

# Green Synthesis and Characterization of Silver Nanoparticles by Aerial Parts of *Achyranthes Aspera* Linn

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**Abstract** - The present study pacts with synthesis and characterization of silver nanoparticles using aqueous extract of *Achyranthes aspera*. The synthesis of silver nanoparticles was analyzed by changes of colour from greenish to reddish brown and it indicates the formation of silver nanoparticles. The nanoparticle was also characterized by Surface Plasmon Resonance through UV- Visible spectroscopic analysis. A methodical characterization of silver nanoparticles was performed using UV, SEM, FTIR, EDAX and antibacterial activities. Antibacterial activity shown by synthesized silver nanoparticles against microbial pathogens such as *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Staphylococcus aureus*, *Klebsiella pneumoniae* and *E.coli* by agar well diffusion method. The significant antibacterial was observed.

**Keywords:** FTIR, SEM, EDAX, Silver nanoparticles, Medicinal plants, Antibacterial test

## I.INTRODUCTION

Silver nanoparticles are one of the promising products in the nanotechnology industry. The development of consistent processes for the synthesis of silver nanomaterials is an important aspect of current nanotechnology research. One of such promising process is green synthesis. Silver nanoparticles can be synthesized by several physical, chemical and biological methods. However for the past few years, various rapid chemical methods have been replaced by green synthesis because of avoiding toxicity of the process and increased quality. 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

*Achyranthes aspera* is a perennial herb belonging to the family of Amaranthaceae. It grows throughout the tropical and warmer regions of the world. The plant was reported to contain many phytochemicals like alkaloids, flavonoids, tannins, terpenoids, saponins, glycosides, steroids etc. The pharmacological properties of *Achyranthes aspera* was also established by many scientific reports as anti-microbial (Saravanan *et al.*, 2008), hypoglycemic (Akhtar *et al.*, 1991), cancer chemo-preventive (Chakraborty *et al.*, 2002), hepatoprotective, analgesic (Sutar *et al.*, 2008), anti-pyretic, anti-inflammatory and anti-arthritic (Vijaya *et al.*, 2009), hypolipidemic, nephroprotective (Jayakumar *et al.*, 2009), diuretic and immunomodulatory. Here we report green

synthesis of silver nanoparticles using leaf extract which was confirmed by using various characterization techniques.

## II.MATERIALS AND METHODS

### *Collection of plant samples*

*Achyranthus aspera* evergreen herb native to Southern part of Tamilnadu. The herb was collected from Tirunelveli district Tamilnadu. The samples were washed, airdried and powdered.

### *Aqueous extract*

*Achyranthus aspera* leaves and thorns were broken with help of mortar and pestle. The plant extract were prepared by using 5gm of washed and cut leaves in a 250ml Erlenmeyer flask with 50ml of sterile distilled water and then boiling the mixture for 5min. The herbal aqueous extract was collected in separate conical flasks by standard filtration method and stored at 4°C in a refrigerator. The plant extract was collected for the synthesis of nanoparticles (Torresday *et al.*, 2003).

### *Synthesis of silver nanoparticles*

One milimolar aqueous solution of silver nitrate (Himedia, Mumbai) was prepared for synthesis of silver nanoparticles (Park *et al.*, 2011). For the synthesis of AgNps, two boiling tubes were taken, one containing 10ml of 1mM AgNO<sub>3</sub> solution as control and the second containing 9ml of 1mM silver nitrate solution and 1ml of plant extract as test solution. These were incubated at room temperature for 1-2 hours. The colour change of the leaf extracts from pale yellow to dark brown was checked periodically. The brown colour formation indicates that the silver nanoparticles were synthesized from the plant extract and they were centrifuged at 5000rpm for 15 minutes in order to obtain the pellet which is used for further study. Supernatant is discarded and the pellet is dissolved in deionized water. The silver nanoparticles were confirmed by colour changes and qualitatively characterized by UV-Visible spectrophotometer

### Characterization of silver nanoparticles

The synthesized silver nanoparticles were characterized with the help of UV-Visible spectrophotometer. Functional groups were analyzed by Fourier Transform Infra-Red Spectroscopy. SEM and EDAX spectrum were recorded by focusing on morphology and clusters of particles.

