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Preliminary Phytochemical and Pharmacognostical Investigation of Pediatrics Antimalarial *Laggera pterodonta* (DC) Sch. Bip.: Asteraceae of Nigerian Origin

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Abstract

Laggera pterodonta is a reputable ethnomedicinal plant in Nigeria for the treatment of pediatric malaria and inflammations. The leaves, stem and root of *Laggera Pterodonta (DC) Sch. Bip* (compositae) were investigated for their phytochemical and thin layer chromatographic profiles. Twelve secondary metabolites namely carbohydrates, terpenes, flavonoids, phenols, tannins, phlobatannins, sterols, alkaloids, volatile oil, balsams, reins and chlorogenic acid were detected in all the plant parts. Carbohydrate and resin were present in the leaves. Saponins were present in the stem and root. Quantitative pharmacognostic analysis of the leaves revealed moisture content of 9.57%, total ash of 19.45%, acid-insoluble ash of 2.35%, alcohol extractive value of 16.12%, and water extractive value of 27.75%. Comparative thin layer chromatography of the successive cold maceration and soxhlet extraction using solvents of increasing polarities: hexane, ethyl acetate and methanol of the leaves, stem and root showed that soxhlet extraction yielded more components. This is the first report of the presence of alkaloids in this plant.

Key words: *Laggera pterodonta,* chemical composition, alkaloids, antimalaria, pharmacognosy.

Introduction

The aerial part *of Laggera pterodonta* has been widely used in China as a folk medicine for several centuries to ameliorate some inflammatory ailments, arthritis, and hepatitis and as anti-viral agents (Yihang *et al*., 2007 and Shuyun *et al*., 2007). In Nigeria the fresh aerial part of the plant is used for the treatment of pediatrics malaria. For this purpose the fresh aerial part of the plant is pounded and water added, filtered and the filtrate is drunk and the residue is rubbed all over the body

(Muazzam Ibrahim, personal communication, 2009).

Laggera pterodonta (DC) Sch. Bip belonging to the family Asteraceae/Compositae is a robust herb that grows up to 1.70m in height. It is viscid and strongly aromatic. It has white flowers, basal leaves bigger than the upper ones. It is a weed found in open waste land and partially shaded galleried forest. It is a native of Africa and Asia. In Africa, it can be found in Senegal, Sierra Leone, Nigeria and West Cameroon. In Nigeria, the Yorubas refer to it as 'taba-agbe', while the Hausas refer to it as 'taba-taba' because it resembles tobacco leaves (Burkill 2000).

Yihang *et al*. (2007) reported that the phenolics from *Laggera pterodonta* have hepatoprotective and anti-oxidant effects on chemical-induced hepatic injury in neonatal rat hepatocytes. *L. pterodonta* is also use as aromatic substances in cosmetics, scents and incense (Burkill 2000). The main secondary metabolites isolated so far from *L. pterodonta* are sesquiterpenoids such as eudesmanoic acids, flavonoids and phenolic acids of which Isochlorogenic acid is reputed. Pharmacological investigations revealed that certain extracts of *L. pterodonta* possess significant anti-inflammatory, anti-tumor and anti-viral activities (Zhou *et al*., 2008). Three bioactive compounds (Fig. 1): 3, 5-O-dicaffeoylquinic acid **(1)**; 3, 4-O-dicaffeoylquinic acid **(2)** and 4, 5-O-dicaffeoylquinic (**3**) had been isolated from the aqueous extract of *L. pterodonta.* These compounds have been reported to be responsible for the anti-viral, anti-bacterial and antifungal activities of the plant. The isolation and purification of these compounds was achieved by high speed counter-current chromatography (HSCCC) method (Shuyun et al 2007). The principal component of the phenolic content of *L. pterodonta* has been identified as Isochlorogenic acid which is responsible for its hepatoprotective and anti-oxidative effect. This may support the folkloric use of *L. pterodonta* in the treatment of inflammatory ailments, arthritis and hepatitis (Yihang *et al*., 2007).

Previous investigations on this plant led to the isolation of 55 eudesmane sesquiterpenes, nine flavonoids; and eleven compounds which comprises of terpenoids and flavonoids from the aerial part of the plant (Liu *et al*., 2008). The eleven compounds have been identified as 6-O-beta-d- glucopyranosyl-carvotanacetone, pterodontic acid (**3**), 1-beta hydroxyl pterodontic acid, pterodontoside A, pterodontriol, pterodotriol B, 5-hydroxy-3,4′,6,7-tetramethoxyflavone (**4**), armitin, chrysosplenetin B, quercetin and beta-sitosterol. Reports revealed that pterodontic acid and pterodontriol showed moderate activity against bacteria while they both displayed no activity against *E.coli* (Guang-zhong, *et al*., 2007). Further reports revealed that three eudesmanoic acid (**5**) and two eudesmanoic acid glycosides were isolated from the n-butanol extracts of whole plant of *L. pterodonta (*Zhou -Yu *et al*., 1997). Chlorogenic acid (**6**) is the esterification product of quinic acid (**7**) and (E)-3-(3, 4-dihydroxyphenyl)-prop-2-enoic acid (**8**).

