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Volatile constituents of the essential oil leaf of *Lantana salvifolia* Jacq. (Verbenaceae)

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ABSTRACT: The essential oils from the leaves of *Lantana salvifolia* Jacq. (Verbenaceae) growing in Brazzaville, Congo, were analysed by GC and GC–MS. They were characterized by the predominance of neral (15–20%) and geranial (26–34%); the more representative sesquiterpenes were β-caryophyllene and its oxide (11–18%). This essential oil is compared with that of *Lantana camara* L. and other species. Copyright © 2005 John Wiley & Sons, Ltd.

KEY WORDS: *Lantana salvifolia*; *Lantana camara*; essential oil; composition

Introduction

Lantana salvifolia Jacq is a hardy and erect stump with tall stalks (40–75 cm).[1] The leaves, usually verticillated, have an oval limb of 2–3 cm, wider at the base; the flowers, in dense and short spiciform glomerules, purple with an orange centre, emerge from oval bracts of width 3–7 cm. The plant is found growing wild from Ethiopia to Congo. *L. salvifolia* differs from *L. camara* L., which is common in many tropical areas.[2–6]

Lantana salvifolia is a plant widely used in Congo as a herbal tea, like *Lippia multiflora*.[7] The decoction of the leaves is used against typhoid fever. *L. camara* has been used in folk medicine; an aqueous decoction of the leafy stalk is used as a fever-lowering agent, an infusion of the flowers is used against colds and coughs and, in association with an infusion of the leafy stalks of *Clerodendron spinescens*, it is used against malaria.[2,5,6]

The essentials oils of *L. camara* have been the subject of numerous studies;[8–14] other species of the same genus, such as *L. indica* Roxb.[15] *L. balansae*[16] and *L. orangemene*,[17] have also been studied. On the other hand, we have only noticed one reference concerning *L. salvifolia* essential oil,[18] which in that study contained pinene, phellandrene, terpinene and various sesquiterpenes. The results of our study on the essential oils of this species are presented in detail here, completing the previous data. We also compare these extracts with the essential oils of *L. camara* prepared under the same conditions.

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Experimental

Plant Material

The five samples studied originated from Brazzaville (Congo) in three different areas. Leaves of the *L. salvifolia* were collected in the Centre of Studies on Vegetable Resources (C.E.R.VE.) area in May 2003 (sample 1) and in July 2003 (sample 2), and in July 2003 in the Talangaï area (samples 3 and 4) ; *L. camara* leaves were collected in May 2003 in the Kinsoundi area. Each sample comprises a set of several plants. Voucher specimens were identified at the Laboratory of Botany of C.E.R.V.E. and deposited at the National Herbarium of Brazzaville.

Essential Oils

The air-dried leaves of two species were hydrodistillated for 5 h using a Clevenger-type apparatus. The oils are obtained after decantation and drying over anhydrous sodium sulphate. The weights of vegetal material used, the amounts of essential oils obtained and the extraction yields are reported in Table 1.

Analysis

The quantitative analysis was carried out using a Shimadzu GC-14A chromatograph equipped with flame ionization detectors. Separations were performed on a silica capillary column (25 m × 0.25 mm i.d., 0.15 μm

Table 1. Preparation of the essential oils of *Lantana* spp.

Species	*Lantana salvifolia*				*Lantana camara*
	Sample 1	Sample 2	Sample 3	Sample 4	
Weight (g) of material	132	82	260	66	300
Essential oil Weight (g)	0.52	0.31	0.95	0.24	0.81
Yield (%)	0.39	0.38	0.37	0.36	0.30

Table 2. Chemical composition of the essential oils leaf of *Lantana salvifolia* Jacq. and *Lantana camara* L.

