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Bioethanol Production from Two Varieties (*Saccharum Officinarum* and *Saccharum Barberi*) Of Sugarcane Peels

¹Badamasi Abu., ²B.U Bagudo, ²Salihu Sani, ³M.M Garba, ²Abdullahi Muhammad Sokoto, ¹S. A. Zauro, ¹Chika Muhammad, ²Imrana Ibrahim, ¹Shamsudeen Yahaya

¹Department of Energy and Applied Chemistry, Faculty of Chemical and Life Sciences, Usmanu Danfodiyo University Sokoto.

²Department of Pure and Environmental Chemistry, Faculty of Chemical and Life Sciences, Usmanu Danfodiyo University Sokoto

³ Sokoto Energy Research Center, Usmanu Danfodiyo University Sokoto

Corresponding Author's Email & Phone No.: badamasiabu954@gmail.com; 08140400795

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ABSTRACT

Provision of an alternative clean source of fuel with less cost, will reduce fossil fuel demand. Pollution is the major environmental problem. Air pollution is among the three types of pollution where harmful substances such as CO₂ and CO are introduced to the environment and cause harm to humans and animals. Fossil fuel combustion from automobiles and industries causes this type of pollution. There is need to replace another source of fuel with renewable feedstock such as the peels of *Saccharum officinarum* and *Saccharum barberi* which are lignocellulose materials to produce bioethanol that has a lower impact on air pollution and the Ozone layer which causes Green-House effect than fossil fuels. Dilute H₂SO₄ at different concentrations of 1M,2M,3M,4M and 5M were replicated into three different parts respectively as hydrolysing solution. *Saccharomyces cerevisiae* was used as fermentation enzymes. Different pH values of 5, 6 and 7 was used for fermentation periods of 5, 6 and 7 days, respectively. The Bioethanol was distilled by the use of fractional distillation. Hydrolysed samples of 3M for 6th day of both *Saccharum officinarum* and *Saccharum barberi* produced the best yields of bioethanol at the pH of 5 and 5M hydrolysed samples of both *Saccharum officinarum* and *Saccharum barberi* produced the least bioethanol for all pH values and fermentation days. The Bioethanol produced was blended with kerosene fuel to create EK10 and EK20 kerosene-bioethanol blends for use as a fuel source in a kerosene lamp. EK10 blend took 126 hours to burn in a rotary kerosene lamp, while EK20 blend took 167 hours to burn-off in the same kerosene lamp. Hydrolysed H₂SO₄ of 3M, pH 5 and fermentation period of 6 days for both *Saccharum officinarum* and *Saccharum barberi* shows the best sample to produce bioethanol. The bioethanol kerosene blend EK10 and E20 was concluded to show long period of burning with clean soot in a rotary kerosene lamp, therefore the bioethanol kerosene blends can be used as substitutes for kerosene fuel.

Keywords: Bioethanol, *Saccharum officinarum*, *Saccharum barberi*, EK10 and EK20

1.0 INTRODUCTION

Over the past few years, there has been increasing concern about global warming, resulting in a growing demand for renewable energy sources, which have a significant lower contribution to CO₂ and CO emission. Badmos *et al.*, (2019).

Renewable energy sources that have been explored include solar thermal energy, hydropower, geothermal energy, tidal energy, wind energy, photovoltaics, biodiesel, biogas and bioethanol, which are clean sources of energy Bruna *et al.*, (2020). In particular bioethanol became a recognized renewable substitute for fossil fuels Kwazo *et al.*, (2021).

Biofuels are fuels derived from living or dead organism's parts, both plant and animals, as a

result of solid materials called fats and liquid materials called oil during a process of transesterification and fermentation, respectively, that are the basis of biodiesel, bioethanol and biokerosene. Baki *et al.*, (2020).

The process of obtaining biofuel such as bioethanol, biodiesel, and biogas is from fermentation of glucose materials, transesterification reactions, and slurry digestion. The advantages of bioethanol over fossil fuels are the production of carbon dioxide, which has a lower impact on the atmosphere compared to fossil fuels, which have some poisonous gases such as sulphur, nitrogen, and chlorine, which all form oxides that are poisonous to the green-house effect. The two stepwise reactions for hydrolysis

of lignocellulose substrate reveal the following chemical components for bioethanol:



Bioethanol was produced and collected via fractional distillation Muhammad *et al.*, (2021).

