

Original Research Article

Volatile constituents from the leaves of *Pachira aquatica* Aubl

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: Extraction of essential oil from the air-dried leaf samples of *P. aquatica* and investigation of its chemical constituents

Place and Duration of Study: Mature leaves of *P. aquatica* were collected in Surulere Local Government Area, Lagos State, in December 2014.

Methodology: Air-dried and pulverized leaves were hydrodistilled in a Clevenger-type apparatus to obtain colourless volatile oil whose chemical constituents was analyzed by GC GC/MS

Results: A total of six compounds accounting 98.8% of the oil were identified from the GC/MS 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*; Euphorbiaceae; 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]. *P. aquatica* seeds have tryptophan, threonine and phenylalanine and tyrosine contents higher than those reported for human milk, chicken egg and cow's milk [6]. Previous chemical analyses on *P. aquatica* led to the isolation and identification of antifungal fungitoxin known as isohemigossypolone [6,7], aquatidial, bis-norsesquiterpenoid, triacontyl p-coumarate and lupeol [7], 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, 2 α ,3 β -dihydroxylupene, lupenone, 24-methylenecycloartenol and (23*E*)-cycloart-23-ene-3 β ,25-diol [8]. 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 IC₅₀ values of 28.84 $\pm$ 2.26 and 12.77 $\pm$ 2.48 μ M, respectively [9]. In addition, cyanidin-3-glucoside and cyanidin-3-rutinoside [10], palmitic acid [11], heptadecanoic acid, stearic acid, linoleic acid, arachidic acid [12] and sterculic acid [13] 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 [14,15]. The main volatile compounds of the flower oil of *P. aquatic* in Brazil [16] 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. aquatic* 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. aquatic* growing in South-western Nigeria.

2. MATERIAL AND METHODS

2.1 Plant material

Fresh leaves sample of *P. aquatic* were collected from a private garden in Surulere Government Area of Lagos State, Nigeria. Identification of the plant material was carried out at the 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. aquatic* (300g) were subjected to hydrodistillation in a Clevenger-type glass apparatus for 3 h in accordance with the British Pharmacopoeia specification [17]. 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 μ m and the split ratio was 1:25. The oven temperature was programmed from 50 $^{\circ}$ C (after 2 min) to 240 $^{\circ}$ C at 5 $^{\circ}$ C/min and the final temperature was held for 10 min. Injection and detector temperatures were 200 $^{\circ}$ C and 240 $^{\circ}$ C, respectively. Hydrogen was the carrier gas. An aliquot (0.5 μ L 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 (30m x 0.25 mm id, film thickness 0.25 μ m). 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 [18] and published data [19, 20].

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. Six constituents representing 98.8% 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 palmitate (19.1%). These components represent different classes of 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 result showed some difference in composition with respect to data in the literature. Palmitic acid was not detected as found in *P. glabra* from Brazil [21], while 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 present study. In addition, (*Z*)-2-hexenol, octanone, hexenyl butanoate, allo-ocimene, verbenene, cadina-1(10),6-diene and *epi*- α -muurolol, *trans*-linalool-oxide, mentha-1-7(8)-diene and *p*-cymenene, that were present in the volatile oil of *P. dolichocalyx* [22] were not identified in the Nigerian grown *P. aquatica*.

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

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 C₉-C₂₄ *n*-alkanes on the DB-5 column.

4. CONCLUSION

The chemical compositions of essential oil from the leaves of *P. aquatica* grown in Nigeria are being reported for the first time. It was found that the compositional pattern was different from previous study on the essential oil from the flower of this plant as well as those from other member of the genus. This may be attributable to the fact that different parts of the same plant contained different phytochemical. In additional, factors such as the ecological and climatic conditions as well nature and age of the plant, period of collection, **handling procedures etc** may contribute to the different nature of the compounds obtained form the essential oil.

