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Assessment of *Cymbopogon Flexuesus* as a Sustainable Feedstock for the Production of Bioethanol.

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ABSTRACT

Perennial grasses, a renewable resources can serve as an alternative lignocellulosic biomass for the production of bioethanol which solves the emerging problem of scarcity and high price of fuel, environmental production and climatic changes. In this research, the potential of lemon grass (*Cymbopogon flexueses*) was assessed for its potential as a suitable feedstock for bioethanol production. Lemon grass, a lignocellulosic biomass was collected and treated. Proximate analysis and chemical composition of the sample were carried out to identify the potential of the grass as a viable resource for a better yield of sugars. The determination of proximate analysis revealed 9.20% moisture content, 4.00 % ash content, crude fiber 14.90 % and 66.00 % carbohydrate content. The results of the chemical composition revealed 39.52 % cellulose, hemicellulose content 22.60 % and 18.50 % lignin content. The results of the analysis indicates that lemon grass has a high viability for better yield of sugars and its sustainability for bioethanol production.

Keywords: Bioethanol, Lignocellulosic biomass, Lemon grass, Sustainability, Renewable energy.

1.0 INTRODUCTION

Renewable energy plays a very vital role in addressing the increase in energy demand as well as reducing environmental problem. It serves as a sustainable alternative to gasoline, minimizes the greenhouse gas emission and reduces the dependence on fossil fuels (Singh et al., 2022). Bioethanol, a widely accepted renewable biofuel derived from various biomass such as corn, sugarcane, and lignocellulosic materials such as agricultural residues, industrial sludge, forestry wastes, and selected energy crops (Wang et al., 2021).

Bioethanol produced from non-food lignocellulosic biomass, is made up of cellulose, hemicelluloses, lignin, protein, and minor pectin (Toor et al., 2020). It is relatively abundant, affordable, cost effective, and eco-friendly (Lynd et al., 2021). It serves as transportation fuel, and has economic and environmental benefit (Kanik and Sanyogita, 2023).

The bioethanol production between 2018 to 2022 from corn, soyabeans, and sugarcane increases from 110billion litres to 140 billion litres which revealed an appreciable growth rate. The U.S, China, and Canada utilizes sugarcane and corn and obtained a high production of bioethanol of 27.6 billion litre to 57.7 billion litres (Mohanty et al., 2019).

However, bioethanol is considered a potential substitute for the gasoline which can be blended with gasoline thereby reducing greenhouse gas emission and high consumption of gasoline. However, the utilization of bioethanol (E100) is usually characterized with difficulty in starting the engine at low temperature due to high heat of vaporization. The blending of bioethanol with gasoline increases the engine performance and ignition (Carrillo-Nieves et al., 2019).

Lemon grass is a native of aromatic tall sledge family, poacae. It is a perennial grass with blade tend to be 18 - 36 inch long. It is stout, with long leaves, green and linear. It grows in many tropical and plant natured to maritime South East Asia and Africa. It was introduced to many tropical region such as Magadascar, South America and Central America after world war.

II. MATERIALS AND METHODOLOGY

a. Sample Collection

The Lemon grass was collected behind the Department of Sciences, Kebbi State Polytechnic, Dakingari, Kebbi State.

b. Sample Treatment

The Lemon grass was cut into pieces and sun dried for twenty-one (21) days. The sample was ground into fine powder using pestle and mortar. The powdered sample was stored at room temperature in an air tight container (Tambuwal et al., 2018).

c. Determination of Cellulose, Hemicellulose, and Lignin content

EXTRACTIVES

2.5g of dried raw sample was loaded into the cellulose thimble of the soxhlet extractor. 150ml of acetone was added and the extractor adjusted to 70^0C for 4hr run on the heating mantle.

After extraction, the sample was air dried at room temperature for few minutes.

The residue (extractive) was placed in an oven 105^0C for 1hr and air dried until a constant weight was achieved.

The percentage weight (w/w) of the extractives was evaluated as the difference in weight between the raw biomass and the extractive-free biomass (Lin et al., 2010).

HEMICELLULOSE CONTENT

1g of the extracted dried biomass was added into a 250ml flask. 150ml of 500mol/m^3 was added. The mixture was boiled for 3hrs with distilled water.

It was allowed to cool and filtered through vacuum filtration. The residue was washed under running tap water until neutral p H. The residue was dried to a constant weight at 105^0C in an oven. The percentage hemicelluloses content is the difference between the weight before and after treatment (Lin et al., 2010).

LIGNIN CONTENT

0.3g of dried extracted raw biomass was weighed in a test tube. 3ml of 72% H_2SO_4 was added. The test tube was kept for 2hr at room temperature with careful shaking at 30min interval for of complete hydrolysis. After initial hydrolysis, 84ml of distilled water was added. The mixture was kept in an autoclave at 121^0C for 1hr for the second hydrolysis. The slurry was cooled at room temperature.

The hydrolyzates was filtered through vacuum using a filtering crucible. The acid insoluble lignin was determined by drying the residue at 105^0C and accounting for ash by incinerating the hydrolyzates at 575^0C in a muffle furnace .

The acid soluble lignin fraction was determined by measuring the acid hydrolysate absorbance at 320nm. The lignin content was calculated as the summation of acid insoluble lignin and acid soluble lignin (Sluter, 2001).

CELLULOSE CONTENT

This was calculated by difference, assuming that extractives, hemicelluloses, lignin, ash (Lin et al., 2010).

Table 1 : Proximate Analysis of Lemon grass

CONTENT	Moisture	Ash	Crude Fibre	Carbohydrate
%	9.20 ± 0.76	4.00 ± 0.22	14.90 ± 0.32	66.00 ± 0.25

Table 2: Determination of Chemical Composition of Lemon grass

CONTENT	Cellulose	Hemicellulose	Lignin
%	39.52 ± 1.04	22.60 ± 0.86	18.50 ± 0.74

III. RESULTS AND DISCUSSION

The results obtained from proximate analysis of the lemon grass is shown in Table 1. The results shows higher percentage of carbohydrates 66.00 ± 0.25, low moisture content 9.20 ± 0.76, and ash content 4.00 ± 0.22 %. The result indicated that high percentage of carbohydrates revealed high yield of sugar for better bioethanol production. Also, low moisture and ash content indicate that lemon grass is a better potential for bioethanol. The result of lemon grass is in line with parameswara *et al*., (2010). Furthermore, the high percentage content of carbohydrate shows that lemon grass is a good source of sugars which is suitable for the production of biofuel.

The basic composition of the three lignocellulosic biomass is shown in table 2. Each experiment was replicated. The result indicates the average values and it falls within the range of most values reported for grasses. The cellulose content 39.52 ± 1.04, hemicelluloses 22.60 ± 0.86, and lignin 18.50 ± 0.74.

The results as shown in table 2 is in line with the report of Sharma *et al*., (2020). Therefore, the results in table 1 and 2 agree when compared with the reported values in the literature. Hence, lemon grass has a high potential for bioethanol.

IV. CONCLUSION

From the results, it was observed that bioethanol can be produced from lemon grass. Comparing the results in Table 1 and 2 which is in line with the report of parameswara et al., (2010). This revealed that lemon grass is a good feedstock for bioethanol.

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