1.1 Sugarcane

Sugarcane is used worldwide as a feedstock for ethanol and sugar production, with different varieties such as *Saccharum officinarum* and *Saccharum barberi*. In Brazil, for instance, circa 570 million tons of sugarcane were reduced in 2009, Swati *et al.*, (2019). Sugarcane was milled for juice extraction, the sugarcane stalk peels and its bagasse are obtained as a residue, which corresponds to about 25% of the total weight and contains 60% to 80% carbohydrates Bruna *et al.*, (2020). The fermentation of these carbohydrates could significantly improve bioethanol productivity and sustainability, but instead, sugarcane stem and bark are discarded as agricultural waste or burned for energy supply and ethanol mills Swati *et al.*, (2019).

1.2 Bioethanol blends

Fuel blending is the process of blending two or more fuels in a specific ratio based on the needs of a country standard, examples of blending standards are E10 (900cm³ fossil fuel and 100cm³ bioethanol) and E20 (800cm³ fossil fuel and 200cm³ bioethanol), such as in Brazil and the United States, where all automobiles, modified or unmodified engines, use blended fuels. Blending is a technique used to reduce the volume of unwanted gases, thereby halting the greenhouse effect (Pradhan Mantri Ji-Van, 2020).

1.3 Wick lamp (Rotary Kerosene lamp)

A kerosene lamp, also known as “rotary kerosene lamp” or “wick lamp” is so named because it employs the osmosis mechanism, in which kerosene moves from a region of higher concentration to a region of lower concentration via the medium of a substance known as “wick” which is made of cotton and absorbs kerosene for lighting purposes.

2.0 EXPERIMENTAL

2.1 Sample Collection

The sugarcane stem peels were collected from fresh *Saccharum officinarum* and *Saccharum*

barberi, respectively, from the sugarcane selling area in Sokoto (“kasuwar daji”) and transported to the biological laboratory for identification UDUSOK.

2.2 Pre-treatment

The pre-treatment was conducted in two phases, viz.,

Mechanical pre-treatment.

Acid pre-treatment.

The mechanical pre-treatment was conducted on each sample by picking any substances that were not stem or peel and hand-picking stones, which ensured all the samples were clean and free of dirt. Using a mortar and pestle, each sample was pulverized into powder and sieved using fine pore separators.



Plate 2. 1 *Saccharum officinarum* Peels

The acid pre-treatment was also conducted by diluting concentrated sulfuric acid into five different concentrations: 1M, 2M, 3M, 4M and 5M, respectively. Each sample was weighted at 50 g, which was then soaked into a different conical flask that was autoclaved at a temperature of 121°C for 15 minutes. The samples were allowed to cool for 24 hours and filtered, respectively.

Plate 2.2 *Saccharum Barberi* Peels

2.3 Activation of Yeast

The yeast was activated with 3g of peptone water in 200cm³ distilled water that formed a solution in a conical flask that was covered with cotton wool and wrapped with foil paper. The mixture was autoclaved at a temperature of 121°C for a period of 15 minutes and then allowed to cool. 5g of Beaker's yeast was incubated for 24 hours at room temperature.

2.4 Fermentation

The fermentation of *Saccharum officinarum* L. *Poaceae* stalk bark peel (S.O.), which was dark brown in color, and *Saccharum barberi* (S.B.), which was light green in color,

2.4.1 *Saccharum officinarum* Peels (S.O)

For each concentration, the fermentation was carried out for 5 days, 6 days and 7 days at different pH values of 5, 6 and 7. 50 g of the pulverized powder of the peels was put into different conical flasks with three replicates of each sample for both the pH and day differences, respectively.

