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ORIGINAL PAPER

Biofabrication of copper oxide nanoparticles using *Solanum tuberosum* L. var. Vitelotte: characterization, antioxidant and antimicrobial activity

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Abstract
In this study, *Solanum tuberosum* L. var. Vitelotte extract and copper oxide nanoparticles (CuONPs) were synthesized for the first time by the green synthesis method, which is the cheapest and most effective method. The synthesized nanoparticles were analyzed by SEM, EDX, XRD, and FTIR. In the SEM analysis, the synthesized particles had a spherical morphology in the size range of 190–220 nm. In the EDX analysis, the amounts of Cu and O atoms forming the structure of the nanoparticles were determined as 66.77% and 31.75%, respectively. In XRD analysis, the crystal size of nanoparticles was calculated as 7.22 nm. The bonds that are effective in nanoparticle synthesis were identified by FTIR spectroscopy. The antibacterial activities of CuONPs obtained by green synthesis against gram-negative *Escherichia coli* and gram-positive *Staphylococcus aureus* were examined and determined that they had antibacterial effects against both bacteria. The antioxidant activity of CuONPs was also investigated on the basis of free radical scavenging activity by the DPPH method. The antioxidant capacities of *Solanum tuberosum* L. var. Vitelotte extract and CuONPs were determined in the range of 28–31% at 50–250 µg/mL concentrations, and over 80% activity was determined at 500 µg/mL concentration.

Keywords CuONPs · Green synthesis · Antimicrobial · DPPH scavenging · *Solanum tuberosum* L. var. Vitelotte

Introduction

Nanotechnology allows the controlled application of materials to science at the nanoscale (1–100 nm) and provides advanced technologies for biological applications. Nanomaterials have physicochemical properties, such as ultra-small size, large surface area/volume ratio, and high reactivity. Since they have similar dimensions and chemical stability with biological molecules, they show high biomedical efficiency in areas where large molecules are poorly accessible (Reyes-Torres et al. 2019; Dhandapani et al. 2020).

Recently, the antibacterial and antioxidant values of metallic and metal oxide nanoparticles such as Ag, Au, TiO, ZnO, CuO, FeO, and Al_2O_3 have been investigated.

CuONPs are preferred in many application areas among metal oxides because they are economical and versatile, abundant starting materials, non-toxic, different acid–base properties, and reduction properties.

CuONPs are of interest in areas such as high Tc superconductors (Khene 2021), sensors (Bang et al. 2021), optics (Velliyan and Rajendran 2021), electricity (Pramothkumar et al. 2021), giant magnet resistor materials, gas sensors (Zhang et al. 2021), heat transfer (Khooshechin et al. 2020), solar cells (Siddiqui et al. 2020) and batteries (Li et al. 2021), photocatalysis (Sharma et al. 2021), antimicrobial (Nithiyavathi et al. 2021) and biomedical industry (Ruddaraju et al. 2021).

CuONPs, which is more stable, robust, and have a longer shelf life than organic antimicrobials, do not harm human tissues but show activity on microorganisms even at low concentrations. In addition, CuONPs and hybrid nanocomposites are increasingly preferred in wastewater treatment

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