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# Proximate Analysis of Wood Saw Dust Collected from Ilorin Metropolis, Kwara State, Nigeria

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**ABSTRACT**: *Five samples of wood sawdust were collected from the Saw Mill in Ilorin metropolis and the proximate analysis was investigated. The study shows that Adansonia Digitata, a soft wood has the lowest ash % of 0.85, while Tectona Grandis has the highest figure of 4.27%, Gmelina Arborea is 3.46%, and Khaya invorensis 3.0%. The moisture content of Tectona Grandis is the highest at 7.1% followed by Khaya invorensis and Gmelina Arborea at 3.0 and 2.5% respectively. The lowest is Butyrospermum paradoxium which has 1.6%. the lignin content of all the samples is very close, with Khaya invorensis having 27.845% and the lowest is Tectona Grandis with 16.69%. The cellulose contents of the samples range from 36.82-56.20% with Khaya invorensis having the lowest and Tectona Grandis having the highest. It can be concluded from the study that wood sawdust can be used utilized in energy, manufacturing, and Agriculture.*

**KEYWORDS:** proximate analysis, wood saw dust, Ilorin metropolis, Kwara state, Nigeria

## INTRODUCTION

As the demand for wood or wood products increases, there are always sawdust, trimmings, and edgings that remain when logs are cut for timber. Timber is a valuable natural resource that serves directly as a material for wood products such as construction, papermaking, and furniture, and as a fuel source. Udeozo et.al described wood as an organic material, a natural composite of cellulose fibers (which are strong in tension) embedded in a matrix of lignin which resists compression. In the strict sense, wood is produced as secondary xylem in the stems of trees (and other woody plants). Wood is a complex three-dimensional polymer composite primarily composed of cellulose, hemicellulose and lignin. Cellulose is the main component that gives wood its strength and structural stability. Hemicellulose is also a structural component of wood, but lignin is more non-polar than cellulose and acts as chemical bonding agent within and between cellulose fibers. Petterson R.C (1984).

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Sawdust materials are global wastes obtained from wood processing and exploitation activities. They are usually dumped/stored in uncontrolled conditions, thus becoming a major contributor to environmental pollution. Adegoke et.al. Sawdust is considered a polluting waste product from the wood industry and can be a valuable commodity considered in three ways: production, energy and agricultural use. Sawdust can be used for home heating in a sawdust stove. It can also be used to generate electricity, heat and petroleum through gasification, combustion and pyrolysis processes. In addition, sawdust exhibits many desirable properties such as being absorbent, abrasive, bulky, fibrous, non-conductive, and granular, making it a popular material for the production of fiber composites. A variety of products, including bedding, abrasives, insulation, and packaging, can be produced from sawdust using this process.This study is targeted at determining the proximate analysis of five wood samples collected from saw mill in Ilorin, Kwara State, Nigeria metropolis and studying the importance of the proximate analysis to the end use.

## EXPERIMENTAL METHODS

### Materials

Saw dust of the following woods samples were collected from Offa Garage sawmill in Ilorin South Local Government Area of Kwara State, North Central Nigeria, Teak (*Tectona grandis*), Baobab (*Adansonia Digitata*), African Mahogany (*Khaya invorensis*), Shea Butter (*Butyrospermum paradoxium*) and Parrot Beak (*Gmelina Arborea*). The sawdust was sun-dried, milled, and sieved into a uniform particle size of 300um, weighed, and stored at room temperature in an airtight plastic bottle.

### Proximate analysis

Moisture Content determination.
0.5g of the sample material was weighed into a crucible that had been weighed previously. The crucible containing the sample was dried in an oven for 24hrs, cooled in a desiccator, and weighed to a constant weight.
Calculation

$$\% \text{ moisture} = \frac{W-(W2-W1)}{W} \times 100$$

$W_1$ = Weight in grams of empty crucible
$W_2$ = Weight in grams of crucible + residue
W = Weight in grams of the sample used
2.2.2 Determination of Ash Content
0.5g of the sample was weighed into a crucible that had already been weighed. The crucibles containing the sample were ashed in the furnace at $550^0$ – $600^0$c for 3 hours, it was cooled in a desiccator and weighed to a constant weight.
Calculation

$$\% \text{ Ash} = \frac{W2-W1}{W} \times 100$$

$W_1$ = Weight in grams of empty crucible

$W_2$ = Weight in grams of crucible + ash
W = Weight in grams of the sample
2.2.3 Fibre Content determination.

0.5g of the sample material was weighed into a beaker, 200$cm^3$ of $H_2S0_4$ solution (1.25%) was added to the sample in the beaker, the beaker containing the mixture was placed on fiber digestion apparatus, the mixture was refluxed for about 30 minutes after which it was filtered using sintered crucible with the help of a suction pump. The residue was washed with hot water to remove completely the acid solution. The crucible containing the residue was returned to the beaker, and about 200$cm^3$ of NaOH solution (1.25%) was added to the beaker containing the residue. The beaker was placed on the fiber digestion apparatus and refluxed for another 30 minutes. The mixture was filtered with the help of a suction pump and washed with very hot water, the residue was washed with acetone to remove any trace of oil and any color pigment. The crucible containing the residue was dried in the oven for 30 minutes at $105^0$C, the crucible was then cooled in a desiccator and weighed to a constant weight. The crucible and its content were ashed in the furnace for 30 minutes at $600^0$c, cooled, and weighed to a constant weight.
Calculation

Crude fiber = $\frac{100\,(W1-W2)}{W}$

Where:
$W_1$ = weight in grams of sintered crucible and contents before ashing
$W_2$ = weight in grams of sintered crucible containing ash.
W = weight in grams of the material used.

