GREEN SYNTHESIS OF SILVER NANOPARTICLES FROM LEAF EXTRACTS OF *ASCLEPIAS CURASSAVICA*

Rajesh TP1, Narendhar C2, Sivakumar Ponambalam A1, Mohanambal V1, R.Dheeran[1]
[1] Department of Biotechnology, Ann Univeristy, BIT campus Trichy, Tamilnadu
[2]Department of Nanotechnology, Sri Ramakrishna Engineering College, Coimbatore, Tamilnadu.
***Corresponding author:** E-mail:tprajesh2009@gmail.com

ABSTRACT

Nanoparticles have a wide variety of potential applications in biomedical, optical and electrical fields. Due to these applications research in nanoparticles is an area of intense scientific interest. In this work we have synthesized silver nanoparticles using the leaf extract of *Asclepias curassavica.* This paper describes a rapid and eco-friendly method for green synthesis of silver nanoparticles from aqueous solution of silver nitrate using *Asclepias curassavica* leaf extract. Formation of stable silver nanoparticles AgNO3 gave mostly spherical particles with a diameter ranging from 75 to 95 nm. It was observed that the use of *Asclepias curassavica* leaf extract makes a fast and convenient method for the synthesis of silver nanoparticles and can reduce silver ions into silver nanoparticles within 20 min of reaction time without using any severe conditions.

KEYWORDS: *Asclepias curassavica*,silver nanoparticles, silver nitrate.

1. INTRODUCTION

Nanobiotechnology is an upcoming branch of nanotechnology which have been playing an important role in the field of medical science and electronics. Physical chemical properties nanoparticles synthesis: Solvothermal synthesis, which is a versatile low temperature route in which polar solvents under pressure and at temperatures above their boiling points are used. Under solvothermal conditions, the solubility of reactants increases significantly, enabling reaction to take place at lower temperature. Synthesis and characterization of nanoparticles is an important area of research as selection of size and shape of nanoparticles provide an efficient control over many of the physical and chemical properties. Biological materials like plant leaf extract, bacteria, fungi and enzymes are used for the green synthesis of silver nanoparticles (Abdel-Aziza, 2013; Awwad, 2013; Bhandary and Chandrasekhar, 2011).

Recently, green bio-reduction methods for the synthesis of silver nanoparticles were adapted by many researchers using plant extracts such as Macrotyloma uniflorum, Anacardium Mushroom extract, Coleus amboinicus lour, Medicago sativa, and Citrus sinensis peel etc (Christensen, 2011; Firdhouse and Lalitha, 2010). It has been reported that silver nanoparticles (SNPs) are non-toxic to humans and most effective against bacteria, virus and other eukaryotic micro-organism at low concentrations and without any side effects (Firdhouse, 2010; Gangula, 2011). Moreover, several salts of silver and their derivatives are commercially manufactured as antimicrobial agents Antimicrobial capability of SNPs (Gavhane, 2012; Joshi, 2011) allows them to be suitably employed in numerous household products such as textiles, food storage containers, home appliances and in medical devices (Kantamreddi, 2010; Kavitha, 2013). The most important application of silver and SNPs is as tropical ointments to prevent infection against burns and open wounds.

2. MATERIALS AND METHODS

2.1. Plant material collection: The plants were collected from Pachaimalai hills region of Salem district.

2.2. Sample processing: The plant material was cleaned in running water, stems and leafs were separated, cut into small pieces and air dried in shade for three days to facilitate size reduction through grinding (Krishnaraj, 2009; Kulkarni, 2011).

2.3. Preparation of Plant Extract: Fresh leaves collected and 2g dried powder of leaves was boiled in 20ml of distilled water at 100^0c for 10mins.After cooling of the plant extract, it is centrifuged at 10000rpm for 10mins and filtered in whatman No.1 filer paper and 5ml of extract was collected (Kumar and Suryanaraya, 2009; Lakshmi, 2011).

2.4. Preparation of sliver nitrate: 1mM silver nitrate was dissolved in 25ml of distilled water. It was kept in sonicator for 15 mins for complete dissolution of silver nitrate in distilled water.

2.5. Preparation of silver nanoparticles: 5 ml of fresh leaves extract was added to a beaker containing 25 ml of 1 mM aqueous $AgNO_3$ solution and heated at 65^0C with continuous stirring. Silver ions were reduced to silver nanoparticles in the extract within 20 mins. The reduced silver nanoparticles can be observed by colour change from light yellow to black.

