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Green Synthesis of Silver Nano Particles Derieved from Leaf Extract *of Syzygiumcuminii (SNSC)* – to Evaluate Antibacterial Activity

K. P. Ghoshal
Department of Botany. DhoteBandhu Science College, Gondia, Maharashtra India
kalpanaghoshal@gmail.com

Abstract: *Synthesis of metals nanoparticles from the plant or plant extracts has emerged as an important alternative to the chemical method. The biological approach to the synthesis of nanoparticles has many advantages such as non-elaborative process, no multiple purification steps, no need of intracellular synthesis and dosenot require maintenance of microbial cell cultures. Medicinal plants and green synthesis of silver nanoparticles (AgNPs) have proven to be good sources of agents effective in the treatment of various diseases. The present study focuses on the green synthesis of SNSC, silverna noparticles (AgNPs) from leaf extract of Syzygiumcuminii in order to evaluate the antibacterial properties of this extract and synthesized AgNPs. The characterization of the Synthesized nanoparticles (SNSC) was determined using UV-VIS spectroscopy, TEM,X ray diffraction and FTRI studies, silver nanoparticles (AgNPs) showed absorption peak at 470 nm in aqueous medium in UV-VIS spectrum. TEM analysis shows themorphology of AgNPs as a hexagonal matrix with average particle size of about 50 nm. XRD analysis displays the crystalline structure of AgNPs.FTIR analysis shows that amide groups present in proteins are dominant reducing agents and play an important role in the bio reduction of Ag+ ions to Ag0. The synthesized silver nanoparticles from leaf extract of Syzygiumcuminii(SNSC) showed antibacterial activity against common clinical pathogens. Owing to the remarkable potential antibacterial activity against common pathogenic microorganisms, the synthesized AgNPs derieved from SNSCcan have potential for development in medical applications in the future..*

Keywords: Silver Nanoparticles, Syzygiumcuminii, Antibacterial Activity

I. INTRODUCTION

Nanotechnology constitutes strategies for synthesis of new nanomaterial's. It is an economic alternative to chemical and physical methods for the synthesis of nanoparticles. Nanoparticles represent completely new and improved properties based on specific characteristics such as size distribution and morphology (Logeswari and Abrahim. 2015).Recently, nanotechnology has gained significant attention due to its unique and different properties such as catalytic, electrical, optical, magnetic and thermal, having wide range of applications.

They are extensively used in various fields like cosmetics, textiles, food industries and medicines.Numerous approaches are in practice to generate AgNPs such as chemical, electrochemical, photochemical and radiation. The best and ecofriendly way to synthesize nanoparticle is a biological method as because this green technology does not involve any toxic chemicals (Zhang etal 2006). There is still a need to enhance and develop high yield, low cost, non-toxic and environmentally friendly procedures using green extracts like bark, leaf, root etc which are non toxic and has effective stability, for which the biological loom for the synthesis of NPs becomes crucial.(Prasad et.al.,2012; Ajay M. Ghatole et. al. 2012)

The use of leaf extract for nanoparticle synthesis is low-cost and eliminates the need for culture preparations and maintenance of aseptic conditions required for microorganisms. Syzygiumcuminii, a traditional medicinal tropical plant commonly referred to as Jamun or java pulm, belonging to Family Myrtaceae(Banerjee and Narendhiranrakanan, 2011; Ajay M. Ghatole et. al. 2014) is also recognized for its antifungal, antioxidant, anti-inflammatory, hypolipidaemic, hypoglycaemic and pharmacological properties, due to the presence of bioactive compounds in various parts of the

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plant (Gadekar et.al. 2021). However, the remedial outcome of medicinal plants has been consistently queried due to little bio-availability of the chief constituents subsequent to metabolic conversion in the liver. The use of nanoparticles confirmed to be a valuable substitute, as they are biodegradable, biocompatible and can allow the sustained release of specific drug (Ghoshal et.al. 2020)

Therefore, the study describes a simple, facile, rapid and efficient green process for the synthesis of AgNPs using the aqueous leaf extract of Syzygiumcumini to evaluate there antibacterial activity against common human pathogenic bacteria like Pseudomonas aeruginosa, Serratia marcescens, Staphylococcus aureus, Salmonella typhimurium and Klebsiella pneumonia.

