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Synthesis of silver nanoparticles by endosymbiont *Pseudomonas fluorescens* CA 417 and their bactericidal activity

Baker Syed[a,b], Nagendra Prasad M.N.[c], Dhananjaya B.L.[d], Mohan Kumar K.[e,f], Yallappa S.[g], Satish S.[a,*]

[a] *Bionanotechnological Laboratory, Department of Studies in Microbiology, University of Mysore, Manasagangotri, Mysore, India*
[b] *Laboratory of Biotechnology of New Materials, Siberian Federal University, Siberia, Russia*
[c] *Department of Biotechnology, JSS Science and Technology University, JSS Technical Institutional Campus, Mysore 570006, India*
[d] *Toxicology and Drug Discovery Unit, Centre for Emerging Technologies (CET), Jain University, Ramanagara, 562 112, India*
[e] *Universidad Nacional Autonoma de Mexico, Instituto de Ciencias Fisicas, Avenida Universidad s/n, 62210, Cuernavaca, MOR, Mexico*
[f] *Department of Chemistry, Madanapalle Institute of Technology & Science, Post Box No: 14, Kadiri Road, Angallu (V), Madanapalle, 517325, Chittoor District, Andhra Pradesh, India*
[g] *BMS R and D Centre, BMS College of Engineering, Bangalore 560 019, India*

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ABSTRACT

The present study emphasizes on biogenic synthesis of silver nanoparticles and their bactericidal activity against human and phytopathogens. Nanoparticle synthesis was performed using endosymbiont *Pseudomonas fluorescens* CA 417 inhabiting *Coffea arabica* L. Synthesized nanoparticles were characterized using hyphenated spectroscopic techniques such as UV–vis spectroscopy which revealed maximum absorption 425 nm. Fourier transform infrared spectroscopy (FTIR) analysis revealed the possible functional groups mediating and stabilizing silver nanoparticles with predominant peaks occurring at 3346 corresponding to hydroxyl group, 1635 corresponding carbonyl group and 680 to aromatic group. X-ray diffraction (XRD) analysis revealed the Bragg's diffraction pattern with distinct peaks at 38° 44°, 64° and 78° revealing the face-centered cubic (fcc) metallic crystal corresponding to the (111), (200), (220) and (311) facets of the crystal planes at 2θ angle. The energy dispersive X-ray spectroscopy (EDS) analysis revealed presence of high intense absorption peak at 3 keV is a typical characteristic of nano-crystalline silver which confirmed the presence of elemental silver. TEM analysis revealed the size of the nanoparticles to be in the range 5–50 nm with polydisperse nature of synthesized nanoparticles bearing myriad shapes. The particle size determined by Dynamic light scattering (DLS) method revealed average size to be 20.66 nm. The synthesized silver nanoparticles exhibited significant antibacterial activity against panel of test pathogens. The results showed *Klebsiella pneumoniae* (MTCC 7407) and *Xanthomonas campestris* to be more sensitive among the test human pathogen and phyto-pathogen respectively. The study also reports synergistic effect of silver nanoparticles in combination with kanamycin which displayed increased fold activity up to 58.3% against *Klebsiella pneumoniae* (MTCC 7407). The results of the present investigation are promising enough and attribute towards growing scientific knowledge on development of new antimicrobial agents to combat drug resistant microorganisms. The study provides insight on emerging role of endophytes towards reduction of metal salts to synthesize nanoparticles.

1. Introduction

Nanoparticles are defined as ultrafine particles which are considered as particles of the century owing to their unique size dependent and physicochemical properties [1]. In a world marked by technological advances, these nanoparticles are playing significant role with myriad applications in multidisciplinary field of sciences [2]. Synthesis of nanoparticles can be grouped into top down and bottom up process but majority of these processes are bound with one or more limitations such as generation of high energy, use of toxic materials thus causing environmental pollutions and restricted use in biomedical applications [3–5]. In recent years, advance scientific domains have envisioned new era which unfolds the bio-nano revolution wherein biological entities are

* Corresponding author.
E-mail address: satish.micro@gmail.com (S. S.).

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