Extraction and Characterization of Nanocellulose from Agricultural Waste

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Abstract

Polymers are class of substances composed of very large molecules. Most of the polymers are usually made from petroleum-based by-products. However, petroleum-based polymer production has created economic and environmental sustainability issues. To satisfy the increasing demand for polymers, innovative technologies are required to produce polymers from sustainable materials. Rice is the main agricultural crop in Sri Lanka today. It is cultivated in most parts of the country and rice straw is the main agricultural waste product. Rice straw is a harvesting residue that is traditionally burned and contributes heavily to air pollution today. Rice straw is a lignocellulosic biomass comprising of lignin, cellulose and hemicellulose materials. Nanocellulose is a naval nanomaterial derived from cellulose that acts a major role in the nanotechnology related researches and applications.

The objective of this research was to extract the nanocellulose from Sri Lankan rice straw. First, chemically purified cellulose was extracted from rice straw using de-waxing, delignification, hemicellulose and silica removal processes. Nanocellulose synthesis was performed from extracted cellulose by subjecting acid hydrolysis, quenching, centrifugation, dialysis, sonication and freeze drying process. Extracted product was characterized by Fourier Transform Infrared Spectroscopic techniques (FTIR), Scanning Electron Microscopic techniques (SEM), Differential Thermal Analysis (DTA) and Thermo Gravimetric Analysis (TGA) techniques. SEM images indicated that extracted cellulose fibres and nanocellulose having diameter less than 10 µm and 50 nm respectively. Experimental results verified that extracted cellulose and nanocellulose had very high chemical purity. TGA results indicated that extracted nanocellulose thermally stabilized up to 300 ^{0}C. This extracted product can be used as a naval and sustainable raw material for various applications.