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Characterization, Compositional and Thermogravimetric Analyses of Lignocellulosic Fibers of Syzygium Cumini (L.) Leaf Litter: Investigating the Potential for Biofuel Production

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Citation

Hadiza Adamu Dawi and Taofik Olatunde Uthman (2024), Characterization, Compositional and Thermogravimetric Analyses of Lignocellulosic Fibers of *Syzygium Cumini* (L.) Leaf Litter: Investigating the Potential for Biofuel Production. *Green Energy and Environmental Technology* 3(1), 1–15.

DOI

https://doi.org/10.5772/geet.20240061

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Received: 4 July 2024

Accepted: 16 December 2024

Published: 23 December 2024

Abstract

The quest for greener and more sustainable energy sources has led to the consideration of lignocellulosic materials as possible candidates for this purpose. The present study investigated the potential of *Syzygium cumini* leaf litter as a lignocellulose source for biofuel production. The study involved comprehensive characterization (compositional, proximate, thermogravimetric, and Fourier Transform Infrared analyses) of raw *Syzygium cumini* (RSC) fibers and lignocellulose extracted from the plant, termed lignocellulose *Syzygium cumini* (LSC). RSC fibers were composed of lignocellulosic, cellulose, hemicellulose, and lignin contents of 60%, 50.52%, 31.53%, and 17.95%, respectively, indicating their potential for biofuel production. Nitrogen and fatty acid contents were significantly depleted after alkaline hydrolysis of RSC fibers from 0.532% to 0.196% and 2.5% to 1.0%, respectively. Thermogravimetric and differential thermal analyses at 10 °C/min recorded a steady mass for LSC between 0 to 20 mins until it reached 250 °C indicating thermal stability. However, a 28% mass reduction was reported for RSC between the temperature range of 50 °C – 200 °C, suggesting the presence of

volatile compounds, including amino acids, and oxides of nitrogen and sulfur. The FTIR spectra of RSC and LSC fibers confirmed the presence of several organic functional groups. The peaks at 1023.2 for RSC and 1026.9 for LSC indicate the presence of an alkyl amine group, cyclic alkene or OH group while the peak at 1606.5 indicates unsaturated C=C bond. The compositional variations in LSC fibers distinctively showed the presence of C=O and C–O which were not depicted in the RSC spectra. Overall, the high lignocellulose content, low nitrogen values and high decomposition of 79.25% at 466.71 °C, renders LSC fiber a viable raw material for biofuel production.

Keywords: biofuel, biomass, energy, lignocellulose, *Syzygium cumini*

1. Introduction

Biomass is a complex, renewable, naturally occurring carbonaceous material of biological origin with enormous chemical variability [1]. Biomass can be classified as wood and woody biomass, herbaceous biomass, aquatic biomass, animal and human waste biomass, and biomass mixtures [2]. Waste biomasses, including leaves and poultry manure, constitute a serious menace by virtue of their tendency to litter the environment [3]. In most cases, the leaves are usually gathered in large quantities and burnt resulting in air pollution. Leaf litter is generally rich in lignocellulose due to the presence of volatile organic matter and waxes [4].

Lignocellulosic biomass, including leaf litter, bagasses, husks, straws, barks, sawdust, cobs and agricultural/paper mill wastes mostly end up in landfills or are incinerated, resulting in environmental pollution [5]. Studies have shown that these resources can be converted into useful products through optimized processes. The conversion of biomass into energy can occur via chemical, biochemical and thermochemical processes [6]. Chemical conversion mainly involves the transesterification of bio-oil to produce biodiesel, while biochemical conversion can be anaerobic digestion or fermentation using microorganisms and thermochemical conversion includes processes such as pyrolysis, gasification and liquefaction. For instance, lignocellulose biomass can be converted through gasification to produce synthetic gas; liquefaction or pyrolysis to produce bio-oil; and hydrolysis to produce monomeric units of sugars [7]. Additionally, lignocellulosic biomass can be subject to physical and chemical pretreatments to further enhance its application, including biofuel production [8].

