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Anti-cancerous activity of *Senna Montana* mediated AgNPs on human alveolar adenocarcinoma

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Abstract
Alveolar lung adenocarcinoma is the most prevalent form of cancer that leads to high mortality worldwide. The conventional chemotherapies affect human health and life in a disruptive way. To combat these, nanoatechnology stood as a promising solution with efficacy, also the green synthesis adds the potential to the nanoparticles with their phytochemicals. Hence, the present study was designed to synthesize the silver nanoparticles from *Senna Montana* – leaf, bark and fruit extracts and evaluate their anticancerous activtiy against A549 cell lines through MTT assay. The biosynthesized silver nanoparticles (SNPs) from various parts exhibited varying degrees of antiproliferative activity. The fruit-mediated SNPs (SmF) showed highest cytotoxic potential with an IC_{50} value of 32.1 µg/mL, followed by bark-derived SNPs (SmB) with an IC_{50} of 70.78 µg/mL. But, SNPs from leaf extract exhibited lower activity with an IC_{50} value of 95.08 µg/mL. The results indicate that *Senna montana*-mediated AgNPs, particularly those synthesized from fruit extracts, possess significant anticancer activity against A549 cells.

Keywords: *Senna Montana*, anticancerous activity, A549 cell lines

Introduction

Now-a-days, Cancer became a substantial burden on global health systems. The occurrence of various types of cancer is due to pollution, lifestyle, and genetic factors of humans. The urgent need is a safer and effective solution for conventional therapies to treat such dangerous cancers. Lung cancer is one of the most diagnosed cancers, causing a high mortality rate. Human alveolar lung adenocarcinoma, represented by A549 cell lines, is a major subtype of non-small cell lung cancer (NSCLC) and is characterized by its aggressive nature, high metastatic potential, and resistance to conventional chemotherapy (Sharma *et al*., 2019; Kamboj *et al*., 2025) [3, 4].

Multiple therapies such as chemotherapy, radiotherapy and targeted therapies have evolved in the medical systems, but their limitations: toxicity, drug resistance and non-specific targeting remain major challenges. Nanoparticles have gained attention as effective tools for drug delivery as well as direct anticancer agents, due to their unique physiochemical properties and ability to induce cytotoxic effects selectively in cancer cells (Tian *et al*., 2020; Amrithpal *et al*., 2019) [1, 9]. Especially, green synthesized nanoparticles using plant extracts has become an eco-friendly and cost-effective alternative to conventional chemical and physical methods. Plant-mediated synthesis eliminates the use of toxic chemicals and utilizes bioactive compounds such as flavonoids, alkaloids, and phenolics as reducing and stabilizing agents (Ramakrishna and Savithramma, 2023) [10]. This approach not only enhances biocompatibility but also improves the therapeutic potential of nanoparticles.

Medicinal plants have long been recognized as valuable sources of bioactive compounds with diverse pharmacological properties, including anticancer activity. Among these, *Senna Montana* is a promising medicinal plant known for its rich phytochemical composition. Although traditionally used for various therapeutic purposes, its potential in nanomedicine, particularly in the synthesis of anticancer nanoparticles, remains underexplored. Therefore, the present study focuses on the green synthesis of silver nanoparticles using different parts of *Senna Montana* and evaluates their anticancer activity against human alveolar lung adenocarcinoma (A549) cell lines.

Material and Methods

Parts of *Senna Montana* were collected from the Talakona hills, Seshachalam, Tirupati, India. They were thoroughly washed, dried, and powdered using a grinder. The aqueous extracts (8% w/v) were prepared using 500 ml Erlenmeyer flask containing 8g powder and 100ml deionized water and heated at 70 Cusinga hot plate for 2 h. The extract was obtained by centrifuge the mixture at 3000 rpm for 5 min followed the filtration using Buchner funnel and Whatman no.1filter paper. These filtrates were stored in the refrigerator for further use.

Synthesis and Characterization of Nanoparticles

Silver nanoparticles were synthesized from different parts of the plant by adding 5mL of plant extract to 50 mL of 1mM $AgNO_3$. Primarily, their synthesis was confirmed by colour change (Ankanna *et al*., 2010; Kumar *et al*., 2016) [5, 6]. These syntheiszed nanoparticle samples were characterized for their size, shape, and crystallinity by using UV-Vis spectrometry, FTIR, DLS, Z-Potential, and TEM analysis.

MTT assay

Senna Montana derived silver nanoparticles were evaluated for their toxicity towards human lung adenocarcinoma (A549) cell lines through MTT assay. Five different concentrations of SNPs (6.25, 12.5, 25, 50 and 100 µg/mL) were used to test the potentiality. 200 µl of cell suspension in a 96-well plate and allowed to grow for 24 hrs. To this suspension, add the nanoparticle samples and inbucate for 24 hrs at 37ºC in CO_2 atmosphere. After incubation period, the spent media was removed and again incubated by 0.5 mg/mL MTT reagent for 3 hrs. Later, this MTT reagent was removed and dissolved in 100 µl of DMSO in a gyratory

shaker. The absorbance was read at 570 nm and calculate the percentage of cell viability using the formula:

% cell viability = [Mean abs of treated cells/mean abs of untreated cells] * 100

Results:

