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Green synthesis of copper oxide nanoparticles using christia vespertilionis aerial parts extract: A sustainable approach for antibacterial efficacy assessment

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ABSTRACT

Metal nanoparticles typically exhibit sizes ranging from 1 to 100 nanometers and can be produced by several techniques, such as green synthesis and chemical synthesis. This study focuses on the green synthesis of copper oxide nanoparticles (CuO-NPs) using aerial extract of *Christia vespertilionis*. The observation of CuO-NPs formation was made based on the variations in colour exhibited by the extract mixture following the introduction of copper (II) sulphate (CuSO₄). The synthesised nanoparticles underwent characterization utilising various instrumentation techniques, including UV-Vis spectrophotometry, FTIR, TEM, SEM, EDX, and TGA. The antibacterial activity of these nanoparticles was assessed by using disc diffusion method, against selected Gram-positive and Gram-negative bacteria. The investigation also encompassed an examination of the combined effect of the nanoparticles and the antibiotic Ciprofloxacin on antibacterial activity. In this study, it was noted that the maximum absorbance of the CuO-NPs occurred at a wavelength of 253nm. The functional groups of the CuO-NPs were confirmed through FTIR spectrum. TEM analysis revealed the average particle size of the CuO-NPs as 62.16 nm. Additionally, examination of SEM images revealed that the particles exhibited irregular shapes while maintaining a homogeneous distribution. The nanoparticles exhibited enhanced antibacterial efficacy against Gram-positive bacteria in comparison to the Gram-negative bacteria that were examined. Significant synergistic effect was shown when the CuONPs were used with the antibiotic against the bacteria tested. In conclusion, the study conducted demonstrates favourable outcomes as an antibacterial agent and recommended to conduct additional research to investigate the mechanism of action and toxicity of this agent.

Keywords: *Christia vespertilionis*, Copper Oxide nanoparticles, Characterisation, Anti-bacterial efficacy.

INTRODUCTION

Nanotechnology encompasses the scientific, engineering, and technological endeavors that are carried out at the nanoscale, typically ranging from 1 to 100 nanometers. Nanotechnology encompasses the investigation and utilization of particles at the nanoscale, offering potential contributions to diverse scientific domains such as chemistry, biology, physics, materials science, and engineering [1]. Nanoparticles exhibit a high degree of adsorption capacity, which serves as a fundamental basis for their improved performance and enhanced applications [2]. Numerous methodologies exist for the synthesis of

nanoparticles, encompassing coprecipitation, hydrothermal synthesis, inert gas condensation, ion sputtering scattering, microemulsion, microwave, pulse laser ablation, sol-gel, sonochemical, spark discharge, template synthesis, and biological synthesis, also known as green synthesis [3]. However, the utilization of green synthesized nanoparticles is regarded as a more cost-effective approach that minimizes environmental pollutants in comparison to existing conventional methods [4].

Copper oxide (CuO) is an inorganic compound that exhibits notable