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Oil Palm Trunk of Elaeis guineensis as a Major Source of Commercial Lignocellulosic Materials: A Short Review

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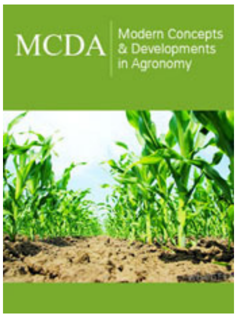

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Abstract

The goal of this paper was to review the uses of oil palm trunk (OPT) as a source of lignocellulosic materials (LM), and to discuss its future prospects. The present review focuses on three points; first, large quantity of OPT; second, many studies reported the commercial use of OPT and third, many studies reported the conversion methods of OPT into LM sources. Most of the studies revealed that OPT can be transformed readily into biomaterials for value-added products The LM from OPT have many potential industrial applications.

Keywords: Oil palm trunks; lignocellulosic materials; industrial application.

Introduction

Oil palm (OP) (Elaeis guineensis Jacq.) is a valuable crop commodity that has expedited the progress of the agricultural sector in Malaysia. Apart from the OP products, the oil palm biomass (OPB) is also produced abundantly in plantations. This OPB includes oil palm empty fruit bunch (OPEFB), oil palm fronds (OPF), and oil palm trunk (OPT) [1]. Recently, Yap et al. [2] reviewed the potentials and challenges of using renewable oil palm biomass wastes (OPBW) in Malaysia including the OPT.

The purpose of this paper was to review the uses of OPT as a source of LM, and to discuss its future applications. OPT is the main subject of this review article, which is discussed comprehensively based on the following three major points.

First, large quantity of oil palm trunk

According to Abdullah et al. [3], the OPT is normally left at planted locations to be decomposed naturally. Because of the low decomposition rate, the lack of correct management of this OPBW will disrupt the OP plantation's regular growth process. Furthermore, it has the potential to stimulate the spread of OP disease caused by Ganoderma boninense, which is harmful to the OP crop.

Despite the large amount of OP produced, the oil only accounts for a small fraction of the total biomass produced in OP plantations while the remainder consisting of lignocellulosic materials (LM) such as OPT [4]. Even though the OPBW are classified as organic wastes that can be degraded naturally. Nonetheless, huge amounts of these wastes can potentially harm the OP plantation environment.

The OPT is a solid trash that is produced in great amounts once OP trees are felled, and it is available all the year round. OPT lumber, OPT chips, and OPT fibers are the three types of OPT [5]. Because of the wide range of physical and mechanical qualities, scientists and manufacturers have difficulties using these solid wastes for various applications. The solid wastes of OPT have a higher commercial potential than the other varieties of OPBW. OPT's cellulosic material is used to make value-added products since it is made up of LM [6]. Sulphuric acid hydrolysis was used to study the possibility of manufacturing glucose from OP lignocellulosic wastes such as OPT, OPF, and OPEFB. The glucose was then fermented with the Saccharomyces cerevisiae yeast [7].

Second, many studies reported the commercial use of oil palm trunk

Lignocellulosic materials (LM) are the dry matters of plants. They are composed of aromatic polymers like lignin and carbohydrate polymers (cellulose and hemicellulose). Different sugar monomers (six and five carbon sugars) are strongly linked to the aromatic polymer in carbohydrate polymers [8]. Because of their low cost and abundance, LM are the best feedstocks [9]. These lignocellulosic compounds have huge potential in food, chemical, and pharmaceutical industries [10]. The OPT, like OPEFB, has a stronger commercial potential than the other forms of OPBW [11]. As a result, the OPT, which makes up the majority of lignocellulosic waste, is now available for commercial use. However, in order for OP producers across the world, such as Malaysia and Indonesia, to keep their competitive edge, a zero-waste policy must be implemented [12].

Previous research has demonstrated that biomass and other agricultural waste may be utilized to manufacture a number of high-value items, such as medium-density panels, chip boards, thermoset composites and thermoplastics, nano biocomposite, pulp and paper [13]. The OPT houses the majority of LMs that can be used for commercial purposes. Lamaminga et al. [14] examined the cellulose nanocrystals extracted from OPT and recommended it as a value-added product [12].

According to Sumanthi et al. [15], an OP tree produces 231.5kg dry weight of biomass per year, which includes oil and lignocellulosic components. Oil palm agriculture produces a large amount of lignocellulosic biomass, including OPT, from OPB. Only a little percentage is used for fibre production and energy generating. About 40% of the biomass is cellulose, 40% is hemicellulose, 18% is lignin, and 2% is extractives [4]. The OPT, for instance, has 34.4, 23,9, 35.9%of cellulose, hemicellulose and lignin, respectively [16].

OPT solid wastes have a higher commercial potential than other types of OPBW [11]. The high proportion of cellulose and hemicellulose in the OPF, OPT and EPB suggests that the OPB could be employed as a bioprocessing feedstock [17]. Laminated bio-composite and hybrid laminated bio-composite with good characteristics have been successfully manufactured using OPT and OPT reinforced with EFB [3].

Mazlan et al. [18] proposed that lignocellulosic OPT biomass might be used as an alternate substrate for enzymatic saccharification of glucose. Prior to the enzymatic saccharification procedure for glucose production, the OPT biomass was pre-treated using a steam-alkali-chemical technique. The researchers discovered that by employing treated OPT as a substrate improved the enzyme digestibility.

Using two different ionic solutions, Mohd Basyaruddin et al. [19] investigated the swelling and dissolving of OPB and cellulose fibre from OPEFB, OPF, and OPT. Mohtar et al. [20] extracted lignin from OPB, namely OPEFB, OPT and OPF, using an ionic liquid solution followed by precipitation with various precipitating agents such as CO2-AlK (SO4)2·12H2O precipitation. The chemical and lignin contents of OPT samples from two genetic origins were studied by Ho et al. [21]. The two OP genotypes' structural carbohydrate and lignin compositions were found to differ considerably.

Third, many studies reported the conversion methods of OPT into LM sources

Mazlita et al. [22] claimed to have effectively developed chemical-sonication processes from OPT lignocellulosic biomass. Noorshamsiana et al. [10] conducted a review of the conversion of OPT into lignocellulosic compounds, focusing on several extraction procedures and discussing their advantages and disadvantages.

According to Eom et al. [23], fermentation of the sap, bagasse, or cell wall can efficiently convert solid lignocellulosic OPT to ethanol. Hydrothermal treatment of cellulose, hemicellulose and lignin in OPT's cell wall, followed by enzymatic hydrolysis, can yield the required bio-products [23]. Kosugi et al. [24] reported the production of ethanol and lactic acid by using sap squeezed from old OPT. They found that sugars (glucose, sucrose, and fructose) were present in the sap of the OPT tree [24]. Vitamins, amino acids, and organic acids are among the other chemical substances found in OPT sap. As a result, the sap from the OPT tree can be immediately fermented to yield chemical compounds such lactic acid and ethanol [25-27].

Conclusion

This review article focuses on three main points: large quantity of OPT, many studies reported the commercial uses of OPT, many studies reported the conversion methods of OPT into LM sources. All the literature reviews pointed toward the potentials of OPT to be transformed into biomaterials for value-added products for industrial applications in the future.

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