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ORIGINAL ARTICLE

A Bacteriophage Mediated Gold Nanoparticles Synthesis and Their Anti-biofilm Activity

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Abstract In the present study, gold nanoparticles (AuNPs) synthesis was carried out by using a rare bacteriophage which is morphologically similar to 7–11 phages of the C3 morphotype of tailed phage belonging to Podoviridae family as green route. Effect of various physiological parameters like pH, temperature and concentration of gold chloride salt on AuNPs synthesis was studied. The reaction mixtures have shown vivid colours at various physiological parameters. Phage inspired AuNPs were further characterized by using different techniques such as UV–Vis spectrophotometry, scanning electron microscopy (SEM), energy dispersive spectroscopy (EDS), X-ray diffraction (XRD) and dynamic light scattering (DLS). DLS study revealed synthesis of various sizes of AuNPs in the range of 20–100 nm. SEM studies revealed synthesis of varied shaped AuNPs, viz., spheres, hexagons, triangles, rhomboids and rectangular etc. The presence of Au in the nanostructures was confirmed by EDS. The XRD pattern reflects the crystalline nature and nano size of AuNPs. These phage inspired AuNPs showed anti-bacterial activity against different bacterial pathogens. Anti-biofilm activity of AuNPs was evaluated on a glass slide. It was noticed that at 0.2 mM concentration of these AuNPs about 80% of biofilm formation by *Pseudomonas aeruginosa,* a human pathogen was inhibited. Thus, the phage inspired AuNPs synthesis could be potential therapeutic agents against human pathogens.

Keywords Bacteriophages · Biofilms · Biopharmaceuticals · Biotechnology · Viruses

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Introduction

Bacteriophages are a class of viruses with ability to multiply and survive in bacterial host cells [1]. Phages are found to be abundant with ability to persist in nature without their host. They have potential of a high resistance to various environmental conditions as compared to the host cells [2]. They have high specificity for their host and are explored extensively with respect to their applications in different fields. Lytic phages are considered as therapeutic agents for the treatment of human, animal and plant diseases. Phages have been used in food industries as biocontrol agents to control human and plant pathogens [3].

Recently, viruses are considered as valuable biological resources in the field of nanotechnology. Virus mediated nanoparticles synthesis is an attractive and could be a promising 'green technology'. M13 viruses are used in preparation of cobalt oxide nanowires and Co–Pt crystals [4]. Hybrid gold–cobalt oxide nano-wires are also synthesized by using gold binding peptides and incorporated into the filament coat of virus. Such nano-wires are being used in battery industries to improve the power of battery [4, 5]. Phagemid vectors are also used for expression of metal binding peptides on the major coat proteins and synthesis of semiconductor metallic nanowires [6, 7]. FCC iron

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