Biofuels such as biogas, bio-butanol, biodiesel and gasoline equivalents are renewable energy fuels that can alleviate the demand for petroleum products in combustion engines [9]. Biofuels can be obtained from lignocellulosic biomass via three major conversion processes, namely chemical, biochemical and

thermochemical [6]. Chemical conversion involves transesterification of bio-oil to produce biodiesel, while biochemical conversion is achieved through anaerobic digestion or fermentation using microorganisms. Thermochemical conversion involves processes such as pyrolysis, gasification and liquefaction to generate biogas and biochar. Production of hydrogen gas for electricity generation can also be achieved through steam reformation of methane from pyrolysis or gasification of lignocellulosic biomass [2].

The lignocellulose content of plants consist of holocellulose, hemicellulose, cellulose, and lignin, all of which constitute the polysaccharide component of plant cell wall [4]. Lignin encloses both hemicellulose and cellulose to give plants structural strength. Hemicellulose is an amorphous organic polymer that breaks down faster than cellulose under the effects of chemicals or heat [10]. Hemicellulose fraction in lignocellulosic biomass is usually 20%–40% of the total dry biomass while cellulose is commonly 30%–50% of the total lignocellulosic dry matter. Additionally, hemicellulose contains a considerable amount of carboxyl groups while cellulose contains both carboxyl and carbonyl groups [11]. Cellulose is a crystalline polymer consisting of stable hydrogen-bonded chains of 1–4 linked glucose units, which are insoluble in most solvents due to its crystalline structure [12, 13]. The degradation of cellulose and hemicellulose by pyrolysis occurs via heterolytic cleavage of the glycosidic C–O bonds [14] and involves complex reactions and several pathways [15]. Cellulose breaks into lower molecular weight compounds to form the so-called "activated cellulose" which further decomposes to form volatile anhydrosugars, char and gases [16]. The extraction of volatile matter and waxes to obtain lignocellulose is an important process in the use of biomass for biofuel production because it increases the yield and calorific value of the product [17]. One such plant that can be exploited for this purpose is *Syzygium cumini*.

Syzygium cumini, also known as Java plum or black plum, is a plant native to the Indian subcontinent and Southeast Asia. It is a medium-sized tree 10–30 m high, with a straight to crooked, short, stout trunk of 40–100 cm in diameter and a circumference of 62.5 cm [18]. The tree is well known for its thick and heavy foliage with light green twigs that turn light grey, slightly flattened and hairless. Leaves are narrow with a transparent margin of about 7–18 cm long and 3–9 cm wide. The upper surface is dark green, and the lower surface is yellowish and dull [19]. In the last two decades, seedlings of *Syzygium cumini* were distributed and planted in the north-eastern part of Nigeria under the 'great green wall initiative (GGWI)'. This accounts for the overwhelming presence of this tree in Nigeria [20].

Currently, the world is facing dwindling fossil fuel reserves coupled with increased greenhouse gas emissions which contribute to climatic and environmental degradation. Additionally, a surge in waste biomasses generated, especially from agricultural activities, constitutes a serious environmental menace. Furthermore,

the use of chemicals for biomass degradation further negatively impacts the environment. These challenges have heightened the demand for greener energy sources, exploration of eco-friendly and economically viable alternative sources, including the use of biomass from plants. Thus, the aim of the present study is to assess the potential of lignocellulose fiber from *Syzygium cumini* leaf litter as a valuable biomass resource for biofuel production to meet global energy demands.

2. *Materials and Methods*

2.1. Collection and identification of plant materials

Fallen leaves of *Syzygium cumini* were gathered and collected from Maiduguri metropolis in January 2024 for this study. Prior to the study, fresh leaves of the plant were taken for identification and authentication at the Department of Biology, Nile University of Nigeria, Abuja, Nigeria. A voucher specimen labelled NUN.H.0005 was prepared and kept in the Herbarium for future reference.

