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Secondary Metabolites of *Pterocarpus santalinoides* (L) Trees in Rivers State

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ABSTRACT

The study assessed the secondary metabolites of Pterocarpus santalinoides' leaves, stem and roots in a completely randomized design (CRD) with seven treatments (alkaloids, saponin, tannin, flavonoid, oxalate, phytate and cytogenic glycosides) using extraction method replicated thrice, collected data were subjected to descriptive statistics and analysis of variance (ANOVA). The aim of study was to analyse the species because of its popularity in some parts of Ogoniland; leaves are used as vegetable and herbal therapy in the treatment of some ailments, the wood is used in carving and joinery because of its fibre flexibility. The results showed that there were significant differences (P<0.05) between the secondary metabolites (SM) of root, wood and leaf particularly in alkaloids, saponin, flavonoid and no significant differences (P>0.05) in oxalate, phytate and cynogenic glycosides.The alkaloid was the same in leaf and wood (3.56%) and lowest in root bark while saponin was highest in wood (13.16%) followed by root bark (8%) and lowest in leaf. Tannin was absent in both the leaf and wood and little quantity in the root bark (1.05%), flavonoid was highest (17.92%) in root bark, followed by wood and lowest in leaf, oxalate was almost the same in leaf and wood -1.60 g/100g and 1.54 g/100g respectively and lowest in root bark (0.33g/100g); no phytate in the leaf and wood but had 0.0024g/100g while cynogenic glycosides was the same in axially; leaf to root bark (0.002mg/kg). Pterocarpus santalinoides has potentials in terms varieties of secondary metabolites for pharmaceutical and confectionery industries. Further studies on the species should be conducted on the phytochemicals and its potentials.

KEYWORDS: Secondary metabolites, flavonoids, *Pterocarpus santalinoides*

INTRODUCTION

Secondary metabolites are generally compounds more complex than the primary; their formation within the organism is essentially irreversible. Thus secondary metabolites express individuality of species in chemical terms. Glucose can be considered the primary product of photosynthesis and is the starting material for producing cell wall components and most secondary metabolites, certain secondary metabolites are ubiquitous to hard woods. All hardwoods thus possess the enzyme necessary for producing these compounds. Examples of secondary metabolites common

to all hardwoods include starch, sitosterol, simple terpenoids, oxalate, alkaloids, phytate, chlorophyll, phenyl propanoids, the common flavonoids, simple tannins, and probably compound such as scopoletin. Wood extractives are non-cell wall components and can be removed using solvents such as petroleum ether, acetone, ethanol and water. Relatively small molecules (< C40) can be extracted with a solvent from wood, bark, or foliage and usually comprise 1-5% of the wood and under genetic control vary by species (Cole, 2012). There are thousands of different extractives present in the wood. Extractives are from two sources-the first is the compounds involved in trees metabolic processes; the second is artefacts from further modification of metabolites by means other than metabolic processes of trees or other sources.

The tree, *Pterocarpus santalinoides* (L), belongs to the family Papilionaceae and is a water-side tree which is very conspicuous during the flowering season. The fruits float and are commonly washed up on river banks. Mature trees attain a height of 30-40ft and 3-4ft in girth, similar to other species in the family for instance *Pterocarpus mildbridii, P.osun*, branching low down with straggling branches. The bark is thin, flaking off in small patches; slash is yellowish-white and slowly exudes drops of red gum. The species is sometimes leafless for a short period-deciduous (Keay, 1964). Popularity of the species in some parts of Ogoniland; while the leaves are used as vegetable and herbal therapy in the treatment of some ailments, the wood is used in carving and joinery in the wood sector because of its fibre flexibility. Secondary metabolites were sample because the primary metabolites are the integral component of the wood cell matrix; primary metabolites are the wood building blocks for instance cellulose, hemicellulose and lignin (David, 2013). Extractives are natural products extraneous to a lignocellulose cell wall; they can be removed with inert solvents such as ether, benzene-alcohol, acetone, and cold water (Akpofure, 1992), they may be within a cell wall, but are not chemically attached to it. The study analysed and quantified the secondary metabolites (phytochemicals) composition of the leaves, barks, roots and wood of *Pterocarpus santalinoides.*

MATERIALS AND METHODS

The Study area: The materials for the study were collected from two locations each in Rivers State University of Science and Technology, Port Harcourt in Obio-Akpor Local Government Areas, Rivers State on Longitude 6º44'N and 7º33'N and Lat. 4 º38'E and 5º4'E.

Sample preparation of phyto-nutritional (Phytochemicals) analysis: The following anti-nutrients were assessed: tannins, flavonoids, saponin, cynogenic glycosides, oxalate, phytate and alkaloids.

Bark: Debarked samples were collected from-top, middle and base and bagged, referenced by labelling and taken to Department of Food Science and Technology, RSUST Port Harcourt and Department of Biotechnology, University of Port Harcourt, Choba for further analysis.

