Extraction of microcrystalline cellulose from Washingtonia fibre and its characterization

ABSTRACT

Washingtonia is a desert plant with great sustainability and renewability in nature and is abundantly cultivated across global urban regions. Its fibre biomass comprises cellulose as the major structural part, and this is why it can be potentially utilized as an alternative biomaterial for manufacturing microcrystalline cellulose (MCC) products that can be widely applied in industrial fields. In the present study, NaOH-treated Washingtonia fibre (WAKL), NaClO2-treated Washingtonia fibre (WBLH), and Washingtonia microcrystalline cellulose (WMCC) were extracted through combined treatments of alkalization, bleaching, and acidic hydrolysis, respectively. The obtained chemically treated fibre samples were subjected to characterization to investigate their morphology, physico-chemistry, and thermal stability. In a morphological examination, the large bunch WAKL fibre reduced into small size WMCC fibrils, evidencing that the lignin and hemicellulose components were greatly eliminated through chemical dissolution. The elemental composition revealed that almost all impurities of anions and cations had been removed, particularly for the WMCC sample, showing its high purity of cellulose content. Additionally, the WMCC sample could attain at 25% yield, giving it the advantage for feasible economic production. Furthermore, the physicochemical analysis, Fourier Transform Infrared-ray (FTIR), indicated the presence of a crystalline cellulose region within the WMCC structure, which had promoted it with high crystallinity of 72.6% as examined by X-ray diffraction (XRD). As for thermal analysis, WMCC showed greater thermal stability comparing to WAKL and WBLC samples at high temperature. Therefore, Washingtonia fibre can be a reliable biosubstituent to replace other plant material for MCC production in the future.

Keyword: Microcrystalline cellulose; Washingtonia fibre; Morphology; Crystallinity; Thermal stability