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Essential Oil Composition of Two *Lantana* Species from Mountain Forests of Pernambuco (Northeast of Brazil)

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Abstract

The essential oils of *Lantana camara* L. and *L. fucata* Lindl. leaves collected in the region of Mata Serrana in the municipality of Brejo da Madre de Deus in Pernambuco - Brazil were obtained by hydrodistillation and analyzed by GC and GC/MS. Twenty-five compounds were identified in *L. camara*, representing 99.4% of the leaf oil constituents, while 15 compounds were identified in *L. fucata*, representing 97.1% of the leaf oil constituents. The major compounds present in the oil of *L. fucata* were caryophyllene oxide (27.9%), gossonorol (18.2%), β-caryophyllene (12.3%) and bulnesol (10.8%), whereas those in the oil of *L. camara* were germacrene D (28.6%), germacrene D-4-ol (19.9%), β-caryophyllene (16.2%) and bicyclogermacrene (14.7%).

Key Word Index

Lantana camara, *Lantana fucata,* Verbenaceae, essential oil composition, germacrene D, caryophyllene oxide, germacrene D-4-ol, gossonorol, β-caryophyllene, bicyclogermacrene, bulnesol.

Introduction

The predominant vegetation type in the phytogeographical region of the Agreste of the state of Pernambuco is called Caatinga (white forest). But, another exuberant type can be found at isolated points in the Caatinga vegetation, known as Matas Serranas or Brejo of higher altitudes, whose vegetation is different from that of the typical one of the Caatinga region. These atypical forestry formations in the Agreste of Pernambucao can be preserved due to their high altitude (superior to 600 m) and humid winds, which are responsible for temperature reduction and relative humidity (1).In the different vegetation types, which can be found in the phytogeographical region of the Agreste of the state of Pernambuco, the ones with the richest flora are beyond any doubt the Matas Serranas. These biomas are rich in aromatic species of the genera *Eugenia*, *Piper* and *Cordia*, some of the essential oils of which have already been analyzed by our research group (2–4). Other species with a good distribution are from the genus *Lantana* which can be found in the localized Mata Serrana in the municipality of Brejo da Madre de Deus, Agreste of Pernambuco / Brazil.

The genus *Lantana* L. is native in tropical and subtropical America. It is one of the major genera of the family Verbenaceae with around 150 species in pantropical distribution (5). Its species are characterized by their bushy habits; rough, and aromatic leaves, known around the whole world for their ethnomedical and ornamental use. *Lantana camara* and *L. fucata* are native species with a good distribution in the Serrana Forests of Brejo da Madre de Deus. Their popular names are chumbinho and cidreira brava, respectively. Some species, due to their beautiful flowers are cultivated for ornamentals (principally *L. camara*) which can be found in various parts of the world (5). Beyond this, different parts of the plants are used by the local people in folklore remedies and traditional medicine systems for the treatment of various human ailments (6). An infusion of the aromatic leaves of *L. camara* and *L. fucata* is sometimes used in home remedies as a tonic and stimulant or in the treatment of itches, cuts, ulcers, swellings, bilious fever and rheumatism (6). The community of Brejo da Madre de Deus use an infusion of the flowers of *L. camara* in the form of tea in popular medicine for the treatment for chest complaints of children, while *L. fucata* is used as remedy against rheumatism and stomach affections beyond the use of both essential oils as antiseptic for wounds.

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Table I. Percentage composition of the leaf oils of *Lantana camara* and *L. fucata*

