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Biosynthesis and Characterization of Silver Nanoparticles Using Leaf Extract *Abutilon indicum*

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Abstract: Plant mediated silver nanoparticle synthesis has been reported as a good alternative for physical and chemical methods the present work, nano scaled silver were synthesized from the plant extract of *Abutilon indicum* under atmospheric conditions through green synthesis of silver nanoparticle. A systematic characterization of silver nanoparticles was performed using UV, FTIR, SEM and antimicrobial studies. The diameter of silver nanoparticles was predominantly found within the range 50-100 nm. The novelty of this study is to comprehend a suitable biocompatible herbal reductant for biosynthesis of silver nanoparticles at a very cost effective level and the results are quite encouraging.

Key words: *Abutilon indicum* · Biosynthesis · Nanoparticle · Eco-Friendly · Antibacterial Activity

INTRODUCTION

Nanotechnology is the most promising field for generating new application in medicine in recent years, the development of efficient green chemistry methods employing natural reducing, capping and stabilizing agents to prepare silver nanoparticles with desired morphology and size have become a major focus of researchers [1, 2]. The bio-reduction of metal ions by combinations of bio-molecules found in the extracts of certain organisms is environmentally benign, yet chemically complex. Many studies have reported successful synthesis of silver nanoparticle using organisms [3, 4].

The major advantage of using plant extracts for silver nanoparticle synthesis is that they are easily available, safe and nontoxic in most cases, have a broad variety of metabolites that can aid in the reduction of silver ions and are quicker than microbes in the synthesis. The main mechanism considered for the process is plant-assisted reduction due to phytochemicals [5].

Abutilon indicum belonging to family Malvaceae is distributed throughout all tropical zones. *A. indicum* is reported to be used to treat ulcers, headaches, gonorrhea, bladder infection, inflammation, hepatic and pulmonary disorders. There are several reports proved that this plant also used as demulcent, aphrodisiac, laxative, diuretic and sedative (leaves), diuretic; laxative, expectorant and demulcent [6] The leaves can also be used to treat ulcers, headaches, gonorrhea and bladder infection, Such plants root, bark, flowers, leaves and seeds are very much used in Siddha medicines. The leaves are also used for pile complaints [7] So far not adequate characterization of its analgesic and anti-inflammatory activity has not been yet confirmed. Hence, this study shows the synthesis of AgNPs from ethanolic extraction of *A. indicum* and it is anti-inflammatory and antioxidant properties of carrageenan induced paw edema in inflammatory rats [8]. Plant extract of *Abutilon indicum* under atmospheric conditions through green synthesis of silver nanoparticle. A systematic characterization of silver nanoparticles was performed using UV, FTIR, SEM and antimicrobial studies.

MATERIALS AND METHODS

Reagents and Chemicals: 0.001 M Silver Nitrate was obtained from Sigma Aldrich. Freshly prepared distilled water was used throughout the experiment.

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Silver Nitrate Preparation: Silver nitrate was used as organic solvents, chemical reduction and photo-reduction precursor for the synthesis of silver nanoparticles. In reverse micelles and radiation chemical reduction Analytical grade, silver nitrate (AgNO3) was prepared for have been reported in the literature. Most of these 16.96 mg of silver nitrate was carefully weighed and methods are extremely expensive and also involve the use dissolved in 90 ml of Milli-Q-water. This aqueous Silver of toxic, hazardous chemicals, which may pose potential nitrate solution, was always prepared fresh.

Preparation of Plant Extract: The different plant *Abutilum indicum* of were collected from home garden and the campus of SPK Centre for Environmental Sciences, Manonmaniam Sundaranar University, Alwarkurichi, Tamilnadu. In this experiment, the above mentioned natural products extract were involved in the synthesis of silver nanoparticles. About 10 g of natural products were washed with double distilled water and finely chopped and boiled it with 100 ml double distilled water at 60-80°C for 10 min. After that, the solution was filtered through nylon mesh cloth and stored at 4°C for further nanoparticle synthesis process.