2.4.2 *Saccharum barberi* Peels (S.B)

The fermentation was also conducted at different pH values (5, 6 and 7) for each concentration for a period of 5 days, 6 days and 7 days. 50 g of the pulverized powder of the peels was put into different conical flasks, with three replicates of each sample for both the pH and day differences, respectively.

2.5 Distillation

Each sample was distilled with distillation apparatus and redistilled with the fractional distillation and recovery method on a rotary evaporator machine at 78°C.



Plate 2.11. Distillation Apparatus

2.6 Rotary Evaporation

The distillates were evaporated in a rotary evaporator at 78°C (Degrees Celsius).

3.0 TEST FOR BIOETHANOL

3.1 Colour Test

The fractional distillate was discovered to be colourless but chocking liquid and irritating, which are properties shared by ethanol.

3.2 Boiling Point Test

The bioethanol obtained was boiled in a round bottom flask with a mounted thermometer and it was observed to boil at around 80°C which was around the boiling point of ethanol 78°C.

3.3 pH Test

The pH meter recorded a pH of 7 on the bioethanol obtained, respectively.

3.4 Rotary Evaporation

The distillates were evaporated in a rotary evaporator at 78°C (Degrees Celsius).

3.5 Benedict Test

When exposed to reducing sugars, the reactions undergone by Benedict's reagent result in the formation of a brick-red precipitate, which indicates a positive Benedict's test.

3.6 Fehling's Test

The appearance of a reddish-brown precipitate indicates a positive result and the presence of reducing sugars. Absence of the reddish precipitate or the appearance of deep blue color indicates a negative result and lack of reducing sugars.

3.7 FTIR Analysis

FTIR machine was used to analysed the functional groups present in the different bioethanol produced. Fourier Transform Infrared machine with model number Agilent Technologist 630-FTIR was used to analysed the functional groups present in the different bioethanol produced with wavenumber range of 4000cm^{-1} - 650cm^{-1} . Inserting 2cm^3 of the produced ethanol in the gas column where the absorption of the functional group present was determined at the screen part of the FTIR-Machine (Model:AG-TEC.FTIR-630) and printed with printer for documentation

3.8 Ceric Ammonium Test

0.4 g of ceric ammonium nitrate was produced in 2M, which was 1:2 in water. To 1cm^3 of the ceric ammonium nitrate reagent, add 5 drops of ethanol, and after being thoroughly mixed, the yellow colour changes to red, confirming the presence of bioethanol.

3.9 Reconcentration of Bioethanol

The bioethanol was reconcentrated using magnesium sulphate and zinc nitrate after passing through sodium sulphate crystals in order to increase the volatility of the bioethanol.

4.0 BIOETHANOL BLENDS

The ethanol produced was blended with kerosene fuel bought from NNPC Sokoto; the blends were EK10 and EK20. In the EK10, it contained 900cm^3 of kerosene were removed and replaced with 100cm^3 of bioethanol and EK20 contained 800cm^3 kerosene and 200cm^3 of bioethanol produced.

4.1 Kerosene Wick Lamp (Rotary Wick Lamp) Test

The kerosene wick lamp test was conducted on kerosene and different bioethanol blends, respectively, for the EK10 and EK20. The blends contained one litre each, their consumption of burning was determined. Plate 3.13 Rotary Kerosene Lamp test for EK10, EK20 and kerosene fuel.

5.0 RESULTS AND DISCUSSIONS

5.1 Results

The results obtained from the study are presented in Table 5.1-5.9 as well as in figures 5.1-5.2

Table 5. 1 Bioethanol yield from fermentation of *Saccharum officinarum* and *Saccharum barberi* Peel after 5 days at pH 5 using different acid concentration.

Acid concentration (M)	SOPB yield (cm^3)	SBPB yield (cm^3)
1.0	0.93 ± 0.05	0.83 ± 0.05
2.0	2.63 ± 0.05	2.53 ± 0.05
3.0	4.30 ± 0.08	4.20 ± 0.08
4.0	1.60 ± 0.08	1.50 ± 0.08
5.0	0.30 ± 0.08	0.20 ± 0.08

KEY: SOPB = *Saccharum officinarum* Peels bioethanol

SBPB = *Saccharum barberi* Peels bioethanol

All values are mean \pm standard deviation (S.D) of triplicate measurement

Table 5.2 Bioethanol yield from fermentation of *Saccharum officinarum* and *Saccharum barberi* Peel after 6 days at pH 5 using different acid concentration.

