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Characterization of green synthesized silver nanoparticles using *Tridax procumbans*

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ABSTRACT: *An attempt was made for the green synthesis of silver nanoparticles using leaf extract of Tridax procumbans and it was confirmed through the formation of silver nanoparticles following the change of colour from green to dark brown of the reactive solution. The synthesized silver nanoparticles were found to be spherical in their shape with average particle size of 20-50 nm. Further characterization of the green synthesized nanoparticle using UV-Vis, SEM and TEM with EDAX showing all the desirable physical and chemical characters of nanoparticles were discussed in this paper.Keywords: Tridax procumbans, Silver nanoparticles, SEM, TEM with EDAX*

INTRODUCTION

In the present scenario, there is an urgent and continuous need for the exploration and development of cheaper, effective, plant based nanoparticles with better bioactive potential and least side effects (Bhattacharya and Gupta, 2005). Hence in continuation of earlier work an attempt was made to green synthesis of nanoparticle suitable for the management of plant pathogens like phytonematodes, fungi and bacteria in the present study to nullify the ill effects of metal silver nanoparticles (Mohanpuria Rana *et al.,* 2007 and Farooqui *et al.,* 2010).

MATERIALS AND METHODS

Green synthesis of silver nanoparticles

The uneconomic weed plant *Tridax procumbens* was chosen for the green synthesis of silver nanoparticles. The plant extracts were obtained by boiling 50 g of fresh chopped leaves in 500 ml of distilled water at 100! for 30 min and filtered through Whatman No. 1 filter paper and the total volume was made as 400 ml. The filtered plant leaf extract of 25 ml was added to 100 ml of 1mM of $AgNo_3$ in a 250 ml conical flask and heated at 90 °C for 10 min. The content of the flasks were stirred at 150 rpm at 30 °C using the magnetic stirrer. The process was continued till the change of colour from green to dark brown indicating the synthesis of silver nanoparticles. Then the extract was centrifuged at 6000 rpm for 20 min and the resultant pellet was kept in hot air oven overnight at 70°C to make a fine powder of nanoparticles.

Characterization of silver nanoparticles

Particle size

The particle size analyzer works on the principle of DLS (Dynamic Light Scattering) was used to determine the particle size of green synthesized silver nanoparticles using *T. procumbans*.

A sample of 0.5 mg of green synthesized silver nanoparticles was dispersed in 20 ml distilled water and sonicated for 32 min (4 cycles) using Citizon Digital Ultrasonic Cleaner at 42,000 Hz frequency to determine the size of nanoparticles (Pravin *et al.*, 2014).

UV-Vis

To confirm the green synthesis of silver nanoparticles a sample of 0.5 mg nanoparticles was taken to disperse in 20 ml distilled water. It was followed by sonification for 32 min at regular intervals for measuring the absorbance through scanning with UV–vis spectra at the wavelength of 200–700 nm in Beckman–DU20 spectrophotometer.

Scanning Electron Microscope (SEM) with EDAX

The SEM (FEI QUANTA 250, Netherlands) was used to characterize the size and morphology of the green

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synthesized nanoparticles using *T. procumbans*. For image analysis through SEM a sample of 0.5 mg of AgNPs were dusted on one side of the double sided adhesive carbon conducting tape. The tape was then mounted on 8 mm dia aluminium stub. The sample was observed at different magnification and the images were captured.

Transmission Electron Microscope (TEM) with EDAX

The TEM (FEI TECHNAI SPRIT, Netherlands) was used to image the green synthesized nanoparticles. A sample of 0.5 mg of AgNPs was dispersed in 20 ml distilled water and sonicated for 32 min using Citizon Digital Ultrasonic Cleaner at 42,000 Hz frequency. A drop of the sonicated solution was placed on 300-mesh lacy carbon coated copper grid, air dried and the images were picturized at different magnifications.

RESULTS AND DISCUSSIONS

Green synthesis of silver nanoparticles

The change in the colour of reactive solution from green to brown confirmed the green synthesis of silver nanoparticles using *T. procumbans.* Similar reports regarding the green synthesis of silver nanoparticle using various plant sources support the present findings (Bhati *et al.,* 2014).

Characterization of silver nanoparticles

The green synthesized silver nanoparticles using *T. procumbans* were characterized using Particle size analyzer, UV- Vis, SEM, TEM with EDAX analysis as follows.

Particle size analyzer

The Particle size analyzer revealed the green synthesized AgNPs having the particle size of 78.9 nm (Fig. 1). Earlier Pravin *et al*. (2014) also succeeded in an attempt of green synthesis of silver nanoparticles with the average particle size of 68.74 nm and 108 nm respectively using *Ocimum sanctum* L. and *Parthenium hysterophorus* L. Therefore it is concluded that the uneconomic weed plant *T. procumbans* is acting as reducing agent in the synthesis of nanoparticles.