2.2. Preparation of raw and lignocellulose fibers of *Syzygium cumini*

The fallen leaves of *Syzygium cumini* (5 kg) were thoroughly rinsed under running tap water to remove dirt and other debris before oven drying at 105 °C for 7 h. The resulting product was then subjected to mechanical grinding to obtain raw *Syzygium cumini* (RSC) fiber [21]. To obtain lignocellulose fiber, RSC fiber (1.5 kg) was subjected to alkali pretreatment by immersing it in 20 L of 0.5 M NaOH (Kermel, 96.00%) for 24 h [22]. This process was done to dewax and render biomass free of all extractives. The resulting product was washed and neutralized with 2% glacial acetic acid to obtain lignocellulose *Syzygium cumini* (LSC) fiber [23].

2.3. Determination of lignocellulose content

The lignocellulose composition, including hemicellulose, lignin, and cellulose, was determined according to standard methods. The resulting samples were weighed and calculated in percentage to determine the yield of each component.

2.3.1. Determination of hemicellulose content

The hemicellulose content of RSC fiber was determined by extracting 2 g of the sample in 150 ml of 3.5% sodium chlorite ($NaClO_2$, DC Fine Chemicals, 80.00%) for 3.5 h on a hot plate at a temperature of 80 °C [24]. The sample was thereafter washed with deionized water until it was free from sodium and dried in an oven at 105 °C until a constant weight was obtained. The amount of hemicellulose was determined by subtracting the final weight from the starting weight and the percentage was calculated in triplicates.

2.3.2. Determination of lignin content

Lignin content was determined by adding 30 ml of 30% sulfuric acid (H_2SO_4, Merck, 98.00%) to 2 g of RSC fiber [25]. The resulting solution was left at an ambient temperature for 24 h and then boiled for 1 h at a temperature of 100 °C using a hot plate. The mixture was filtered, and the residue was washed with deionized water until sulfate ion was undetectable via titration process with 10% of barium chloride solution. The sample was dried in an oven at 105 °C until constant weight was obtained. The concentration of lignin was determined by subtracting the final weight from the starting weight and the percentage was calculated in triplicates.

2.3.3. Determination of cellulose content

Cellulose content was calculated by the subtraction of hemicellulose and lignin concentrations from 2 g of RSC fiber [26].

2.4. Proximate analysis

The proximate analysis of RSC and LSC fibers was done in triplicates according to standard methods described in AOAC [27]. The nutrients evaluated were moisture, ash, lipids, nitrogen, fiber, proteins and carbohydrates.

2.5. Ultimate analysis

The concentrations of carbon (C), hydrogen (H), nitrogen (N), and sulfur (S) in RSC and LSC fiber samples were determined using LECO CHNS 2000 Elemental Analyzer (Leco Corporation, USA). Briefly, the sample (2 g) was weighed in a platinum crucible and placed in the Leibig-Pregle chamber containing 2 M magnesium perchlorate ($Mg(ClO_4)_2$, Kermel, 98.00%) and 2 M sodium hydroxide (NaOH, Kermel, 96.00%). The sample was burnt to produce carbon dioxide (CO_2) and water (H_2O), which were absorbed by sodium hydroxide and magnesium perchlorate, respectively. The display gave the elemental composition of C, H, N, and S while oxygen (O) was obtained by difference.

2.6. Determination of pH value

To determine the pH, 2 g of RSC fiber was soaked in 20 ml of deionized water and the initial pH was recorded using a pH meter (Biobase, China). The same process was done at each reaction stage [9].

2.7. Thermogravimetric analysis

Thermograms of RSC and LSC fibers were recorded using a DTG-60H differential thermal analyzer (Shimadzu Corporation, Japan). RSC fiber (25 mg) and LSC fiber (12 mg) were placed separately in a crucible. The experiment was conducted under

inert conditions with a constant flow of nitrogen gas at a rate of 100 mL/min. The samples were heated at a rate of 15 °C/min in the temperature range of 20 °C to 600 °C. The resulting thermogravimetric data were compiled into a thermogravimetric curve.

