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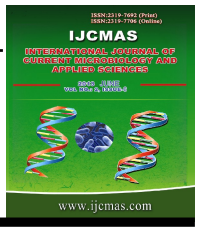

Original Research Article

Synthesis and characterization of silver nanoparticles from leaf extract of *Parthenium hysterophorus* and its anti-bacterial and antioxidant activity

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A B S T R A C T

Development of biologically inspired experimental processes for the synthesis of nanoparticles is evolving into an important branch of nanotechnology**.** The bioreduction behaviour of leaf extracts of *Parthenium hysterophorus* (Asteraceae) in the synthesis of silver nanoparticles was investigated employing UV/Visible spectrophotometry**,** particle size analyser and fourier-transform infrared spectroscopy(FT-IR).*Parthenium hysterophorus* is a noxious weed which is native to the American tropics. It is considered to be a cause of respiratory problems, dermatitis, mutagenicity in human and livestock. It confers many health benefits and it is used for the removal of heavy metals and dye from the environment. The antioxidant potential and antimicrobial potential of the leaf extract was tested. The antioxidant property was determined using DPPH (1,1-diphenyl-2-picrylhydrazyl) assay and hydrogen peroxidase assay. The anti-bacterial and antioxidant property were found to be better for the aqueous leaf extract and the extract containing the metal particle.

K e y w o r d s

Parthenium hysterophorus; antioxidant activity; anti-bacterial activity; DPPH; silver nanoparticles; FT-IR.

Introduction

Nanoparticles are fundamental building blocks of nanotechnology. The most important and distinct property of nanoparticles is their larger surface area to volume ratio (ArangasamyLeela*et al*., 2008). Physical and chemical methods are more popular for nanoparticle synthesis but the use of toxic compounds limits their application (Hasna Abdul Salam *et al*., 2012) and also not economically feasible one. Biosynthesis of nanoparticles is now established as a alternative to chemical and physical methods of synthesis (Peter Amaladhas *et al*.,2012).

Unique properties such as electronic, magnetic, catalytic and optical propertiesare exhibited by metal nanoparticles which are different from those of bulk metals. These properties would result in interesting new applications of metal nanoparticles that could potentiallybe utilised in the

biomedical sciences and areassuch as optics and electronics (Gericke *et al*., 2006). Thus, to make use of such nanoparticles, biosynthesis of nanoparticles is now established as a alternative to chemical and physical methods of synthesis (Hasna Abdul Salam *et al*., 2012).

*Parthenium hysterophorus*is a noxious weed which is native to the American tropics.The weed which ispopularly known as Congress weed, is an alien weed introduced into India as contaminants in PL 480 wheat imported from the USA in the 1950s. It is considered to be a cause of respiratory problems, dermatitis, mutagenicity in human and livestock. Eradication of *Parthenium hysterophorus* is being carried out with variable degrees of success. *Parthenium hysterophorus* confers many health benefits and it is used for the removal of heavy metals and dye from the environment (Seema Patel *et al*., 2011). In addition to the above mentioned benefits, the weed is also reported as promising remedy against hepatic amoebiasis, neuralgia and certain types of rheumatism (VyomParashar *et al*., 2009)

Molecules that are capable of preventing the oxidation of other molecules are known as antioxidants. The role of these molecules is very important in the treatment of various diseases. The basic function of these molecules is to help in preventing the oxidative stresses and to help in protecting the cells by scavenging the free radicals (Mohamed Imran, *et al.*, 2011).

Materials and Methods

Collection of sample

The leaves of the selected plant *Parthenium hysterophorus*were collected from Tiruchengode, Namakkal district, Tamil Nadu State, India. After that the plant materials were dried under shade condition.

Preparation of leaf extracts

Leaves weighing 25 g were thoroughly washed in distilled water for 5 min, dried, cut into fine pieces and were boiled in a 500 ml Erlenmeyer flask with 100 ml of sterile distilled water up to 15 min and were filtered for the removal of dust (Peter Amaladhas*et al*.,2012).