UV-Vis Spectra

The UV-Vis spectra characterization of green synthesized silver nanoparticles using *T. procumbans* showed the brownish colour of reactive solution due to excitation of surface plasma resonance. It showed that there was reduction of pure Ag^+ to Ag^0 ions with

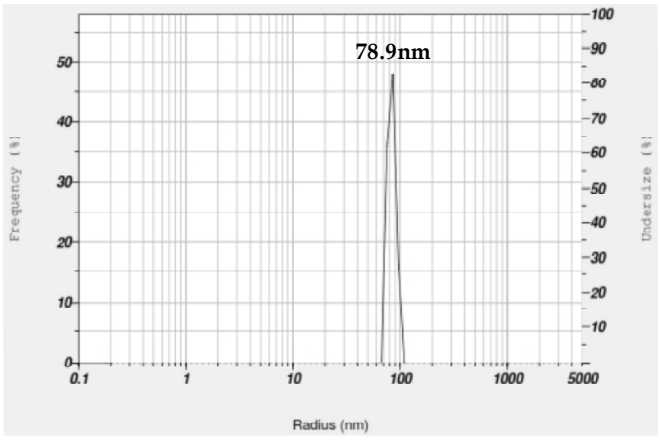

Figure 1: Particle size of green synthesized AgNPs using *T. procumbans*

plant extracts of *T. procumbans* as measured by the UV-Vis spectrum. When the plant extract got exposed to $AgNO_3$ solution the maximum absorbance was noticed at 400 nm also indicated the formation of silver nanoparticles in the reaction mixture. Further the broadening of peak in the Fig. 2 indicated that the resultant green synthesized nanoparticles were possessing poly dispersal property. Bhati *et al.* (2014) and Ondari Nyakundi Erick and Nalini Padmanabhan, (2014) also obtained the similar absorbance peak of 452 nm in the attempt for the green synthesis of silver nanoparticles using the same plant of *Tridax procumbans*.

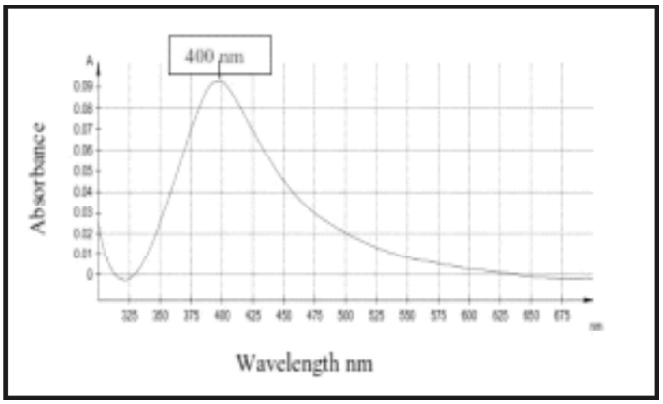

Figure 2: Characterization of AgNPs using UV-Vis Spectra

Characterization of silver nanoparticles through SEM with EDAX

The characterization of green synthesized silver nanoparticles using *T. procumbans* through SEM revealed that the nanoparticles were spherical in their shape with the property of agglomeration. Further analysis made through Energy Dispersive Absorption Spectroscopy (EDAX) showed strong signal for the

Ag atoms to indicate the crystalline nature of green synthesized nanoparticles obtained through the present study. The strong silver peak in the EDAX-spectrum confirmed the presence of elemental Ag. In addition the presence of 'O' peaks along with the Ag signals suggested that the Ag NPs were protected with phenolate ion. The optical absorption peak is observed approximately at 3 keV (Fig. 3). The above findings were supported by Bhati *et al.* (2014) and Ondari Nyakundi Erick and Nalini Padmanathan, (2014).

