Synthesis of Silver Nanoparticles from Extracts of Wild Ginger (Zingiber zerumbet) with Antibacterial Activity against Selective Multidrug Resistant Oral Bacteria

ABSTRACT

Antibiotic resistance rate is rising worldwide. Silver nanoparticles (AgNPs) are potent for fighting antimicrobial resistance (AMR), independently or synergistically. The purpose of this study was to prepare AgNPs using wild ginger extracts and to evaluate the antibacterial efficacy of these AgNPs against multidrug-resistant (MDR) Staphylococcus aureus, Streptococcus mutans, and Enterococcus faecalis. AgNPs were synthesized using wild ginger extracts at room temperature through different parameters for optimization, i.e., pH and variable molar concentration. Synthesis of AgNPs was confirmed by UV/visible spectroscopy and further characterized by scanning electron microscopy (SEM), X-ray diffraction (XRD), energy-dispersive X-ray spectroscopy analysis (EDXA), and Fourier-transform infrared spectroscopy (FTIR). Disc and agar well diffusion techniques were utilized to determine the in vitro antibacterial activity of plant extracts and AgNPs. The surface plasmon resonance peaks in absorption spectra for silver suspension showed the absorption maxima in the range of 400–420 nm. Functional biomolecules such as N–H, C–H, O–H, C–O, and C–O–C were present in Zingiber zerumbet (Z. zerumbet) (aqueous and organic extracts) responsible for the AgNP formation characterized by FTIR. The crystalline structure of ZZAE-AgCl-NPs and ZZEE-AgCl-NPs was displayed in the XRD analysis. SEM analysis revealed the surface morphology. The EDXA analysis also confirmed the element of silver. It was revealed that AgNPs were seemingly spherical in morphology. The biosynthesized AgNPs exhibited complete antibacterial activity against the tested MDR bacterial strains. This study indicates that AgNPs of wild ginger extracts exhibit potent antibacterial activity against MDR bacterial strains.