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Endo-symbiont mediated synthesis of gold nanobactericides and their activity against human pathogenic bacteria

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ABSTRACT

Synthesis of gold nanobactericides (AuNBs) were achieved by treating 1 mM chloroaurate with cell free supernatant of *Aneurinibacillus migulanus*. Formation of AuNBs was initially was monitored with change in colour to ruby red. Further confirmation was assessed with UV–visible spectra with maximum absorption occurring at 510 nm. Transmission electron microscopy (TEM) analysis revealed the polydispersity of AuNBs with size distribution ranging from 10 to 60 nm with an average size of 30 nm. Crystalline nature was studied using X-ray diffraction which exhibited characteristic peaks indexed to Bragg's reflection at 2θ angle which confers (111), (200), (220), and (311) planes suggesting AuNBs were face-centred cubic. Fourier transform infrared spectroscopy (FTIR) analysis revealed absorption peaks occurring at 3341 cm^{-1}, 1635 cm^{-1} and 670 cm^{-1} which corresponds to functional groups attributing to synthesis. The antibacterial efficacy of AuNBs was tested against selective human pathogenic bacteria and activity was measured as zone of inhibition by using disc and well diffusion. Bactericidal activity was interpreted with standard antibiotics gentamicin and kanamycin. Micro broth dilution assay expressed the minimal concentration of AuNBs to inhibit the growth of test pathogens. Highest activity was observed against *Pseudomonas aeruginosa* (MTCC 7903) with 21.00 $\pm$ 0.57 mm compared to other pathogens. The possible mode of action of AuNBs on DNA was carried out with *in vitro* assay as preliminary test against pathogenic DNA isolated from *P. aeruginosa*. Further studies will be interesting enough to reveal the exact interactive mechanism of AuNBs with DNA. Overall study contributes towards biogenic synthesis of AuNBs as one of the alternative in combating drug resistant pathogens.

1. Introduction

Nano-sized particles are of great interest to the scientific world owing to their unique physico-chemical properties (Wang et al., 2013). Particles at nano-size have traded their applications in different industrial sectors. In recent years, over usage of antibiotics against infectious pathogens has led to development of drug resistant era. In order to combat the expansion of drug resistant pathogens, scientific communities have engaged in developing new antimicrobial agents. Use of nano-size materials as antimicrobial agents forms one of the alternative tool against drug resistant pathogens. Nanobactericides are ultra fine particles with nano-dimension bearing bactericidal activity (Syed et al., 2016). Nanobactericides act efficiently against targeted pathogens with multiple mode of actions such as destruction in cell wall, causes oxidative stress, interrupting vital cell components, thus restraining cell proliferation (Duran et al., 2007; Li et al., 2014). Among different nanomaterials, metallic nanomaterials have immense potential and have been used in catalysis, sensing, drug delivery, biolabelling, electrical conductivity, food packaging, dressing materials and anti-infective agents (Kitching et al., 2015). However, gold forms one of the most precious metal and use of gold can be traced down in ancient records. The recent introduction of gold nanoparticles in technical world has led to its innumerable applications (Dreaden et al., 2012). One such application includes their evaluation against wide range of infectious pathogenic microorganisms. The profound bactericidal activity may be attributed to its unique properties like size, surface catalytic activity and low toxicity (Zhang et al., 2015). Synthesis of nanomaterials *via* conventional methods are not feasible owing to its cost effective,

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