Synthesis of silver nanoparticles

10 ml of plant extract was added to the aqueous solution of 1mM Silver Nitrate. Then the sample was incubated in dark for 24 hours. After 24 hours, the sample was measured for its maximum absorbance using UV-Visible spectrophotometry. The sample was then heat dried to obtain the synthesized silver nanoparticles for characterization(Figure 1).

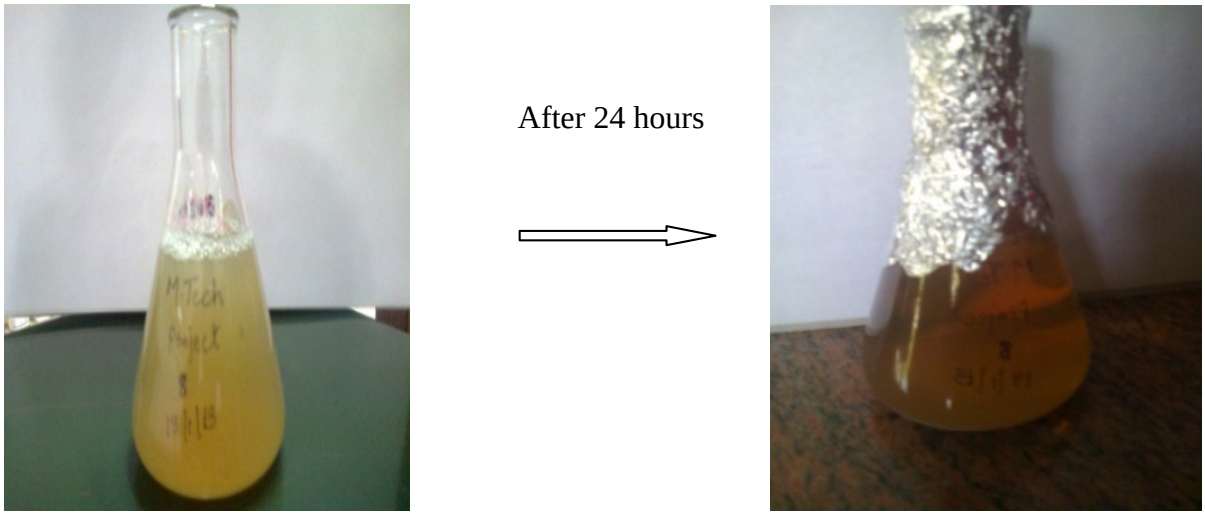
Anti-bacterial activity

Anti-bacterial activity of aqueous extract was determined by well diffusion method for *Salmonella typhi, Pseudomonas aeruginosa, Staphylococcus aureus* and *Klebsiella* spp. The cultures were inoculated by spread plate method. Gentamycin disc was used as standard control and distilled water was used as control for the extract. The plates were then incubated for 24 hours at 37°C.

Antioxidant activity

Antioxidant property of the leaf extract was determined by DPPH assay and Hydrogen Peroxidase assay.

Figure.1 Observed color change of the solution after incubation



P.hysterophorus+silver nitrate *P.hysterophorus*+silver nitrate

DPPH assay (Rajan Rushender *et al*., 2012)

The free radical scavenging ability of the extracts against DPPH free radical was evaluated. 1ml of 0.1mM DPPH in ethanol was prepared. To that prepared solution plant extracts varying in concentrations from 50-250µg /µl, 1ml ethanol and 0.95 ml Tris HCl were added. The mixture was left for 30 minutes and the absorbance was measured at 517 nm. The DPPH free radical scavenging activity was subsequently calculated.

$$\% \text{ DPPH radical scavenging} = \frac{\text{Control OD- sample OD}}{\text{Control OD}} \times 100$$

Hydrogen Peroxide assay (Sarvajeet Singh Gill *et al* ., 2010)

To the different concentrations of the plant extracts ranging from 20-100 µg /µl the hydrogen peroxide prepared with phosphate buffer (pH 7.4) was added in the volume of 0.6ml. then the mixture was kept at room temperature for 10 minutes and the absorbance was measured at 230nm using UV-visible spectrophotometer.

$$\% \text{ of inhibition} = \frac{\text{Control OD- sample OD}}{\text{Control OD}} \times 100$$

Characterization of the synthesized silver nanoparticles

UV-Vis spectrophotometry analysis

The sample was observed under UV-Vis spectrophotometer (Hitachi-2900) for its maximum absorbance and wavelength to confirm the reduction of Silver nitrate.