Acid concentration (M)	SOPB yield (cm^3)	SBPB yield (cm^3)
1.0	1.10 ± 0.08	1.00 ± 0.08
2.0	2.90 ± 0.08	2.80 ± 0.08
3.0	4.60 ± 0.00	4.50 ± 0.00
4.0	1.90 ± 0.08	1.80 ± 0.08
5.0	0.63 ± 0.12	0.53 ± 0.12

KEY: SOPB = *Saccharum officinarum* Peels bioethanol

SBPB = *Saccharum barberi* Peels bioethanol

All values are mean \pm standard deviation (S.D) of triplicate measurement

Table 5.3: Bioethanol yield from fermentation of *Saccharum officinarum* and *Saccharum barberi* stem-bark peel after 7 days at pH 5 and different acid concentration.

Acid concentration (M)	SOPB yield (cm ³)	SBPB yield (cm ³)
1.0	0.80±0.80	0.70±0.08
2.0	2.17±0.12	2.07±0.12
3.0	3.87±0.12	3.77±0.12
4.0	1.20±0.08	1.03±0.05
5.0	0.20±0.08	0.20±0.08

KEY SOPB = *Saccharum officinarum* Peels bioethanol

SBPB = *Saccharum barberi* Peels bioethanol

All values are mean ± standard deviation (S.D) of triplicate measurement

Table 5.4 Bioethanol yield from fermentation of *Saccharum officinarum* and *Saccharum barberi* peel after 5days at pH 6 using different acid concentration.

Acid concentration (M)	SOPB yield (cm ³)	SBPB yield (cm ³)
1.0	0.60±0.08	0.5±0.08
2.0	2.03±0.12	1.93±0.13
3.0	2.57±0.12	2.47±0.12
4.0	1.20±0.08	1.10±0.08
5.0	0.47±0.12	0.37±0.12

KEY SOPB = *Saccharum officinarum* Peels Bioethanol

SBPB = *Saccharum barberi* Peels Bioethanol

All values are mean ± standard deviation (S.D) of triplicate measurement

Table 5.5: Bioethanol yield from fermentation of *Saccharum officinarum* and *Saccharum barberi* peel after 6 days at pH 6 using different acid concentration.

Acid concentration (M)	SOPB yield (cm ³)	SBPB yield (cm ³)
1.0	0.93±0.09	0.83±0.09
2.0	2.40±0.08	2.30±0.08
3.0	3.50±0.08	3.40±0.08
4.0	1.50±0.08	1.40±0.08
5.0	0.50±0.08	0.40±0.08

KEY: SOPB = *Saccharum officinarum* Peels bioethanol

SBPB = *Saccharum barberi* Peels bioethanol

All values are mean ± standard deviation (S.D) of triplicate measurement

Table 5.6 Bioethanol yield from fermentation of *Saccharum officinarum* and *Saccharum barberi* Peel after 7 days at pH 6 using different acid concentration.

Acid concentration (M)	SOPB yield (cm ³)	SBPB yield (cm ³)
1.0	0.80±0.08	0.60±0.22
2.0	1.50±0.08	1.47±0.17
3.0	2.50±0.08	2.40±0.08
4.0	0.90±0.08	0.80±0.08
5.0	0.20±0.08	0.20±0.00

KEY: SOPB = *Saccharum Officinarum* Peels Bioethanol

SOPB = *Saccharum barberi* Peels Bioethanol

All values are mean ± standard deviation (S.D) of triplicate measurement

Table 5.7 Bioethanol yield from fermentation of *Saccharum officinarum* and *Saccharum barberi* Peel after 5 days at pH 7 using different acid concentration.