RI	Compounds	*L. salvifolia*				*L. camara*
		Sample 1	Sample 2	Sample 3	Sample 4	
940	α-Pinene					0.2
955	Camphene					0.1
973	Sabinene	0.2	0.1			2.5
977	β-Pinene					0.4
980	Octen-3-ol	0.1		0.1	0.3	0.1
983	Methylheptenone	0.5	0.3	0.4	1.1	
990	Myrcene	0.2				0.3
1005	δ-3-Carene	0.2				0.5
1020	*p*-Cymene			0.2		0.2
1025	Limonene					0.2
1030	1,8-Cineole					4.5
1035	(*Z*)-β-Ocimene					0.3
1045	(*E*)-β-Ocimene	0.2	0.1			0.3
1055	γ-Terpinene					0.2
1065	*cis*-Sabinene hydrate	0.4	0.4	0.4	0.5	0.5
1085	Terpinolene					0.2
1086	*trans*-Linalool oxide	0.1	0.1	0.1		
1099	*cis*-Linalool oxide	0.1	0.1	0.1		
1100	Linalool	1.5	1.4	1.4		0.4
1145	*trans*-Verbenol	0.7	0.6	0.7	1.0	
1147	Camphor					0.9
1155	Citronellal				0.2	0.3
1172	Rosefurane epoxide	0.4	0.1	0.2	0.4	
1173	Borneol					0.5
1185	Terpinen-4-ol		0.1		0.3	0.9
1187	Verbanol*	0.5		0.2	0.2	
1196	Myrtenal	0.6	0.4	0.8	0.5	
1198	α-Terpineol					0.6
1210	Verbenone		0.1	0.2		
1224	Epoxyneral	0.8	0.6	0.7	0.4	
1226	Nerol	0.3	0.5	0.1	0.5	
1235	Citronellol	0.1				0.2

film thickness) coated with DB-5, using the following experimental conditions: oven temperature, 50 °C (3 min), rising to 200 °C at 4 °C/min; injection temperature, 220 °C; carrier gas, nitrogen at a flow rate of 1.0 ml/min.

The qualitative analysis was carried out using a GC–MS Hewlett-Packard apparatus (Model 5890) equipped with the same capillary column and using the same experimental conditions. Helium was used as the carrier gas at a flow rate of 1.0 ml/min. Component identification was carried out by comparison with authentic reference compounds, spectrometric electronic library (Wiley), published mass spectra and retention indices.[19–22]

Results and Discussion

The hydrodistillation of *L. salvifolia* dried leaves gives a pale yellow essential oil with an average yield of 0.38%. The chromatographic analyses allowed the identification of 54 products, representing 91–94% of the total oil (Table 2). These analyses show that the *L. salvifolia* essential oils are almost exclusively composed of terpenes, mainly monoterpenes, dominated by two acyclic aldehydes, neral and geranial. These two products represent 40–54% of the all the components. The sesquiterpenic fraction is always in the minority and mainly includes β-caryophyllene and its oxide (13–18%).

Table 2. (*Continued*)