Particle size analyser (PSA)

Particle size analyser gives information about the size of the synthesized silver nanoparticle form the leaf extract.

Fourier-Transform Infrared Spectroscopy (FT-IR)

Infrared Spectroscopy gives information on the vibrational and rotational modes of motion of a molecule and hence an important technique for identification and characterization of a substance. The particles were analyzed under FT-IR for the size conformation.

Results and Discussion

UV-Vis spectrophotometry analysis

The sample was found to show the peak at 354nm which confirms the reduction of silver nitrate to silver nanoparticle. The wavelength which had obtained varies slightly to the peak value mentioned in the work carried out by Vyom Parashar *et al*., (2009) in which the wavelength was found to be 374nm. The graph obtained is shown figure .2.

Anti-bacterial analysis

The leaf extract was found to exhibit a anti-bacterial activity against four species of bacteria in both the crude form and along with the reduced metal (Figure 3)

Wen-Ru Li *et al*., (2011) had stated in their in their work that the silver nanoparticles can act against both the gram positive and gram negative species of bacteria. The result obtained in this work also states the same that the synthesized nanoparticle can act against both the species. In addition to the result obtained by them it was also found that the crude leaf extract of the plant *Parthenium hysterophorus* could also act against the four species that were used in this work. The result obtained against *Pseudomonas aeruginosa* was found to be in line with the result obtained against the same species in the work carried out by Malarkodi and Manoharan (2013)

Antioxidant activity

The antioxidant activity of the plant extract was studied using DPPH assay and Hydrogen peroxide assay. The antioxidant activity was found to be better for the higher concentration of the of the leaf extract(Figure 4).

Particle Size Analyser

Particle size analyser has been used to detect the size of the synthesized nanoparticle (Figure 5).

Result of the particle analysis has confirmed the synthesis of silver nanoparticles from the leaf extract. On analyzing the result it has been found that the particle synthesized ranges from 5nm – 25 nm in size. The particles are analysed based on the "mass median diameter" which indicates the 50% diameter of the particle comprising of smaller particles. The particles will considered as spherical while it is analysed in particle size analyser. The result obtained is in line with the size of the silver nanoparticle represented in the review paper published by Xiangqian Li *et al*., (2011).

Fourier - Transform Infrared Spectroscopy analysis

The synthesized silver nanoparticles were found to have the stretching at 3745cm^{-1} which shows the presence of O-H

Figure.2 Graph indicating the conversion of silver nitrate to silver nanoparticle

