Heliyon 9 (2023) e21698

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Green biosynthesis of silver and gold nanoparticles using Teak (*Tectona grandis*) leaf extract and its anticancer and antimicrobial activity

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ARTICLE INFO

Keywords:
Teak extract
Tectona grandis
Silver nanoparticles
Gold nanoparticles
Green synthesis
Anticancer

ABSTRACT

The green synthesis of nanoparticles (NPs) utilizing a green path is eco-friendly and profitable compared to traditional physical and chemical techniques. This research conducted a green synthesis of gold NPs (AuNPs) and silver NPs (AgNPs) using an extract of Teak (*Tectona grandis*) and their anticancer and anti-microbial activities. Various techniques like transmission-electron microscopy (TEM), UV–Vis spectroscopy, thermal-gravimetric analyses (TGA), X-ray diffraction (XRD), and Fourier transform-infrared spectroscopy (FT-IR) were used to analyze synthesized AuNPs and AgNPs. The effects of different factors like the amount of extract used, solution pH, and contact time were measured to obtain the best possible conditions for synthesizing NPs. The AgNPs showed significant anticancer activity against HepG2 with an IC_{50} of 6.17 mg/ml compared to Teak extract (>50 mg/ml) and AuNPs (44.1 mg/ml), while AuNPs (6 % Teak extract and 2.9×10^{-3} M $HAuCl_4$) showed significant antibacterial and antifungal activity against *Pseudomonas aeruginosa, Aspergillus niger*, *Bacillus subtilis*, and *Escherichia coli* with an inhibition zone of 11 mm, 12 mm, 12.5 mm, and 15.5 mm, respectively as compared to other treatments. These findings confirmed the medical applications of AuNPs and AgNPs and might open new possibilities in this field.

1. Introduction

Metal and metal oxide NPs (nanoparticles) have garnered significant interest in physical and chemical fields due to their distinct properties from bulk materials, their applications as delivery systems for drugs, biomolecules, antimicrobials, nucleic acids, and their roles in cancer diagnostics and treatment [1–4].

Gold NPs (AuNPs) and silver NPs (AgNPs) can be synthesized through various methods, including physical (vapor deposition, lithography, thermal evaporation, and laser ablation) and chemical synthesis (evaporation solution method, sol-gel process, and vapor method). The most commonly used methods are photochemical reduction, chemical reduction, and electrochemical reduction. Chemical reduction involves reducing agents like citrate salt, sodium borohydride, elemental hydrogen, and ascorbate salt. While these agents are inexpensive, it is necessary to consider environmentally friendly alternatives like the Tollens, polysaccharide, irradiation, and biological (eco-friendly) methods. In the biological method, bio-organism extract can serve as reducing and capping

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https://doi.org/10.1016/j.heliyon.2023.e21698
Received 4 August 2023; Received in revised form 19 October 2023; Accepted 26 October 2023
Available online 4 November 2023