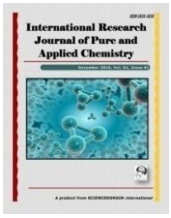

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Volatile Constituents from the Leaves of *Pachira aquatica* Aubl Grown in Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author OAL designed the study, isolation of the oils and wrote part of the manuscript. Author IAO managed the literature searches and wrote the final draft of the manuscript. Author ARO managed the analyses of the GC and GC/MS. All authors read and approved the final manuscript.

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ABSTRACT

The hydrodistilled essential oil obtained from the leaves of *Pachira aquatica* Aubl. growing in Nigeria was analyzed by gas chromatography-flame ionization detector (GC-FID) and gas chromatography coupled with mass spectrometry (GC/MS). Six constituents representing 99.8% of the oil were identified from the GC/MS spectra. The major components of the oil were 9-octadecenamide (35.1%), phytol (31.2%) and methyl palmilate (19.1%). This is the first report on the chemical composition of essential oil of *P. aquatica* growing in Nigeria.
Aims: The aim of the research is to investigate the volatile constituents from *P. aquatica* harvested in Surulere area, Lagos, Nigeria.
Study Design: The design includes the extraction of essential oil the air-dried leaves samples of *P. aquatica* and the determination and identification of the chemical constituents of the oil.
Place and Duration of Study: Mature leaves of *P. aquatica* were collected in Surulere Local

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Government Area, Lagos State, in December 2014.
Methodology: Air-dried and pulverized leaves were hydrodistilled in a Clevenger-type apparatus to obtained colourless volatile oil whose chemical constituents was analyzed by GC-FID and GC/MS.
Results: A total of six compounds accounting 98.8% of the oil were identified from the GC/MS and the major constituents were found to be 9-octadecenamide (35.1%), phytol (31.2%) and methyl palmilate (19.1%).
Conclusion: The present oil compositions were found to be different from the results previously reported from other part of the world.

Keywords: Pachira aquatica; bombacaceae; essential oil composition; 9-octadecenamide; phytol.

1. INTRODUCTION

In continuation of an extensive research into the volatile constituents of poorly studied species of Nigerian flora [1-3], we report herein the chemical constituents of essential oil of *Pachira aquatica* aubl. The genus *Pachira* has 24 species, three of which have located in Nigeria namely *Pachira glabra, Pachira aquatica* and *Pachira insignis. Pachira aquatica* of the Bombacaceae family is a plant whose seed is used for the production of local condiments. The plant is known to possess hypoglycaemic effect [4] and used to ameliorate stomach ache, ulcers, diabetes, bacterial infections, skin rashes and sores and used as blood purifier [5]. An ethanol extract of *P. aquatica* displayed fungicide activity [6]. *P. aquatica* seeds have tryptophan, threonine and phenylalanine and tyrosine contents higher than those reported for human milk, chicken egg and cow's milk [7].

Previous chemical analyses on *P. aquatica* led to the isolation and identification of antifungal fungitoxin known as isohemigossypolone [7,8], aquatidial, bis-norsesquiterpenoid, triacontyl p-coumarate and lupeol [8],11-hydroxy-2-*O*-methylhibiscolactone A and *O*-methylhibiscone D, together with 18 known compounds, including 5-hydroxyauranetin, kaempferol-3,7,4'-trimethyl ether, santi-7-methyl ether, 3,5,6,7,8,3',4'-heptamethoxyflavone, calycopterin, retusin, 5,4'-dihydroxy-3,7-dimethoxyflavone, isohemigossylic acid lactone-7-methyl ether, hibiscolactone A, hibiscone C, hibiscone D, 2-*O*-methylisohemigossypolone, scopoletin, benzophenone, 2α,3β-dihydroxylupene, lupenone, 24-methylenecycloartenol and (23*E*)-cycloart-23-ene-3β,25-diol [9]. Both 5-hydroxyauranetin and isohemigossylic acid lactone-7-methyl ether exhibited potent inhibition against *N*-formyl-L-methionyl-L-leucyl-L-phenylalanine-induced superoxide production with IC_{50} values of 28.84±2.26 and 12.77±2.48μM, respectively [10]. In additional, cyanidin-3-glucoside and cyanidin-3-rutinoside [11], palmitic acid [12], heptadecanoic acid, stearic acid, linoleic acid, arachidic acid [13] and sterculic acid [14] were isolated previously from the plant. Fatty acids such as malvalic acid, sterculic acid and α- hydroxy-sterculic acid and palmitic acid were previously described from the plant [15,16]. The main volatile compounds of the flower oil of *P. aquatica* from Brazil [17] were (*E, E*)-α-farnesene (19.2%), β-caryophyllene (11.5%), *trans*-linalool oxide (pyranoid) (7.2%), elemol (5.6%), phenylacetaldehyde (5.3%), *cis*- and *trans*-linalool oxide (furanoids) (5.2% and 4.2%), and palmitic acid (4.3%).

In Nigeria, *P. aquatica* is cultivated and grown as an ornamental plant. However, to the best of our knowledge, there are no reports on the volatile and non-volatile constituents and biological activities of this *Pachira* species growing in Nigeria. In this paper we report for the first time the chemical composition of essential oil of *P. aquatica* growing in South-western Nigeria.

2. MATERIALS AND METHODS

2.1 Plant Material

Mature and fresh leaves sample of *P. aquatica* were collected from plants growing at a private garden in Surulere Government Area of Lagos State, Nigeria (6.58 N, 3.75 E), in October 2014. Identification of the plant material was carried out by Mr. O.O. Oyebamji of the herbarium, Department of Botany, University of Lagos. Voucher specimen (LUH 5742A) was deposited at the University Herbarium.

