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Enzymatic pretreatment of palm oil empty fruit bunch

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ABSTRACT

Fibers from Palm Oil Empty Fruit Bunch (OPEFB) are high in cellulose, lignin, hemicelluloses, small wax depositions, and inorganic components. Intractable lignin in lignocellulosic biomass (LCB) is a main hindrance to cellulose extraction. As a result, it must be removed from LCB before production of value-added products such as cellulose nano crystal (CNC), fermentable sugar, and biofuels. When compared to chemical and physical methods, enzyme-mediated lignin breakdown is considered a "green" technique since it does not create any harmful intermediates. An attempt was taken to reduce (delignify) lignin from OPEFB through laccase enzyme pretreatment process without usage any hazardous chemicals like alkali, bleaching agents. After 12 h incubation period at 50 °C, laccase's delignification potential from OPEFB was 66.5 %. According to the findings, the laccase was successful at breaking down lignin and has the potential to enhance the quantity of cellulose in lignocellulosic biomass as OPEFB in a sustainable and environmental favorable way. The morphological results from Scanning Electron Microscopy (SEM) image, functional group from Fourier Transform Infrared Spectroscopy (FTIR) results and crystalline nature of X-ray Diffraction (XRD) graph was proved the reduction of lignin from raw OPEFB after enzymatic pretreatment. In the future, this approach would be used to extract additional types of cellulose from other lignocellulosic waste biomass which is environmentally friendly and sustainable to obtain value-added products.

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1. Introduction

The most widespread plant material on nature is lignocellulosic biomass, which is derived mostly from agriculture and forestry wastes. In recent decades, there has been a drastic increase in interest in using this lignocellulosic biomass as a fermentation substrate for a variety of useful products, including biofuels and bio-based chemicals [1]. Palm oil is the most important agricultural product in Malaysia and palm oil waste biomass is the mostly produced each year [2,3]. The palm oil industry has become Malaysia's most significant agricultural sector due to rising demand for vegetable oils. However, palm oil extraction has resulted in major biomass waste generation, with empty fruit bunch (OPEFB) accounting for roughly 16 metric tons per year. Typically, 20 % of each tons of palm harvest is oil, while the remaining 80 % is waste biomass [4]. Palm oil production is one of Malaysia's most important agricultural products, contributing significantly to the country's economic development. Malaysia's current strategy targets to create 23 % oil extraction recovery in the oil palm milling sector, with biomass production rising from 80 million tonnes in 2010 to 110 million tonnes in 2020. Oil palm empty fruit bunches (OPEFB), palm kernel shell (PKS), oil palm mesocarp fiber (OPMF), palm oil mill effluent (POME), oil palm trunk (OPT), oil palm leaves (OPL), and oil palm fronds are all part of the biomass produced (OPF) [5]. The OPEFB and OPMF, which are the most abundant oil palm waste biomass generated at the mills, has not yet been fully utilized. It also offers the chance for researchers since it is rich in lignocellulose, which has a good prospect for cellulose production [6].

To use OPEFB as a fermentation substrate, adequate and efficient pretreatment are needed to lower the resistance of lignocellulosic biomass by modifying its lignocellulosic structure, particularly lignin [7]. Cellulose, the most common biopolymer on the globe, could be used to make commodities, speciality chemicals, and high-value-added goods [8,9].

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