Article

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Biogenic Silver Nanoparticles Combined with L-Arginine Using *Escherichia coli* and their Antibacterial and Cytotoxic Activities via ROS Production against A-549 Cells

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Background: Silver and its nanoparticles have gained attention owing to their unique physicochemical properties which contribute to their antimicrobial and anticancer properties. The primary focus of this study was the synthesis of silver nanoparticles (AgNPs) using the cell filtrate of *Escherichia coli* (*E. coli*) American Type Culture Collection (ATCC) 8739.

Methods: Silver nanoparticles were synthesized using *E. coli* and coated with non-toxic, naturally occurring L-arginine. L-arginine-coated AgNPs (L-AgNPs) were tested for purity, elemental composition, morphology, topology, and stability. Subsequently, they were tested for their antibacterial, apoptotic, reactive oxygen species (ROS), and cytotoxic effects on A549 lung cancer cells using the 3-(4,5-Dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay.

Results: The study revealed the formation of well-defined nanoparticles with a spherical shape, falling within the size range of 8.8 nm to 44.6 nm. The L-AgNPs exhibited significant antibacterial characteristics, with the largest zone of inhibition observed against *Salmonella* spp. (18.7 $\pm$ 0.9 mm) and the smallest against *Bacillus cereus* (8.7 $\pm$ 0.9 mm). The half maximal inhibitory concentration (IC_{50}) value of L-AgNPs against A549 lung cancer cells was 58.67 µg/mL, while against 3T3-L1 cells, it was measured as 98.03 µg/mL via MTT assay. L-AgNPs induced apoptosis, as confirmed by morphological alterations in the cells, membrane blebbing, and chromatin condensation. These nanoparticles also triggered the production of reactive oxygen species (ROS) due to cellular oxidative stress, as indicated by the increased levels of dichlorodihydrofluorescein (DCF).

Conclusion: This research demonstrates the potential application of these L-AgNPs in the biotechnology and pharmaceutical industries for their antibacterial and anticancer properties.

Keywords: L-AgNPs; MTT assay; antibacterial; ROS; lung cancer

Introduction

Nanotechnology has expanded its applications across various sectors with the ability to work with materials in 1 to 100 nm size range. Strategies for effective therapeutic drug administration include implementing the emerging field of nanotechnology to suitable targets for better efficacy and safety [1]. Nanoparticles have immense applications in various fields, such as vaccines, drug therapy, and cancer treatment, and have attracted the attention of many researchers [2]. Functionalization of nanoparticles by surface modification enhances their availability and reduces toxicity, with unique applications in biomedicine [3].

The increasing prevalence of antimicrobial resistance (AMR) in the modern era has become a significant public health concern. It poses a significant challenge in effec-