THE EXTRACTION AND CHARACTERIZATION OF CELLULOSE NANOCRYSTALS (CNC) FROM CUCUMBER PEELS USING ACID HYDROLYSIS AND CHOLINE CHLORIDE-BASED DEEP EUTECTIC SOLVENT (DES)

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This Final Year Project Report entitled **"The Extraction And Characterization Of Cellulose Nanocrystals (CNC) From Cucumber Peels Using Acid Hydrolysis And Choline Chloride-Based Deep Eutectic Solvent (DES)"** was submitted by Nur Alia Binti Mohd Yusoff in partial fulfillment of the requirements for the Degree of Bachelor of Science (Hons.) Applied Chemistry, in the Faculty of Applied Sciences, and was approved by

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ABSTRACT

THE EXTRACTION AND CHARACTERIZATION OF CELLULOSE NANOCRYSTALS (CNC) FROM CUCUMBER PEELS USING ACID HYDROLYSIS AND CHOLINE CHLORIDE-BASED DEEP EUTECTIC SOLVENT (DES)

Cellulose nanocrystals (CNC) have garnered significant attention due to their high cellulose content, surface area, aspect ratio, mechanical strength, and more economical. Commonly, the extraction of CNC is by using sulfuric acid hydrolysis due to its effectiveness in hydrolyzing the cellulose. However, the toxicity, pollution, and inefficiency of sulfuric acid, emphasize the need for a greener extraction method. This study aims to measure the effectiveness of the CNCs extracted from cucumber peels, using two different methods: sulfuric acid hydrolysis and a greener alternative harnessing deep eutectic solvent (DES) containing choline chloride and malonic acid. The CNCs were characterized for their yield, morphological structure, interaction, stability, moisture content and impurities using techniques such as scanning electron microscopy (SEM), Fourier-transform infrared spectroscopy (FTIR), and ultraviolet-visible (UV-vis) spectroscopy. The results revealed that CNC_2 obtained from extraction using DES yielded 38.25% with lower moisture content and slightly higher ash content while CNC_1 extracted using acid hydrolysis yielded 53.15% with lower ash content but higher moisture content. Morphological analysis confirmed the rod-like and needle-like structure of oven-dried CNCs extracted by both methods. The FTIR spectra analysis confirms the existence of various functional groups on both CNC, including a sulfate ester on CNC extracted using acid hydrolysis which could cause thermal degradation which not happen to CNC from DES. The existence of CNC were confirmed by the absorbance peaks at 205 nm and 274.5 nm obtained by UV-vis result. Interestingly, CNC extracted using DES exhibited a lower moisture content (16.25%) than CNC obtained via acid hydrolysis (41.70%), enhancing its suitability for bio-plastic production, as high moisture content in CNC cause reduction in network stiffness and strength of bio-plastics. The CNC extracted using acid hydrolysis have higher pH value (6.4) compared to CNC extracted with DES (6.2). In conclusion, the green synthesis of CNC using cucumber peels is comparable with CNC from acid hydrolysis but DES offers eco-friendly and efficient approach for producing greener CNC for food and biomedical industry especially.

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