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ECO-FRIENDLY SYNTHESIS OF SILVER NANOPARTICLES USING AQUEOUS EXTRACT OF *PHYLLANTHUS NIRURI* AND THEIR EVALUATION FOR ANTIMICROBIAL ACTIVITY

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ABSTRACT

Eco-friendly synthesis of silver nanoparticles (AgNPs) was done by bio-reduction method. The synthesized nanoparticles were characterized by UV-visible spectrophotometer. X-ray diffraction (XRD), Field emission scanning electron microscopy (FESEM), Zetasizer, and High resolution transmission electron microscopy (HRTEM). For the evaluation of antimicrobial activity cup plate method was used. Silver nanoparticles were formed with in 1 h as observed by change in colour of the solution from light yellow to dark brown. The UV- visible spectrophotometer showed a absorption peak between at 380-460 nm and which was the characteristic of AgNPs due to Surface plasmon resonance. X-ray diffraction analysis revealed the crystalline nature of AgNPs. The size distribution was measured by Zeta sizer, which revealed that majority of size distribution of AgNPs were in the range of 50-70 nm. FESEM and HRTEM images showed the spherical nature of the particles. Biosynthesized AgNPs showed antimicrobial activity against gram positive and gram negative bacteria.

INTRODUCTION:

Nanotechnology is a multidisciplinary research field that emerges from physical, chemical, engineering and materials science with novel techniques and produces material at nanoscale[1]. This technology is mainly concerned with the synthesis of nanoparticles of variable size, shape, chemical composition and controlled dispersity and their potential use for human benefits[2]. Generally, particles less than 100 nm are considered as nanomaterials[3].

Nanoparticles are very important and they have unique properties when compared to bulk materials, i.e., large surface area to volume ratio. Due to the high surface volume and smaller size, nanoparticles are involved in a many applications such as catalysis[4], drug delivery[5]. Among different types of technologies, nanotechnology is one of the cutting-edge technology which connecting various academic disciplines of science.