Synthesis of Silver Nanoparticles: The silver nitrate was purchased from Hi-media Laboratories, Mumbai. Separately, 10 ml of Plant extract were added to 90 ml of 1 mM AgNO3 and kept at room temperature. The color of the solution was change from yellow to brown color indicates the formation of silver nanoparticles and the absorbance of silver nanoparticles in the solution were monitored at different time interval using UV-vis spectroscopy.

Test Bacterial Strains: The two bacterial strains used in the present study were obtained from Microlabs, tamil nadu, india. They are *Bacillus sp.* and *Streptococcus* sp. cultures were purchased from Microlabs, Chandigar, India.

Antibacterial Assay by Using Agar Well Diffusion Method: The antimicrobial activity is tested using silver nanoparticles, *Abutilum indicum* extract against from *E.coli* and *Streptococcus aurous*. The diameter of zone of inhibition can be measured in millimeters.

Characterization of Synthesized Metal Nanoparticles: Successfully synthesised nanoparticles were characterized by spectroscopic techniques like UV-vis spectroscopy, Fourier transform infrared spectroscopy (FTIR) and Scanning Electron Microscope (SEM).

RESULTS AND DISCUSSION

Synthesis of Silver Nanoparticles: Reduction of silver ions into silver nanoparticles during exposure to plant extracts was observed as a result of the color change. The color change is due to the Surface Plasmon Resonance phenomenon Fig: 1. The metal nanoparticles have free electrons, which give the SPR absorption band, due to the combined vibration of electrons of metal nanoparticles in resonance with light wave. The broad bands of silver nanoparticles were observed around 420 nm in case of *Abutilon indicum* Fig: 1 From different literatures it was found that the silver nanoparticles show SPR peak at around 420 nm. From our studies we found the SPR peak for *Abutilon indicum* at 420 nm we confirmed that *Abutilon indicum* leaf extract has more potential to reduce Ag ions into Ag nanoparticles, which lead us for further research on synthesis of silver nanoparticles from *Abutilon indicum* leaf extracts. The intensity of absorption peak increases with increasing time period.

Fourier Transform Infrared Spectrometer (FT-IR): FTIR measurements were carried out to identify the biomolecules for capping and efficient stabilization of the metal nanoparticles synthesized. The FTIR spectrum of silver nanoparticlesratios showed the band between, 2028 cm-1 corresponds to –c=c- stretch H- alkynes Fig. 2. The peak found around 2360 cm-1 showed a stretch for C=N and nitriles band, Therefore the synthesized nanoparticles were surrounded by proteins and metabolites such as terpenoids having functional groups. From the analysis of FTIR studies we confirmed that the carbonyl groups from the amino acid residues and proteins has the stronger ability to bind metal indicating that the proteins could possibly from the metal nanoparticles (i.e.; capping of silver nanoparticles) to prevent agglomeration and thereby stabilize the medium. This suggests that the biological molecules could possibly perform dual functions of formation and stabilization of silver nanoparticles in the aqueous medium. Carbonyl groups proved that flavanones or terpenoids absorbed on the surface of metal nanoparticles. Flavanones or terpenoids could be adsorbed on the surface of metal nanoparticles, possibly by interaction through carbonyl groups or δ-electrons in the absence of other strong ligating agents in sufficient concentration.