II. Materials And Methods

2.1 Preparation of Plant Extract

Syzygiumcumini leaves were chopped into small pieces, washed thoroughly in running tap water for 20 min and shade dried for two days at room temperature. Then dry leaves were grind into fine powder in a mortar and pestle. The extract obtained was filtered through Whatman filter paper No.1. The filtrate was collected and stored at 4°C, and was further used for all experiments

2.2 Synthesis of AgNPs

The material (well grinded leaf)was mixed with 100 mL of double distilled water (DDW) and then transferred in 500 mL Erlenmeyer flask which was continuous stirred on the magnetic stirrer for about 10 min. Then the content was centrifuged at 10,000 rpm for 10 min to remove of cell debris. 50 mL of aqueous silver nitrate (1 mM) was added to 10 mL of the leaf extract with continuousstirring. A color change from colorless to yellowish-brown, visually confirms the formation of AgNPs

2.3 Characterization

The resulting solution was then diluted by using double distilled water and characterized using UV–Visible spectroscopy, X-ray diffraction, Transmission electron microscopy Energy dispersion spectroscopyand FT-IR analysis.

2.3.1 UV-visible spectroscopy

The synthesized Silver nanoparticles were characterized by using Systronics UV–Vis spectrophotometer. The bio-reduction absorption spectra was observed at about 300–700 nm range.

2.3.2 X-ray diffraction spectroscopy

AgNPs synthesized using Syzygiumcumini leaf extract were lyophilized to powdered form and then were coated on the XRD grid, and the spectra was recorded using Rich Seifert p 300 instruments.

2.3.3 Transmission electron microscopy and Energy dispersive spectroscopy

TEM (Transmission electron microscopy) studies were carried out to know the morphology of the biosynthesized AgNPs (The size and shape of the AgNPs were recorded by using the FEI (Netherland) model TECNAI-G2U twin operated at an accelerating voltage of 200 KV. EDS analysis was carried out at the same time by the EDS compatible with TEM.

2.3.4 Fourier transform infrared spectroscopy (FTIR) analysis

The biosynthesized AgNPs were centrifuged at 10,000 rpm for 15 min. The pellet obtained were re-dispersed in double distilled water to removal any uncoordinated bio-molecules, The process of centrifugation was repeated twice in order to obtain the better separation of nanoparticles. The purified pellet was then subjected to FTIR analysis (Shimadzu IR).

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2.5 Antimicrobial activity

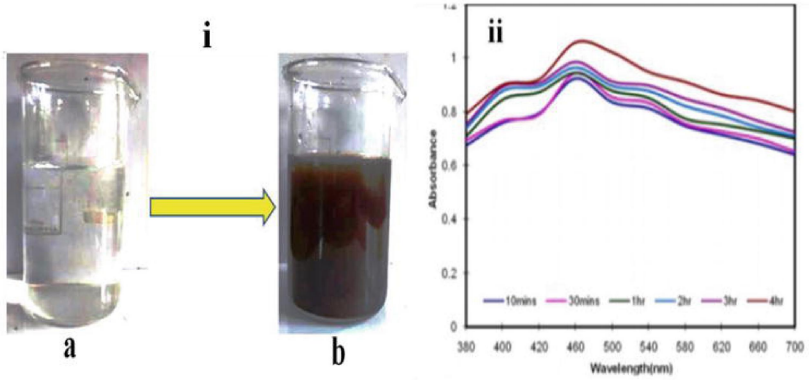
The antimicrobial activity of the biosynthesized nanoparticles were assessed by Disc Diffusion method (Baurer et al.,1959) against pathogenic bacteria such as Serratia marcescens (NCIM 2078), Staphylococcus aureus (NCIM 5021), Pseudomonas aeruginosa (NCIM 5029), Salmonella typhimurium (NCIM 2501) and Klebsiella pneumonia (NCIM 2957), etc.