2.8. Fourier transform-infrared (FTIR) spectroscopic analysis

Characterization of RSC and LSC fibers was done using a Shimadzu 8400 FTIR spectrometer to determine the structure of the functional groups present in the samples. The unit has an interferometer having a Globar SiC element as the IR source and the time dependence of the IR intensity is measured with a pyroelectric deuterated triglycine sulfate (DTGS) detector. Potassium bromide (250 mg) was added to the sample (1 mg) followed by homogenization using a mortar and pestle and moulded into pellets. The pelleted sample was placed in the sample holder of the instrument to obtain the spectra data. The spectra were displayed as absorbance vs frequency in wavenumbers ranging from 500 to 4000 cm^{-1} with 32 scans in each case at a resolution of 4 cm^{-1}. The functional groups present were identified using IR correlation charts.

2.9. Statistical analysis

Data obtained were analyzed using SPSS 10 with results expressed as mean ± standard deviation (SD) for three observations. Statistical evaluations were done using design expert (Design-Expert® (ver. 11, Stat-Ease Inc., Minneapolis, USA) in one-way analysis of variance (ANOVA) followed by Tukey's post hoc test for multiple comparison. Differences between means were considered statistically significant at $p < 0.05$.

3. Results and Discussion

3.1. Lignocellulose composition of *Syzygium cumini* leaves

The concentrations of hemicellulose, lignin, and cellulose in LSC fiber are presented in Table 1. The results indicated that LSC has a significantly high alpha cellulose content of 50.52%, compared to lignin and hemicellulose content ($p < 0.05$). This finding agrees with that of Bratishko *et al.* [28], which reported high cellulose content in fallen maple and linden leaves. This is an indication that biomass resources of this nature, including fallen leaves of *Syzygium cumini*, have a higher potential for biofuel production. The concentration of lignin at 31.53% indicates high fiber content, which is a good source of phenolic compounds. Thermal decomposition of cellulose leads to reformation of D-glucose monomers into furans, paraffinic, esters, and alkyl-alcohols [29]. The decomposition of lignin and hemicellulose leads to the formation of aromatic and phenolic compounds [10].

Table 1. Concentration of lignocellulose in *Syzygium cumini* leaves.

Parameters	Mass (g)	Concentration (%)
Hemicellulose	0.36 ± 0.01^{a}	17.95 ± 0.12^{a}
Lignin	0.63 ± 0.02^{b}	31.53 ± 0.31^{b}
Cellulose	1.01 ± 0.01^{c}	50.52 ± 0.51^{c}

Results are presented as mean ± standard deviation for three readings. Column values with different superscripts are significantly different ($p < 0.05$).

Findings from this study affirm the economic and industrial viability of LSC fibers for use as biofuel. Isolation and modification of cellulose are constantly being investigated for applications in several industries, such as renewable and sustainable energy, environment, pharmaceuticals, and nanotechnology. The use of an appropriate concentration of alkali or acid to hydrolyze RSC fiber is an important factor in avoiding the dissolution of excessive sugar molecules from lignocellulose fibers [30]. In this study, the extraction of volatile compounds rendered LSC fiber much lighter than RSC fiber, thereby occupying a larger surface area than its weight. However, this may require further verification with larger quantities of samples.

3.2. Proximate composition of RSC and LSC fibers

Alkaline pretreatment considerably lowered the concentrations of proteins, lipids and other extractives in LSC fiber, as presented in Table 2. Given the objective of this study to determine the yield of energy compounds, it is imperative that carbohydrates and fiber remain intact. Results show that the concentrations of carbohydrates and fiber are not significantly different and relatively higher than other parameters in both RSC and LSC fibers. Carbohydrates and fiber represent the concentration of total lignocellulose content [13]. The fiber content of 20%–25% is also an indication of the potency of both samples for biofuel production. Carbohydrates and fiber are the major determinants of approximate biofuel yield to be expected from thermal or chemical decomposition of LSC fibers. The relatively high fiber reported is not surprising, given the fibrous nature of *Syzygium cumini* leaves. The moisture contents of RSC and LSC fibers are not significantly different, and they are compared favorably with fir tree, a common biomass used in Europe, as reported by McKendry [31] and Basu [32]. In a study by Siddique [33], walnut shells, almond shells, babul tree barks, and neem tree barks were used as biomass based on their low moisture content (3.08%–5.69%) and nitrogen content (0.19%–0.88%). Their results are in agreement with our findings, where extraction of RSC with NaOH reduced nitrogen content from 0.54% to 0.19%, which subsequently lowered the protein content from 3.33% to 1.23% in LSC. The lower the nitrogen content, the higher the quality of biofuel produced [34].

