UNIVERSITI TEKNOLOGI MARA

ISOLATION OF NANOCRYSTALLINE CELLULOSE FROM EMPTY FRUIT BUNCH (EFB) VIA MICROWAVE ASSISTED TECHNIQUE

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ABSTRACT

Nanocrystalline cellulose (NCC) was isolated from cellulose and holocellulose of palm oil empty fruit bunch with microwave assisted technique. The microwave assisted acid hydrolysis process was conducted for 10 min with various power of 100 W, 200 W and 300 W. 11 wt.% of oxalic acid dehydrate was used to performed the acid hydrolysis. Ultrasonication was applied to break up aggregates of micron-sized colloidal particles in the formed NCC. NCC particles was characterized by using Malvern Zetasizer, X-Ray Diffraction (XRD) and Fourier Transform Infrared Spectroscopy (FTIR) was used to determine zeta potential and average particle size, the functional groups and crystallinity of the sample. Cellulose and holocellulose samples treated at 300 W showed the highest value of zeta potential with value of -42.9 mV and -40 mV respectively. XRD analysis showed that cellulose and holocellulose sample treated at 300 W had the highest value of crystallinity index which is 77.7% and 69.6%.Analysis by FTIR showed that both of the samples had the functional groups that represent cellulose chemical structure by presence of C-H and O-H bonds at wavelength of 1315 cm^{-1} and 1160 cm^{-1} respectively.

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CHAPTER ONE
INTRODUCTION

1.1 Research Background

Concern regarding the scarcity of renewable resources, it is important to find another alternative material. Besides that it is also crucial to take a serious look on it impact toward the environment. The emerging of one of nanomaterials which is nanocrystalline cellulose (NCC) has received increasing interest in nanotechnology due to its advantages of abundance, renewability, biodegradability, and excellent mechanical properties (Peng, Dhar, Liu, & Tam, 2011). NCC is explicitly a promising renewable materials, NCC is made of crystalline particles that is structurally organize hence made it naturally strong.

Extensive studies have shown that NCC has great application potential in fields such as regenerative medicine, optics and composite materials (Li, Wang, & Liu, 2011). Nanocrystalline cellulose (NCC) acquired by acid hydrolysis from a wide source of natural materials, has been acknowledged as another class of nanomaterials (de Souza Lima & Borsali, 2002; Pu, Zhang, Singh, & Ragauskas, 2008; M. Roman, Winter, Oksman, & Sain, 2006). Empty fruit bunch (EFB) from palm oil is one of the natural source materials that been used to isolate the NCC. EFB mainly composed of cellulose, hemicellulose and lignin. Removal of amorphous region in the cellulose will generated the cellulose nanocrystals.

Besides that, NCC is one of nanomaterial that serve a wide range of applications, such as enzyme immobilization, synthesis of antimicrobial and medical materials, green catalysis, biosensing, synthesis of drug carrier in therapeutic and diagnostic medicine, etc (Lam, Male, Chong, Leung, & Luong, 2012; Maren Roman, Dong, Hirani, & Lee, 2009). According to (Taheri & Mohammadi, 2015) nanomaterials could offer several potential advantages as drug delivery excipients because nanomaterials' properties such as smaller size, hydrophilicity and biocompatibility. Due to their very large surface area and