In view of the rich medicinal uses of *L. pterodonta* coupled with its rich phytochemical profile, *L. pterodonta* no doubt is a potential drug plant. The aim of this work therefore is to document the medicinal uses of *L. pterodonta* and to evaluate its secondary metabolites constituents and quantitative pharmacognostical characteristics that could be useful for the development of a monograph on this plant.

Materials and Methods

The Plant was collected from Life Camp Abuja, Nigeria. The plant was identified and authenticated at the herbarium of the National Institute for Pharmaceutical Research and Development, Abuja, Nigeria, where the voucher specimen (NIPRD/H /6298) was deposited.

Plant preparation: The plant was air-dried for two weeks. The leaves were dried at room temperature while the stem and roots were sun-dried. The particle size of the various parts was reduced using a warring blender and the powdered samples were stored in airtight polythene bags.

Phytochemical screening and quantitative pharmacognostical analysis: These were carried out using standard procedures (MHFW 1990, Evans 2002, and Sofowora 2008).

Extraction and thin layer chromatography: Successive extractions with hexane, Ethylacetate and methanol were carried out on the powdered samples of all the parts by cold maceration for 24 hours and soxhlet extraction using 1g and 10g sample respectively. Each extract was spotted on a normal phase silica gel precoated glass plate previously activated at 120^0C for 2 hours, developed using mobile phase hexane-ethyl acetate (3:1) for hexane and ethyl acetate extracts and hexane-ethyl acetate -methanol (35:15:1) for methanol extracts.

Results and Discussion

Phytochemical screening of the leaf, stem and root of *Laggera Pterodonta* (Table 1) revealed twelve secondary metabolites namely carbohydrates, terpenes, flavonoids, phenols, tannins, phlobatannins, sterols, alkaloids, volatile oil, resins, balsams and chlorogenic acid, collectively in all the plant parts. Carbohydrates were present only in the leaves. Saponins were present only in the stem and root. The presence of these secondary metabolites suggests that *L. pterodonta* might be of great importance in phytomedicine development. For instance, the presence of flavonoids and resins might be responsible for the use of this plant to ameliorate inflammatory ailments in China. Yihang *et al*., (2007) reported that the flavonoids from *L. pterodonta* had anti-inflammatory effect on both acute and chronic-inflammation.

The presence of phenols may confer anti-oxidative, antibacterial and anti-viral effects as reported earlier (Yihang *et al*., 2007, Shuyun *et al*., 2007 and Wasagu *et al*., 2005). The presence of alkaloids, tannins and saponins in the plant suggests that it might possess anti-bacterial activity. Favel *et al.,* (1994) as well as Isaac and Chinwe (2001) reported that alkaloids along tannins and saponins are responsible for anti-bacterial activity in *Fetracarpidium Conopheoum*. Onoruvwe and Olorunfeni (1998) also attributed the anti-bacterial effect of the root extract of *Dcibrostachys cinerea* to alkaloids, saponins and flavoniods. The presence of tannins could also mean that it is an astringent, with wound healing and anti-parasitic properties. Presence of volatile oil in all the parts suggests its use in natural body cosmetic and scents. The presence of terpenes could suggest that *L. pterodonta* of Nigeria origin might have anti-tumor and antibacterial activities since as reported by Guang-zhong et al 2007 eudesmane sesquiterpenes isolated from *L. pterodonta* displayed cytotoxicity toward tumor cells and possessed

anti-bacterial properties.

The quantitative pharmacognostic analysis of the leaves revealed moisture content of 9.57%, total ash of 19.45%, acid-insoluble ash of 2.35%, alcohol extractive value of 16.12%, and water extractive value of 27.75% as shown in Table 2. Low moisture content of 9.57% implies that, the plant has low chance of microbial attack hence can be stored in the dried form as a drug plant for a long period of time. Ash value of 19.45% value indicates that it has high inorganic content this may be due to the presence of high non-physiological ash. Hence, when processing this plant as a drug it should be rinsed sufficiently in clean water before drying to remove sand. Acid-insoluble ash value of 2.35% is indicative high digestibility of the plant when consumed. Water extractive value of 27.72% which is greater than the alcohol extractive value of 16.12% means water will be a better solvent for extraction of the plant. This may explain why in Nigeria the fresh aerial part of the plant is used for the treatment of pediatrics malaria by pounding, mixing it with water, filtering and drinking the filtrate.

The successive cold maceration and soxhlet extraction using solvents of increasing polarities: hexane, ethyl acetate and methanol of the leaves, stem and root showed that soxhlet extraction yielded more components for all the plant parts investigated compared to cold maceration. Hence soxhlet extraction would be a better method of extraction of this plant as shown in Table 3. Components on the chromatogram were detected using various visualization techniques such as viewing under daylight (D), ultraviolet light 365 nm (UV) and placement in iodine vapor tank. The visualization technique that revealed each component in the chromatogram is indicated in table 3 above. Chemical component with Rf 0.65 visible under daylight and iodine vapor as well as Rf 1.00 are common to the leaf, stem and root.

