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Chemical composition of the leaf essential pil of *Terminalia catappa* L. growing in southwestern Nigeria

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ABSTRACT

The essential oil from the leaves of *Terminalia catappa* L. growing in southwestern Nigeria has been obtained by hydrodistillation and analyzed by gas chromatography – mass spectrometry (GC-MS). The leaf oil was dominated by (*Z*)-phytol (41.2%), palmitic acid (11.0%), and (*E*)-nerolidol (4.7%). Alkane hydrocarbons (25.5%) made up a significant portion of the leaf oil composition. The composition of Nigerian *T. catappa* leaf oil is qualitatively similar to previous reports of *T. catappa* from Taiwan, but with significant quantitative differences.

Keywords: *Terminalia Catappa*, Essential Oil Composition, Phytol, Palmitic Acid, Nerolidol.

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1. Introduction

Ever since the dawn of civilization, medicinal plants have been of great importance to the health of individuals, communities in Nigeria, and the whole world. Man has continually investigated tropical and subtropical medicinal plants in order to assess the importance of developing natural, sustainable, and affordable drugs and cosmetics [1, 2]. The genus *Terminalia* L. are perennial shrubs or trees of the Combretaceae, and nearly 200 species are identified [3]. The genus is distributed in tropics and sub tropics regions, a few species are found in Africa, northern Australia, Pakistan, India, Sri Lanka and many other south Asian countries [4]. Tropical almond (*Terminalia catappa* L.) is a large tropical tree growing up to 35 m with an upright, symmetrical crown and horizontal branches.

This plant has been studied extensively. The bark is rich in tannins, the fruit is bitter, acrid, astringent, an aphrodisiac [5]. The leaves contain several flavonoids including kaempferol and quercetin, saponins, and phytosterols [6]. Fallen leaves of *T. catappa* have been widely used in traditional medicine for the treatment of liver diseases, headache, colic, and as a diuretic and cardiotonic [7, 8]. *T. catappa* extracts have shown antidiabetic [9, 10], actinociceptive [11], antiparasitic [12], antibacterial [13, 14], and antioxidant [15] activities, while the aqueous extract of the bark is used traditionally to treat dysentery and diarrhea [16, 17].
Other *Terminalia* species have notable ethnomedicinal utility. For example, *T. chebula* is used in the treatment of fevers, cough, asthma, urinary diseases, piles and worms [18]; and *T. belerica* is used for the treatment of fever, cough, asthma, urinary diseases, piles, chronic diarrhea, dysentery, flatulence, vomiting, colic and enlarged spleen and liver [19]

2. Materials and Methods

2.1 Plant Material

Fresh leaves of *T. catappa* were collected from a mature tree in August, 2012, from Lagos State University External System, Agege Campus, Agege, Lagos state, Nigeria. The plant was taxonomically identified and authenticated at the Herbarium of the Department of Botany of the University of Lagos. A voucher specimen (LUH 4897) was deposited. The leaves were air-dried for five days, pulverized, and a sample (450 g), subjected to hydrodistillation in a Clevenger-type apparatus for 4 h, to give 0.43% yield (w/w) of essential oil. The oil was dried over anhydrous sodium sulfate and stored in a sealed vial under refrigeration prior to analysis.

2.2 Gas Chromatographic – Mass Spectral Analysis

T. catappa leaf oil was analyzed by GC-MS using an Agilent model 6890 gas chromatograph with a HP-5ms column and an Agilent 5973 mass selective detector as described previously [20]. Identification of the constituents of the volatile oil was achieved based on their retention data (retention indices) determined with reference to a homologous series of *n*-alkanes and by comparison of their mass spectral fragmentation patterns with those reported in the literature [21] and stored on the MS library [NIST database (G1036A, revision D.01.00) / ChemStation data system (G1701CA, version C.00.01.08)].