### Antibacterial activity

*Pseudomonas aeruginosa*, *Bacillus subtilis*, *Staphylococcus aureus*, *Klebsiella pneumoniae* and *E.coli* was inoculated in nutrient broth and incubated overnight at 37°C. 0.1 ml of culture was added in soft agar and mixed well. This was poured on basal agar plate. After 30 min. of incubation at 4°C, plates were punched using 5mm cork borer. Control plate was prepared by adding 10µl of silver nitrate solution & 50µl of plant extract in wells. All plates were incubated at

37°C for 48hrs. After incubation, zone of inhibition was measured (Perez *et al.*, 1990).

### III. RESULTS AND DISCUSSION

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 (Ojha *et al.*, 2013). The present study, when we added the plant extract of *A.aspera* to the 0.1M of silver nitrate aqueous solution, colour of reaction mixture rapidly change yellowish to reddish brown due to the reduction of silver ions  $Ag^+$  to silver nanoparticles and excitation of surface plasmon vibrations, which indicates the formation of silver nanoparticles (Figure 1 &2).

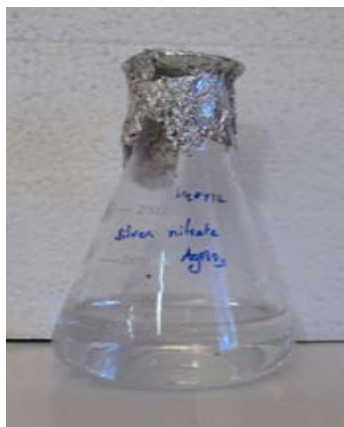


Fig. 1. Silver nitrate solution

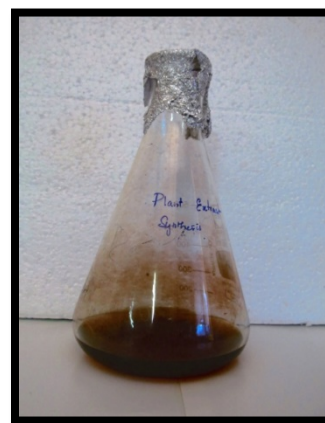


Fig. 2. Silver nanoparticles

### Characterization

The *A. aspera* extract mediated nanoparticles showed absorbance peaks at nm region in the spectral analysis. The peaks were stable with time duration also. It indicates that the synthesis of silver nanoparticles requires the reduction of  $\alpha$ -NADPH to  $\alpha$ -NADP<sup>+</sup> and the hydroxy quinoline

probably acts as electron shuttle transforming the electron generated during the reduction of nitrate to  $Ag^+$  ions convert them to  $Ag^0$  (Figure 3). SEM analysis shows that the *Achyranthes aspera* leaf extract has shown the ability to synthesize Silver nanoparticles which are roughly spherical in shape. This SEM analysis was performed just after the synthesis of the nanoparticles (Figure 5).



Fig 3. UV Spectroscopy

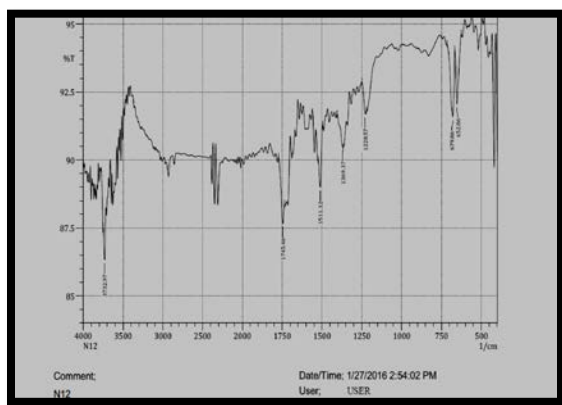


Fig. 4. FTIR Analysis

Fourier transform infrared spectroscopy analysis of the silver nanoparticles showed absorption peaks of reduced silver at  $1745.46\text{ cm}^{-1}$ . The stretching vibration of C=O obtained and single absorbance peak located at  $1511.12\text{ cm}^{-1}$  (Figure 4). EDAX results, a peak of silver and confirmed