Acid concentration (M)	SOPB yield (cm ³)	SBPB yield (cm ³)
1.0	0.05±0.08	0.40±0.08
2.0	1.80±0.08	1.70±0.08

3.0	1.90±0.16	1.80±0.52
4.0	0.77±0.05	0.67±0.05
5.0	0.20±0.08	0.13±0.05

KEY: SOPB =*Saccharum officinarum* Peels bioethanol

SBPB =*Saccharum barberi* Peels Bioethanol

All values are mean ± standard deviation (S.D) of triplicate measurement

Table 4.8 Bioethanol yield from fermentation of *Saccharum officinarum* and *Saccharum barberi* speel after 6 days at pH 7 using different acid concentration.

Acid concentration (M)	SOPB yield (cm ³)	SBPB yield (cm ³)
1.0	0.70±0.08	0.60±0.08
2.0	2.10±0.08	2.00±0.08
3.0	2.50±0.08	2.40±0.08
4.0	0.90±0.08	0.73±0.05
5.0	0.30±0.08	0.23±0.05

KEY: SOPB =*Saccharum officinarum* Peels Bioethanol

SBPB =*Saccharum barberi* Peels Bioethanol

All values are mean ± standard deviation (S.D) of triplicate measurement

Table 5.9 Bioethanol yield from fermentation of *Saccharum officinarum* and *Saccharum barberi* Peel after 7days at pH 7 using different acid concentration.

Acid concentration (M)	SOPB yield (cm ³)	SBPB yield (cm ³)
1.0	0.40±0.08	0.27±0.16
2.0	0.60±0.08	0.50±0.08
3.0	1.40±0.08	1.27±0.12
4.0	0.67±0.05	0.57±0.05
5.0	0.20±0.08	0.17±0.09