2.6. Sample preparation of silver nanoparticles in powder form: The synthesized colored solution was centrifuged at 16000rpm for 5mins, the supernatant was discard. The Pellet was taken and 2ml ethanol solution added .Then it was dried in the fume hood to get dried powder.

3. RESULTS

The plants material *Asclepias curassavica* collected from Pachaimalai hills region of Salem district. Was thoroughly ground after cleaning it is running water, and cutting the steam and leaves into small pieces.2g dried powder of fresh leaves was boiled for 20mins, 20ml of distilled water set at 100^0c for 10mins. It was allowed to cool for some time. This cooled plant extract was centrifuged at 10000rpm for 10mins and filtered in Whattman No.1 filer paper.

The nanoparticles were primarily characterized by UV-Vis spectroscopy, which was proved to be a very useful technique for the analysis of nanoparticles. Reduction of Ag^+ ions in the aqueous solution of silver complex during the reaction with the ingredients present in the plant leaf extracts observed by the UV-Vis spectroscopy revealed that silver nanoparticles in the solution may be correlated with the UV-Vis spectra. As the leaf extracts were mixed with the aqueous solution of the silver

ion complex, it was changed into dark yellowish-brown color due to excitation of surface plasmon vibrations, which indicated that the formation of silver nanoparticles.

UV-Vis spectrograph of the colloid of silver nanoparticles has been recorded as a function of time by using a quartz cuvette with silver nitrate as the reference. In the UV-Vis spectrum, the broadening of peak indicated that the particles are poly dispersed.

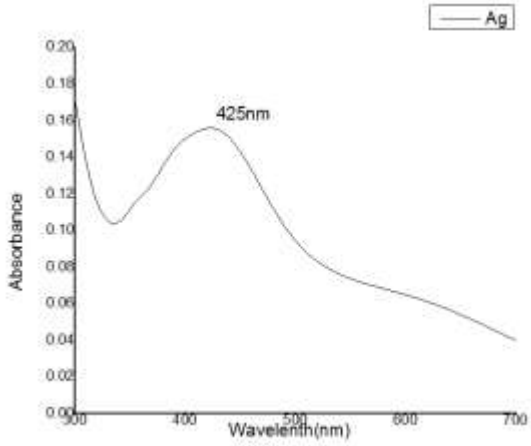
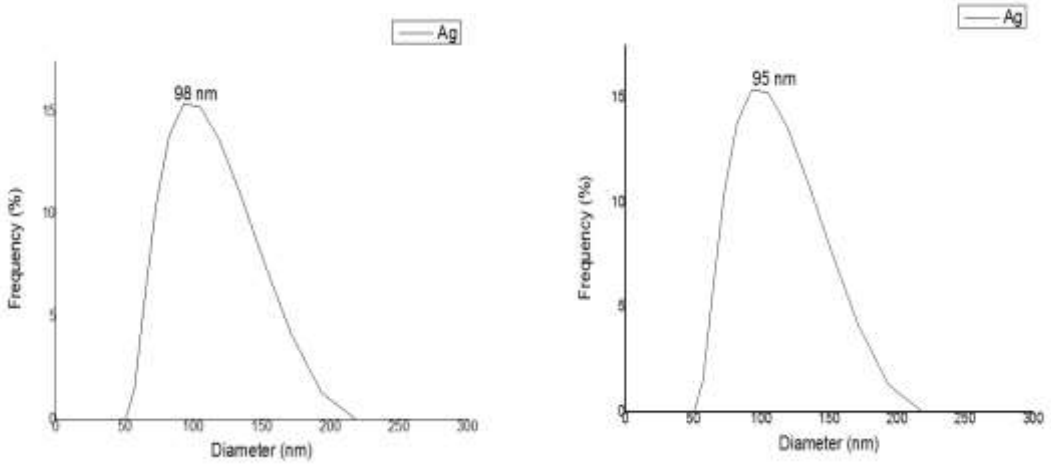


Figure 1, UV-Visible spectra of Ag nanoparticles

The reduction of silver ions and the formation of stable nanoparticles occurred rapidly within 20 min of reaction making it one of the fastest bioreduction methods to produce silver nanoparticles. The surface plasmon band in the silver nanoparticles solution remains close to 425 nm throughout the reaction period indicating that the particles are dispersed in the aqueous solution, with no evidence for aggregation (Figure 1).