The organisms were collected from National Chemical Laboratory (NCL), Pune. Bacterial cultures were uniformly spread carried out in the individual plates using a sterile glass spreader. Using a cork borer wells of about10 mm diameter were made on the agar plates. 100 µg ofAgNPs were added in 100 µL of distilled water. And 50 µL dispersed solution was added to the well. The diameters of zone of inhibition surround the wells were measured in millimeters after 24 h.

III. Result and Discussion

3.1 Biosynthesis of Silver nanoparticles

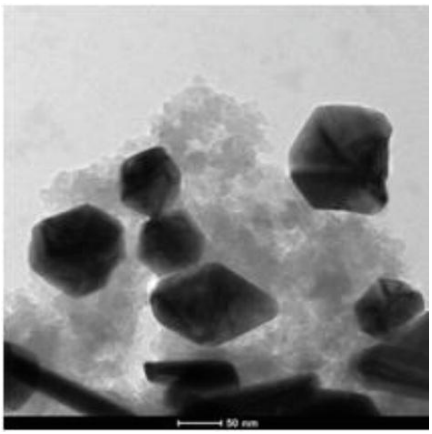
The (SNSC) Silver nanoparticles were synthesized using Syzygiumcumini leaf extract. The reduction of Ag+ to Ag0 NPs was carried out by aqueous leaf extract of Syzygiumcumini. The color change of the solution (from colorless to yellowish-brown) observed indicated the synthesis of AgNPs shown in Fig1 i.The UV–Vis absorption spectrum of the biosynthesized AgNPs showed a characteristic absorption peak at 470 nm, (a typical band for the silver) shown in Fig iiFurther confirmation of AgNPs was done by using X-ray diffraction (XRD), Transmission electron microscopy (TEM) analysis and FT-IR, EDS



3.2.1 Transmission Electron Microscopy Analysis

The TEM analysis is being carried out to describe the size, shape and morphology of the biosynthesized AgNPs.(Fig 2) it is observed that the AgNPs is showing a hexagonal matrix and the average particle size measured is 50 nm, which are in good agreement with the particle size calculated from XRD analysis.

TEM image of Silver nanoparticle.



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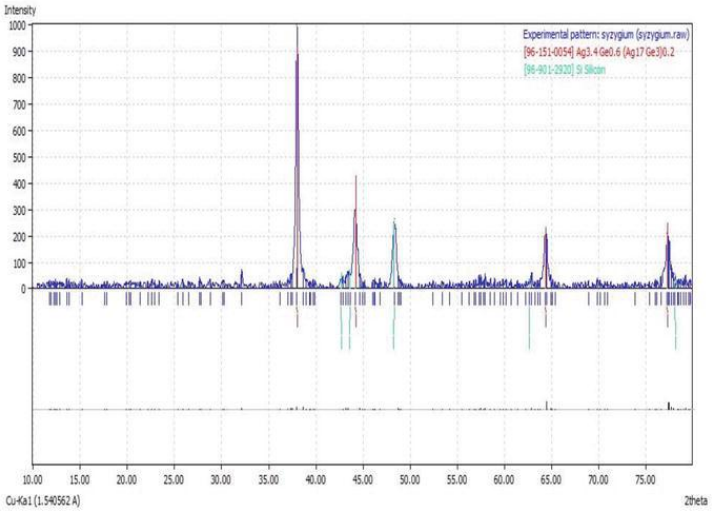
3.2.2 X-Ray Diffraction Analysis

