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Volatile compounds from leaves of *Aegle marmelos* (L.) Correa grown in Cuba

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Palabras clave: componentes volátiles, hojas, *Aegle marmelos* CG-EM.
Key words: volatile compounds, leaves, *Aegle marmelos*, GC-MS.

RESUMEN: *Aegle marmelos* (L.) Correa pertenece a la familia botánica Rutaceae y es abundante en toda la India. Casi todas las partes de la planta son usadas en la medicina tradicional de esta región. Los compuestos volátiles de las hojas de plantas cultivadas en Cuba fueron aislados por el método estándar de hidrodestilación, lo que arrojó 0,31 % (v/m) de aceite esencial. El análisis del aceite esencial mediante cromatografía de gases capilar y cromatografía de gases-espectrometría de masas permitió la identificación de 65 compuestos que comprenden más del 85 % de la composición total del aceite. El aceite de las hojas está constituido principalmente por compuestos sesquiterpénicos, a diferencia del aceite de hojas procedente de la India, el cual es rico en compuestos monoterpénicos. Los compuestos mayoritarios identificados fueron el β-cariofileno (10,0 %) y δ-cadineno (12,1 %).

ABSTRACT: *Aegle marmelos* (L.) Correa which belongs to the Rutaceae family is abundantly available all over India. Almost every part of the plant is used in traditional medicine of this region. Volatile compounds from leaves of plants grown in Cuba were isolated by the standard method of hydrodistillation as an oil which yielded 0.31 % (v/m). Analysis of the leaf oil by capillary gas chromatography and gas chromatography-mass spectrometry resulted in the identification of 65 components comprising more than 85 % of the total oil. The leaf oil was constituted mainly of sesquiterpene compounds, whereas Indian oil was rich in monoterpene compounds. Major components were β-caryophyllene (10.0 %) and δ-cadinene (12.1 %).

INTRODUCTION

Aegle marmelos (L.) Correa (syn. *Craterva marmelos* L.) which belongs to the Rutacea family, commonly named as Bael in Hindi is abundantly all over India. Almost every part of the plant is used in traditional medicine.[1]It is extensively planted near Hindi temples for its leaves and wood which are used for worship and for its edible fruits which are valued in indigenous medicine and are official in the Indian Pharmacopeia. The leaves are valued as febrifuge. A poultice made from the leaves is used for ophberiberi associated with weakness of heart. The diluted leaf juice is used for catarrh and aqueous and alcoholic extracts of leaves possess cardiotonic effects.[2]

A. marmelos is a tree up to 15 m. Branches short, strong, sharp, spiny. Leaves alternate, compound, with one pairs of shortly stalked opposite leaflets and a larger long-petioled terminal ones, leaflets 2.5-5 cm long, ovate or oval ovate flowers 2 cm wide, sweet-scented, stalked, solitary or in a few-flowered, axillary or terminal cymes; petals 5, oblong-oval, pale greenish-small, ovary oblong-ovoid, with numerous ovules in each cell. Fruit usually globose, 5-13 cm in diameter, pericarp nearly smooth, greyish-yellow, filled with softer tissue becoming very hard and orange-red when dry. Seeds very numerous, somewhat compressed and surrounded by a very tenacious slimy transparent mucus which becomes hard when dry.

The chemical composition of the leaf oil from plants grown in India has been a subject of previous papers.[3-6] The leaf oil was constituted mainly of monoterpenecompounds.

As a part of this investigation on aromatic and medicinal plants the authors present the results of the chemical investigation of the leaf oil volatiles from *Aegle marmelos* (L.) Correa grown in Cuba.

MATERIALS AND METHODS

Fresh leaves of *A. marmelos* were collected in January 2000 near Güira de Melena, province of Havana. The specie was identified for one of the authors (V.F.) and a voucher specimen has been kept in INIFAT. Leaves were air-dried for about one week. The oils were obtained by hydrodistillation for 4 h in a Clevenger-type apparatus. The oil yield (calculated per weight of dried material) was 0.31 %.

GC analysis was carried out in a Konik 4000A GC, fitted with FID and column DB-5 (30 m X 0.25 mm X 0.25 mm) (J&W Scientific). The temperature program was 70 °C (4 min)

peratures were both 250 °C . Carrier gas (hydrogen) at 1 mL/min . Linear retention indices were calculated against those of n-paraffins. Components were quantified as area percentage of total volatiles from electronic integration (EZChrom V. 6.7 software), neglecting FID response factors.

