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Chemical Composition of the Leaf Oil of *Lantana camara*

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Abstract

The essential oil of the fresh leaves of *Lantana camera* growing in Dehra Dun was analyzed by GC and GC/MS. The major constituents identified in the oil included β-caryophyllene (23.3%), α-humulene (11.5%), germacrene D (10.9%), davanone (7.3%) and γ-curcumene (6.3%).

Key Word Index

Lantana camara, Verbenaceae, essential oil composition, β-caryophyllene, α-humulene.

Introduction

Lantana camara (Verbenaceae) is an aromatic shrub up to 0.3-3 m in height native to tropical America and was introduced in India as an ornamental and hedge plant. However, it is now abundantly occurring as a weed throughout India. Its flowers are small, usually yellow or orange changing to red or scarlet, in dense axiliary heads (1,2). The leaves are used in the treatment of tumors, tetanus, rheumatism, malaria and reported to possesses diaphoretic, carminative, antiseptic properties, and are main source of phosphorous and potassium when used as green mulch (2,3). In Africa, an infusion of the leaves is used against rheumatism, asthma, coughs and colds (4,5). The oil is reported to possess insecticidal (6) and repellent activities towards bees (7,9), mosquitoes and cattle flies (7). The leaf oil of *L. camara* exhibits ovipositional (10) and it also possesses antimicrobial activities (11).

The oil composition of *L. camara* has been the subject of considerable study. The oils of leaves and flowers of *L. camara* from Cameroon and Madagascar were found to contain β-caryophyllene (13.3%), ar-curcumene (24.7%), β-caryophyllene (12.0%) and davanone (15.9%) as a major components, respectively (12). Oils produced from plants collected from three different Brazilian states possessed oils rich α-phellandrene (16.4%), limonene (16.5%), β-caryophyllene (10.8%), germacrene D (13.2-28.4%), γ-+ ar-curcumene (27.6-31.9%) and zingiberene (15.5-19.2%) as a major components (13). The commercial Brazilian *L. camara* oil was also found to have mainly bisabolene derivatives (14). Sabinene (16.5% and 7.3%), β-caryophyllene (14.0% and 22.5%), 1,8-cineole (10.0% and 6.0%), bicyclogermacrene (8.1% and 18.5%) and humulene (6.0% and 10.8%) were found as chief components of leaves and flowers oils of Iranian *L. camara* (15). Further, α-fernesene (28.8%), α-phellandrene (15.0%), longifolene (10.0%), α-cedrene (8.6%) and β-caryophyllene (7.1%) in a sample of leaf of oil of Indian origin (16). Also, germacene D (20.5% and 10.6%), 3-elemene (10.3% and 6.8%), β-caryophyllene (9.4% and 7.0%), β-elemene (7.3% and 14.5%), α-copane (5.0% and 10.7%) and α-cadinene (3.3% and 7.2%) were found to be main constituents in the leaves and flowers oils Indian *Lantana* (17).

The object of the present work is to carry out the detailed analysis of *L. camara* leaf oil growing in Dehra Dun by GC and GC/MS.

Experimental

Lantana camara leaves were collected from four plants in July 2001 from a wild population growing in Dehra Dun valley. A voucher specimen (H-101) was deposited at the Herbarium of Medicinal Plant Research Institute, Dehra Dun, India.

Fresh leaves were hydrodistilled in Clevenger-type apparatus for 3 h. The distillate was extracted with diethyl ether, the ethereal layer was dried over anhydrous sodium sulfate and ether distilled off on a gently heated water bath. The yield of the oil obtained was found to be 0.24%. The oil isolated from the leaves have the following physicochemical properties, n_D^{31}: 1.4798; $[\alpha]_D^{30}$: +14.9 (c,0.1 in petroleum ether); d^{30}: 0.8778; acid value 1.2 and ester value 4.2.