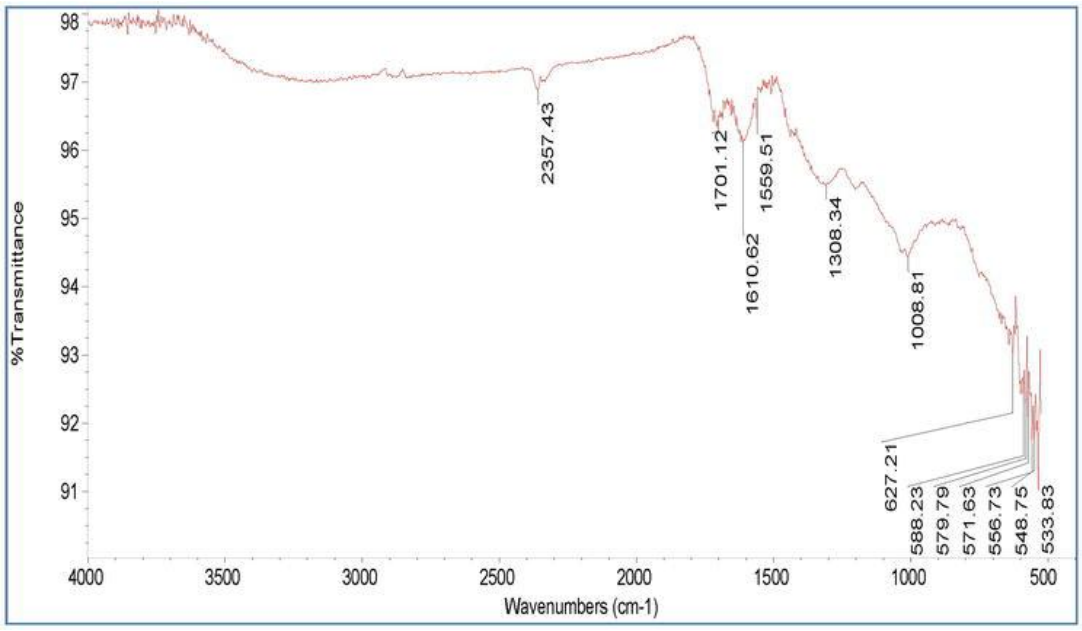
The Ag crystal in the sample was confirmed by using an X-ray diffracto meter. In XRD pattern, the Braggs reflections were observed at 2θ value 38.00, 44.80, 47.50, 64.60 and 78.00 confirm the presence of AgNPs Fig 3 A strong diffraction peak located at 38.00 was ascribed to the (111) facets of Ag. Thus clearly indicating that the AgNPs are in crystalline form. No impurities were observed in the XRD pattern.



XRD patern of synthesized AgNPs

3.2.4 Fourier transform infrared spectroscopy (FTIR) analysis

FTIR absorption spectra of AgNPs are shown in the Figure below.The different possible functional groups at various positions will be determined by using FTIR analysis. The band at 1559 cm−1 indicates the presence of amide group. arises due to carbonyl stretch in proteins. It can be stated from FTIR analysis. The band at 1610 cm−1 is attributed to the stretching vibration of (NH) C=O group. That amide groups present in carbohydrates, proteins are dominant reducing agents and play an important role in the bio-reduction of Ag+ ions to Ag0 leading to nanoparticles synthesis.



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3.4 Antibacterial Activity

Antibacterial activity of biosynthesized AgNPs was investigated against human pathogens. The synthesized AgNPs showed a high inhibitory effect on bacteria, and it may serve as an option for decreasing bacterial infections [36]. The zone of inhibition was found to be as per Table 1.

Sr.no	Name of the Organism		Diameter of inhibition zone
1	Pseudomonas aeruginosa NCIM 5029		14
2	Serratia marcescens NCIM 2078		18
3	Staphylococcus aureus NCIM 5021		22
4	Salmonella typhimurium NCIM 2501		16
5	Klebsiella pneumonia NCIM 2957		12

IV. CONCLUSION

The Syzygiumcumini leaf extract can be used for synthesis of nanoparticles.by reduccing Ag+ metal ions with fairly well-defined dimensions. This green approach for the synthesis of AgNPs has many advantages, such as the simplicity with which the process can be commercialized.. The synthesized AgNPs showed excellent bacterial activity. Thus, this rapid, eco-friendly and economical route can be used to synthesize AgNPs with wide biotechnological and chemical applications. The antimicrobial screening showed that the synthesized AgNPs had a high inhibitory effect on bacteria. These observations may serve as a guide for studying the controlled release of AgNPs, in the field of controlling infectious diseases.

Conflict of interest

The authors of this have declared there is no conflict of interest.

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