KEY: SOPB =*Saccharum officinarum* Peels Bioethanol

SBPB =*Saccharum barberi* Peels Bioethanol

All values are mean ± standard deviation (S.D) of triplicate measurement

5.2 Results of bioethanol blends test on a rotary kerosene lamp

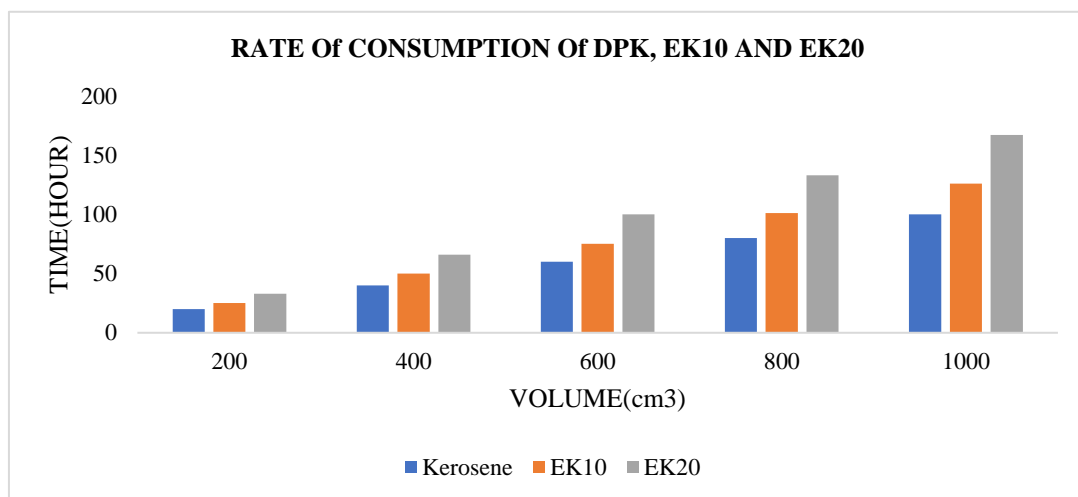


Figure 5.1 Time Graph of kerosene fuel, E10 and EK20

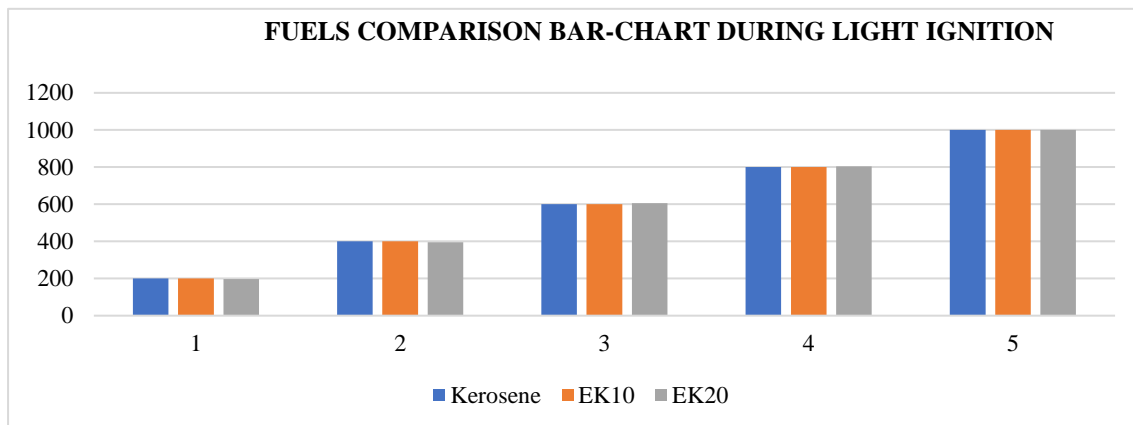


Figure 5.2 Volume Graph of kerosene fuel, EK10 and EK20

Figure 5.1-5.2: The Graph above shows the burning of kerosene fuel, EK10 and EK20 in a rotary kerosene lamp.

Table 5.16: Comparison between physicochemical properties of bioethanol produced with the standard

Physicochemical Properties	Bioethanol from <i>Saccharum Officinarum</i>	Bioethanol from <i>Saccharum barberi</i>	Standard Order
Water Content	2023.9 mgkg ⁻¹	2023.5 mgkg ⁻¹	2024 mgkg ⁻¹
Flash point	13.3°C	13.4°C	13°C
Octane number	100	100	110
Density	790.4 kgm ⁻³	790.1kgm ⁻³	790 kgm ⁻³

Table 5.17: The amount of reduced sugar present or absent.

Concentrations	Reducing Sugar of bioethanol from <i>Saccharum officinarum</i>	Reducing Sugar of bioethanol from <i>Saccharum Barberi</i>
1M	Present (+)	Present (+)
2M	Present (+)	Present (+)
3M	Present (+)	Present (+)
4M	Present (+)	Absent (-)
5M	Absent (-)	Absent (-)

5.3 Discussions

5.3.1 Effects of pH

The sets of experiments were conducted at pH values of 5, 6, and 7 for the two samples (*Saccharum officinarum peels* and *Saccharum barberi peels*) at room temperature with three replicates. The mean and standard deviation were calculated as shown in Tables 4.1 to 4.9. The highest ethanol yield was discovered at pH 5, with an average yield of 4.30 ± 0.08 for SO peels and 4.20 ± 0.08 for SB peels. The bioethanol with the lowest yield was found to be at pH7, with an average yield of 0.20 ± 0.08 for S.O. and

0.17 ± 0.09 for S.B. The results obtained implies that the higher the ethanol yield, the lower the pH value, as shown in the tables. pH 5 gave ethanol a higher yield than pH 7. The best ethanol yield was observed within the acidic pH range (pH 5). This was in-line with experimental report conducted on the effect of pH on bioethanol production which argued that the higher amounts of bioethanol were produced at lower pH value of 5 but as pH value of 7 is higher the amounts of bioethanol produced decreases Josua *et al.* (2019).