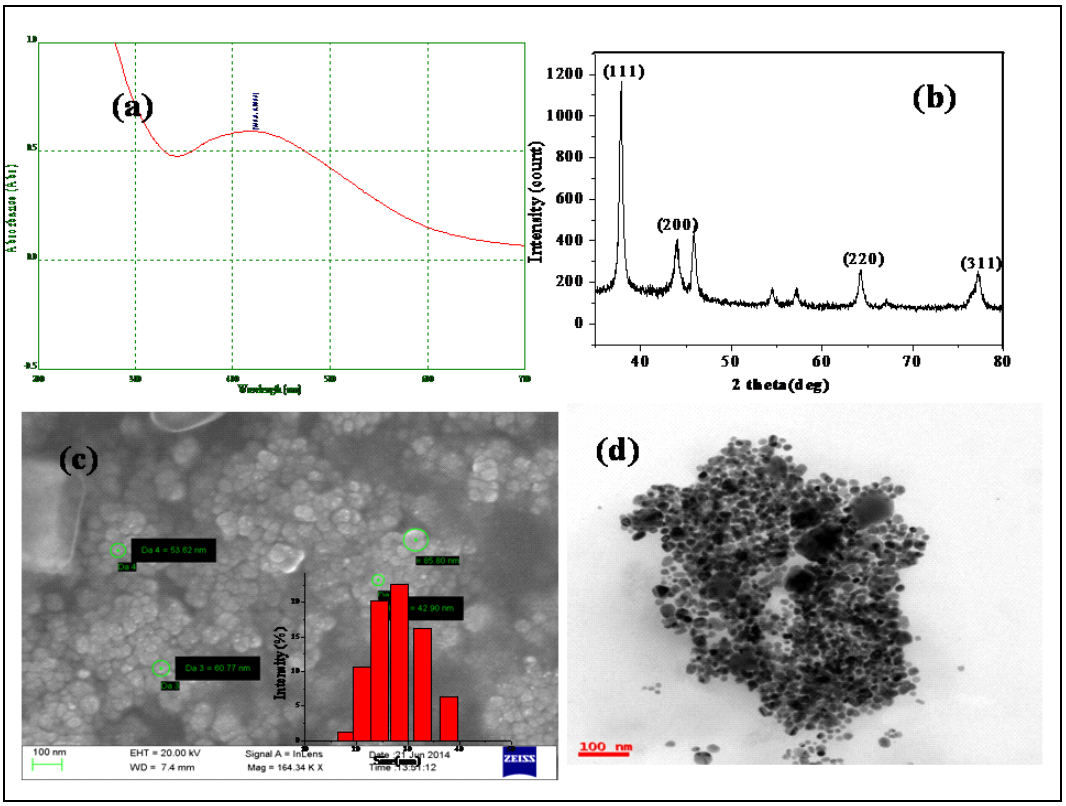

Fig-1: (a) UV-visible spectrum of AgNPs, (b) XRD pattern of AgNPs,(c) and (d) FESEM and HRTEM of AgNPs.

Table-1: Antibacterial activity (Zone of Inhibition) results of silver nanoparticles of *Phyllanthus niruri*.

S. No	Test pathogen	Zone of Inhibition (mm)			
		Volume of AgNPs dispersion			Streptomycin
		10µl	20 µl	30 µl	30 µl
1	***Escherichia coli***	10	10	11	11
2.	***Stephylococcus aureus***	9	10	10	12

Silver nanoparticles (AgNPs) are involved in a many applications such as interest because of their potential applications in mechanics[6], optics[7], sensors[8], drug delivery[9] etc. The main advantage of green approach for synthesis of nanoparticles over traditional chemical and physical synthesis methods is production in aqueous media under standard conditions leads to many cost advantages, in terms of both capital equipment and operating expenses, especially in the purchase and disposal of solvents and other consumable reagents. Various plant extracts including *Tithonia diversifolia, Cissus quadrangularis, Cassia angustifolia* were also reported for biosynthesis of AgNPs. *Phyllanthus niruri* known as "Stone breaker" is plant belonging to the Euphorbiaceae family with worldwide distribution and it is used in folk Brazilian medicine for patients with Urolithosis[10].

EXPERIMENTAL METHODS

The *Phyllanthus niruri* was collected during flowering season from Sri Venkateswara University, Tirupathi, India. 10 gm of fine powder was dissolved in 100 ml of distilled water and heated up to 70^0C for 30 min. Solution was filtered with Whatman No. 1 filter paper. For the preparation of AgNPs, 10 ml of aqueous leaf extract was added to 90 ml of 1mM $AgNO_3$ solution and kept in a dark place at room temperature. Bio-reduction was monitored by visual observation and spectrophotometrically[11]. The formed

nanoparticles were characterized by UV-visible spectrophotometer (UV-vis), X-ray diffraction (XRD), Field emission scanning electron microscopy (FESEM), Zeta sizer, High resolution transmission electron microscopy (HRTEM). Synthesized AgNPs tested against both gram positive and gram negative bacteria via cup plate method method for their antimicrobial activity.

RESULTS AND DISCUSSION

Nanoparticles were formed with in 1 h as observed by change in colour of the solution from light yellow to dark brown. The UV-visible spectrophotometer showed absorption peak between 380-460 nm and which is the characteristic of AgNPs due to Surface plasmon resonance shown in Fig.1(a). X-ray diffraction (Fig.1 (b)) analysis revealed the crystalline nature of AgNPs. The size distribution was measured by Zeta sizer which revealed that majority of size distribution of AgNPs was in the range of 50-70 nm. FESEM and HRTEM images showed the spherical nature of the particles shown in Fig.1(c) and Fig.1(d) respectively. Biosynthesized AgNPs showed antimicrobial activity against gram positive and negative bacteria *Escherichia coli* and *Stephylococcus aureus* respectively.

Synthesized AgNPs exhibited effective antimicrobial activity against both gram positive and gram negative bacteria. The values of ZOI placed in table 1. The exact mechanism for the antimicrobial activity of AgNPs is not yet known, but hypothetically, many studies reported that the AgNPs could bind to the bacterial membrane, invade the cell and cause dissipation of proton motive force which leads to the disruption of bacterial cell by forming pores on the bacterial cell wall.

CONCLUSION

In the present work, we report the bio-reduction of silver salts into silver nanoparticles using extract of *Phyllanthus niruri* by simple, eco-friendly method. The synthesized AgNPs were spherical in nature and well dispersed with average size of 60 nm evidence by HRTEM and particles size studies. The synthesized AgNPs were proved as excellent antimicrobial agent.

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