

Thermal Characteristics, Phytochemical and Functional Groups Assay of *Gmelina arborea*: A Tropical Timber

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Abstract: The elucidation of *Gmelina arborea* timber was carried out in terms of thermal and physico-chemical techniques. Various physical and thermal test performed on the timber which includes: oven dry density, water imbibitions (At different time intervals: 30min, 5h and 24h), afterglow time, flame duration, flame propagation rate, ignition time, thermal conductivity, electrical conductivity, moisture content and ash content showed it to be a good timber suitable for various construction purposes. The Atomic absorption spectroscopy (AAS) result indicated the absence of Cd and Hg, as well as the presence of Pb, As, Na, Zn, Mg, Ca, K and Cu in the decreasing order of their concentrations. Thin layer chromatography (TLC) analysis gave R_f value of 0.6 in the chloroform-methanol extract. The phytochemical screening showed the presence of all the tested secondary metabolites except tannin which indicated its therapeutic ability. The Fourier Transform Infrared and Ultraviolet spectra suggested that the active compound might be 1, 2, 3-trisubstituted aromatic compound with C=O, O-H and C=N groups attached.

Key words: *Gmelina arborea* • Verbanaceae and Thermal characteristics

INTRODUCTION

Gmelina arborea is a flowering plant that belongs to the Verbanaceae Family.

It is a hardwood with *Gmelina* as its common name. In Nigeria, its Igbo name is *Gmelina*, *igi-melina* in Yoruba and *kalankuwa* in Hausa [1, 2]. It is a white teak *Vernonia* locally known as *gamhar*, a fast growing deciduous tree, occurring naturally throughout the greater part of India, Myanmar, Thailand, Lagos, Cambodia, Vietnam and in Southern Provinces of China and has been planted extensively in Sierra Leone, Nigeria, Malaysia and on experiment basis in other countries as well. It is planted in gardens and avenues.

The root, stem and bark of *G. arborea* are useful in stomach ache, galactagogue laxatives and anthelmintic, improve appetite also useful in hallucination, piles, abdominal pain, burning sensation, fever and urinary discharge. Its leaf paste is applied to relieve headache and juice is used as wash for ulcer. Its flowers are sweet, cooling, bitter, acidic and astringent. They are useful in leprosy and blood disease [3]. There is paucity of

information on *G. arborea* wood as a result, some thermal properties, variable properties, phytochemical and functional group assay of the wood were investigated.

MATERIALS AND METHODS

Sample Collection and Identification: *Gmelina arborea* timber was collected from timber shed at Nnewi in Nnewi North Local Government Area of Anambra State. Timber dealer, forest officer (Mr. Vin Okakpu of Nnewi Forestry) as well as literature helped in the timber identification.

Sample Preparation: The timber was cut in a saw mill into two different shapes and sizes; dust from the timber was also collected. The timber was cut into splints of dimensions 30 x 1.5 x 0.5cm and cubes of dimensions 2.5 x 2.5 x 2.5cm. The samples were dried in an oven at 105°C for 24 h before the experiments.

Methods

The Thermal Characteristics: Afterglow time, flame duration, flame propagation, ignition time, oven dry

density, moisture content, water imbibitions, ash percentage, thermal conductivity and electrical conductivity were variously determined using American Society for testing and material (ASTM) methods American Society for Testing and materials [4] American Society for Testing and Materials [5] and American Society for Testing and Materials [6]. The microelement composition was analysed using atomic absorption spectrophotometer model PG 990 manufactured by PG instrument Ltd U.S.A.

The Phytochemical Compounds: Resins, steroids / terpenoids, tannin, alkaloids, saponin, flavonoids, carbohydrate and protein were qualitatively determined by the method outlined by Harbone [7].

The chloroform and chloroform-methanol extracts were monitored using TLC, Fourier Transform Infrared and Ultraviolet Spectroscopic methods.

RESULTS AND DISCUSSION

The results of the thermal investigation and the analysis of the active constituents present in the timber extract of *G. arborea* are given in Tables 1-5.

The thermal characteristics analysis carried out on the wood of *G. arborea* showed that it had low afterglow time (Less than five minutes) which made it less hazardous in fire situations because it wouldn't glow long enough for rekindle to take place. Its flame duration value indicated that it can sustain combustion. Water imbibitions at 30 min, 5 h and 24 h intervals showed the capacity of *G. arborea* timber to absorb water over a period of time [12]. The oven dry density and ash content values are in line with the ascertain of Desch and Dinwoodie [8] which stated that denser and small ash content timbers are suitable in their use as a source of carbondioxide for internal combustion engine. One can deduce from the result that *G. arborea* is a hardwood that will be very good for construction and other purposes.