5.3.2 Effects of dilute acid concentration

The experiment for both samples was conducted at 1M, 2M, 3M, 4M and 5M with three replicates, after which the mean and standard deviation were calculated. The ethanol concentration was found to be highest at 3M, with an average yield of 4.30 ± 0.08 for S.O. and 4.20 ± 0.08 for S.B., and the lowest yield was found at 5M dilute acid concentration, with 0.20 ± 0.08 and 0.17 ± 0.09 for S.O. and S.B. samples, respectively. The result indicated that the lower value of dilute acid concentration (3M) gave a higher ethanol yield, whereas the higher value of dilute acid concentration (5M) gave the lowest yield. Higher concentration of sulphuric acid hydrolysis does not yield high bioethanol production from the experiment conducted which even produce less bioethanol yield, this is as a result of 4M and 5M hydrolysed sample seems to like it burn which may be the reason why reducing sugar show absence for 5M *Saccharum officinarum* L. Poacea and 4M and 5M absence when tested for Benedict and Fehling test for reducing sugar. This was in accordance with the findings under the bioethanol production potential of *Andropogon gayanus* (Gamba grass) as investigated (Bagudo *et al.*, 2014).

5.3.3 Effects of fermentation days

The sets of experiments with S.O. and S.B. were conducted after a 5, 6, 7 days fermentation period with three replicates. Hence, the mean and standard deviation were calculated. The results showed that the highest ethanol yield occurred on day 5 with an average yield of 4.30 ± 0.08 for SO and 4.20 ± 0.08 for SB, while the lowest ethanol yield occurred on day 7 with 0.20 ± 0.08 for SO and 0.17 ± 0.09 for SB. The high availability of glucose at the beginning of the fermentation affected the fermentation time and consequently the productivity. This result agreed with the experiment on the effect of time and concentration of sulphuric acid on the yields of bioethanol from peat soil and concluded that a period of 6 days yielded the best outcome and a concentration of 3M produced the best yield of bioethanol production. (Kiagus *et al.*, 2019).

5.3.4 Effect of kerosene, EK10 and EK20 on the test of burning in a rotary kerosene lamp

At point 1, kerosene fuel was at 20 hours when 200 cm^3 of it was consumed, EK10 was at 25 hours when 200 cm^3 was exhausted, and EK20 was at 33 hours and able to be consumed at 198

cm^3 , so blend EK20 and blend EK10 can be a substitute fuel for kerosene in a rotary kerosene fuel only engine.

At point 2: This also demonstrates that 400 cm^3 kerosene fuel burned up in a rotary kerosene lamp in 40 hours, EK10 at 400 cm^3 in 50 hours, and EK20 at 396 cm^3 in 66 hours; this also demonstrates that blends EK10 and EK20 can be used as a fuel source in a rotary kerosene lamp for lighting purposes.

At point 3: At this point, kerosene fuel was burned up within 60 hours at 600 cm^3 , while EK10 was burned up within 75 hours at 600 cm^3 , and EK20 at 606 cm^3 within 100 hours. This also shows that the blend can be a substitute. Kerosene fuel burned for 80 hours with 800 cm^3 .

At point 4: EK10 burned for 101 hours with the same volume of kerosene (800 cm^3), and EK20 burned for 133 hours with nearly the same volume of 804 cm^3 , EK10 and EK20 can be substitutes for kerosene fuel.

At point 5, the experiment concluded that blend EK20 and blend EK10 can serve as substitutes for kerosene fuel in a rotary kerosene lamp for lighting purposes during the night. A litre (1000 cm^3) of kerosene was burned up at about 100 hours, while EK10 burned at 126 hours and EK20 burned at 167 hours.

This was also observed in previous research conducted on bioethanol blending were combustion, performance and exhaust emissions of a bioethanol-kerosene blended spark shows that kerosene can be blended with bioethanol since it can be blended with petrol, with the blend EK 15 showing more than the others and lower fuel consumption, the authors concluded that bioethanol can be blended with kerosene as EK15 as demonstrated. (Dhande *et al.* 2021)

5.3.5 Water content

In the cathode and anode compartments of the titration cell, the Karl-Fischer reagent is inserted using a diaphragm. The solvent was titrated dry after starting the coulometer. The sample was injected with a single syringe into the titration cell after preliminary titration and drift stabilization. Weighing the syringe before and after injection allowed us to calculate the precise sample weight; subtracting that weight from the sample weight allowed us to calculate the water content. The water content in bioethanol was determined using the calibration curve obtained with anhydrous

bioethanol experiment on the comparison of the results of Karl Fischer titration and was applied to commercially available bioethanol (Yoon *et al.*, 2019).