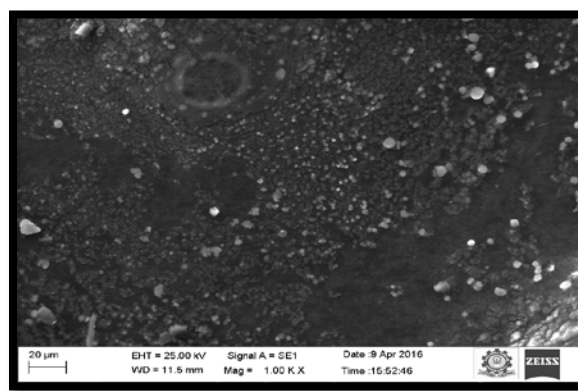


Fig. 5. SEM

the presence elemental silver in the suspension (Figure 6 & 7). This result is with consistent with many reports, leaf extract of *Aloe barbadensis* (Chikdu *et al.*, 2015) and leaf extract of *Euphorbia hirta* (Durgadevi *et al.*, 2014).

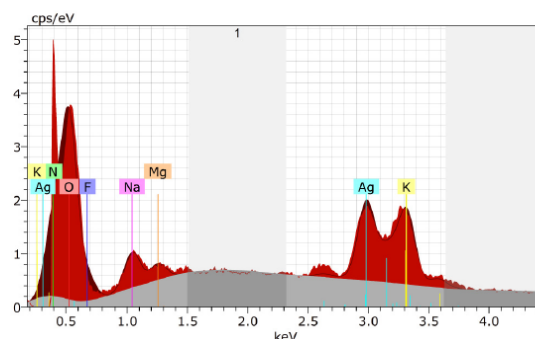
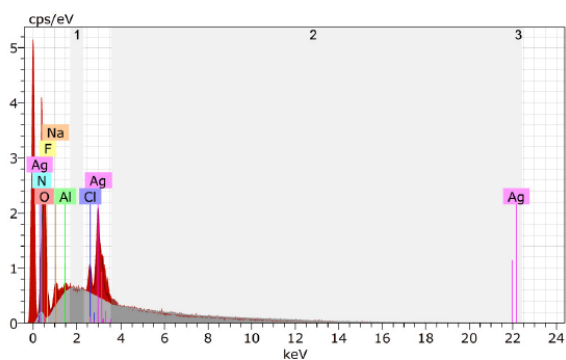


Fig. 6. EDAX analysis

**Antibacterial activity**

The selected plant mediated synthesized silver nanoparticles showed good inhibitory activity against *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Staphylococcus aureus*, *Klebsiella pneumoniae* and *E.coli*. In the present study the silver nanoparticle synthesized using aqueous extract of *A.*

*aspera* as reducing agent has exhibited a significant antibacterial activity against *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Klebsiella pneumoniae* with distinct zone of inhibition as per table no.1 which is more as compare to silver nitrate solution (control) against only three pathogen here in our present work we detect antibacterial activity against five pathogens (Table 1).

TABLE I ZONE OF INHIBITION (IN DIAMETER IN MM) OBTAINED BY SILVER NANOPARTICLES PRODUCED BY *ACHYRANTHES ASPERA* EXTRACT.

S.No.	Microorganisms	Zone of Inhibition (mm)	
		Silver nitrate	Silver nanoparticles
1	<i>Pseudomonas aeruginosa</i>	15	13
2	<i>Bacillus subtilis</i> ,	-	-
3	<i>Staphylococcus aureus</i>	13	12
4	<i>Klebsiella pneumoniae</i>	13	12
5	<i>E.coli</i>	-	-

#### IV.CONCLUSION

It has been demonstrated that the plant extract is capable of producing silver nano particles that shows good stability in solution. The antibacterial activity shows by leaf extract synthesized silver nanoparticles indicates green synthesis a potential route for metal nanoparticles synthesis in biomedical sector.

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