The result of the phytochemical analysis (Table 3) showed the presence of resins, alkaloids, saponin, protein, flavonoids, steroids, carbohydrate and absence of tannin. The medicinal values of medicinal plants lie on these phytochemicals which produce definite physiological actions in human body. Resins are valued for their chemical properties and associated uses as the product of varnishes, adhesives and food glazing agents. The presence of alkaloids showed that it can be used as

Table 1: Results of thermal characteristics of *Gmelina arborea*

Characteristics	Units	Results
Afterglow time	Sec	183.67
Flame duration	Sec	113.33
Flame propagation rate	cm.5 ⁻¹	6.2 x 10 ⁻²
Ignition time	Sec	14.67
Over dry density	g.cm ⁻³	40.3 x 10 ⁻²
Moisture content	%	42.14
30 min Water imbibitions	%	16.9
5 h Water imbibitions	%	29.6
24 h Water imbibitions	%	48.9
Ash Content	%	0.66
Thermal conductivity	Umoh/cm	10.06 x 10 ²
Electrical Conductivity	Sm ⁻¹	4.2 x 10 ⁻³

Table 2: Micro elemental composition %

Zinc	0.43
Lead	0.61
Cadmium	Nil
Copper	0.0002
Sodium	0.56
Calcium	0.14
Magnesium	0.18
Potassium	0.09
Arsenic	0.59
Mercury	Nil

Table 3: Phytochemical composition of *Gmelina arborea*

Class of phytochemicals	Inference
Saponin	++
Flavonoids	++
Resins	+++
Steroids / terpenoids	++
Tannin	-
Alkaloids	+++
Carbohydrate	++
Protein	++

Key	+++	-	highly present
	++	-	moderately present
	+	-	slightly present
	-	-	absent

Table 4: Results of Thin layer chromatographic characteristics Extract of *Gmelinaarborea*

Sample	Number of spot	Rf value
Chloroform-methanol extract.	1	0.6

antimycotics and also in the treatment of stomach pains. Protein indicated high nutritional value of the extract, therefore can help in physical, mental growth and development [9]. Flavonoids exhibit an anti-inflammatory, anti-allergic effects, analgesic and anti-oxidant properties [10]. Saponin has been found to be anti-carcinogenic, cholesterol reducer and anti-inflammatory substance.

Table 5: Result of Fourier Transformed Infrared and Ultraviolet Spectra of Chloroform – methanol extract

Wave number (cm ⁻¹)	Suspected chromophores
3458.66	O-H stretch for alcohol, phenol and carboxylic acid.
3436.30	O-H stretch for alcohol
3421.83	O-H stretch for alcohol
2855.71	C-H stretch for alkanes
2106.36	C=N stretch for nitriles
1645.33	C=O stretch for ketones, acid amides and esters.
1458.23	C=C stretch for alkenes and aromatics
1105.25	C-O stretch for alcohol, carboxylic acids and esters
1016.52	C-H deformation bonds for alkyl groups.
UV _{max} 277, 366 and 669	Indicating highly conjugated trisubstituted aromatic compound.

The results of the Atomic Absorption Spectrophotometric analysis of the sample (Table 2) showed that copper, calcium, magnesium and potassium were present and are involved in body enzymatic activities. Sodium helps in P^H balance of body fluids, zinc which is essential for the activity of DNA polymerases, arsenic and lead were also present while mercury and cadmium were absent [11, 12].

The thin layer chromatography of the extract (Table 4) showed one component with R_f value of 0.6 when chloroform-methanol extract was spotted. The TLC result confirmed the presence of some components and its high purity.

The results of the FTIR and UV (Table 5) showed strong absorption at 3458 cm⁻¹, 3436 cm⁻¹ and 3421 cm⁻¹ which indicated the presence of alcohols, carboxylic acids and phenols. The absorption at 2855 cm⁻¹, 2106 cm⁻¹ and 1645 cm⁻¹ showed the presence of alkanes, nitriles, amides and esters. The presence of C=C, C-O and C-H for carbon bond in alkenes and aromatics, keto attached to benzene ring and deformation bonds for alkyl groups were shown by absorption at 1458 cm⁻¹, 1105 cm⁻¹ and 1016 cm⁻¹ respectively. The absorption in the ultraviolet visible spectra and FTR spectra suggested that the active compound might be 1, 2, 3-trisubstituted aromatic compound with C=O, O-H and C=N groups attached.

CONCLUSION

The results of thermal and variable characteristics, phytochemical and AAS analysis of the timber of *Anogeissus leiocarpus* had shown that it contain some components of medicinal value and as well a good material for various construction works. The UV and FTIR spectra showed that it contains some bioactive compounds too. The presence of alkaloids,

flavonoids, Ca and Mg from AAS analysis confirmed its anti-inflammatory and anti-oxidant effect. It is recommended that the anti-microbial properties of the timber be elucidated.

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