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Biofabrication of iron and silver nanoparticles using *Desmodium triflorum* and their antimicrobial activity *in vitro*

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ABSTRACT

Introduction: Nanotechnology stands as one of the most effectual and influential domains in contemporary materials science. Environmentally friendly methods have emerged as a noteworthy advancement compared to conventional techniques, providing a more dependable and economical means of synthesizing metal nanoparticles.

Methods: In this study, leaves extract of *Desmodium triflorum* was utilized as the medium for the synthesis of iron and silver nanoparticles. A comprehensive suite of analyses was performed, including phytochemical screening, thin-layer chromatography, antioxidant activity assessment, and GC-MS analysis. The nanoparticles were synthesized employing established methodologies such as UV-Vis absorption spectroscopy, Fourier Transform Infrared spectroscopy, X-ray diffraction analysis, Scanning Electron Microscopy, Energy Dispersive Spectroscopy, and Transmission Electron Microscopy. Subsequently, the antimicrobial efficacy of the synthesized nanoparticles was assessed.

Results: The GC-MS analysis of the leaves extract revealed the antioxidant potential of phytoconstituents responsible for the observed antimicrobial activity. The nanoparticles were characterized by UV-Vis absorption spectroscopy, which showed notable peaks at 358 nm for iron nanoparticles and 446 nm for silver nanoparticles. The biological moieties involved in the synthesis were confirmed by Fourier Transform Infrared spectroscopy. The crystallinity of the materials was verified by X-ray Diffraction analysis, and the morphology of the nanomaterials was examined through Scanning Electron Microscopy. Energy Dispersive Spectroscopy studies indicated that the iron nanoparticles consisted of 38.08 % iron and 61.92 % oxygen, while the silver nanoparticles contained 40.38 % silver and 59.62 % oxygen. Transmission Electron Microscopy micrographs revealed spherical shapes for the iron nanoparticles and a combination of spherical and round shapes for the silver nanoparticles, with an average size of approximately 50 nm. The antibacterial and antifungal properties of the synthesized iron and silver nanoparticles were evaluated, including the determination of the Minimum Inhibitory Concentration. The antimicrobial activity results demonstrated potent bactericidal effects against *Staphylococcus aureus*, with inhibition zones of 5 ± 0.001 mm and 7 ± 0.019 mm for the iron and silver nanoparticles, respectively.

Conclusion: These findings suggest that iron and silver nanoparticles synthesized using *Desmodium triflorum* leaves extract hold promising potential for applications in the medical field.

1. Introduction

The peculiar properties of nanomaterials drive the development of nanoscience and nanotechnology [1]. Nanotechnology spans multiple disciplines, aiming to craft materials at atomic and molecular levels for

Traditional chemical and physical techniques often involve costly processes and can generate byproducts that contribute to cytotoxicity, carcinogenicity, and environmental harm [5]. In contrast, biological methods are considered more promising due to their cost-effectiveness, eco-friendliness, and adaptability. These methods utilize medicinal