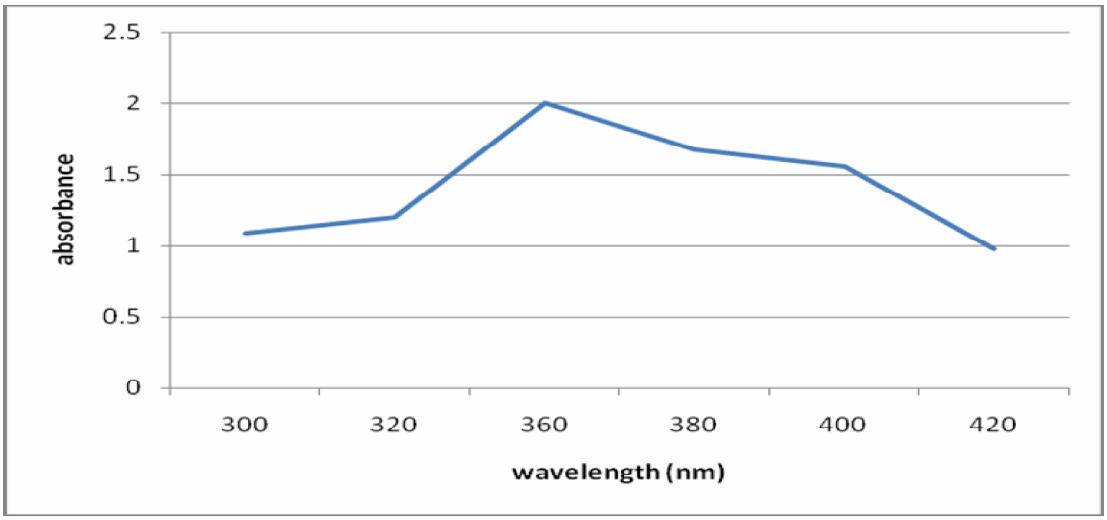
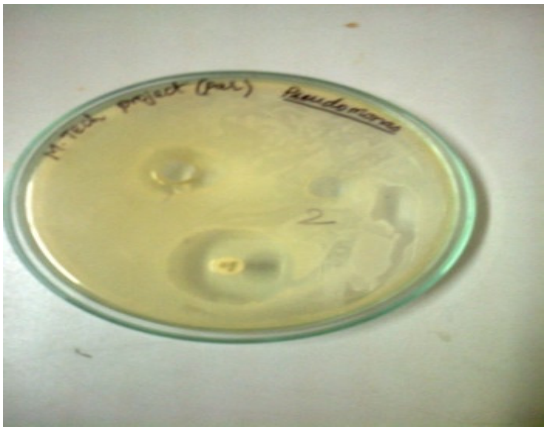
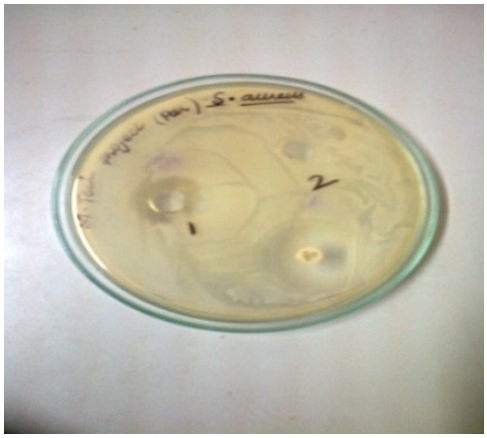


Figure.3 Antibacterial activity of silver nanoparticles against *Klebsiella pneumoniae, Pseudomonas aeruginosa, Staphylococcus aureus, Salmonella typhi*