Leaf: Twigs of the leaves were taken from the trees, fresh, bagged, labelled and conveyed to Department of Food Science and Technology, RSUST Port Harcourt and Department of Biotechnology, University of Port Harcourt, Choba for further analysis.

Extraction methods: Two hundred grams of the powdered plant material was defatted with 1000cm^3 petroleum Ether (60-80 ^{o}C) using batch method of extraction in a conical flask for 24 hours, with intermittent shaking. The mixture was filtered and filtrate allowed to evaporate to dryness at room temperature to give a brownish extract 1.3g (0.65%w/w) and coded "PEE". One hundred grams of the resulting marc was exhaustively extracted by soxhlet for about six hours absolute MeOH to give a reddish-brown gummy mass 30.1g (30.1% w/w) coded "CME" after evaporation over steam bath.

Experimental design and data analysis

The design adopted was completely randomized design (CRD) with seven treatments (alkaloids, saponin, tannin, flavonoid, oxalate, phytate and cytogenic glycoside) replicated thrice and collected data were subjected to descriptive statistics and analysis of variance. Least significance difference (LSD) was used to separate the means where significant difference was statistically inferred at 5% probability of risk of committing Type 1 error.

RESULTS

Secondary metabolites (SM) of root, wood and leaf of *Pterocarpus santalinoides*

The results showed that there was significant difference ($P \leq 0.05$) between the secondary metabolites (SM) of root, wood and leaf of *Pterocarpus santalinoides* particularly in alkaloids, saponin, flavonoid and no significant difference ($P > 0.05$) in oxalate, phytate and cynogenic

glycosides (Table 1). The alkaloid was the same in leaf and wood (3.56%) and lowest in root bark while saponin was highest in wood (13.16%) followed by root bark (8%) and lowest in leaf. This finding disagreed with Ogbonnya (1983) that the leaf of *Monodora myristica* contained 0.12% and root 0.39% of extractives. Tannin was absent in both the leaf and wood and little quantity in the root bark (1.05%), flavonoid was highest (17.92%) in root bark, followed by wood and lowest in leaf, oxalate was almost the same in leaf and wood -1.60 g/100g and 1.54 g/100g respectively and lowest in root bark (0.33g/100g). Though, no significant difference (P>0.05) in phytate and cynogenic glycosides; no phytate in the leaf and wood but had 0.0024g/100g while cynogenic glycosides was the same in axially; leaf to root bark (0.002mg/kg) (Table 1).

Table 1: Secondary Metabolites of Leaves, wood and Roots of *Pterocarpus santalinoides*

	Alkaloids (%)	Saponin (%)	Tannin (%)	Flavanoid (%)	Oxalate (g/100g)	Phytate (g/100g)	Cynogenic Glycoside (mg/kg)
Leaf	3.56	1.30	0.00	10.80	1.60	0.00	0.002
Wood	3.57	13.16	0.00	13.92	1.54	0.00	0.002
Root Bark	2.20	8.00	1.05	17.92	0.33	0.0024	0.002
LSD(P<0.05)	0.84	3.61	Ns	1.43	ns	ns	ns

Similarly, the results of secondary metabolites (SM) within the stem bark showed that there was significant difference (P≤0.05) amongst the top, middle and bottom of *Pterocarpus santalinoides* woods; alkaloids were almost at par with 2.22 and 2.54 at top and middle respectively. At the top saponin was highest (6.10%) followed by bottom (4.30%) and least at the middle, no tannin in the species stem, the bottom had highest flavonoid (15.04%) followed by middle (13.88%) and lowest at the top (12.84%) and no significant difference (P>0.05) in oxalate, phytate and cynogenic glycosides (Table 2). Oxalate was almost the same in top and middle was 1.83g/100g and 1.98g/100g respectively and lowest at bottom (1.15g/100g), phytate was absent in the stem while cynogenic glycosides the same within the stem bark; top to root (0.002mg/kg) (Table 2).

Composition of SM of *Pterocarpus santalinoides* amongst Leaf, Wood and Root

The results of secondary metabolites (SM) assessment showed that phytate and tannin were absent in the entire stem (Figure 1), alkaloids were almost at par with 2.22 and 2.54 at top and middle respectively and highest at the bottom (6.68%) (Figure 1).

Table 2: Mean Secondary Metabolites of Stem Bark of *Pterocarpus santalinoides*

	Alkaloid (%)	Saponin (%)	Tannin (%)	Flavanoid (%)	Oxalate (g/100g)	Phytate (g/100g)	Cynogenic Glycoside (mg/kg)
Top	2.22	6.10	0.00	12.84	1.83	0.00	0.002
Middle	2.54	2.50	0.00	13.88	1.98	0.00	0.002
Bottom	6.68	4.30	0.00	15.04	1.15	0.00	0.002
LSD (P<0.05)	1.32	1.43	Ns	1.22	ns	ns	ns

At the top saponin was highest (6.10%) followed by bottom (4.30%) and least at the middle, the bottom had highest flavonoid (15.04%) followed by middle (13.88%) and lowest at the top (12.84%), Oxalate was almost the same in top and middle was 1.83g/100g and 1.98g/100g respectively and lowest at bottom (1.15g/100g), cynogenic glycosides remained constant at 0.002mg/kg (Fig. 1).

