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Thermal Characteristics and Pharmaceutical Constitutents of *Anogeissus leiocarpus* as a Tropical Timber

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Abstract: The thermal and pharmaceutical properties of *Anogeissus leiocarpus* timber were investigated. Various variable and thermal analysis performed on the timber; oven dry density, water imbibitions (at different intervals: 30 mins, 5 hrs & 24 hrs), thermal conductivity, electrical conductivity, afterglow time, flame duration, flame propagation rate, ignition time, moisture content and ash content showed that it is a good timber suitable for various construction purposes. The AAS showed the presence of Na, K, As, Zn and Cu in the decreasing order of their concentration and the absence of some metals such as, Pb, Ca, Mg, Hg and Cd. The TLC analysis showed one spot for chloroform-methanol extracts and two spots for chloroform extracts. Phytochemical screening revealed the presence of flavonoids, alkaloids, saponin, protein, resins, tannin and absence of steroids and carbohydrate. The Fourier Transform Infrared and Ultraviolet spectra revealed the presence of some functional groups such as N-H, C=N, C=O, C-H and C=C which showed that it contain some bioactive compounds. The extract have been shown to exhibit anti bacterial effects on *Staphylococcus aureus* and *Escherichia coli* and anti fungal effect on *Candida albicans*. The results showed that *Anogeissus leiocarpus* has a very high medicinal value and could be administered as theraphy for the cure of related diseases of the test organisms.

Key words: *Anogeissus leiocarpus* · Timber · Thermal and pharmaceutical properties

INTRODUCTION

Anogeissus leiocarpus is a plant that belong to the Combretceae Family.

It is a hardwood with N galama as its common name. In Nigeria, its Igbo name is atara, ayin in Yoruba and marike in Hausa [1 and 2].

Its origin and geographic distribution occurs from Senegal to Eritrea and Ethiopia, south to DR Congo in Benin, the tree is occasionally planted near villages for its dye and in Burkina Faso and Mali plantations have been planted.

In Nigeria, *anogeissus leiocarpus* stem and roots are used and traded as chewing stick and is located mostly in the south eastern part of Nigeria [3]. It's a graceful ornamental avenue and also could be used for restoration. In Burkina Faso, it is highly esteemed and respected holy tree named "Siiga" meaning "the soul".

Its properties and description indicate that it is rich in Tanin and flavonoids, it is hardwood found in a deciduous forest. Evergreen shrub or small to medium sized tree up to 30m tall, with straight, slightly grooved bole up to 1m in diameter and open crown with gracefully drooping, pubescent branches [4]. There is paucity of information on *Anogeissus leiocarpus,* as a result, some thermal and variable properties, phytochemical, functional group and anti microbial assay of the wood was investigated.

Experimental

Sample Collection and Identification: *Anogeissus leiocarpus* 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.

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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 hours before the experiments.

Method

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 [5 and 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, tanin, 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

Results: The results of the thermal investigation and the analysis of the active constituents present in the timber extract of *Anogeissus leiocarpus* are given in tables 1- 7.

Table 1: Results of thermal characteristics of *Anogeissus leiocarpus*

Characteristics	Units	Results
Afterglow time	Sec	598.33
Flame duration	Sec	216.67
Flame propagation rate	$cm.5^{-1}$	2.1×10^{-2}
Ignition time	Sec	13
Over dry density	$g.cm^{-3}$	87×10^{-2}
Moisture content	%	15.89
30 mins Water imbibitions	%	13.4
5 hrs Water imbibitions	%	21.7
24 hrs Water imbibitions	%	32.3
Ash Content	%	0.74
Thermal conductivity	Umoh/cm	11.24×10^{2}
Electrical Conductivity	Sm^{-1}	6.8×10^{-3}

Table 2: Micro elemental composition %

Zinc	0.17
Lead	Nil
Cadmium	Nil
Copper	0.013
Sodium	0.34
Calcium	Nil
Magnesium	Nil
Potassium	0.32
Arsenic	0.20
Mercury	Nil

Table 3: Phytochemical composition of *Anogeissus leiocarpus*

Classes of phytocompounds	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 of chloroform-methanol and chloroform extracts.

Sample	Number of spot	Rf value
Chloroform-methanol extract.	1	0.7
Chloroform extract	2	0.6 & 0.5

Tables 5: Results of Fourier Transformed Infrared and Ultraviolet spectra of Chloroform extract.