Table 2. Proximate composition of RSC and LSC fibers.

Parameters	RSC fiber (%)	LSC fiber (%)
Moisture content	6.00 ± 0.05^{a}	6.50 ± 0.03^{b}
Ash content	8.00 ± 0.06^{a}	7.00 ± 0.04^{b}
Lipid	2.50 ± 0.11^{a}	1.00 ± 0.01^{b}
Fiber	20.50 ± 2.01^{a}	25.00 ± 3.03^{a}
Nitrogen	0.54 ± 0.01^{a}	0.19 ± 0.01^{b}
Protein	3.33 ± 0.04^{a}	1.23 ± 0.01^{b}
Carbohydrate	59.67 ± 2.01^{a}	59.27 ± 1.91^{a}

Results are presented as mean ± standard deviation for three readings. Values with different superscripts for each parameter are significantly different ($p < 0.05$).

3.3. Elemental composition of RSC and LSC fibers

The elemental composition of RSC and LSC fibers are presented in Table 3. The carbon and hydrogen concentrations recorded for both samples are higher than the values reported for most biomass wastes [35]. The levels of these two elements indicate the heating value of fiber. Higher carbon and hydrogen contents improve the heating value of samples as opposed to higher oxygen value which is an indicator of high calorific value of the fibers [36]. The oxygen content in the fiber samples (15–16%) is relatively low compared to the value reported for the biomass sample [35]. This is a positive affirmation of the viability of the feedstock for biofuel production.

Table 3. Elemental composition of RSC and LSC fibers.

Parameters	RSC fiber (%)	LSC fiber (%)
Carbon	78.42	77.23
Hydrogen	5.26	6.04
Nitrogen	0.73	0.29
Sulfur	0.02	0.09
Oxygen	15.57	16.35

3.4. Thermogravimetric and differential thermal profiles of RSC and LSC fibers

The thermogravimetric and differential thermal profiles of RSC and LSC fibers are presented in Figure 1. The curves clearly depict the decomposition temperatures of both RSC and LSC fibers with respect to a time of 60 mins at 10 °C/min heating rate. However, based on the thermogravimetric data obtained for RSC, the temperature range required to yield moisture content (50 °C – 200 °C) led to 28% weight loss. This implies a higher volatile content than moisture. This finding agrees with the

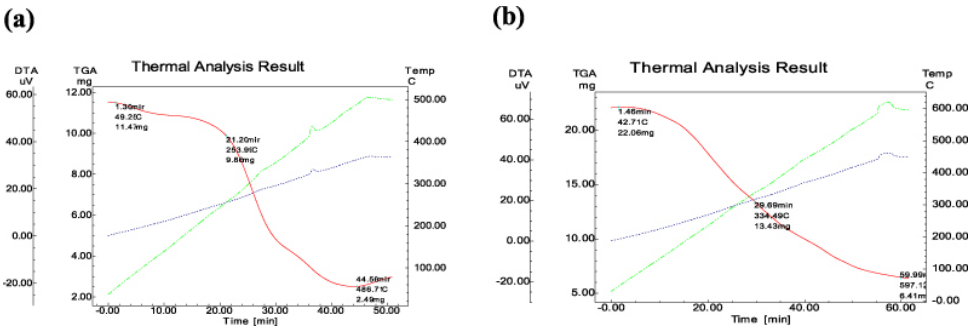

Figure 1. Thermogravimetric and differential thermal profiles of (a) RSC and (b) LSC fibers.

study of Rashidi *et al.* [37], where *Pistacia terebinthus* oil was employed as a biomass resource to produce biodiesel. The authors reported that weight loss occurred in the range of 250 °C – 450 °C, leading to the removal of volatile organic compounds including microcrystalline cellulose and stearic acid. This resulted in the loss of 31% of its original weight before reaching stability, which aligns with the findings in the present study.