GC: Gas chromatography was carried out with a Varian instrument (GC model Star 3400; MS model Saturn II) equipped with a capillary column HP (DB-5) 25 m x 0.25 mm; film thickness 0.25 μm; of crossed linked 5% phenylmethyl silicone was used. Column oven temperature was held at 40°C for 5 min,

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Table I. Chemical constituents of *Lantana camara* leaf oil

Compound	RI	Area (%)	Compound	RI	Area (%)
Monoterpene hydrocarbons			borneol	789	0.1
α-pinene	315	0.5	terpinen-4-ol	819	0.3
sabinene	378	2.2	α-terpineol	851	0.6
β-pinene	385	0.7	verbenone	893	0.1
myrcene	413	1.2			
α-phellandrene	435	0.6	**Sesquiterpene hydrocarbons**		
p-cymene	470	0.1	α-copaene	1338	0.4
limonene	477	0.6	β-elemene	1376	2.8
(Z)-β-ocimene	497	0.4	β-caryophyllene	1446	23.3
(E)-β-ocimene	517	0.4	α-humulene	1529	11.5
γ-terpinene	548	0.1	γ-curcumene	1596	6.3
terpinolene	605	0.1	germacrene D	1598	10.9
			γ-cadinene	1703	2.3
Oxygenated monoterpenes					
1-octen-3-ol	386	1.3	**Oxygenated sesquiterpenes**		
3-octanol	517	0.3	davanone	-	7.3
1,8-cineole	483	0.7	caryophyllene oxide	1864	0.3
linalool	644	0.7	T-cadinol	1974	0.3
camphor	732	0.1			

RI = retention indices on a 5% Phenylmethyl silicone column

programmed at 3°C/min to 280°C and then held for 5 min. The carrier gas was hydrogen at a flow rate of 2 mL/min. The injector and the detector temperatures were kept at 260°C and 270°C, respectively, and the splitless mode of injection was used. Quantitative data was obtained from electronic integration of peak areas without the use of an internal standard.

GC/MS: Gas chromatography/mass spectrometry analysis of the oil was carried out on a Thermo mass spectrometer (Model Trio 1000), coupled with a Thermo gas chromatograph (Model 8000, Fisons Instruments) equipped with a nonpolar Hewlett Packard OV-17 capillary column 25 m x 0.25 mm with film thickness 0.25 µm. Column oven temperature was held at 60°C for 6 min, programmed at 5°C/min to 150°C and then held for 10 min. The carrier gas was helium at a flow rate of 2 mL/min (splitless mode). The quadrupole mass spectrometer was scanned over the 28-400 amu range at 1 scan/sec, with an ionizing voltage of 70 eV and an ionization current of 150 µA. Retention indices were calculated using co-chromatographed standard hydrocarbons. The individual compounds were identified by MS and their identity confirmed by comparison of their retention indices, relative to C_8-C_{19} n-alkanes and comparing their mass spectra and retention times with those of authentic samples and with the data available in the literature (18-20).

Result and Discussion

The oil was isolated by conventional hydrodistillation of the leaves of *L. camara* in a Clevenger-type apparatus. It gave oil in 0.24% yield (v/w) on a fresh weight basis. GC and GC/MS analysis resulted in the identification of a total of 30 constituents from the leaf oil. The relative concentration of the oil components identified is presented in Table I according to their elution order on DB-5 column. Analysis of the oil showed that the oil was a complex mixture of numerous compounds; many of which were present in trace amounts (< 0.02%) (Table I). Thirty compounds accounting for 76.5% of the oil were identified while more than 160 compounds constituting 23.5% of the oil remain unidentified. Monoterpene hydrocarbons constituting 6.9% of the oil, contained sabinene (2.2%) and myrcene (1.2%) as main compounds while oxygenated monoterpenes (4.2%) were present in the minor quantities. The sesquiterpenes hydrocarbon fraction (57.5%) contained β-caryophyllene (23.3%), α-humulene (11.5%), germacrene D (10.9%), γ-curcumene (6.3%), germacrene B (4.7%%), β-elemene (2.8%) and γ-cadinene (2.3%) as major components of the leaf oil. In the oxygenated sesquiterpene fraction (7.9%) only davanone (7.3%) could be identified as the major component.

It is worth mentioning here that there is great variation in the chemical composition of *L. camara* oils reported up to now from the different parts of the world (12-17). β-Caryophyllene was observed as the only versatile common component present in all the *Lantana* oils analyzed thus far. But this study showed that β-caryophyllene (23.3%) was present in maximum percent as compared to Indian *Lantana* leaf oil (16,17) and oils from other parts of the world (12-15). The major components of the leaf oil were β-caryophyllene (23.3%), α-humulene (11.5%), germacrene D (10.9%), davanone (7.3%), γ-curcumene (6.3%), germacrene B (4.7%), β-elemene (2.7%), γ-cadinene (2.3%) and sabinene (2.2%).

On the basis of above fact it may be concluded the *L. camara*, growing widely in Dehra Dun, may be utilized as a source for the isolation of natural β-carophyllene.

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