5.3.6 Flash point

The flash point is the lowest liquid temperature at which under certain standardized conditions, a liquid gives off vapours in a quantity such as to be capable of forming an ignitable vapour or air mixture. As shown from the table 4.10. The high flash point was for bioethanol produced from S.B (13.4°C) which is slightly bigger than the bioethanol from S.O (13.3°C), both the flash point values are very close to the flash point standard order value for bioethanol. This was in-line with another experiment conducted on flash point values of bioethanol to be 13.6°C very close to the flash point standard order value for bioethanol. Bruna *et al.*, (2020).

5.3.7 Octane number

Octane number measure a fuel's resistance to knock or to ignite prematurely. The bioethanol produced from both samples shows the same octane number value of 100, which is the same as the octane number standard order value for bioethanol. That's, why the bioethanol produced cannot be tested in a modified or unmodified gasoline-bioethanol blends. Which tally with another experiment conducted on the improvement of ethanol molecule rebel an octane number 100 (Farkha *et al.*, 2016)

5.3.8 Density

Density indicates the quality and cleanness of bioethanol, it's nothing but the ratio of mass per unit volume. From the table 4.10. The high value of density was for the bioethanol from S.O with 0.7904gcm⁻³ whereas for bioethanol from S.B was found to be 0.7901gcm⁻³. The value of densities obtained was closer to the bioethanol standard order density value of 0.7900gcm⁻³. The result also revealed that the bioethanol produced from S.O has high quality and cleanness than the bioethanol produced from S.B. This result tally with another research conducted on the density of bioethanol found to be 0.7960 gcm⁻³ which was measured by a device called a pycnometer and hydrometer on bioethanol produced from *Maranta arundinacealinn* Swati *et al.*, (2019).

5.3.9 Effect of the presence or absence of reducing sugar

The results show that using the Benedict reagent and Fehling solutions reveals the presence of reducing sugar in the hydrolysate acid concentration of *Saccharum officinarum* at 1 M, 2M, 3 M, and 4 M except for 5 M, which reveals absence; for *Saccharum barberi*, it reveals the presence of reducing sugar at 1 M, 2 M, 3 M except for 4 M and 5 M, which reveals absence. Looking at the experiment, it shows that reducing sugar plays a vital role in bioethanol production. If 5M acid hydrolysis for SO produces the least bioethanol, and SB of 4M and 5M acid hydrolysis produces the least bioethanol production, this shows that reducing sugar has an effect on bioethanol production. This was in conformity with the Experiment conducted on improvement of measurement of reducing sugar in a hydrolysed sample during bioethanol production using Fehling reagent shows brick red colouration showing the presence of reducing sugar (Yun *et al.*, 2020). In another experiment conducted on *Lagenaria Vulgaris* seed cake yield 503 ppm reducing sugar to show the presence of glucose and 0.4241±0.4865% bioethanol (Sokoto *et al.*, 2013)

6. CONCLUSION

The experiment was conducted on two different varieties of sugarcane stem bark peels, *Saccharum officinarum* and *Saccharum barberi*, for bioethanol production. Different acid concentrations were used for the hydrolysis, and three different replicates at both concentrations, pH, and fermentation duration periods in days were used. The bioethanol produced was blended with kerosene fuel and tested in a rotary kerosene lamp; the blends were EK10 and EK20. In EK10, a litre of kerosene of 1000 cm³ will contain 900 cm³ of kerosene and 100 cm³ while EK20, contained 800cm³ of kerosene fuel and 200cm³ of bioethanol produced by stirring with a stirrer. The hydrolysed sample of 3M at both pH especially pH 5 and the period of 5, 6 and 7 days of fermentation for *Saccharum officinarum* and *Saccharum barberi* shows the best yields of bioethanol production, while at pH 5, 6, 7 and 5M, bioethanol production was produced the list bioethanol production. From the experimental findings, blend EK20 shows a better consumption rate burning and fuel economical than blend EK10 and kerosene fuel. This implies bioethanol when blended with kerosene can be a good fuel substitute.

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