Characterization and Comparative Study on Chemically Treated Luffa Fiber as Reinforcement for Polylactic Acid Bio-composites

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Luffa reinforced polylactic acid (PLA) bio-composites were prepared and examined. The luffa surface was treated using three chemicals, *i.e*., sodium hydroxide, 3-aminopropyltriethoxysilane, and acetic anhydride, which enhanced luffa compatibility with PLA. Mechanical testing was done on the chemically modified luffa reinforced PLA bio-composites, *i.e*., tensile, flexural, hardness, and thermal. Infrared spectral functional group and morphological analyses were performed on each sample. The results showed increases in tensile and flexural strength of 7.1% and 6.9% for sodium hydroxide, 5.7% and 1.4% for silane, and 4.3% and 0.4% for acetylation, respectively, especially to the surface-treated samples at 15 wt.% fiber volume, and a decrease in water uptake (%). Fourier transform infrared spectroscopy confirmed that the chemical surface treatments were successful with the removal of lignin and hemicellulose structures, which cause the surface structure of the modified fiber to be rough. Smooth surfaces were observed through SEM images. Thermal stability was enhanced due to improved interfacial bonding between luffa and PLA, eliminating other constituents and impurities. Moreover, the morphological analysis showed improved bonding compatibility between the luffa and PLA matrix.

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INTRODUCTION

Biodegradable composites have been developed to minimize polymer pollution caused by non-biodegradable polymer composites. Therefore, many researchers have begun extensive research on natural fibers and biodegradable polymers to mitigate polymer pollution (Bakri *et al.* 2022). These natural fibers are commonly used due to their wide-ranging advantages, *i.e*., lightweight, abundant, cheap, renewable, biodegradable, and