3.1. Particle size analysis: The particle size analysis of the synthesized nanoparticle in aqueous reaction media and dry silver nanoparticles dispersed in distilled water using zeta sizer in DLS mode was shown in the (Figure 2)



A **B**

Figure 2, Particle size analyse in DLS mode using zeta size A – Aqueous Sample; B – Dry Sample

The particle size analysis was done by measuring the average particle size in the aqueous reaction media after the completion of reduction. It was observed that the average particle size was 95 nm which indicates the presence of silver nanoparticles. The average particle size was also analyzed for the dried silver nanoparticles dispersed in water. The average particle size in dry sample was observed as 98nm. Hence it was concluded that the average size of the silver nanoparticles were in the range of 1 to 100 nm.

3.1. FTIR (Fourier transform infrared spectroscopy: FT-IR spectra of biosynthesized silver nanoparticles Results of the FT-IR study of biosynthesized AgN03 showed sharp absorption peaks located 2,963, 1,640, 1,445,1363 cm−1 (Figure 2; Table 1). The absorption peak at 1,608 cm−1 may be assigned to the amide I bond of proteins arising from carbonyl stretching in proteins, and the peak at 1,445 cm−1 is assigned to C-C stretch(in ring) Aromatics compounds. The absorption peak at 1363 cm−1 is close to that reported for native proteins, which suggests that proteins are interacting with biosynthesized silver nanoparticles and also their secondary structure was not affected during reaction (C-H stretch Alkanes) groups in *Asclepias curassavica* leaf extract are mainly involved in reduction of Ag+ ions to silver nanoparticles. The FT-IR spectroscopic study also confirmed that the protein

present in *Asclepias curassavica* leaf extract acts as a reducing agent and stabilizer for the silver nanoparticles and prevents agglomeration. The carbonyl group of amino acid residues has a strong binding ability with metal, suggesting the formation of a layer covering silver nanoparticles and acting as a stabilizing agent to prevent agglomeration in the aqueous medium.

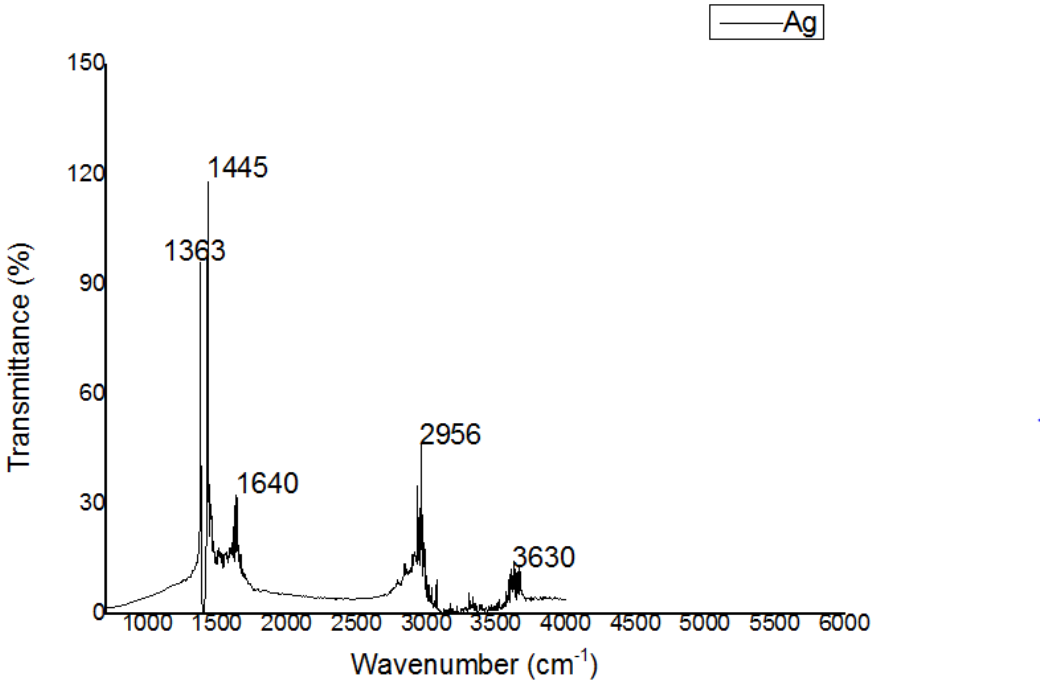


Figure 2, FTIR Spectra of the synthesized particles

Table 1, FTIR Interpretation table showing characteristic absorption

Frequency(cm-1)	Bond	Functional group
2963 cm-1	C-H Stretch	Alkanes
1640 cm-1	C-C Stretch	Alkanes
1445 cm-1	C-C Stretch	Aromatics
1363 cm-1	C-H rock	Alkanes

FT-IR spectroscopic study confirmed that the Aromatic group of Alkanes residues has a strong binding ability with silver, suggesting the formation of a layer covering silver nanoparticles and acting as a capping agent to prevent agglomeration and provide stability to the medium, yet further research is needed in this area to explore the possible bimolecular responsible for the bioreduction process.