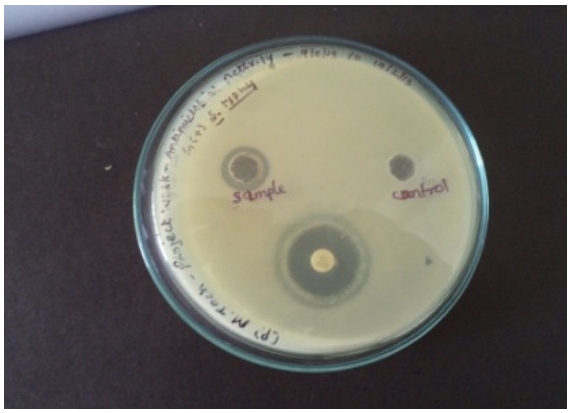
Klebsiella pneumoniae



Pseudomonas aeruginosa



Staphylococcus aureus



Salmonella typhi

Figure.4 Antioxidant activity of the *Parthenium hysterophorus*

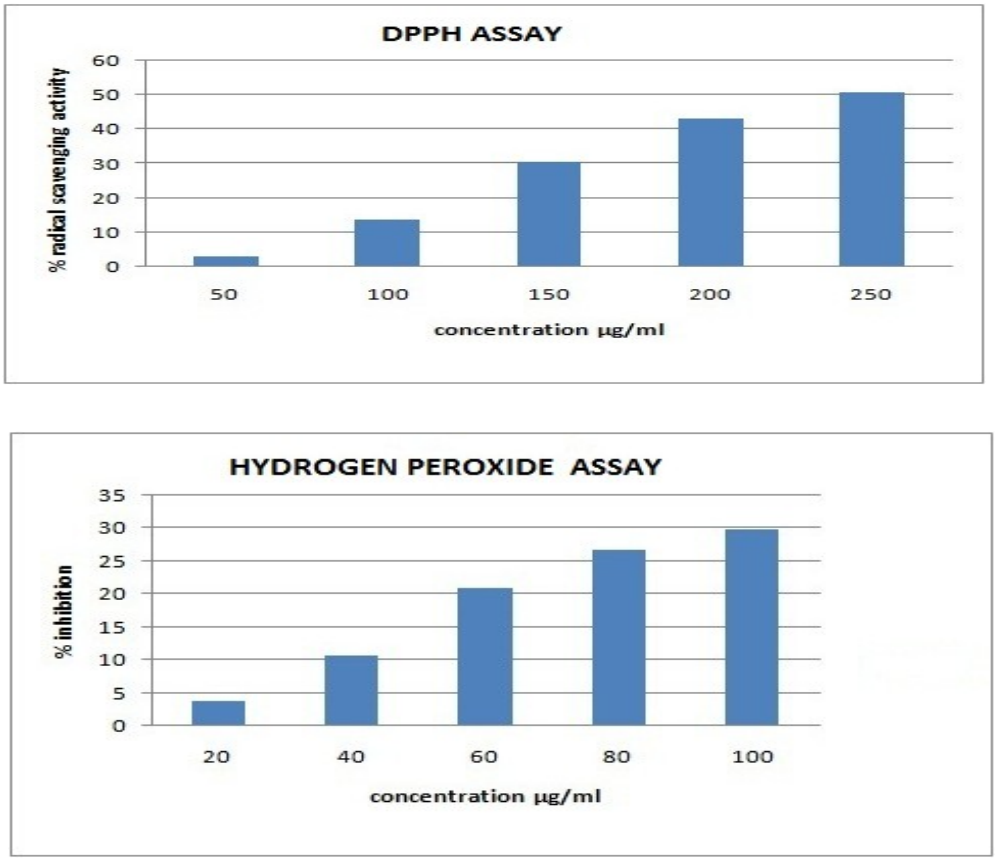


Figure.5 Particle analysis indicating the size of the synthesized silver nanoparticles

