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Preparation and Characterization of Cellulose Nanofiber (CNF) from Mango Peel

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Structured Abstract

Background: Mango peel is one of agricultural waste in Malaysia. It is typically discarded after the fruit is processed, and can pose a number of environmental and agricultural issues. To solve this issue, an environmentally-safe materials such as cellulose nanofiber (CNF) can be extracted from mango peels. The acid hydrolysis method was chosen because it is a rapid method to produce CNF with a high yield, improved characteristics, and minimal processing. The objective of this study was to determine the effect of different concentrations of sulfuric acid on the yield of CNF from mango peel via acid hydrolysis and to evaluate the effect of different concentrations of sulfuric acid on the physicochemical characteristics of mango peel's CNF.

Methods: Microwave-assisted alkaline extraction (MAAE) and bleaching treatment were employed for the extraction of cellulose fibre (CF) followed by acid hydrolysis. Firstly, the MAAE was carried out by mixing mango peel and sodium hydroxide (NaOH) solution at solid to liquid ratio of 1:25% (w/v). After completing the process of microwave extraction, the samples were filtered. The filtrate underwent bleaching treatment using 40% sodium hypochlorite (NaOCl) solution. Then, the bleached samples were hydrolyzed with two different sulfuric acid (H_2SO_4) concentrations (34% and 64%). The obtained CNF was dried and weighed. The physicochemical properties of CNF were characterized using FTIR, SEM, TGA and XRD.

Results: The yield for CNF 34% H_2SO_4 and 64% H_2SO_4 produced 89.07% and 81.59% respectively. The FTIR spectra revealed that the samples had a similar functional group and structure of C=O at 1600 cm^{-1}. The SEM analysis showed the morphological structure of untreated CNF had a rough and needle-shaped microfibril whereas for treated CNF, the structure became agglomerates and less microfibril. The XRD analysis showed that the crystallinity index of untreated CNF, 34% CNF and 64% CNF were at 50.5%, 51.2% and 61.9% respectively. Initial degradation temperatures for untreated CNF, 34% CNF, and 64% CNF were 215.3°C, 192.2°C, and 218.7°C, respectively, according to the TGA results.

Conclusion: In conclusion, the 34% CNF produced 89.07% yield, which was higher than 64% CNF. The physicochemical characteristics of CNF was successfully characterized using FTIR, SEM, XRD and TGA

Keywords: mango peel, cellulose, cellulose nanofiber, acid hydrolysis

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