In conclusion, the indigenous knowledge on *L. pterodonta* shows that in Nigeria aerial part of the plant is reputable for the treatment of pediatrics malaria. The analyses carried out on this plant shows that *L. pterodonta* from Nigerians' rich in secondary metabolites which could be explored as potential drug leads and phytomedicines. This study revealed for the first time the presence of alkaloids in *L. pterodonta*. Further studies are on-going in our laboratories to isolate and characterize the alkaloids in *L. pterodonta* from Nigeria, investigate their biological properties and to verify the antimalarial properties of the plant.

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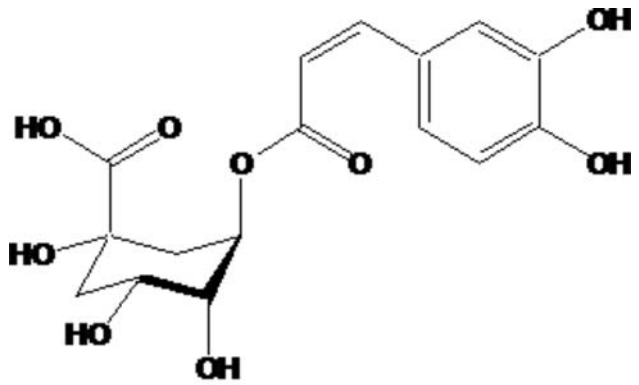

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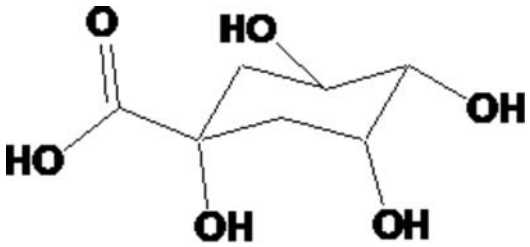

(8)

Fig.1. Bioactive compounds of *L. pterodonta.*

Table 1. Phytochemical analysis of *Laggera pterodonta* leaf, stem and root.

Phytochemical Constituents	**Leaf**	**Stem**	**Root**
Carbohydrates	+	-	-
Tannins	+	+	+
Saponins	Key: + = Detected;	- = Not detected	+

Table 2. Result of Quantitative Pharmacognostical analysis of L. *pterodonta* leaf.

Parameter	Values (%)
Moisture content	9.57
Total ash	19.45
Acid-insoluble ash	2.35
Alcohol extractive value	16.12
Water extractive value	27.75

Table 3. Retardation factors (Rf values) of components in hexane, ethyl acetate and methanol extracts of *L. pterodonta* leaf.

	Spots/extracts 1	2	3	4	5	6	7	8
LH1	0.33(D)							
LH2	0.61(D)							
LE1	0.70(D)							

LE2	0.08(D)	0.26(D)	0.33(D)	0.46(D)	0.53(D)	0.65(DI)	0.73(D)	1.00(I)
SH1	0.65(DI)							
SH2	0.11(I)	0.65(DI)	0.76(D)	0.80(D)	0.88(D)	1.00(I)		
SE1	0.65(DI)							
SE2	0.61 (I)	0.65(DI)	0.83(UV)					
RH1	0.61(I)	0.65(DI)	0.75(D)	0.81(UV)	0.95(D)			
RH2	0.60(D)	0.65(DI)	0.71(D)	0.76(D)	0.81(UV)	0.90(D)	1.00(I)	
RE1	0.08(D)	0.65(DI)						
RE2	0.65(DI)							
ME	O.37(D)	0.54(D)	0.74(D)	0.87(D)				

Key: LH1 = cold maceration Leaf hexane extract; LH2 = soxhlet Leaf hexane extract.
LE1 = cold maceration Leaf ethyl acetate extract; LE2 = soxhlet Leaf ethyl acetate extract.
SH1 = cold maceration Stem hexane extract; SH2 = soxhlet Stem hexane extract.
SE1 = cold maceration Stem ethyl acetate extract; SE2 = soxhlet Stem ethyl acetate extract.
RH1 = cold maceration Root hexane extract; RH2 = soxhlet Root hexane extract.
RE1 = cold maceration Root ethyl acetate extract; RE2 = soxhlet Root ethyl acetate extract.
ME = cold maceration Leaf methanol extract UV = visible under ultraviolet light 365 nm;
D = visible under Daylight; I = visible under iodine vapor; and (DI) = visible under daylight and iodine vapor. Mobile phase solvent system used are: hexane-ethyl acetate (3:1) for hexane and ethyl acetate extracts; and hexane-ethyl acetate -methanol (35:15:1) for methanol extracts.