RI	Compounds	*L. salvifolia*				*L. camara*
		Sample 1	Sample 2	Sample 3	Sample 4	
1238	Epoxygeranial	0.5	1.0	0.9	0.4	
1248	Neral	20.0	15.9	19.1	16.2	
1260	Geraniol	0.7	1.2	0.2	1.4	0.4
1283	Geranial	34.1	26.6	29.0	26.4	
1285	NI	3.0	0.2	0.4	0.4	
1290	NI	1.5	0.2	0.3	0.1	
1295	NI	0.1	0.2	0.5		
1303	Thymol			0.2		0.1
1332	Myrtenyl acetate			0.2	0.1	
1340	Neric acid	0.1	0.1	0.2		
1345	α-Cubebene	0.2	0.4	0.1	0.2	
1355	Thymyl acetate					0.2
1360	Eugenol		0.1		0.1	
1370	Piperitone	0.5	1.4	0.7	0.8	
1375	Geranic acid	0.5	0.5	1.7	0.3	
1382	NI	0.4	0.7	1.8	0.2	
1385	α-Copaene	0.3	0.6	0.4	0.4	0.7
1387	Geranyl acetate	0.4	0.4	0.9	0.5	
1390	β-Bourberene	0.1	0.4	0.2	0.3	
1395	β-Cubebene	1.0	0.7	0.3	1.3	0.5
1400	β-Elemene	0.5	1.1	0.7	0.9	0.6
1427	β-Caryophyllene	5.7	2.4	3.4	7.5	20.6
1430	γ-Elemene	0.2			0.2	
1437	β-Copaene	0.5	1.0	0.7	0.6	0.8
1442	*trans*-α-Bergamotene	0.2	0.2		0.2	
1460	α-Humulene	0.5	0.2	0.1	0.5	10.6
1465	(*E*)-β-Farnesene		0.2		0.4	
1467	*allo*-Aromandrene	0.5	1.0	0.7	0.7	0.4
1477	γ-Muurolene	0.3	0.5	0.4	0.4	0.5
1485	(*E*)-β-Ionone		0.2	0.2		
1487	Germacrene D	1.7	0.2	0.1	3.4	3.5
1488	*epi*-Cubebol	0.5	1.2	1.1	0.6	
1500	Bicyclogermacrene					8.6
1503	α-Muurolene	0.5	1.1	0.6	0.7	1.0
1510	Germacrene A	1.0			1.4	1.4
1515	γ-Cadinene				0.2	0.2
1517	Cubebol	1.2	2.5	1.6	1.2	1.0
1520	δ-Cadinene	0.5	0.4	0.4	0.6	1.3
1537	α-Cadinene					0.2
1550	Elemol				0.3	2.5
1552	Davanone					0.3
1555	Germacrene B					1.5
1560	Nerolidol	0.4	0.7	0.7	0.5	3.6
1575	Spathulenol	0.8	1.6	1.0	4.1	0.3
1577	Caryophyllene oxide	5.6	16.0	14.8	5.5	3.7
1602	Humulene oxide II	0.4	1.5	1.4	0.7	1.3
1607	*diepi*-Cubenol				1.0	
1620	NI					5.6
1630	*epi*-α-Cadinol		0.9	0.5	2.2	1.0
1632	*epi*-α-Muurolol					0.5
1635	α-Muurolol					0.4
1637	NI	1.7	1.7	1.1	1.3	
1640	Cubenol					2.1
1643	α-Cadinol	0.2	0.8	0.1	1.5	2.0
1657	NI					2.3
1695	Pentadecanal	0.3	0.3			
1705	Oplopanone	0.2	0.3	0.2	0.2	

* Stereochemistry not determined.

Mass spectra of non-identified (NI) compounds [retention index (RI): *m*/*z* (%)].

1285: 59(100), 81(74), 43(65), 127(40), 84(40), 109(28), 128(27) and 143(15).
1290: 43(100), 69(56), 41(54), 108(45), 111(25), 126(10) and 152(4).
1295: 59(100), 43(60), 81(55), 84(54), 127(50), 128(30), 143(18) and 153(6).
1382: 81(100), 59(85), 85(73), 41(55), 97(50), 82(48), 125(12) and 153(2).
1620: 81(100), 95(32), 93(31), 79(30), 137(17), 138(15), 148(12) and 220(1).
1637: 135(100), 91(96), 177(92), 105(70), 93(60), 159(50), 220(16) and 202(10).
1657: 107(100), 123(96), 109(58), 81(51), 91(47), 159(16) and 220(14).

The slight quantitative differences in composition that are observed betwen the four samples could be due to differences in soil or cropping period. Because of its important content of monoterpenic compounds, *L. salvifolia* presents a similar chemical composition at the other species of the same genus : *L. india* Roxb.,[15] *L. balansae*[16] and *L. orangemene*.[17]

The essential oil of *L. camara* gathered in Congo and obtained in 0.30% yield presents the characteristics acknowleged for the species by most authors;[8–14] it only contains terpenes, with β-caryophyllene and α-humulene as the major components. These important amounts of sesquiterpenes clearly differentiate the essential oils of *L. camara* from those of the other species.

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