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REVIEW: EXTRACTION AND CHARACTERISATION OF LIGNIN FROM RICE STRAWS

BY

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DECLARATION

I NNAKAZZI MARIAM, hereby declare that this study is original and has not been submitted or published before to any other degree award to any other University before or higher institution of learning except where referenced.

Signature …….…….

Date ……..

Approval

This dissertation has been done under my supervision and guidance.

Supervisor: DR KIGOZI MOSES

Signature ……

Date ……

DEDICATION

This dissertation is dedicated to my lovely mother Mrs Nankya Zaytuni, my elder sisters Nakyaga Mastulah, Nabossa Janat and my brother Bakomereza Muhamuudu for financial and mentor support and encouraging thoughts throughout my academic journey. May the Almighty Allah reward them abundantly.

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Abstract

Lignin makes up 10-25 percent of the lignocellulosic biomass making it the second most abundant naturally occurring polymer. Lignin comprises three substituted phenol types, sinaply, p-coumaryl and coniferyl alcohols. It is a three dimensional cross-linked macromolecules. In this paper, lignin focus was on the Lignin obtained from rice straws one of the lignocellulosic materials with high content. Rice straws have unique characteristics due to silica content in them The paper was intended to review the extraction and characterization of different methods of Lignin obtained from rice straws. The extraction methods such as ultrasound-assisted extraction, DES, hydrotropic treatment, organosolv extraction and soda-AQ were compared in yields of Lignin obtained from rice straws. The characterization methods discussed included; Fourier transformation infrared spectroscopy (FTIR), Thermo gravimetric analysis (TGA), UV spectroscopy and X-ray photo electron spectroscopy. It was discovered that the Lignin obtained by ultrasound-assisted extraction from rice straws yielded the highest percentage compared to other methods.

Key words: rice straw, Lignin, extraction, biomass, yield

1.0. INTRODUCTION

1.1. BACKGROUND

Lignin is one of the most sophisticated biomolecules and an integral part of cellulosic biomass (Llangovan et al., 2019). Lignin in plants is responsible for strengthening the cells' walls, improving resistance to, moisture and water, and protecting the plant from a microorganism that harm it. It is also a generic term for a compound that results from 4-hydroxyphenylpropanoids oxidative combinatorial coupling, and the compounds are a large group of aromatic polymer (Watkins et al., 2014). These polymers are found in the walls of secondarily thickened cells making them waterproof and rigid. Lignin biosynthesis can also be induced on various abiotic and biotic stress like pathogen infection, wounding, perturbation, and metabolic stress in the cell wall structure (Vanholme et al., 2010). Lignin imparts decay resistance by protecting polysaccharides cell walls from microbial degradation. During plant biomass conversion to biofuels or pulp, Lignin acts as a significant limiting factor. Lignin removal from a biomass plant is a costly process. Therefore most research aims to design plants that can deposit and produce Lignin more permeable to chemical degradation.

Due to pollution resulting in environmental impact, fossil resource depletion and ever-growing demand increased the demand for renewable resource materials, which became an important matter. Lignocellulose biomass is considered fuel-based oil and one of the replacing chemicals. One of the most renewable and valuable cellulosic materials and lignocellulosic biomass is the agricultural residues. Rice straw is among the different sources of agricultural residues extensively investigated (Guangjun et al., 2018). This is because rice straw is one of the world's consumed cereals, with about 650-975 million tons per year worldwide. Rice straw comprises approximately 35% cellulose, 18% hemicellulose and 15% lignin (Ma'ruf et al., 2018). It can be used as raw materials for precious products' physical and biochemical processes through chemical conversion. However, this is accompanied by other structural biopolymers apart from cellulose, such as hemicellulose and Lignin. Therefore, the determination methods for separating different constitutes of biomass component is a major obstetrical to its utilization.

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