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THE POTENTIAL OF ANDROPOGON GAYANUS AS A SUITABLE SUBSTRATE FOR THE PRODUCTION OF BIOETHANOL.

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ABSTRACT

The release of greenhouse gas emission from fossil fuel has been a concern to the environment and the researcher. This research was carried out to study the potential of gamba grass (Andropogon gayanus) as a promising substrate to produce bioethanol. The grass was sundried for about 21days, ground into fine particles and sieved to a powdered form in a sample bottle closely tight. The proximate analysis and chemical composition of the sample were carried out. The results of the proximate analysis revealed that the carbohydrate content was 66.17 %, 8.95 % of moisture content, 11.75 % crude fibre and 7.5% ash content. The chemical composition of the grass shows cellulose content 36.40 %, 34.12 % hemicellulose content and 7.20 % lignin content. The results of the analysis shows that the substrate has high potential for a better yield of bioethanol.

Keywords: Bioethanol, Renewable energy, Gamba grass, Proximate, Biofuel, Sustainability.

1. INTRODUCTION

The non-renewable energy has been the major source of energy for the past decades. The increase in population and demand for energy have given rise to the utilization of fossil fuel causing reduction in the availability of the resources (Muhammad and Saha, 2022). However, persistent utilization of gasoline gives rise to emission of greenhouse gas leading to climate change and environmental pollution (Muhammad and Saha, 2022).

High demand and consumption of energy reduces the crude oil reservoir, leading to scarcity and high price of fossil fuel. This prompted research for a replacement of traditional fuel to a more sustainable resources (UEPA, 2023). Advancement in biofuel production has enhanced greener energy and contributing to a sustainable energy in future. Bioethanol, a biofuel, is the most widely acceptable liquid fuel, as a viable alternative to petroleum based fuels. The bioethanol reduces greenhouse gas emission and enhances energy security. It promotes rural development and drives economic growth.

According to the European Union, liquid biofuel production has been increasing at a geometric ratio in the past ten years. In 2019, over 159 billion litres of biofuel was produced globally (WBA, 2021). The average energy content of bioethanol is 21.1 MJ/Liter for transportation, as it reduces carbon monoxide emission (UEPA, 2023).

There is food-fuel competition as a result of substrate for bioethanol from the first generation biofuel. Therefore, research has been focused on the second generation biofuel from agricultural residues, and other cellulosic wastes (Hirani et al., 2018). The conversion of lignocellulosic biomass to biofuel, reduces greenhouse gas emission and a promising resources for renewable energy (Beig et al., 2021).

Bioethnol from lignocellulosic biomass could be the best option for a sustainable biofuel as it compete with no food market for human consumption. The conversion of these wastes to biofuel has help to reduce environmental pollution and makes the environment eco-friendly.

Gamba grass is highly productive, used for pastures and act as a fire-resistance. It is 2.5m high with culms of about 450/plant. It is straight, about 1.5 – 2.5m high. It is up to 1m long and 1.5 – 5cm wide. It was originated from Africa and introduced to the Northern Territory as pasture spices. It is common in the tropical and subtropical savanna region of Africa, from Senegal down to Sudan, Mozambique, Botswana, Namibia and South Africa. It was prominent in countries such as Australia and South Africa (Daf, 2020). It can grow in areas between 400 - 3000m of rainfall per year, and 9 months if there is dry season. It usually grows at peak in the sun and can only tolerate light shade. It does not thrive well in an area where the temperature is below 4.4 ^{o}C. However, it can tolerate frost (Cook et al.,2020).

2. MATERIALS AND METHODS

a.Sample Collection

ssThe Gamba grass collected behind the Faculty of Agriculture, Kebbi State University of Science and Technology, Aliero, Kebbi Sate.

b.Sample Treatment

The Gamba grass was cut into pieces and sun dried for twenty-one (21) days. The sample was grounded 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^{0}C 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^{0}C 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^{0}C 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^{0}C 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 determine by drying the residue at 105^{0}C and accounting for ash by incinerating the hydrolyzates at 575^{0}C in a muffle furnace .

The acid soluble lignin fraction was determine by measuring the acid hydrolysate absorbance at 320nm. The lignin content 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 Gamba grass

CONTENT	Moisture	Ash	Crude Fibre	Carbohydrate
%	8.95 ± 0.06	7.5 ± 0.07	11.75 ± 0.52	66.17 ± 1.22

Table 2 : Chemical Composition of the Gamba grass

CONTENT	Cellulose	Hemicellulose	Lignin
%	36.40 ± 0.43	34.40 ± 0.67	7.20 ± 0.81

3. RESULTS AND DISCUSSION

The results obtained from the proximate analysis of gamba grass as shown in Table 1. The results show high percentage of carbohydrate 66.17 %, and low moisture content 8.95%, and ash content 7.5%. The Crude fiber content 11.75% is in line with the percentage range of grasses of crude fiber between 11 - 28%. The high level of the carbohydrate is also in line with the report of parameswara et al., (2010). The high content of carbohydrates further shows that gamba grass is a good source of sugars which is suitable for the production of biofuel. The basic composition of the three lignocellulosic biomass as shown in Table 2. Each experiment was replicated. The results indicate the average values of the replicated experiment. The results of the study fall with the most reported values for grasses. The cellulose content 36.40%, hemicelluloses 34.40%, and lignin 7.20%. The results in table 2 is in line with the report by Devi et al., (2021). The results in Table 1 and 2 as compared with most other reported values in the literature. Gamba grass has a high potential for bioethanol.

4. CONCLUSION

The study has highlighted a simple method for the compositional analysis of gamba grass. The result obtained compared to the study reported by other researchers revealed that the grass has a great potential for bioethanol production.

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