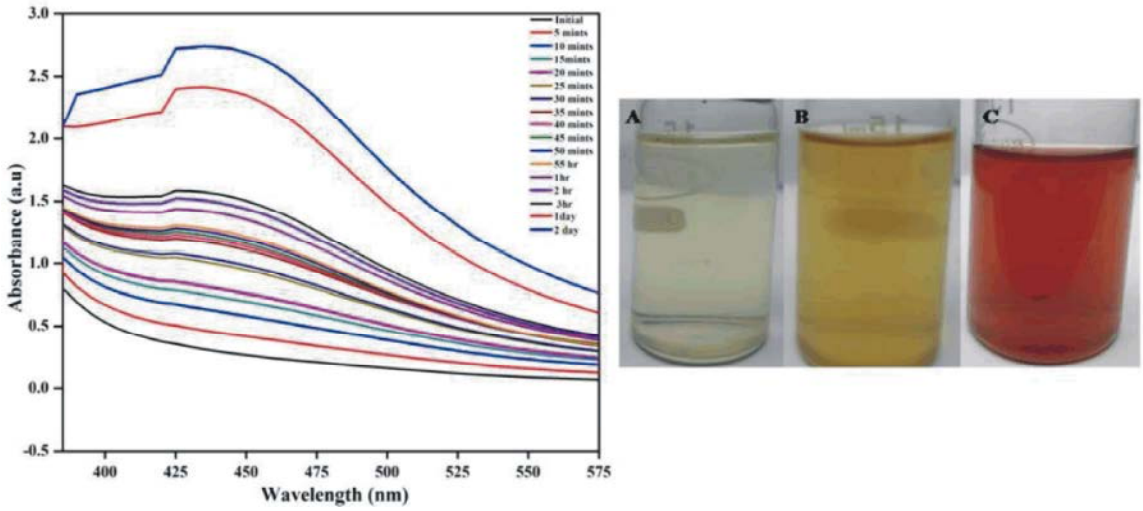

Fig. 1: UV-Vis spectrum analysis Plasmon resonance of silver nanoparticles reduced by *Abutilum indicum* at 440 nm and UV Visible Spectroscopy and Color Change for the Green Synthesized Silver Nanoparticles (A) silver solution (B) *Abutilum indicum* plant extract (C) synthesized silver nanoparticle in brown color solution

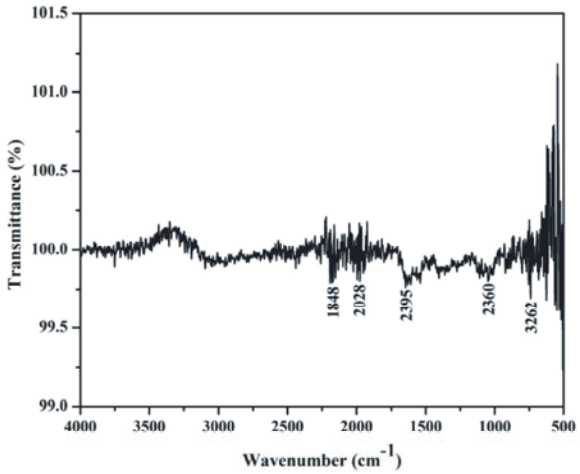

Fig. 2: FTIR spectrum of A) *Abutilum indicum* B) gold nanoparticles synthesized by plant *Abutilum indicum*

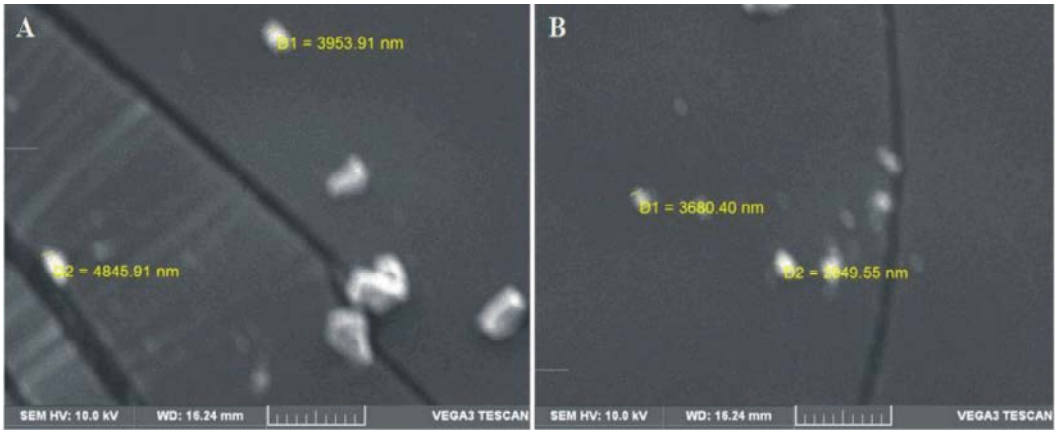

Fig. 3: Scanning electron microscope image of gold nanoparticle synthesized by plant *Abutilum indicum*