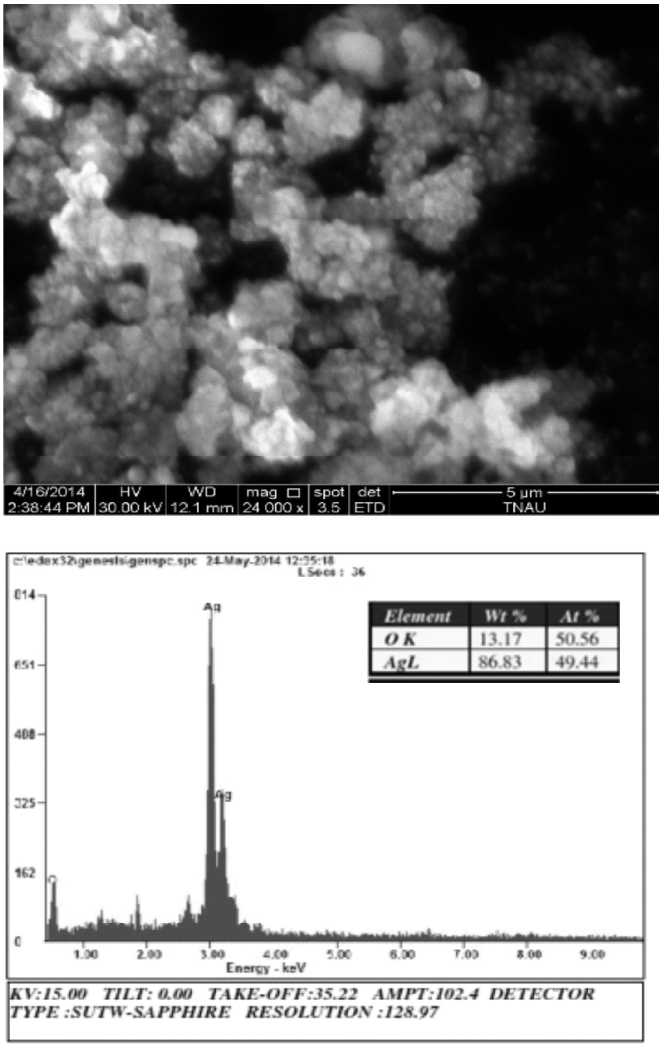

Figure 3: Image of green synthesized nanoparticles through SEM

Characterization of green synthesized silver nanoparticles through TEM with EDAX

The TEM image of the green synthesized silver nanoparticles showed spherical shape with particles size ranging from 10 to 50 nm. The EDAX spectrum analysis revealed the presence of clear silver elemental composition profile with the green synthesized AgNPs using *T. procumbans* in the present study. The appearance of peak for Cu from the TEM copper grid as shown in the Fig 4 also support the peak meant for silver ions due to green synthesized nanoparticles. The present findings fall in line with the report of He *et al*. (2013) who synthesized nanoparticles with spherical shapes using plant extracts of *Chrysanthemum morifolium* L.

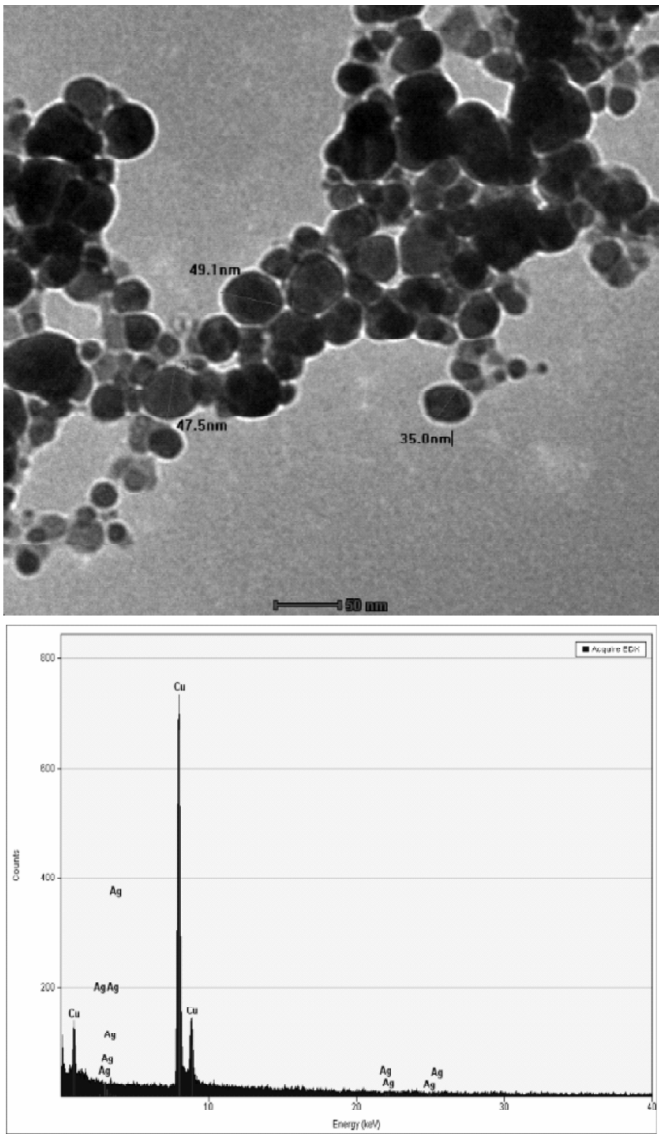

Figure 4: Characterization of green synthesized silver nanoparticles through TEM with EDAX

CONCLUSION

The results of green synthesis of silver nanoparticles and their characterization indicated that the weed plant *T. procumbans* is capable of acting as reducing as well as stabilizing agent to yield silver

nanoparticles with spherical shape and optimum size with the possession of silver elemental composition, property of agglomeration etc., as desirable physical and chemical characters of metal nanoparticles. In continuation a study on the influence of the green synthesized silver nanoparticles on nematodes, fungal and bacterial pathogens is in progress.

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