3. Results and Discussion

The chemical composition of *T. catappa* leaf essential oil was investigated by gas chromatography – mass spectrometry (GC-MS) and is summarized in Table 1. Sixty-six compounds were identified in the volatile oil accounting for 100% of the composition. The oil was dominated by the acyclic diterpenoid (*Z*)-phytol (41.2%), the fatty acid palmitic acid (11.0%), and the sesquiterpenoid (*E*)-nerolidol (4.7%), with lesser quantities of alkane hydrocarbons heptadecane (3.0%), hexadecane (2.3%), pristane (2.2%), and phytane (2.0%). A supercritical CO_2 extraction by Ko and co-workers [22] revealed the leaf volatiles of *T. catappa* to be mostly squalene (31.3%) and alkane hydrocarbons (33.3%). In contrast, Mau and co-workers [23] found the leaf volatiles from supercritical CO_2 extraction to be dominated by phytol (47.8%, isomer not identified), and ketones phytone (28.4%), farnesyl acetone (9.6%), and geranyl acetone (3.5%). Thus, there are some qualitative similarities between the leaf oil from Nigeria and those from Taiwan [22, 23], but very quantitative differences. Not surprisingly, the fruit essential oil of *T. catappa* has a very different composition compared to the leaf oils; Moronkola and Ekundayo [24] found the fruit oil to contain α-farnesene (21.3%), octadedecane (11.7%), palmitic acid (9.5%), 1,2,3-trimethoxy-5-(2-propenyl)-benzene (6.6%), neoisothujol (5.8%) and 1,2,4-trimethoxy-5-(1-propenyl) benzene (4.5%)

Table 1: Leaf Essential Oil Composition of *Terminalia catappa*.

RI	Compound	%
1030	1,8-Cineole	0.1
1100	Linalool	tr
1143	Camphor	0.6
1153	Menthone	0.1
1164	*iso*-Menthone	0.1
1172	Menthol	1.4
1194	Methyl salicylate	tr
1231	(3*Z*)-Hexenyl 2-methylbutanoate	0.1
1235	(3*Z*)-Hexenyl 3-methylbutanoate	tr
1293	Menthyl acetate	0.1
1375	α-Copaene	tr
1384	(3*Z*)-Hexenyl hexanoate	0.3
1387	Hexyl hexanoate	tr
1392	β-Elemene	tr
1400	Tetradecane	tr
1419	(*E*)-Caryophyllene	0.9
1428	(*E*)-α-Ionone	0.4
1452	α-Humulene	0.2
1454	Geranyl acetone	0.2
1460	β-Santalene	tr
1481	Germacrene D	0.3
1487	(*E*)-β-Ionone	0.8
1500	Pentadecane	0.5
1507	(*E*,*E*)-α-Farnesene	0.6
1564	(*E*)-Nerolidol	4.7
1570	(3*Z*)-Hexenyl benzoate	1.5
1579	(*Z*)-Dihydroapofarnesol	tr
1600	Hexadecane	2.3
1633	(3*Z*)-Hexenyl phenylacetate	0.3
1642	τ-Cadinol	tr
1643	τ-Muurolol	tr
1651	Norpristane (= 2,6,10-Trimethylpentadecane)	1.1
1654	(*Z*)-Citronellyl tiglate	0.3
1657	α-Cadinol	0.3
1657	4-Methylhexadecane	0.2
1662	4-Ethylpentadecane	0.6

1670	3-Methylhexadecane	0.2
1700	Heptadecane	3.0
1708	Pristane (= 2,6,10,14-Tetramethylpentadecane)	2.2
1716	Pentadecanal	0.9
1770	Phenanthrene	1.5
1800	Octadecane	1.9
1808	Phytane (= 2,6,10,14-Tetramethylhexadecane)	2.0
1846	Phytone (= 6,10,14-Trimethyl-2-pentadecanone)	2.3
1900	Nonadecane	0.9
1912	(5*E*,9*E*)-Farnesyl acetone	1.0
1920	Methyl palmitate	0.3
1942	Isophytol	0.9
1963	Palmitic acid	11.0
2000	Eicosane	0.6
2111	(*Z*)-Phytol	41.2
2138	Thunbergol (= Cembratrienol)	1.2
2148	Palmitaldehyde, diallyl acetal	1.0
2159	(*E*)-Phytol	0.3
2200	Docosane	0.4
2300	Tricosane	0.6
2341	7-Methyltricosane	0.7
2400	Tetracosane	0.3
2500	Pentacosane	0.4
2600	Hexacosane	0.2
2700	Heptacosane	0.7
2800	Octacosane	0.2
2830	Squalene	2.2
2900	Nonacosane	2.2
3000	Triacontane	0.3
3100	Untriacontane	1.8

4. Conclusions

The leaf essential oil of *Terminalia catappa* growing in southwestern Nigeria was dominated by (*Z*)-phytol, alkane hydrocarbons, and fatty acid derivatives. The composition is qualitatively similar to those previously reported from Taiwan, but does have significant quantitative differences.

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