Reinforced Sweet Potato Starch Bioplastics with Kenaf Fiber and Indian Jujube Extract

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Abstract

The excessive use of petroleum-based plastics has become a critical environmental challenge due to their non-biodegradable nature and fossil fuel origins, which strain existing waste management systems. To promote sustainable alternatives, we developed a biodegradable composite using sweet potato starch (SPS) as the polymer matrix incorporated with glycerol, Indian jujube extract (IJE, Ziziphus mauritiana), and kenaf fiber (KF). A three-factorial experimental design was employed to optimize the formulation for maximum mechanical performance. Based on the output of the experimental design, the optimal composition for the bioplastic—comprising 15 phr glycerol, 2.5 phr IJE, and 7.5 phr KF (designated as sample S9)—exhibited improved tensile properties, achieving a tensile strength of 1.33 MPa and a strain at break of 13.7%, outperforming native starch films. This sample S9 also demonstrated 39% of water absorption, 18% of moisture content, and 31% of water

solubility. Fourier transform infrared (FTIR) analysis confirmed hydroxyl (–OH) and alkane (–CH) functional groups of the starch, while surface morphologies of the bioplastic revealed a smoother surface with fewer cracks. The incorporation of KF, glycerol, and IJE into the bioplastic significantly enhanced the mechanical, physicochemical, and thermal stability of the SPS biocomposite, indicating its strong potential for sustainable packaging applications. © The Author(s), under exclusive licence to Korean Institute of Chemical Engineers 2026.

Author keywords

Biocomposite; Bioplastic; Indian jujube extract; Kenaf fiber; Starch

Indexed keywords

Engineering controlled terms

Design of experiments; Fossil fuels; Fourier transform infrared spectroscopy; Glycerol; Polymer matrix composites; Reinforced plastics; Sustainable development; Thermodynamic stability; Waste management; Water absorption

Engineering uncontrolled terms

Bio-plastics; Biocomposite; Biodegradable composites; Environmental challenges; Factorial experimental design; Indian jujube extract; Mauritiana; Polymer matrices; Sweetpotato starch; Waste management systems

Engineering main heading

Starch; Tensile strength

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