Wave number (cm^{-1})	Suspected chromophores
3409	N-H stretch for primary amines
3389	O-H stretch for carboxylic acids
2842	C-H stretch for alkanes
2144	C=N stretch for nitriles
1652	C = O stretch for carboxylic acid, amides & esters
1438	C=C stretch for alkene and aromatics
1112	C – O stretch for esters
1022	C – H deformation bond for alkyl group
UV_{max} 204, 280, 386,408 and 744	Indicating highly conjugated trisubstituted aromatic compound.

Table 6: Result of Fourier Transformed Infrared and Ultraviolet Spectra of Chloroform – methanol extract.

Wave number (cm^{-1})	Suspected chromophores
3852	N – H stretch for aliphatic primary amine
3384	H - H stretch for phenols and alcohols
2840	C = O stretch for aldehydes
2207	C = N stretch for nitrile
2043	C – H bending for aromatics
1654	C – O stretch for amides
1026	C – O stretch for esters
UV_{max} 259, 267 and 277	Indicating highly conjugated isoquinoline amide.

Table 7: Results of Anti-microbial Screening of Methanol extracts of *Anogeissus leiocarpus*

Test organism	Zone of Inhibition (mm)
Candida albicans	22
Staphylococcus aureus	15
Escherichia coli,	20

DISCUSSION

The thermal characteristics analysis carried out on the wood of *Anogeissus leiocarpus* showed that it had high afterglow time (more than five minutes) which made it hazardous in fire situations because it would glow long enough for rekindle to take place. Its flame duration value indicated that it can sustain combustion. Water imbibitions at 30 mins, 5 hrs and 24 hrs intervals showed the capacity of *Anogeissus leiocarpus* timber to absorb water over a period of time [8, 9, 10 11,12 and 13]. The oven dry density and ash content values are in line with the work of Desch and Dinwoodie (1981) [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 *Anogeissus leiocarpus* 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 flavonoids, alkaloids, saponin, protein, resins, tannin and absence of steroids and carbohydrate. The medicinal values of medicinal plants lie on these phytocompounds which produce definite physicological actions in human body. Flavonoids exhibit an anti-inflammatory, anti-allergic effects, analgesic and anti-oxidant properties [10]. The presence of alkaloids showed that it can be used as antimycotics and also in the treatment of stomach pains [11]. Saponin has been found to be ant carcinogenic, cholesterol reducer and anti-inflammatory substance. Tanins are anti-inflammatory, control gastritics and irritating bowel disorders, they also contribute to antimicrobial power which heals wounds and stop bleeding [9]. Resins are valued for their chemical properties and associated uses as the product of varnishes, adhesives and food glazing agents. Protein indicated high nutritional value of the extract, therefore can help in physical and mental growth and development [13].

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

The thin layer chromatography of the extract (Table 4) showed two components with R_f values of 0.6 and 0.5 when chloroform extract was spotted and one spot with R_f value of 0.7 with chloroform-methanol extract. The TLC results confirmed the presence of some components and its high purity.

The results of the FTIR and UV (Table 5) showed strong absorption at 3409 cm^{-1}, 3389 cm^{-1} and 2842 cm^{-1} which indicated the presence of amines, carboxylic acids and alkanes. The absorption at 2144 cm^{-1}, 1652 cm^{-1} and 1112 cm^{-1} showed the presence of nitriles, amides and esters. The presence of H-H, C=O and C-O (Table 6) for hydrogen bond in phenols and alcohols, keto attached to benzene ring and amides were shown by absorption at 3384 cm^{-1}, 2840 cm^{-1} and 1654 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, C-O and N–H groups attached. The results of the anti microbial studies (Table 7) revealed that the methanol extracts of *Anogeissus leiocarpus* timber exhibited potent activities against all the test pathogenic bacteria and fungi. The zones of inhibitions of the extracts are 15mm, 20mm and 22mm for *Staphylococcus aureus, Escherichia coli* and *Candida albicans* respectively.

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. The extract have been shown to exhibit anti bacterial effects on *Staphylococcus aureus* and *Escherichia coli* and anti fungal effect on *Candida albicans*. The results showed that *Anogeissus leiocarpus* has a very high medicinal value and could be administered as theraphy for the cure of related diseases of the test organisms. However, the complex chemical makeup of the timber (cellulose, hemicelluloses, lignin and pectins), structural determination of the active components and toxicological effects need to be elucidated

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