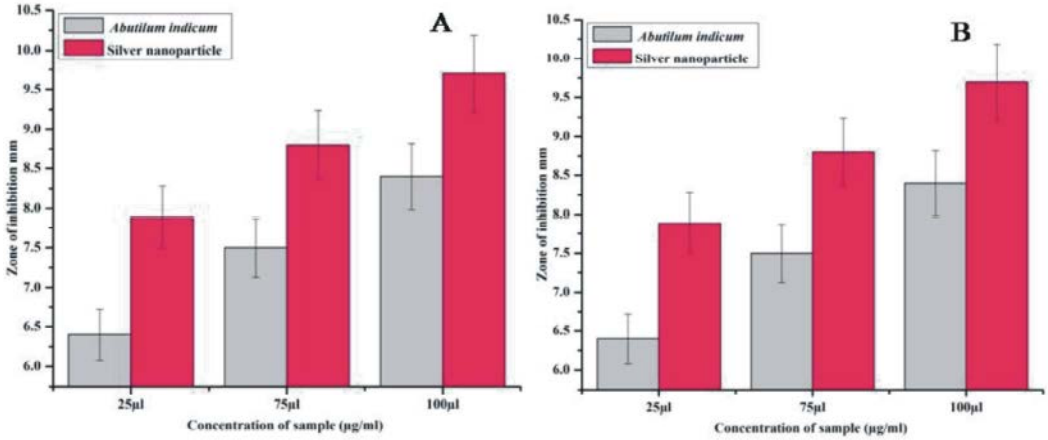

Fig. 4: Antimicrobial activity of silver nanoparticle using A) *Bacillus sp.* B) *Streptococcus s.*

Scanning Electron Microscope (SEM): The SEM image showed relatively spherical shape nanoparticle formed with diameter range SEM provided further insight into the morphology and size details of the silver nanoparticles. The size of the prepared nanoparticles was more than the size of nanoparticle which should be; i.e.; between 1-100 nm Fig. 3. The size was more than the desired size as a result of the proteins which were bound in the surface of the nanoparticles. The result showed that the particles were of spherical shape.

Antibacterial Activity Analysis: The current study was designed to characterise selected medicinal plant extracts, previously demonstrated to exhibit antibacterial activity against drug-resistant Gram positive and negative bacteria [9]. The experiments described here were specifically undertaken to investigate The *Abutilum indicum* extract mediated synthesis of silver nanoparticle exhibit strong antibacterial activity against *E. coli*, *Streptococcus aurous* Fig. 4 around 21-33 mm. Silver nanoparticle showed the most notable antibacterial effect and the inhibition zone diameter increased when compared to plant extracts. *Abutilum indicum* mediated Silver nanoparticle using *E.coli* and *Streptococcus aurous* Zone of Inhibition (mm). *Bacillus sp.* was the most sensitive to silver nanoparticle (100 µg/ml) followed by *Streptococcus sp.* (50 µg/mL). Recent reports also suggest similar mechanism where gold nanoparticles functionalized with small molecules have shown good antibacterial activity Fig. 4.

CONCLUSION

The rapid biological synthesis of silver nanoparticles using *Abutilon indicum* leaves extract provides environmental friendly, simple and efficient route for synthesis of benign nanoparticles. The synthesized nanoparticles were of spherical and sheet shaped and the estimated sizes were 160-180 nm. The size were bigger as the nanoparticles were surrounded by a thin layer of proteins and metabolites such as terpenoids having functional groups of amines, alcohols, ketones, aldehydes, etc., which were found from the characterization using UV-vis spectrophotometer, FTIR SEM and antibacterial activity.

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