2.2 Oil Isolation

The air-dried and pulverized leaves of *P. aquatica* (300 g) were subjected to hydrodistillation in a Clevenger-type glass apparatus for 3 h in accordance with the British

Pharmacopoeia specification [18] to afford a colourless oil in a yield of 0.13% (v/w), calculated on a dry mass basis. The distilled oil was preserved in a sealed sample tube and stored under refrigeration until analysis.

2.3 Gas Chromatography (GC) Analysis

GC analysis of the oil was carried out on a Hewlett Packard HP 6820 Gas Chromatograph equipped with a FID detector and DB-5 column (60 m x 0.25 mm id), film thickness was 0.25 µm and the split ratio was 1:25. The oven temperature was programmed from 50°C (after 2 min) to 240°C at 5°C/min and the final temperature was held for 10 min. Injection and detector temperatures were 200°C and 240°C, respectively. Hydrogen was the carrier gas. An aliquot (0.5 µL of the diluted oil) was injected into the GC. Peaks were measured by electronic integration. A homologous series of *n*-alkanes were run under the same conditions for determination of retention indices.

2.4 Gas Chromatography- Mass Spectrometry (GC/MS) Analysis

GC-MS analysis of the oil was performed on a Hewlett Packard Gas Chromatography HP 6890 interfaced with Hewlett Packard 5973 mass spectrometer system equipped with a HP 5-MS capillary column (30 m x 0.25 mm id, film thickness 0.25 µm). The oven temperature was programmed from 70- 240°C at the rate of 5°C/min. The ion source was set at 240°C and electron ionization at 70eV. Helium was used as the carrier gas at a flow rate of 1 ml/min. Scanning range was 35 to 425 amu. Diluted oil in *n*-hexane (1.0 µL) was injected into the GC/MS.

2.5 Identification of Compounds

The components of the oil were identified based on the comparison of their retention indices and mass spectra with those standards [19] and published data [20,21].

3. RESULTS AND DISCUSSION

The identities of the compounds present in *P. aquatica* as well as their percentage composition could be seen in Table 1. Fewer components were identified in the oil sample when compared with other *Pachira* oil compositions [3,17]. Six constituents accounting for 98.8% of the total oil contents were identified from the GC/MS spectra. The major components of the oil were 9-octadecenamide (35.1%), phytol (31.2%) and methyl palmilate (19.1%).These components belong to different chemical classes of organic compounds. It was noted that the main compounds present in a previous investigated flower sample from Brazil namely (*E, E*)-α-farnesene, β-caryophyllene, *trans*-linalool oxide (pyranoid), elemol and phenylacetaldehyde were conspicuously absent in the present study. This may be attributed to the fact that different parts of a plant normally stored different chemical compounds [2].

Literature information is scanty on the oil composition of *Pachira* species.This reuslt showed some difference in composition with respect to data in the literature on the essential oils of *Pachira* plants. Palmitic acid, the main compound of Brazilian grown *P. glabra* [22] as well as limonene, β-caryophyllene and β-bisabolene that were present in Nigerian grown *P. glabra* [3] were not identified in *P. aquatica*. Although phytol was identified in the Nigerian grown *P. glabra* at a much lower quantity than in the essential oil of *P. aquatica*. In addition, several compounds such as (*Z*)-2-hexenol, octanone, hexenyl butanoate, allo-ocimene, verbenene, cadina-1(10), 6-diene, *epi*-α-muurolol, *trans*-linalool-oxide, mentha-1-7(8)-diene and *p*-cymenene, that were identified in *P. dolichocalyx* [23] were not identified in the Nigerian grown *P. aquatica.*

It is well known that the constituents of essential oil of *P. aquatica* perform several biological activities [24-26]. However, some biochemical origin or reactions may affect the concentrations of these constituents of *P. aquatica*. Phytol is biosynthesized by hydrolysis (decomposition by water) of chlorophyll and the rate of hydrolysis may affect its concentration [24]. Methyl palmitate is a fatty acid ester essential oil that naturally occurs in many plant species. Methyl palmitate concentrations in cells are known to be modulated by methanol, but insoluble in water [25]. Methyl salicylate is a water-soluble liquid and may be converted to salicylic acid [26]. Further research works are on to determine the biological potential of the essential oil and the effect of constituents present in the oil.

Table 1. Chemical composition of essential oil of *Pachira aquatic*

Compounds[a]	RI (Cal.)	RI (Lit.)	% Composition
Camphor	1143	1145	3.6
Methyl salicylate	1191	1197	2.0
Methyl palmitate	1922	1920	19.1
Phytol	2116	2118	31.2
Methyl octadecanoate	2128	2128	8.8
9-Octadecenamide	2327	2330	35.1
Total			99.8
Oxygenated monoterpene			5.6
Diterpene			31.2
Fatty acids			27.9
Fatty acid amide			35.1

[a]*Elution order on DB-5 column; RI (Lit.) = literature retention indices; RI (Cal.) = retention indices relative to C_9-C_{24} n-alkanes on the DB-5 column*

4. CONCLUSION

The chemical composition of essential oil from the leaves of *P. aquatica* grown in Nigeria was reported for the first time. It was found that the compositional pattern was different from previous studies on the essential oils from this species and from other member of the genus Pachira. This may be attributed to the fact that different parts of the same plant contained different phytochemicals. In additional, factors such as the ecological and climatic conditions as well nature and age of the plant, period of collection etc may contribute to the different nature and concentration of the compounds found in the essential oil.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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