Characterization and Application of CuO Nanoparticles in Gelatin–Glycerol Coatings for Enhanced Shelf Life of Strawberries

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Abstract

This study investigates the synthesis, characterization, and application of copper oxide nanoparticles (CuO NPs) for enhancing the shelf life of strawberries and exploring adjacent plasmonic phenomena. Utilizing both sol–gel and precipitation methods, the CuO NPs were synthesized, characterized by X-ray diffraction (XRD) and scanning electron microscopy (SEM), and exhibited high purity as confirmed by energy-dispersive spectroscopy (EDS). SEM analysis showed that nanoparticles created using the precipitation method were uniformly spherical and sized between 30 and 70 nm. BET analysis revealed a surface area of 58.76 m^2/g, enhancing their antimicrobial effectiveness. The application phase involved coating strawberries with CuO NP–infused gelatin and glycerol solutions to assess their impact on fruit preservation. Increased concentrations of CuO NPs correlated with significant enhancements in preservation effectiveness, extending shelf life up to 27 days without spoilage. Additionally, the interaction of CuO NPs with light, despite lacking surface plasmon resonance, provides insightful implications for designing nanocomposites with improved functionalities for food packaging. This study underscores the potential of CuO NPs as promising nanomaterials for food preservation, offering a novel approach to reduce food waste and enhance food safety through innovative nanopackaging solutions.