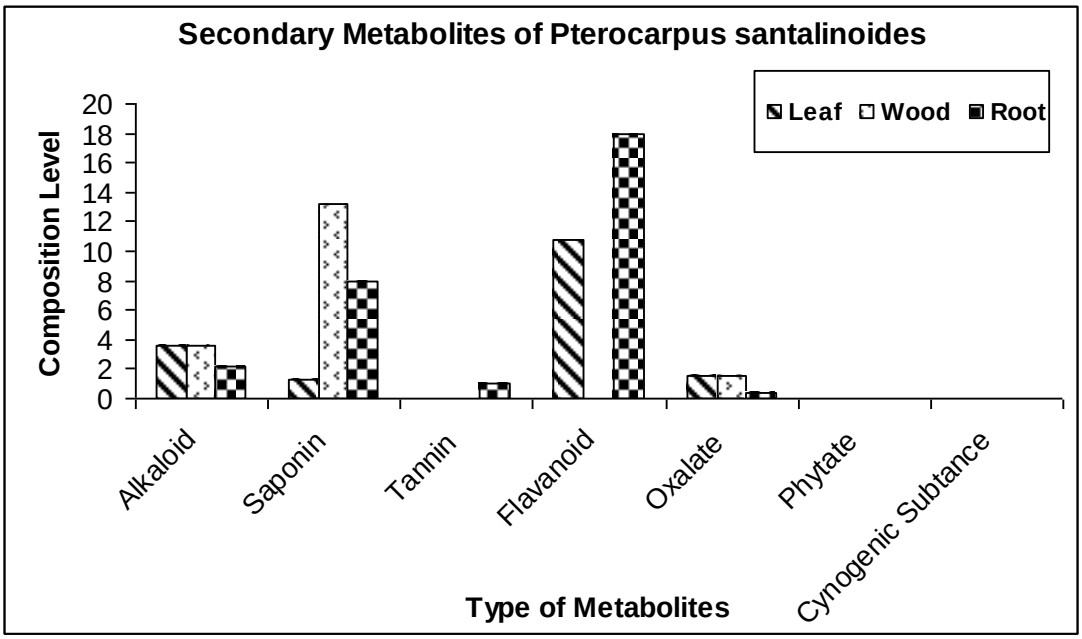

Figure 1: Composition of SM of *Pterocarpus santalinoides* amongst leaf, wood and root

DISCUSSION

The presence of the discovered secondary metabolites (phytochemicals) showed that the *Pterocarpus santalinoides* contained high percentage of anti-oxidants particularly flavonoid which increased from top to bottom bark of the stem but highest root bark. This agreed with Cole (2012) that flavonoids were most abundant phenolic components of wood extractives which bring about coloration in foliage, flowers and astringent taste in unripe fruits (Cole, 2012) and pungent odours in this species particularly along the stems (David, 2013). Flavonoids are condensed tannins: tanning agents, adhesives (Cole, 2012). Saponins found in this species are of the terpenes group - heterogeneous group and composed of triterpenoid or steroid glycone moiety and complex oligosaccharide substituent (www.google.com/extractives). It has hydrophillic properties of the glycoside part and lipophilic properties of the aglycone part give saponins, amphiphilic or surfactant properties- ability to form stable aqueous foams to form complexes with members of steroids and lipid compound (www.google.com/extractives). Saponins have antiviral and antifungal properties as it possesses the ability of the molecules to combine with sterols in fungal membrane and cause pore formation and loss of membrane integrity (www.google.com/extractives).

The importance of flavonoids to human beings cannot be over-emphasized as flavonoids in intestinal tract lower the risk of heart disease. As antioxidants, flavonoids from these plants provide anti-inflammatory activity (Okwu, 2004). Consequently, flavonoids are potent water-soluble antioxidants and free radical scavengers which prevent oxidative cell damage and have strong anticancer activity (Salah *et al.,* 1995, Okwu, 2004). Tannins have astringent properties which hasten the healing of wounds and inflamed mucous membranes (Okwu, 2007). The compendium of anti-oxidants found in the species confers its usefulness and utilization as vegetable particularly the leaf in soup making, stem and root bark for treating in injuries and stomach aches and other ailments (David, 2013).

CONCLUSION AND RECOMMENDATIONS

This species could be used for drug production and consumed un-synthesized because high volume of secondary metabolites or anti-oxidants like alkaloids, saponin, flavonoids, phytate, oxalate, tannin in minute quantity at the root of the species and cytogenic glycosides. From this

study, *Pterocarpus santalinoides* has potentials in terms varieties of secondary metabolites for pharmaceutical and confectionery industries. Since the species' leaves are edible and bark are useful, further studies should be conducted on the phytochemicals and the trees' potentials.

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