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AI-enhanced synthesis and characterization of bioinspired chitosan-ZnO based polysaccharides gums with calendula leaves extract as a biodegradable food packaging material

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Abstract

Back ground: Bioinspiring synthesis and characterization of chitosan–ZnO (C–ZnO) form-based smart food packaging using machine learning approach has been developed with incorporation of Calendula officinalis extract into Acacia senegal gum, almond gum and mastic gum (Pistacia lentiscus). A simple, green and ecofriendly synthesis method was used to prepare zinc oxide nanoparticles (ZnO NPs) using naturally occurring polysaccharide gums as stabilizing and chelating agents.

Methods: The synthesized ZnO nanoparticles using the selected gums (Acacia senegal gum, almond gum and mastic gum) were characterized with their improved physicochemical properties and tunable morphology which were found to be effective and sustainable for the controlled synthesis of the nanoparticles.Further, the synthesized ZnO nanoparticles were embedded within a biodegradable chitosan hydrogel matrix, which was also functionalized with the Calendula officinalis extract for enhancing the antimicrobial, antioxidant and cytotoxicity of the active and intelligent food packaging systems. In the present study we develop zinc oxide nanoparticles sutures for the accelerated for food application.The formation and structure of ZnO nanoparticles and chitosan-ZnO based hydrogel composites were verified by Fourier Transform Infrared Spectroscopy (FTIR), X-ray Diffraction (XRD), UV-Visible spectroscopy, Scanning Electron Microscopy (SEM),zeta sizer.

Results: It was observed that the Acacia gum solution had a transparent white yellow colour, the Almond gum solution an milky white colour, and the mastic gum solution an yellowish brown color. The XRD analysis revealed sharp peaks which indicates the crystalline structure of biogenic nanoparticles.These gum based nanoparticles coated stutures show excellent antioxidant activities confirmed by DPPH radical seavenging assay.The agar well diffusion method was used to check the antibacterial potential against selected bacterial strain such as Escherichia coli, Bacillus subtilis,staph aureus and pseudomonas aeruginosa and their zones of inhibitions were measured indicated excellent antibacterial activity hence the potential value is high for the shelf life extension and to prevent the microbial contamination in packaged foods.

Keywords: *Chitosan–ZnO nanocomposites; Smart food packaging; Zinc oxide nanoparticles; Calendula officinalis; Antibacterial activity*