**Determination of Lignin, Cellulose, and Hemi cellulose**
Acid Detergent Fiber (ADF)
Preparation of Acid Detergent Fiber Solution
20g of Cetyl Trimethyl Ammonium Bromide (CTAB) was dissolved in 1N sulphuric acid solution, the solution was stirred until a homogenous solution of the mixture was formed and the solution was transferred in a well-stoppered container.
Procedure: 0.5g of the prepared sample material was placed in a beaker, 200 ml of ADF solution was added, it was refluxed on a fiber digestion apparatus for an hour, and the mixture was filtered using a previously weighed crucible. The residue was washed with hot water (85 – $90^0$c) and finally washed with acetone. The residue was dried in the oven for an hour at $105^0$C). The residue was cooled in a desiccator and weighed to a constant weight.

$$\% \text{ ADF} = \frac{\text{crucible + residue wt – crucible wt}}{\text{sample wt}} * 100$$

**Acid Detergent Lignin**
Procedure: ADF residues were used in the acid detergent lignin. The crucible containing the residue from the ADF analysis was placed on a glass dish with one end raised 2.0 cm to allow the acid to drain from the crucible. The contents of the crucible were covered with chilled (50° C.)

72% $H_2SO_4$ and stirred with a glass rod to form a smooth paste and break up lumps. The crucible is maintained at 20-23°C, then a suction pump is used to filter out as much acid as possible, the

| Saw dust samples | % DM | % ASH | % CF | % CP | % NDF | % ADF | % Hemi cellulose | % LIGNIN | % MC | % CELLULOSE |
|---|---|---|---|---|---|---|---|---|---|---|
| Teak *Tectona Grandis* | 92.89 | 4.27 | 55.85 | 1.25 | 79.92 | 73.29 | 6.63 | 16.69 | 7.10 | 56.60 |
| Baobab *Adansonia Digitata* | 92.02 | 0.85 | 58.16 | 0.56 | 76.02 | 68.84 | 7.18 | 27.07 | 1.70 | 40.97 |
| African Mahogany *Khaya invorensis* | 92.70 | 1.34 | 44.40 | 0.63 | 74.96 | 67.66 | 7.30 | 27.84 | 3.0 | 38.82 |
| Shea Butter *Butyrospermum paradoxium* | 92.39 | 2.17 | 56.73 | 1.50 | 77.04 | 71.66 | 5.38 | 18.38 | 1.60 | 53.28 |
| Beechwood *Gmelina Arborea* | 92.94 | 3.46 | 60.15 | 0.81 | 84.72 | 76.05 | 8.67 | 26.65 | 2.5 | 49.40 |

contents are washed with hot water (85-95°C) until acid-free, the stir bar is washed and removed. it was done. The crucible was dried overnight at 100° C. and weighed. The crucible containing the residue was ashed in a muffle furnace at 500-600 °C for 3 hours. The crucible was cooled to about 250°C, transferred to a desiccator, cooled to room temperature, and weighed

$$\text{Lignin \%} = \frac{\text{Wt of crucible and lignin} - \text{Wt of crucible and ash}}{\text{Sample weight}} \times 100$$

% Hemi Cellulose = % NDF - % ADF

% Cellulose = Percent ADF – Percent lignin

## RESULTS AND DISCUSSION

Table 1: DM = dry matter, CP = crude protein, CF = crude fiber, NDF = neutral detergent fiber, ADF = acid detergent fiber, MC = moisture content.

### Cellulose, Lignin, and Hemicellulose

Wood is typically composed of about 25% lignin, and 70% cellulosic carbohydrate, with roughly 45% cellulose and 25% hemi cellulose. Petterson (1984). In Table 1 above, *Tectona Grandis* has

56.60% cellulose followed by *Butyrospermum paradoxium* with 53.28%, while *Gmelina Arborea* has the lowest value of 49.40%. The lignin percentage of *Adansonia Digitata and Khaya invorensis* was 27.07% and 27.84% respectively, while *Tectona Grandis* has the lowest value of 16.69%. The hemicelluloses of Gmelina Arborea is 8.67% while others fall within the 5.38-7.30%. Hemicellulose is used for ethanol or Xythol production. Pothiraj et.al (2006) lignin is used for the production of carbon Fibres and Dispersants, Lora J and Glasser W. (2002), and cellulose is used in Pharmaceuticals and Papermaking industries. Shokri J and Adibkia K. (2013)

**Moisture Content**

Generally, exposure of wood to moisture can pre-mediate the wood membrane causing it to rot and to develop staining fungus also the strength and stiffness increase with a decrease in moisture content. For example, in the production of wood plastic composites, Winandy and Rowell (1984) observed that the hygroscopic of wood flour can affect the end composites, the absorbed moisture interfere and reduce hydrogen bonding between the cell wall polymers and alter its mechanical properties. In Pulp milling, if there is too much moisture it may affect the physical and chemical process, and the paper may fall apart.

**Ash contents**

Ash content is an essential parameter for fuel as it is a buy product of combustion. Though conditions of combustion affect the composition and the amount of ash residue, higher temperatures will reduce the ash. Etiegni and Campbel (1991). Wiberg C.(2020) asserted that the ash content of softwood ranges from about 1.5% to 0.35% and for Hardwoods, it will range from about 0.35 to 0.55%. The sequence of the ash content in this paper reflects that the hardwood sawdust has higher ash contents than the softwood sawdust, the only softwood in the samples has the lowest ash content of 0.85%, while other ranges between 1.34-4.27% ash contents.

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