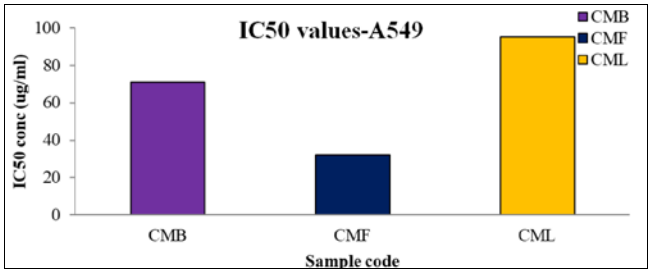
Synthesis of silver nanoparticles from parts of *Senna Montana*, was primarily confirmed by colour change from light brown to dark brown in colour (Fig 1). UV-Vis spectrometry demonstrated the SPR peaks of SNPs as leaf derived SNPs (SmL-SNPs) - 439 nm, bark derived SNPs (SmB-SNPs) - 428 nm and fruit mediated SNPs (SmF-SNPs) - 437 nm peak. These peaks confirmed the synthesis of silver nanoparticles and their surface plasmon resonance indicating their efficient nanoparticle formation. SmB-SNPs possessed a comparatively smallest size than leaf and fruit, because of its low peak representing its phytochemical distribution.

FTIR analysis reported the peaks of alcohols, amines, alkenes, carboxylic acid and haloalkanes in extracts, while the slight shifts in the nanoparticle samples indicating the synthesis and capping of some metabolites on to the surface of the nanoparticles. From the DLS and Z- potential results, the sizes of synthesized nanoparticles ranged from 40 nm to 200 nm in size and charges from –6.4mV to –17.3mV. HRTEM analysis provided a clear size range of 20 to 50 nm size particles, and the fringe on their surface indicates crystalline nature and precise synthesis.

The cytotoxic potential of *Senna montana*–mediated silver nanoparticles (AgNPs) was evaluated against human alveolar lung adenocarcinoma (A549) cell lines using the MTT assay (Fig 1; Graph 1). The results demonstrated a dose-dependent inhibitory effect of all tested samples, with notable variation in activity depending on the plant part used for nanoparticle synthesis. Among the three formulations, fruit-derived AgNPs (CMF) exhibited the highest cytotoxic activity with an IC_{50} value of 32.1 µg/mL, followed by bark-derived AgNPs (CMB) with an IC_{50} of 70.78 µg/mL. In contrast, leaf-derived AgNPs (CML) showed comparatively lower cytotoxicity, with an IC_{50} value of 95.08 µg/mL after 24 hours of treatment. These findings clearly indicate that CMF nanoparticles possess superior antiproliferative efficacy against A549 cells.

The enhanced cytotoxic effect observed in CMF-AgNPs may be attributed to the higher concentration of bioactive phytochemicals present in the fruit extract, which act as both reducing and capping agents during nanoparticle synthesis (Alum *et al*., 2026) [7]. These phytochemicals likely facilitate better interaction of nanoparticles with cancer cells, leading to increased cellular uptake and induction of cytotoxic mechanisms. The mechanism of action of AgNPs generally involves the generation of reactive oxygen species (ROS), disruption of mitochondrial function, DNA damage, and activation of apoptotic pathways, ultimately resulting in cancer cell death (Balakrishna 2021). The comparatively lower activity observed in CML-AgNPs suggests that the phytochemical composition of leaf extracts may be less effective in mediating nanoparticle-induced cytotoxicity (Bhakya *et al*., 2016) [2].

Overall, the results highlight that *Senna montana*–derived AgNPs, particularly those synthesized from fruit extracts, exhibit significant anticancer potential against A549 lung cancer cells. The variation in IC_{50} values among different plant parts underscores the critical role of phytochemical composition in determining nanoparticle bioactivity. These findings support the potential application of plant-mediated AgNPs as promising candidates for the development of novel, eco-friendly anticancer therapeutics.



Graph 1: Anticancerous activity IC_{50} values of AgNPs from *Senna Montana*

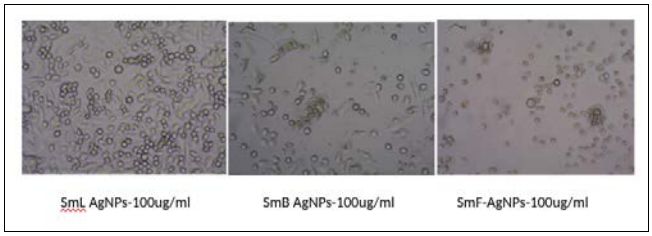


Fig 1: Anticancerous activity of AgNPs from different parts of *Senna Montana*

Conclusion

In the present study, silver nanoparticles (AgNPs) were successfully synthesized using *Senna Montana* leaf, bark, and fruit extracts through a green, eco-friendly approach. The biosynthesized nanoparticles exhibited significant cytotoxic activity against human alveolar lung adenocarcinoma (A549) cell lines, confirming their potential as anticancer agents. Among the tested samples, fruit-derived AgNPs demonstrated the highest antiproliferative activity with the lowest IC_{50} value, followed by bark- and leaf-mediated nanoparticles. Hence, this study underscores the importance of plant-based nanotechnology as a sustainable and effective strategy for developing novel therapeutic agents. However, further *in vivo* studies and clinical investigations are necessary to validate their safety, efficacy, and potential biomedical applications.

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