REFERENCES

1. Lawal OA, Ogunwande IA, Opoku RA. Chemical composition of essential oils of *Plumeria rubra* L. grown in Nigeria. *Eur J Med Pl.* 2015; 6(1): 55-61.
2. Lawal OA, Ogunwande IA, Opoku RA. Phytoconstituents and insecticidal activity of different leaf solvent extracts of *Chromolaena odorata* against *Sitophilus zeamais*. *Eur J Med Pl.* 2014; 5(3): 237-247.
3. Lawal OA, Ogunwande IA, Salvador AF, Sanni AA, Opoku RA. *Pachira glabra* Pasq. Essential oil: Chemical constituents, antimicrobial and insecticidal activities. *J Oleo Sci.* 2014; 63(6): 629-635.
4. Andrade-Cetto A, Heinrich M. Mexican plants with hypoglycaemic effect used in the treatment of diabetes. *J Ethnopharm.* 2005; 99(3): 325-348.
5. Pietsch J, Koch I, Hermanns-Clausen M, Hüller G, Wagner R, Dressler J. Pediatric plant exposures in Germany, 1998–2004. *Clin Toxicol.* 2008; 46(7): 686-691.
6. Oliveira JTA, Vasconcelos IM, Bezeira LCM, Silveira SB, Monteiro ACA, Moreira RA. Composition and nutritional properties of seeds from *Pachira aquatica* Auol, *Sterculia striata* St. Hilet naud and *Terminalia catappa* Linn. *Food Chem.* 2000; 70(2): 185-191.
7. Shibatani M, Yasuyuki H, Satoshi T. A Major fungitoxin from *Pachira aquatica* and its accumulation in outer bark. *J Chem Ecol.* 1999; 25(2): 347-353.
8. Vanderlucia PF, Marcelo RE, de Barbosa LCA, Howarth OW. Aquatidial, a new bis-norsesquiterpenoid from *Pachira aquatica* Aubl. *J Braz Chem Soc.* 2006; 17(7): 1443-1446.
9. Chen J, Cheng L, Liao C, Chung M. New sesquiterpene derivatives and anti-inflammatory constituents from *Pachira aquatica*. *Planta Med.* 2011; 77(12): 58-59.
10. Scogin R. Reproductive phytochemistry of Bombacaceae: Floral anthocyanins and nectar constituents. *Aliso.* 1986; 11(4): 377-385.
11. Rizk AM, Al-Nowaihi AS. *The Phytochemistry of the Horticultural Plants of Qatar*. Oxford:Alden Press, p. 29. 1989.
12. Bohannon MB, Kleiman R. Cyclopropene fatty acids of selected seed oils from Bombacaceae, Malvaceae, and Sterculiaceae. *Lipids.* 1978; 13(4): 270–273.
13. Gibbs RD. *Chemotaxonomy of Flowering Plants*. Montreal:McGill-Queens University Press, V.1, p. 516; V.2, p. 1450, 1974.
14. Spitzer V. GC-MS characterization (Chemical Ionization and electron impact modes) of the methyl sters and oxazoline derivatives of cyclopropenoid fatty acids 1. *J Amer Oil Chem Soc.* 1991; 68(12): 963-969.
15. De Bruin A, Heesterman JE, Mills MR. A preliminary examination of the fat from *Pachira aquatic*. *J Sci Food Agric.* 1963; 14(10): 758-760.
16. das Gracas BZM, Andrade EHA, Maia JGS. Volatiles from flowers of *Pachira aquatica* Aubl. *J Essent Oil Bear Pl.* 2003; 6(2):116-119.
17. British Pharmacopoeia Specification. Vol II, H.M. Stationary Office. 1980.

- 181 18. National Institute of Standards and Technology. Chemistry web book. Data from
182 NIST Standard Reference, Database 69, 2011. (<http://www.nist.gov/>).
- 183 19. Adams RP. Identification of Essential Oil Components by ion trap mass
184 spectroscopy. Academic Press, New York, 2007.
- 185 20. Joulain D, Koenig WA. The Atlas of Spectral Data of Sesquiterpene Hydrocarbons.
186 E. B. Verlag, Hamburg, Germany, 1998.
- 187 21. Chaves MH, Araujo FDS, Moura CVR, Tozeto LJ, Aued-Pimentel S, Caruso MSF.
188 Chemical characterization and stability of the *Bombacopsis glabra* nut oil. Food Pub
189 Health. 2012; 2(4): 104-109.
- 190 22. Courtois EA, Paine CE, Blandinieres PA, Stien D, Bessiere JM, Houel E, Baraloto C,
191 Chave J. Diversity of the volatile organic compounds emitted by 55 species of
192 tropical trees: A survey in French Guiana. J Chem Ecol. 2009; 35(11): 1349-1362.
193
194