Compound	RI[a]	Leaf oil	
		L. camara	*L. fucata*
α-pinene	935	0.8	-
sabinene	971	0.5	-
β-pinene	976	0.7	-
myrcene	986	0.4	-
(E)-β-ocimene	1044	0.8	-
trans-pinocarveol	1138	-	0.6
borneol	1167	-	0.5
α-terpineol	1193	-	0.5
eugenol	1160	-	2.5
δ-elemene	1340	0.6	-
β-elemene	1393	1.1	-
β-caryophyllene	1425	16.2	12.3
β-gurjunene	1434	0.3	-
α-humulene	1456	2.0	1.0
germacrene D	1484	28.6	-
bicyclogermacrene	1489	14.7	-
germacrene A	1505	0.3	-
γ-cadinene	1515	0.3	-
cubebol	1517	0.2	-
δ-cadinene	1526	1.2	-
α-cadinene	1540	0.2	-
elemol	1553	0.3	0.8
germacrene B	1560	1.1	-
(E)-nerolidol	1567	-	1.5
germacrene D-4-ol	1579	19.9	-
dendrolasin	1580	-	1.5
caryophyllene oxide	1584	-	27.9
viridiflorol	1594	0.4	-
trans-isolongifolanone	1620	-	2.7
10-epi-γ-eudesmol	1624	0.3	-
gossonorol	1640	-	18.2
epi-α-muurolol	1643	0.5	-
α-cadinol	1656	3.1	-
bulnesol	1662	-	10.8
khusimol	1670	-	7.0
epi-α-bisabolol	1682	4.9	-
manoyl oxide	1992	-	7.8
2-keto-manoyl oxide	2210	-	1.5
Total		99.4	97.1

RI = values are calculated from retention times in relation the ones of n-alkanes on the non-polar DB-5, capillary column, 30 m.

To the best of our knowledge, the chemical composition of essential oil of *L. fucata* has not been the subject of any previous investigation. However, the chemical composition of the essential oil of *L. camara*, as well as the evaluation of its biological potential has been object of many investigations around the world (7–21) and Brazil (22–24).

As a part of the study of the aromatic flora in Northeastern Brazil carried out by our research group, this paper reports the composition of the leaf oils of *L. camara* and *L. fucata*, that are growing in mountain forests in the region of Brejo da Madre de Deus in Pernambuco.

Experimental

***Plant material*:** Fresh leaves of *Lantana camara* and *L. fucata* were collected in the early morning period in the municipality of Brejo da Madre de Deus in Pernambuco in a region of the Matas Serranas at a height of 740 m. The plants were identified by Dra. Margareth Ferreira Sales from Biology Department of the Federal Rural University of Pernambuco. One voucher specimen of each different plant was deposited under numbers # 33239 (*L. camara*) and # 7618 (*L. fucata*) at the Herbarium Vasconcelos Sobrinho of the Federal Rural University of Pernambuco.

***Oil isolation*:** The essential oils of the fresh leaves from each species (ca. 100 g) were separately isolated using a modified Clevenger-type apparatus by hydrodistillation technique for 2 h. The oil layers obtained were separated and dried over anhydrous sodium sulphate, stored in hermetically sealed glass containers and kept under refrigeration at +8°C before analysis. The yield was calculated through the relation of the volatile oil volume from the Clevenger-type equipment to the mass of plant material used in the isolation.

***GC and GC/MS*:** The oils obtained from leaves of *L. camara* and *L. fucata* were analyzed by GC and GC/MS. Identification was initially made using mass spectra library search with comparison of retention indices obtained by co-injection of the oils and a linear hydrocarbons C_{11}-C_{24} and calculated according of the Van den Dool & Kratz equation (25) followed by computerized matching of the acquired mass spectra with those stored in the Wiley/NBS mass spectral library of the GC/MS data system and other published mass spectra (26).

***GC*:** The oils were analyzed using a Hewlett-Packard 5890 SERIES II GC apparatus equipped with a flame ionization detector (FID) and a DB-5 fused silica capillary column (30 m x 0.25 mm x 0.25 mm) J & W Scientific; column temperatures were programmed from 50–250°C at 3°C/min for integrating purposes. Injector and detector temperatures were 250°C. Hydrogen was used as carrier gas, flow rate 1.5 mL/min, split mode (1:100). Injection volume: 1.5 mL solution of about 10 mg of oil in hexane.