GC/MS analysis of the oil was performed on a Hewlett-Packard series 6890 GC interfaced directly with a HP-4440 mass-selective detector operated in electron impact mode (70 eV) with interface at 230 °C . Detection was performed in the scan mode between 30 and 400 dalton. The chromatographic conditions were the same as those described for GC (FID). Carrier gas (helium) at 1 mL/min . Components were identified as far as possible from the best match to their mass spectrum in the NBS/Wiley, NIST or our IDENT libraries, and confirmed in many compounds by their relative retention indices. Where possible, retention indices and mass spectra were also compared with those of authentic samples. Mass spectra from the literature were also compared.[7]

RESULTS AND DISCUSSION

Table 1 shows the identified compounds in the leaf oil of *A. marmelos* from Cuba. Sixty-five compounds were identified which constitute more than 85 % of the oil composition. The most prominent compounds were β-caryophyllene (10.0 %) and δ-cadinene (12.1 %). The essential oil is characterized by higher percentages of sesquiterpenes in comparison with previous reports from plants grown in India.[3-6] In these papers, major components were α-phellandrene (20.0; %), *p*-cymene (11.5 %), limonene (10.0 %), citronellal (10.0 %) and β-caryophyllene (7.5 %),[3] β-phellandrene (38.0 %), α-phellandrene (27.5 %) and α-pinene (7.7 %),[4] myrcene (54.0 %),[5] or α-phellandrene (39.2 %), limonene (26.8 %), β-phellandrene (16.2 %) and α-pinene (6.6 %).[6]

In conclusion, although extrinsic factors play a role in the yield and composition of an essential oil, these results support the notion that the evaluated plants belongs to a new chemotype.

Table 1. Chemical composition of the leaf oil of *Aegle marmelos* from Cuba.

Compound	RI	%
pentanal	697	< 0.1
α-pinene	939	< 0.1
camphene	953	< 0.1
benzaldehyde	961	< 0.1
heptanol	970	< 0.1
β-pinene	980	< 0.1
6-methyl-5-hepten-2-one	985	< 0.1
myrcene	991	< 0.1
2,4,5-trimethyl-thiazole	995	< 0.1
α–phellandrene	1 005	< 0.1
p-cymene	1 025	< 0.1
limonene	1 030	< 0.1
(Z)-β-ocimene	1 040	< 0.1
acetophenone	1 065	< 0.1
octanol	1 070	< 0.1
cis-linalool oxide (furanoid form)	1 074	< 0.1
trans-linalool oxide (furanoid form)	1 088	< 0.1
methyl benzoate	1 090	< 0.1
linalool	1 098	0.3
nonanal	1 102	< 0.1
6-methyl-3,5-heptadien-2-one	1 104	< 0.1
isophorone	1 118	< 0.1
α-campholenal	1 125	< 0.1
nopinone	1 137	< 0.1
trans-sabinol	1 140	< 0.1
cis-*p*-1(7),8-menthadiene-2-ol	1 167	< 0.1
nonanol	1 171	< 0.1
terpinen-4-ol	1 176	< 0.1
(Z)-3-hexenyl butyrate	1 193	< 0.1
α-terpineol	1 189	< 0.1
(E)-2-hexenyl butyrate	1 193	< 0.1
myrtenal	1 193	< 0.1
trans-pulegol	1 213	< 0.1
nerol	1 228	< 0.1
geraniol	1 255	0.1
δ-elemene	1 339	< 0.1
α-cubebene	1 351	0.6
α-copaene	1 376	6.9
β-bourbonene	1 384	0.8
β-cubebene	1 390	2.5
β-caryophyllene	1 418	10.0
β-gurjunene	1 432	0.3
α-guaiene	1 439	0.4
α-humulene	1 447	5.1
cis-muurola-4(14),5-diene	1 460	0.4
γ-muurolene	1 477	0.3
germacrene D	1 480	2.7
epi-cubebol	1 493	7.0
cubebol	1 514	1.6

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Table 1. *(Continuación).*

Compound	RI	%
δ-cadinene	1 524	12.1
cadina-1,4-diene	1 532	0.8
α-cadinene	1 538	0.1
α-calacorene	1 542	0.7
elemol	1 549	3.7
β-calacorene	1 563	< 0.1
(E)-nerolidol	1 564	3.9
caryophyllene oxide	1 581	6.6
humulene epoxide I	1 593	0.3
humulene epoxide II	1 606	1.6
1,10-di-epi-cubenol	1 615	2.9
unknown	1 631	6.9
epi-a-cadinol	1 640	2.4
cubenol	1 642	1.3
α-cadinol	1 653	2.8
14-hydroxy-α-muurolene	1 775	0.4
phytol	1 949	1.6

Mass spectra of unknown compound [m/z (%)]: 159(100), 177(44), 97(39), 202(37), 121(24), 109(19), 190(17), 149(16), 79(15), 43(13), 220(13), 204(10).
RI: retention index on DB-5 capillary column.

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