3.3. XRD (X –ray diffracto meter): The particle size and nature of the silver nanoparticle were determined using XRD. This was carried out using analytical, Netherlands. Specification poly crystalline analytic collimators and small angle x-ray scattering for wet and dry analysis. X-ray powder diffraction is a rapid analytical technique primarily used for phase identification of a powder material and can provide information on unit ell dimensions. It was observed that the nanoparticles solution was stable, XRD is commonly used for determining the chemical composition and crystal structure of a material; therefore, detecting the presence of silver nanoparticles in plants tissues can be achieved by using XRD to examine the diffraction peaks of the plant. In our experiment the X-ray pattern of synthesized silver nanoparticles matches the FCC structure of the bulk silver with the broad peaks at 38.14°. 44.4º and 28.13º. These are corresponding to 111, 200, 311 planes, respectively. In addition to the Bragg peak representative of FCC silver nano crystals, additional and yet unassigned peaks were also observed suggesting that the crystallization of bio-organic phase occurs on the surface of the silver nanoparticles the line broadening of the peaks is primarily due to small particle size.

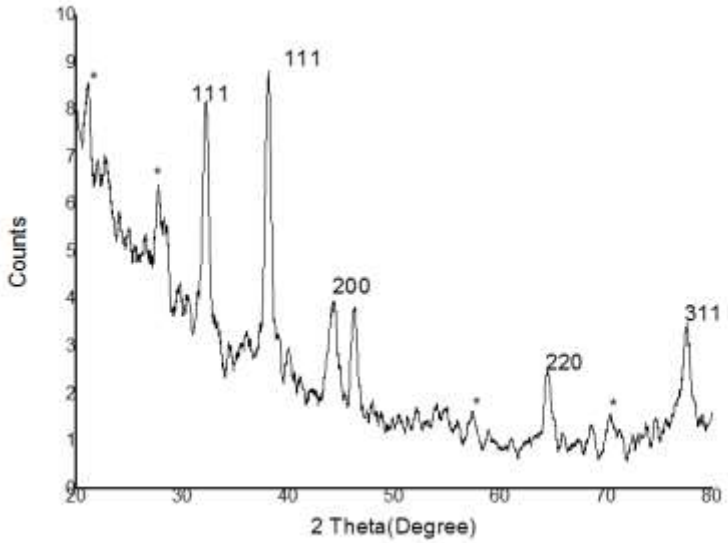


Figure 3, XRD pattern of biosynthesized silver nanoparticles

The bio-reduction of aqueous silver ions by the leaf extract of the *Asclepias curassavica* has been demonstrated. The reductions of the metal ions through leaf extract leading to the formation of synthesized nanoparticles are quite stable in solution. The control of shape and size of silver nanoparticles seems to be easy with the use of plant leaf extracts. In the present study we found that leaves can be good source for synthesis of silver nanoparticle. The synthetic methods based on naturally occurring biomaterials provide an alternative means for obtaining the nanoparticles. Use of plants in synthesis of nanoparticles is quite novel leading to truly 'green chemistry' route. This green chemistry approach towards the synthesis of nanoparticles has many advantages such as, process scaling up, economic viability and safe way to produce nanoparticles.

4. CONCLUSION

We have developed a fast, eco-friendly, and convenient green method for the synthesis of silver nanoparticles from silver nitrate using *Asclepias curassavica* leaf extract at ambient temperature. *Asclepias curassavica* leaf extract is found suitable for the ambient temp continuous stirring. Colour changes occur due to surface plasmon resonance during the reaction with the ingredients present in the *Asclepias curassavica* leaf extract resulting in the formation of silver nanoparticles, which is confirmed by XRD, FT-IR, Particle size analysis, UV-Vis spectroscopy, FT-IR spectroscopic study confirmed that the Alkanes group of amino acid residues has a strong binding ability with silver, suggesting the formation of a layer covering silver nanoparticles and acting as a capping agent to prevent agglomeration and provide stability to the medium, yet further research is needed in this area to explore the possible biomolecule responsible for the bioreduction process.

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