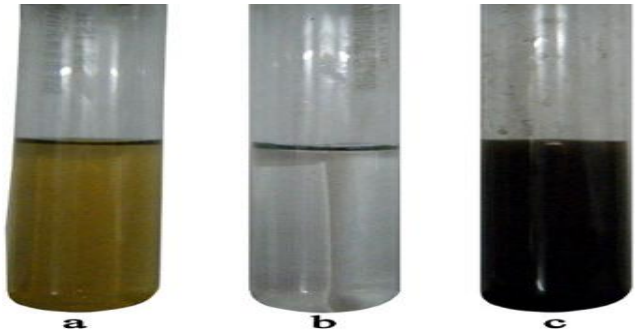

Figure1 (a) Mangofruit extract (b) 1mM $AgNO_3$ without mangoextract (c) 1Mm $AgNO_3$ with mango extract after 5hrs of incubation.

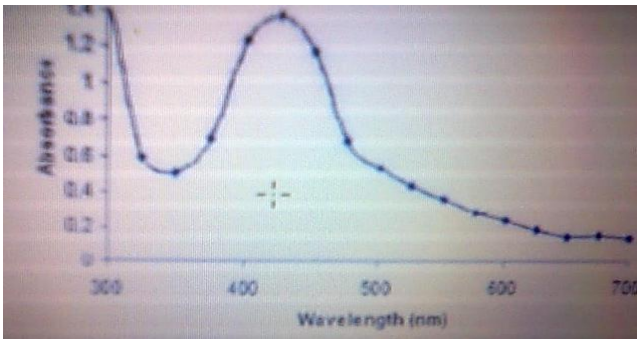

Figure 2UV-Vis absorption spectrum of silver nanoparticles synthesized by treating 1mM $AgNO_3$ solution with mango extract after 5hrs.

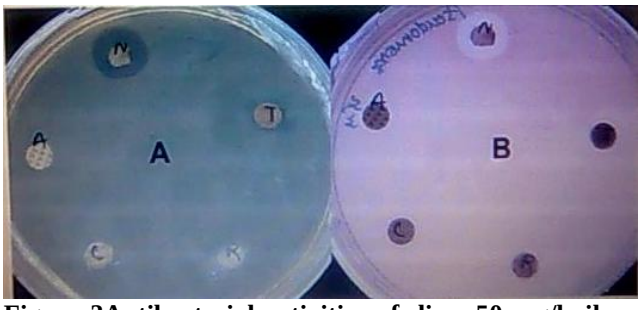

Figure 3Antibacterial activities of discs 50 mg/l silver nanoparticles and other antibiotics

Figure 4SEM analysis of silver nanoparticles showing the size between 10-50nm

CONCLUSIONS

In conclusion, the bio-reduction of aqueous Ag+ ions by the fruit extract of the mango plant has been demonstrated. The reduction of the metal ions through leaf extracts leading to the formation of silver nanoparticles of fairly well-defined dimensions. But the capabilities of the other plant part such as fruit as a capping and reducing agent is not tested and not well defined. In the present study we found that fruits can be also good source for synthesis of silver nanoparticles. This green chemistry approach towards the synthesis of silver nanoparticles has many advantages such as, ease with which the process can be scaled up, economic viability, etc. Applications of such eco-friendly nanoparticles in bactericidal, wound healing and other medical and electronic applications, makes this method potentially exciting for the large-scale synthesis of other inorganic materials (nanomaterials).

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