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Production of Cellulose Nanofiber (Cnf) from Empty Fruit Bunch (EFB) via Mechanical Method

M. A. F Supian, [1] K. N. Mohd Amin,[1] S. S. Jamari,[1] S. Mohamad,[1]

[1] Faculty of Chemical & Natural Resources Engineering, Universiti Malaysia Pahang, 26300 Gambang, Pahang, Malaysia.
**Corresponding author: ariffahmi000@gmail.com*

EXTENDED ABSTRACT

The palm oil production in Malaysia contributes 85.5% of the total biomass production in Malaysia. From the 85.5%, empty fruit bunch (EFB) are the most that contribute to biomass waste produced [1]. With the increasing number of empty fruit bunch (EFB) produced annually, it has raises massive environment concern. Empty fruit bunch (EFB) biomass is made up of cellulose (24-65%), hemicellulose (21-34%), and lignin (14-31%) [2]. Thus it has a great potential to use the cellulose source for the production of cellulose nanofiber (CNF) and changing biomass by-product to a value added product . Besides that, currently the main raw materials for cellulose production are from wood and cotton linter. However it will promote deforestation and accelerate the greenhouse effect. Therefore, empty fruit bunch (EFB) is a great candidate for the future cellulose raw material. In addition, recent technology in cellulose production requires a high amount of production cost due to its chemical treatment and it is not environmentally friendly. Hence the implementation of the mechanical method will decrease the amount of energy and chemical as well as it is more environmentally friendly. In addition, the cellulose was also initially extracted via steam explosion pretreatment. The steam explosion pretreatment technology also has low energy consumption [3]. Mechanical treatment has been proven to be the best treatment for producing cellulose nanofiber (CNF) [4].

The objective of this study is to produce CNF from empty fruit bunch (EFB) via mechanical method. The empty fruit bunches (EFB) are provided by LCSB palm oil mill, Lepar, Pahang. Then the empty fruit bunches (EFB) are dried under the sunlight for 5 days and ground using a grinder equipped with 2mm sieve. The initial stage of the extraction process of alpha cellulose has been done via steam explosion treatments at the Cellulose Pilot Plant, Lepar, Pahang. Then, the common steps were followed by alkaline and bleaching process. When the alpha cellulose is produced (see Figure 1) the mechanical treatments take place using a nano grinder to produce the cellulose nanofiber (CNF). The grinding condition time (10-90 min), rpm (100-1000), pulp consistency (1-50%), moisture content (wet-dry) and ball size (0.5-2 mm) are varied and optimized. The cellulose nanofiber (CNF) produced was characterized accordingly.

Fig 1: Alpha cellulose from Empty fruit bunch (EFB).

The thermo gravimetric analysis (TGA) of the produced alpha cellulose and cellulose nanofiber (CNF) shows an almost similar decomposing trend with the commercialized cellulose. For the

crystallinity test using the x-ray diffraction (XRD), the crystallinity of the cellulose decrease throughout the process but increases slightly after the mechanical treatment. The transmission electron microscopy (TEM) testing confirmed that the produced cellulose nanofiber (CNF) is nano-dimension. These characterization shows that cellulose nanofiber (CNF) production via mechanical method are more beneficial from solvent-based process in terms of environmental aspect. The optimal condition for the mechanical treatment is achieved. These optimization factors allowed the production of cellulose nanofiber (CNF) from the empty fruit bunches (EFB). Thus providing plenty of opportunities for its many applications.

Keywords: EFB; Steam explosion; Mechanical method; Cellulose; CNF

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References
[1] Umar, M. S., et al. (2013). "Strengthening the palm oil biomass Renewable Energy industry in Malaysia." Renewable Energy 60: 107-115.
[2] Chang, S. H. (2014). "An overview of empty fruit bunch from oil palm as feedstock for bio-oil production." Biomass and Bioenergy 62: 174-181.
[3] Oliveira, F. M., et al. (2013). "Industrial-scale steam explosion pretreatment of sugarcane straw for enzymatic hydrolysis of cellulose for production of second generation ethanol and value-added products." Bioresour Technol 130: 168-173.
[4] Spence, K. L., et al. (2011). "A comparative study of energy consumption and physical properties of microfibrillated cellulose produced by different processing methods." Cellulose 18(4): 1097-1111.