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Original Article

Green Synthesis of Silver Nano Particles Structural Characterization and their Antioxidant and Anticancer Potential Using Adenocarcinoma (A549) Cell Line

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ABSTRACT

Background: Over the past two decades, Silver Nanoparticles (AgNPs) have demonstrated a wide range of antioxidant and anticancer properties. Vinca alkaloid exhibits the anticancer efficacy by direct metaphase arrest of cell division. **Aim:** The present study is to develop a green synthesis method for producing silver nanoparticles using vinca, the antioxidant and anticancer potential was assessed using A549 cells. **Materials and Methods:** The synthesized AgNPs were analyzed using Fourier Transform Infrared (FTIR) analysis, UV-visible spectrophotometer (UV), Scanning Electron Microscope (SEM) and Spectra Max i3X energy-dispersive X-ray (XRD) Spectroscopy to determine their physico-chemical and morphological characteristics. **Results and Discussion:** The FTIR spectrum of vinca AgNPs exhibited absorption bands at 692 cm^{-1}, 684 cm^{-1}, 611 cm^{-1}, 592 cm^{-1}, 578 cm^{-1}, 554 cm^{-1}, 548 cm^{-1}, 539 cm^{-1} and 526 cm^{-1}, indicating the presence of silver ion bounded nanoparticles derived from Vinca leaf. These findings suggest that vinca-coated AgNPs possess multiple functions that contribute to their stability. XRD data analysis revealed Bragg's reflections in the XRD pattern (2θ) at 24.75, 31.59, 37.56, 53.01, 64.93 and 76.27, confirming the crystalline nature of the green synthesized AgNPs. Elemental analysis was conducted to determine the elemental composition of the sample, which indicated that approximately 60% of the prepared nanoparticles were bound with silver ions, supporting the formulation. Antioxidant studies were performed using the DPPH assay at different concentrations of AgNPs, while cell-based cytotoxic assays were conducted using different concentrations of $AgNO_3$. **Conclusion:** The results demonstrated that the nanoparticles inhibited the proliferation of A549 cells and reduced cellular motility, indicating their promising anticancer efficacy.

Keywords: Silver Nanoparticle, Vinca, Anticancer, *Catharanthus roseus*, Antiproliferative.

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INTRODUCTION

Silver Nanoparticles

Nanotechnology is one of the rapidly expanding areas of study in technology, engineering and science that deals with nanoscale material manipulation. In the fields of biochemistry and commercial goods, nanomaterials are widely used in coatings, material packaging, cosmetics, targeted medicine delivery and drug carriers.[1,2] AgNPs, or silver nano particles, are inert inorganic metal particles with a size range of 1-100 nm.[3] These minuscule particles of metallic silver exhibit distinct characteristics such as stability, antibacterial activity, conductivity and catalysis.[4] They are therefore frequently used as antioxidant, antibacterial, antimicrobial and anti-inflammatory drugs.[5] As an alternative, plant extracts and microorganisms can be used to physiologically synthesise AgNPs.[6] It has been discovered that the synthesis rate of plant extract is higher than that of chemical processes and green synthesis produced by microorganisms.[7,8] It is well recognised that plant extracts contain in wide range of phytochemicals with distinct structures and bioactivities, including flavonoids, alkaloids, ketones, carboxylic acids and aldehydes. "The silver nanoparticles demonstrate superior antibacterial,[9] antifungal and antiviral properties compared to metallic silver and silver compounds.[10,11]" Utilizing biological processes to create nano particles is biocompatible because plants, in particular, release functional biomolecules that actively decreased metal ions.[12] Both ''Top-down and ''Bottom -up" methods can be used to create NPs. An assortment of techniques, including pulse laser ablation, evaporation-condensation and ball milling, are employed to break down a suitable bulk material into minuscule particles through size reduction in a top-down approach. Conversely, the bottom-up approach enables atoms to self- assembles into new

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