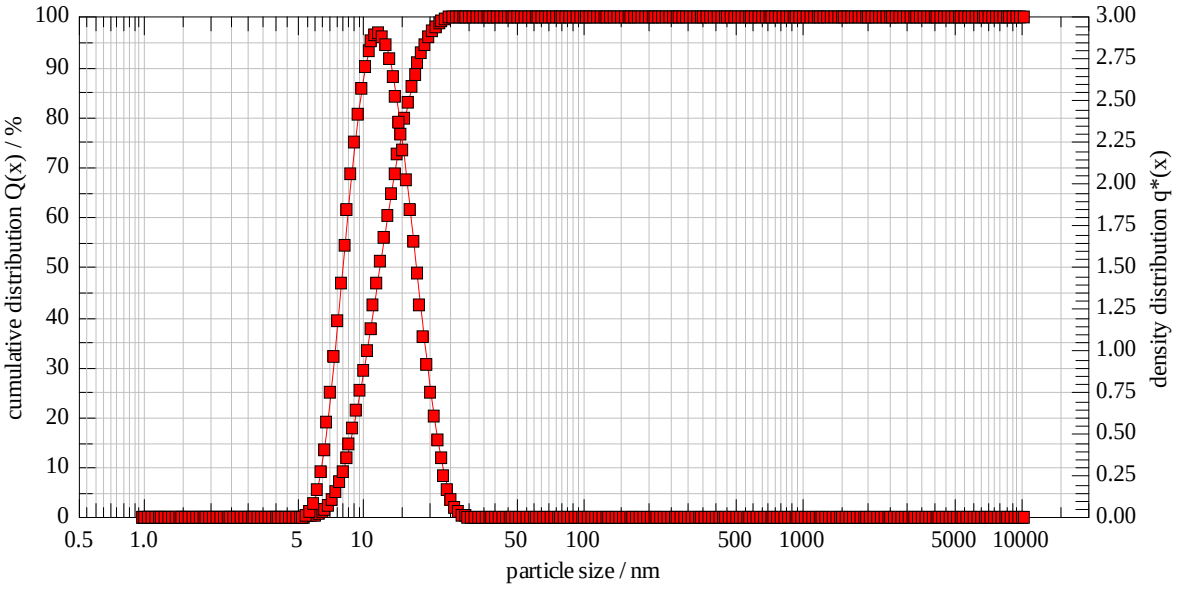
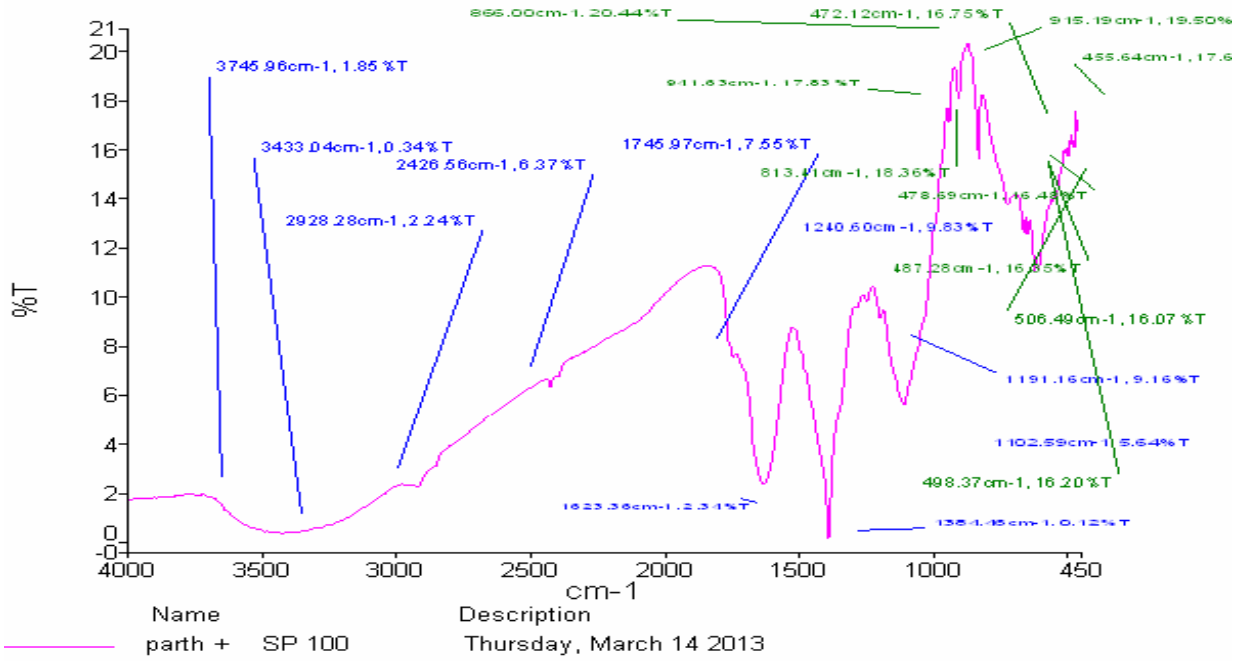


Figure.6 FT-IR image of the synthesized silver nanoparticles



functional group with free hydrogen and the stretching at 1245cm^{-1} showsthe presence of C-N group. Different functional groups that are present in the synthesized particle indicates that it can be used for various application purposes (Figure 6).

The foregoing work proved the capability of using biomaterialtoward the synthesis of silver nanoparticle, by adopting the principles of green chemistry.Synthesized silver nanoparticles from *P.hysterophorus* shows the effective antibacterial, and antioxidant activity. With the help of result obtained from initial characterization plant extract shows the excellent activity on silver nitrate. It confirms that *P.hysterophorus* is having the excellent capability to synthesize the silver nanoparticles. Therefor further study is needed to check that this plant extract is having the capability to inhibit the cancer cells. So that should be carried out as *in vitro* study.

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