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Volatile constituents of *Jatropha gossypifolia* L. grown in Nigeria

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Abstract
In this paper, the volatile constituents identified in the essential oil of *Jatropha gossypifolia* L. grown in Nigeria are been reported. The hydrodistilled oil was analyzed for its constituents by means gas chromatography coupled with mass spectrometry. The main constituents of the oil were the sesquiterpenoid germacrene D-4-ol (23.3%) and hexahydrofarnesylacetone (15.4%). Other significant compounds were δ-cadinene (7.7%), tetradecanal (6.8%) and cubenol (6.1%).

Keywords: Jatropha gossypifolia, *essential oil composition, sesquiterpenes, germacrene D-4-ol, hexahydrofarnesylacetone*

1. Introduction
Jatropha gossypifolia L. is a member of Euphorbiaceae family. It is a bushy, gregarious shrub of about 1.8 m in height. The leaves are 3 - 5 lobed, palmately, 20 cm glandular hairs. The flowers are red-crimson of purple in corymbs, with greenish seed in capsule. In Southern Nigeria, the extract from crushed leaf is routinely used by herbalists and local people to stop bleeding from the skin and nose. The young stem of the plant is used as toothbrush as well as to clean the tongue in the treatment of thrush. The tuber of the plant grinded into a paste is locally used in the treatment of hemorrhoids in Nigeria. Extracts of *J. gossypifolia* were known to have shown pharmacological activities such anti-inflammatory [1], anti-fertility [2], anti-schistosomicidal [3], analgesic [4], antimicrobial [5], antipyretic, purgative [6], anti-coagulating [7], neuropharmacological and anti-diarrheal [8] and anticholinestrate [9] activities. In addition, antifeedant effect of the extract against *Spodoptera frugiperda* [10], larvicidal activity towards *Culex quinquefasciatus* [11], pesticide action against *Spodoptera litura* [12] and *Spodoptera exigua* [13], toxicity to larval neonates of *Busseola fusca*, *Ostrinia nubilalis* [14] and *Poecilia reticulate* [15] as well as piscicidal [9] potential have been reported.
Several biologically active compounds have been isolated and characterized from the plant. They include anticancer diterpenoid [16], cyclogossine B [17], cyclogossine A [18], jatrohelones A and B [19], lignans such as gadain [20], jatrodien [21], gossypifan [22], gossypidien [23] and arylnaphthalene lignin [24], jatrophenone [25], coumarins such as cleomiscosin A [26], coumarin-lignoid [27], flavonoids [28], 12-hydroxyoctadec-cis-9-enoic acid [29] and 9-acetoxynerolidol [30]. An apigenin isolated from the plant is safe to be used as piscicide for the control of freshwater target animal [31].
The main constituents of previous studies on the essential oil of *J. gossypifolia* from other countries [32] were lanosterol (32.47%) and (-) - globulol (18.96%). The leaf oil from Brazil [33] was found to be dominated by humulane-1,6-dien-3-ol (21.28%), phytol (15.58%), 2,6-di-tert-butyl-*p*-cresol (10.28%) and cadinene (7.28%) while heptadecanoic acid (35.81%) and linoleic acid (24.09%) were present in the seed. The seed albumen contained linoleic acid (5518%), oleic acid (19.96%) and palmitic (12.72%). The essential oil was toxic to *Artemia salina* [33].
In continuation of our research into the volatile constituents of Nigeria flora [34], we report in this paper the compounds identified in the essential oil of the leaves of *J. gossypifolia*, which has not been published previously.

2. Materials and methods
2.1 Plant collection
Mature eaves of *J. gossypifolia* were collected from plants growing at a location in Omileye area, Ore, Idgbo Local Government, Edo State, Nigeria, in May 2014. Botanical identification

was carried out at Forestry Research Institute of Nigeria (FRIN), Ibadan, where a voucher specimen was deposited. Plant samples were air-dried prior to extraction.

2.2 Extraction of essential oil

Aliquots of 200 g of air-dried and pulverized leaves were subjected to hydrodistillation for 4h at normal pressure in an glass Clevenger-type apparatus according to the British Pharmacopoeia [35]. The yield of essential oil was 0.87% (v/w), calculated on a dry weight basis. Oil sample was light yellow in coloration.

2.3 Analysis of essential oil

The composition of the essential oils was determined by Gas chromatography-Mass spectrometry (GC/MS) using an Agilent 7890N GC with Agilent mass detector Triple Quad 7000A in EI mode at 70 eV (m/z range 40- 600 amu) and an Agilent Chem Station data system. The GC column was equipped with an HP-5MS column (30 m X 250 µm X 0.25 µm) a split-split less injector heated at 200°C and a flame ionization detector (FID) at 230 °C. The oven temperature was programmed as follows: Initial temperature 40ºC for 5 min, increased 5ºC/min to 180°C for 6 min and then 10°C/min to 280ºC for 12 min. Helium was the carrier gas at flow rate of 1 mL/min. The injection volume was 2.0 µL (split ratio 1:20).

