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Phytomediated synthesis and characterization of silver nanoparticles from the leaf extracts of *Clausena anisata* (Willd.) Hook. F. Ex Benth. and its antimicrobial activity

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Abstract
Development of biologically inspired phytomediated synthesis of silver nanoparticles is evolving into an important branch of nanobiotechnology. In the present investigation, we report the phytomediated synthesis of silver nanoparticles (AgNPs) employing the leaf extract of *Clausena anisata* (Willd.) Hook.f. ex Benth (Rutaceae). The synthesized Ag-NPs were characterized by UV-visible, X-ray diffraction (XRD), Fourier-transform infrared (FT-IR), Scanning electron microscopy (SEM), and Energy dispersive X-ray (EDX). Formation of silver nanoparticles was confirmed by the change of colour from pale yellow to dark brown in colour. These results authenticated that the appearance of AgNPs was analyzed by UV- visible spectrum around the peak 420 nm. XRD (X-ray diffractometer) demonstrated the formation of crystalline AgNPs with FCC structure having an average crystalline size of 20.42 nm from XRD profile. FT-IR analysis revealed the presence of different functional groups in the synthesized AgNPs. Antimicrobial activity of the synthesized silver nanoparticles was evaluated against Gram positive and Gram negative bacteria such as *Bacillus subtilis*, *Staphylococcus aureus*, *Streptococcus faecalis*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Escherichia coli* and fungus *Candida albicans*. Both the leaf extract and synthesized silver nanoparticles from the leaves of *Clausena anisata* showed moderate antimicrobial activity.

Keywords: phytomediated synthesis, characterization, *clausena anisata*, silver nanoparticles, antimicrobial activity

Introduction

Nanotechnology deals with the production and stabilization of various types of nanoparticles (Feymen, 1991) [6]. In order to obtain nanoparticles in large quantities within a short period, physical and chemical procedures are used (Bigall and Eychmuller, 2010) [5]. Biologically synthesized silver nanoparticles (Ag-NPs) have wide range of applications because of their remarkable physical and chemical properties (Balantrapu and Goia, 2009) [2]. Nowadays research mainly based on advanced nanomaterials of noble metals like silver has attracted a lot of interest among scientists during the past decades for its physiochemical properties such as size, distribution and morphology, they have been studied for catalytic activity, optical properties, electronic properties, antibacterial properties and magnetic properties (Song and Kim, 2009; Santos *et al* 2012) [15, 14] and its application in various field such as biomaterial production, biochemistry, medical and pharmaceutical products, toothpastes, optical receptors, biosensing, etc. (Banerjee *et al* 2014; Navaladian *et al.* 2007; Rajasekharreddy *et al.* 2010) [3, 12, 13].

Silver nanoparticles of range between 1 nm and 100 nm in size and have attracted intensive research interest. It is generally recognized that silver nanoparticles may attach to the cell wall, thus rupturing cell-wall permeability and cellular respiration. The nanoparticles may also penetrate inside the cell causing damage by interacting with phosphorus and sulfur containing compounds such as DNA and protein. Generally, silver does not adversely affect viable cells and does not easily provoke microbial resistance (Srividhya *et al.* 2018) [16]. Very recently plant extract of *Neolitsea sericea* (Srividhya Pattabiraman *et al.* 2018) [16], *Hugonia mystax* L (Tamilsevan *et al*. 2016) [17], *Corchorus tridens* (Karuppasamy *et al.* 2019) [10], *Abutilon indicum* (Ashokkumar *et al*. 2013) [1] reported in literature with nanoparticle size ranging from 5 to 20 nm are brimming in literature as a source for the synthesis of silver nano silverparticles as an alternative to the conventional methods. It is evident from the previous reports that no work has been carried for the synthesis, characterization and antimicrobial assay of synthesized silver nanoparticles from the aqueous leaf extracts of *Clausena anisata* (Willd.) Hook.f. ex Benth. By considering the vast potentiality of plants as sources, the present study was envisaged to apply a biological green technique for the synthesis of silver nanoparticles as an alternative to conventional methods.

Materials and Methods

Preparation of *Clausena anisata* leaves extract

The AR grade of silver nitrate was purchased from Sigma-Aldrich chemicals in India. Microbial strains were procured from Department of Biology, Gandhigram Rural Institute - Deemed University, Gandhigram. Mueller–Hinton broth and agar were purchased from Hi-Media, Mumbai, India and fresh leaves of *Clausena anisata* were collected from Pothigai hills, Tenkasi District, Tamil Nadu, India. 25g of the fresh leaf powder was mixed with 100 ml of double distilled water and transferred into the 500 ml beaker and boiled at 100°C for 40 minutes and then brought down to room temperature. Further, the extract was filtered with Whatman No.1 filter paper and stored at 4°C.