***GC/MS*:** The oil analyses were carried out using a Hewlett-Packard GC/MS (CG: 5890 SERIES II/ CG-MS: MSD 5971) fitted with the same column and temperature program as that for the GC experiments. The carrier gas was He, flow rate 1 mL/min, split mode (1:100). Injected volume: 1 mL of 1/100 diluted solution in hexane. Mass spectra were taken at 70 eV. Scanning speed was 0.5 scan/s from m/z of 40 to 550.

Results and Discussion

By the hydrodistillation process used for getting the oils of leaves of *L. camara* and *L. fucata* a clear yellow oil was obtained from each species with a yield of 0.64% and 0.93%, respectively. The oils were analyzed by GC and GC/MS, which permitted the characterization of 25 compounds for the *L. camara* oil and 16 for the *L. fucata* oil. The identified compounds are listed in Table I in increasing elution order of a DB-5 (30 m) capillary column. As Table I shows, the *L. camara* oil contains only terpenes, principally sesquiterpenes (96.2%), while the *L. fucata* oil is characterized by the presence of terpenoids: monoterpenes (1.6%), sesquiterpenes (65.5%), diterpenes (9.3%) and benzenoids (20.7%), where 18.2% are attributed to gossonorol. The identified diterpenes in the *L. fucata* oil were: manoyl oxide (7.8%) and 2-keto-manoyl oxide (1.5%).

The percentage of monoterpenes found in our analysis for *L.*

camara (3.2%) was double that found for *L. fucata* (1.6%) and the compounds were identified in concentrations of less than 1%. The monoterpenes found in *L. fucata* oil were oxidized: *trans*-pinocarveol (0.6%), borneol (0.5%) and α-terpineol (0.5%), all of which were not detected in the *L. camara* oil, which was characterized by the presence of monoterpene hydrocarbons: α-pinene (0.8%), sabinene (0.5%), β-pinene (0.7%) and (E)-β-ocimene (0.8%). Comparing these results with those reported in other *Lantana* species, the amount of monoterpenes obtained in our analysis was drastically inferior.

Even with a higher diversity of compounds present in the oil of *L. fucata*, the presence of sesquiterpenes was quantitatively significant in both oils. The major sesquiterpenoid constituents identified in the *L. fucata* oil were: caryophyllene oxide (27.9%), β-caryophyllene (12.3%) and bulnesol (10.8%), while for the *L. camara* oil, germacrene D (28.6%), germacrene D-4-ol (19.9%), β-caryophyllene (16.2%) and bicyclogermacrene (14.7%) were the major constituents. These data reveal different chemical profiles for leaves oil of the *Lantana* species found in this bioma of Pernambuco.

Within the group of identified sesquiterpenes, only β-caryophyllene, α-humulene and elemol were found concomitantly in both studied species. Many works report high sesquiterpenes percentages, where β-caryophyllene (8–19) and α-humulene (9–13,22) have been identified in significant quantities in *L. camara* oils of different regions of the world. Of these sesquiterpenes, β-caryophyllene was the third most abundant compound in our analysis and the second most abundant in the oils studied from the state of Roraima, Brazil (22), while α-humulene was identified in concentrations of less than 3%. On the other side, germacrene D (28.6%), principal compound of *L. camara* collected in Pernambuco, was also reported, comparable to our work, as major constituent in samples of the state of Roraima, North of Brazil (28.4%) (22) and South of China (15.85%) (11), while germacrene D-4-ol (19.9%), second most abundant component in our analysis was identified in quantities smaller than 1% in samples collected in the states of Amapá and Roraima, both North of Brazil (22) and in the flower oil of *L. camara* L. var. *aculeata* found in Nigeria (13).

This is the first report of the chemical composition of the leaf oil from the species *L. fucata* The results of our analysis of *L. camara*, compared with the ones of samples collected in other regions of the world, but principally in Brazil, suggest that the oil of *Lantana* species is rich in sesquiterpenes, and even compared with the reported data of the oil from Roraima (Brazil) (22), which gave the same major components found in our analysis (germacrene D: 28.4% in Roraima and 28.6% in Pernambuco), the chemical composition of the oils differed in accordance with the geographical region and part of investigated plant.

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