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Effect of Sulfuric Acid Concentration on The Physicochemical Properties of Pineapple Peel Cellulose Nanofiber

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Structured Abstract

Background: Pineapple peel is a significant agricultural waste in Malaysia, causing environmental issues and high disposal costs. To address this issue, cellulose nanofiber extraction from pineapple peel has been performed to create eco-friendly materials. Acid hydrolysis was chosen due to it is an easy and fast method to produce cellulose nanofiber (CNF) with high yield, better properties, and small particle size. The objective of this study was to determine the effect of different concentrations of sulfuric acid on the yield of cellulose nanofiber and to investigate the physicochemical properties of CNF from pineapple peel.

Methods: Microwave-assisted alkaline extraction (MAAE) and bleaching treatment were employed for the extraction of cellulose fiber followed by acid hydrolysis. Firstly, the MAAE was carried out by mixing pineapple peel and NaOH solution at a solid: liquid ratio of 1:25% (w/v). After completing the process of microwave extraction, the samples were filtered. The filtrate underwent bleaching treatment using a 40% NaOCl solution. Then the bleached samples were hydrolyzed using two different concentrations of H₂SO₄ (34% and 64%). The obtained cellulose nanofiber was dried and weighed. The physicochemical properties were analyzed using FTIR, FESEM, TGA, and XRD.

Results: The yield of cellulose nanofiber for CNF 34% H₂SO₄ which was 85.09%. The FTIR analysis shows all the samples have similar functional groups and structures of C=O at 1600 cm⁻¹. The FESEM analysis reveals the morphology structure of untreated CNF has rough and dissociated in microfibril whereas for treated CNF, the structure became crumple, agglomerate, and larger after treatment. The XRD result shows that the amorphous region of untreated and treated CNF 34% H₂SO₄ at 22.40° and 12.627° respectively. The TGA result shows untreated and treated CNF 34% H₂SO₄ start decomposed at temperatures of 175°C and 200°C.

Conclusion: In conclusion, the yield of CNF only can be reported on a sample of treated CNF 34% H₂SO₄ which is 85.09%. However, there is no yield at the 64% H₂SO₄ concentration due to no precipitate formed during hydrolysis. All the samples were characterized using FESEM, FTIR, XRD, and TGA.

Keywords: Cellulose nanofiber, pineapple peel, acid hydrolysis

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