UNIVERSITI TEKNOLOGI MARA

FABRICATION AND CHARACTERIZATION OF POLYLACTIC ACID (PLA) FILM FILLED CINNAMON/ZNO NANOCOMPOSITE FOR FRUIT PACKAGING

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ABSTRACT

This research study aimed to investigate the optical, morphological, and antibacterial properties of polylactic acid (PLA) with zinc oxide nanoparticles (ZnONPs) and cinnamon nanopowder (CINPs) as nanocomposite film for fruit packaging application. Polylactic acid (PLA) has significant commercial potential that can be improved for specific uses by selecting suitable fillers and processing conditions. Therefore, this research study was conducted by preparing an elastic polylactic acid (PLA) film embedded with antimicrobial substances (ZnONPs and CINPs) at nanoscale level. PLA was plasticized with low molecular weight of polyethylene glycol (PEG) at an optimized volume to improve the elasticity of PLA through plasticization effects. In this study, solvent casting method were adopted to prepare PLA nanocomposites film of different volume percentages (2, 4, 6, and 8% v/v) of CINPs. The prepared nanocomposite films were subjected to optical, morphological, and mechanical analysis using Fourier-transform infrared (FTIR) spectrometry, ultraviolet-visible (UV-Vis) spectrophotometry, Field-emission scanning electron microscopy (FESEM), universal testing machine, and Dynamic Light Scattering, respectively. In this research study, the antibacterial properties of the films were investigated using agar disc diffusion method. From this study, an optimum milling speed to produce nano-sized powder were identified at 450 rpm at 60 minutes milling time. CINPs and ZnONPs incorporated into the PLA matrix were an ideal antimicrobial substance capable of blocking UV radiation and enhancing film efficiency, including its mechanical properties by instilling new functionalities. The results indicate that the addition of PEG as plasticizer has influenced the viscoelastic behaviour of PLA, hence exhibiting higher % elongation at break at 3.87%. Nanocomposite films with 8% v/v CINPs content exhibited a rough surface, with presence of voids and agglomeration of nanocomposites. The physical properties and antibacterial efficiencies of the nanocomposite films were strongly dependent on the CINPs and ZnONPs content. The results from the antibacterial tests demonstrated that ZnONPs had good antibacterial inhibition activities, with inhibition zone of 29±0.1 mm and 31±0.1 mm against *E. coli* and *S. aureus* bacteria. Thus, incorporation of CINPs and ZnONPs with good UV protection and antibacterial capabilities into PLA-based films are very promising to be employed as a fruit packaging material that offers a greener alternative in reducing the usage of non-biodegradable petrochemical-based polymer.

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TABLE OF CONTENTS