2.4 Identification of the components

The components were identified by comparison of their mass spectra with NIST 1998 library data of the GC-MS system as well as by comparison of their retention indices (RI) with the relevant literature data [36, 37]. The relative amount of each individual component of the essential oil was expressed as the percentage of the peak area relative to the total peak area. RI value of each component was determined relative to the retention times of a homologous n-alkane series with linear interpolation on the HP-5MS column.

3. Results & Discussion

Table 1 displayed the identities and percentage compositions of compounds present in the leaf oil of *J. gossypifolia*. A total of twenty-eight compounds representing 97.9% of the total oil contents were identified. Sesquiterpenes (17.7% hydrocarbons and 56.6% oxygenated) and fatty acids (10.0%) represents the prominent class of compounds in the essential oil. Monoterpenes (4.2%) are less common in the oil. The main constituents of the oil were germacrene D-4-ol (23.3%) and hexahydrofarnesyl acetone (15.4%). There are significant amounts of δ-cadinene (7.7%), tetradecanal (6.8%) and cubenol (6.1%). It could be seen that the main constituents of previous studies on the essential oil of *J. gossypifolia* from other countries such as lanosterol [32], humulane-1,6-dien-3-ol (21.28%), 2,6-di-tert-butyl-*p*-cresol, heptadecanoic acid, palmitic acid and linoleic acid [33] were not identified in the present sample. In addition, the present oil sample contained lower amount of globulol and phytol than in the previous studies [32, 33]. The variation in the compositional pattern of essential oils of *J. gossypifolia* grown in Nigeria and elsewhere may be attributed to the parts of the plant being studied as well as varying climatic and ecological conditions in the place of collection.

It is well known that the biological activities of an essential oil may depend on the major constituents or a synergy between the major and some minor compounds. Referring to literature, some constituents of essential oil of *J. gossypifolia* such as linalool, (*E*)-β-ionone, β-caryophyllene, hexahydrofarnesyl acetone and phytol have shown antimicrobial potentials [38], larvicidal [39] and insecticidal activity against some insect pest [40]. This may have contributed to the observed biological potentials of *J. gossypifolia*.

3.1 Tables

Table 1: Volatile constituents of *J. gossypifolia*

Compounds [a]	RI [b]	RI[c]	% Composition
Methylcyclohexane	781	778	0.5
Toluene	794	796	0.7
Dimethylfulvene	850	858	0.7
Ethylbenzene	860	868	0.5
m-Xylene	870	870	2.5
α-Phellandrene	1006	1002	1.0
m-Cymene	1030	1022	0.4
Linalool	1100	1095	0.5
n-Nonanal	1104	1100	0.6
β-Cyclocitral	1250	1250	0.3
Cycloisosativene	1365	1362	2.8
α-Copaene	1377	1374	4.1
β-Caryophyllene	1419	1417	1.0
α-Cedrene	1436	1436	1.2
(*E*)-β-Ionone	1488	1486	2.0
α-Muurolene	1500	1500	0.9
δ-Cadinene	1525	1522	7.7
Germacrene D-4-ol	1570	1574	23.3
Globulol	1590	1590	2.0
Tetradecanal	1610	1611	6.8
Acorenone	1634	1632	1.3
epi-α-Cadinol	1640	1638	4.7
Cubenol	1647	1642	6.1
α-Cadinol	1654	1652	3.9
Z,Z,Z-7,10,13-Hexadecatrienal	1690	1691	3.4
Hexahydrofarnesylacetone	1854	1845	15.4
(*E*)-Phytol	2125	2122	3.9
(Z)-9,17-Octadecadienal	2297	2297	1.8
Total			97.9
Monoterpene hydrocarbons			1.4
Oxygenated monoterpenes			2.8
Sesquiterpene hydrocarbons			17.7
Oxygenated sesquiterpenes			56.6
Diterpenes			3.9
Aromatic compounds			4.9
Fatty acids			10.0
Non-terpenes			0.6

[a] Elution order on HP-5MS column; [b] Retention indices on HP-5MS column; [c] Literature retention indices

4. Conclusions

For the first time, the chemical constituents of essential oil of *J. gossypifolia* grown in Nigeria are being described. From this report, major differences were observed between the oil compositions of *J. gossypifolia* in this study and previous studies. This may be attributed to differences in the ecological and climatic conditions between Nigeria and other parts of the world as well as the age and nature of the plant, handling procedure etc.

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6. References

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