

Fabrication of Biodegradable Composite Packaging Film from Banana Fibers

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Plastic Polymers are the most popular petroleum-based material used in food packaging, due to their low cost and functional advantages. As a result of improper waste management, these materials take considerable time to decompose. After harvesting crops, both banana pseudo- stems and leaves are disposed of as landfills and this leads to increase environmental pollution. Biodegradable packagings made up of natural fibers and other environmentally friendly materials are being used to reduce this issue. These materials are eco-friendly and decompose rapidly in ambient conditions. The purpose of this study was to prepare a biodegradable composite film for food packaging using alkali and bleached banana pseudo-stem fibers, polyvinyl alcohol (PVA) and titanium dioxide (TiO₂). Composite films were prepared using the solution casting method. In brief, NaOH was used as a pretreatment chemical and NaOCl/ CH₃COOH were used in the bleaching process where incorporating the latter step produced pure cellulose with respect to the alkali pretreatment. The compositional effect on the structure and properties of the resulting films were investigated and synthesized films were characterized using Fourier Transform Infrared Spectroscopy (FT-IR) and Scanning Electron Microscopy (SEM). FT-IR showed more prominent peaks for bleached cellulosic fibers indicating pure cellulosic fibers. Furthermore, SEM analysis showed a smooth surface for bleached composite film and a rough lignin-based surface for the pretreated composite film. Due to the photocatalytic effect of TiO₂ an enhanced antibacterial resistivity was observed in the composite films. Biodegradability test showed biodegradation upon three days at ambient soil condition whereas Water Vapor Permeability (WVP) test and water solubility tests showed, lowest water solubility and WVP at 25% fiber loading. The highest tensile strength of 42.9 N/mm² was observed for PVA+bleached fiber (25%) +TiO₂ film with effect from the increase in fibre-matrix adhesion. Furthermore, it was observed that incorporating bleached fibers resulted in an increased tensile strength from 4% to 6%. Banana pseudostem fibers in combination with PVA and TiO₂ demonstrated to be a potential biodegradable composite packaging film with enhanced antibacterial resistance.

Keywords: Composite; Banana fibers; Pseudostem; Packaging; PVA; TiO₂