The weight loss percentage of each temperature peak was calculated with respect to the corresponding initial mass of each sample (Table 4). The decomposition temperature and time gave an idea of carbonization temperature and time range. The weight loss recorded for RSC at 42.71 °C could be attributed to excessive light volatile compounds, including amino acids, and oxides of nitrogen and sulfur. This finding aligns with the study of Onokwai *et al.* [26] which explored the potential of seven lignocellulose biomass samples, including rice husk and sugarcane straw as sources of biofuel. The authors reported that nitrogen content negatively influenced pyrolysis yield due to low HHV. In our study, light volatile compounds were not extracted from RSC fibers. Therefore, an instant weight drop was expected, as observed in Figure 1a. Such a phenomenon is not depicted on the LSC curve due to reduced weight loss at lower temperature, which accounted for the steady mass recorded between 0–20 mins until it reached 250 °C. This may be attributed to pretreatment with alkali, which dewaxed the sample rendering it free of light volatile compounds. It is expected that the weight loss recorded at 250 °C represents the mass of hemicellulose as it fell within the range of 220 °C – 315 °C while lignin and cellulose decomposition occurs between 315 °C – 400 °C [38]. However, the highest decomposition temperature of RSC fiber which was 597.12 °C at 59 min, is significantly higher than that of LSC fiber which was 466.71 °C at 45 mins. The differential thermal values for both RSC and LSC revealed that the decomposition reactions were exothermic since the curve was above 0 ($\Delta T > 0$).

Table 4. Thermogravimetric and differential thermal (TG/DT) peaks' percentage mass loss.

RSC TG/DT peaks				LSC TG/DTA peaks			
Temp (°C)	**Time (min)**	**Mass (mg)**	**Percentage mass loss (%)**	**Temp (°C)**	**Time (min)**	**Mass (mg)**	**Percentage mass loss (%)**
42.71	1.46	22.06	11.76	49.25	1.30	11.47	4.42
334.40	29.69	13.43	48.00	253.99	21.20	9.86	17.83
597.12	59.99	6.41	74.36	466.71	44.56	2.49	79.25

Temperature profiles provide an anticipated data range and reaction kinetics for thermal degradation of biomass in processes such as gasification, pyrolysis, thermal liquefaction and carbonization [39]. During pyrolysis of RSC fiber, light volatile gases and liquids should be expected at low temperatures of 50 °C – 200 °C, whereas the heavier oils are expected from 200 °C – 550 °C. However, for LSC fibers, pyrolysis fielded heavier fractions of oils from 250 °C – 450 °C.

3.5. FTIR spectra of RSC and LSC fibers

The FTIR spectra of RSC and LSC fibers (Figure 2) exhibited more than five distinct peaks, which confirmed the presence of many organic functional groups by forming complex compounds. The spectral peaks at 1023.2 for RSC and 1026.9 for LSC, indicate the presence of an alkyl amine group, cyclic alkene or OH group, depending on the peak intensities at 3250–3670 as observed in Table 5. The broad band seen on RSC spectra is that of OH group when accompanied by peaks at 1600–1300, 1200–1000. The peak at 1606.5 indicates unsaturated C=C bond or aromatics, while the peaks at 2914.8 and 2922.8 indicate the presence of aliphatic compounds, such as asymmetric or symmetric methylene stretch. Previous studies using FTIR have also reported the presence of OH groups and C–O bonds in waste calcium carbonate and magnesium oxide tablets used as catalysts in transesterification reactions to produce

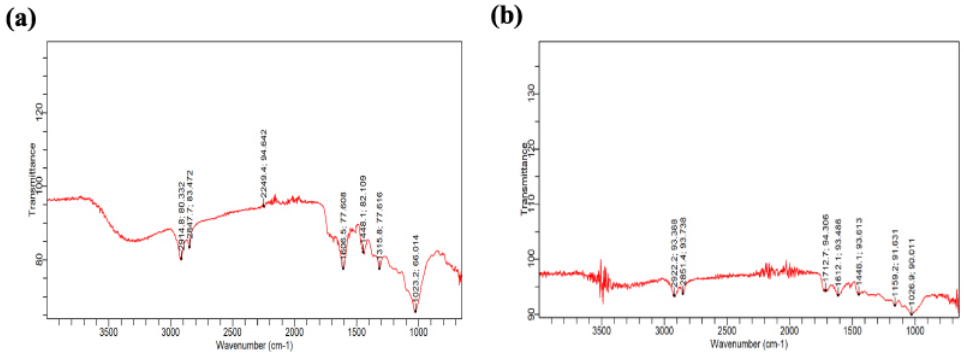

Figure 2. FTIR spectra of (a) RSC and (b) LSC fibers.

Table 5. FTIR spectra peaks with functional groups for RSC and LSC fibers.

RSC fibers		LSC fibers	
Wavelength (cm^{-1})	**Functional group**	**Wavelength (cm^{-1})**	**Functional group**
1023.2	Alkyl amine	1026.9	Alkyl amine
1315.8	OH, Amine	1159.2	Tertiary alcohol, C–O Stretch
1448.1	CH_2 (Bending)	1448.1	CH_2 (Bending)
1606.5	C=C, aromatics	1612.1	C=C, aromatics
2847.7	Methyl stretch	1712.7	Carbonyl (Esters, Ketones or Aldehydes)
2914.8	Methylene stretch (asymmetric/symmetric)	2922.4	Methylene stretch (asymmetric/symmetric)
3300–3400 (Broad)	OH stretch	3500 Sharp	OH/Phenol

biofuel from waste cooking oil. This suggests that LSC may be used as a catalyst to accelerate the production of biofuel from other biomass resources [40, 41].

The peak at 1712.7 is attributed C=O of ketones, esters or aldehydes. The second sharp peak at 3500 indicates an OH belonging to alcoholic or phenolic compounds. The peak at 1159.2 suggests the presence of carboxyl and tertiary alcohol, thus supporting the OH peak at 3500. These variations may be attributed to degradation of RSC by NaOH which confirmed the disintegration of the lignin, hemicellulose and cellulose.

3.6. pH value of RSC and LSC fibers

The pH values recorded for RSC and LSC fibers are presented in Table 6. RSC fiber immersed in deionized water had a low pH of 4.3 after 24 h. This is an indication that hydrolysis of organic salts has occurred. However, after alkaline hydrolysis and thorough washing, the pH was 10.3, while the neutralized LSC using 2% acetic acid, resulted in a pH of 7.3. Generally, low pH greatly influences sample properties, including causing hydrolysis of hemicellulose to monomeric sugars while keeping the cellulose and lignin intact without the formation of toxic compounds. High pH results in the dissolution of lignin, while some hemicellulose remains solid [9].

Table 6. pH values of RSC and LSC fibers.

Sample	pH value
RSC fibers	4.3
LSC fibers	7.3

4. Conclusion

This study elucidated the potential of *Syzygium cumini* leaf litter as a valuable source of lignocellulose for biofuel production. The presence of high concentrations of cellulose, lignin and hemicellulose in the leaves is an indication that it can be utilized for green energy, chemical or bio-composite applications. This study has the potential to be scaled up to accommodate a large quantity of *Syzygium cumini* leaf litter. The thick and heavy foliage produced by the tree can be positively harnessed and channeled to biofuel production. Therefore, an efficient system should be put in place to collect *Syzygium cumini* leaf litter for this purpose. This suggests the possibility of utilizing *Syzygium cumini* leaf litter as a biomass resource for energy generation in Nigeria and simultaneously reducing environmental pollution. Thermogravimetric and differential thermal data also provided insights into the reaction kinetics to adopt when processing the substrate.

Author's contribution

Dawi, Hadiza Adamu: Conceptualization, Methodology and Writing – original draft; **Uthman, Taofik Olatunde:** Investigation, Writing – review & editing, Supervision and Validation.

Funding

This research did not receive external funding from any agencies.

Ethical statement

Not Applicable.

Data availability statement

Source data is not available for this article.

Conflict of interest

The authors declare no conflict of interest.

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