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Chemical Composition and Insecticidal Activity of *Hedeoma mandoniana* Essential Oils

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Abstract

The analysis by GC/MS of samples of essential oils obtained from aerial parts of *Hedeoma mandoniana* allowed the identification of 58 components. The main components were pulegone (37-46%), 1,8-cineole (10-14%), linalool (7-12%) and 1-octen-3-yl acetate (7-12%). We investigated the efficacy of these oils against the Chagas' insect disease vectors (*Triatoma infestans* Klug or *Rhodnius neglectus* Lent) bugs by topical application. Two samples showed a moderate activity (33.3% of mortality) on *Rhodnius neglectus* exemplars.

Key Word Index

Hedeoma mandoniana, Lamiaceae, essential oil composition, insecticidal activity, *Triatoma infestans*, *Rhodnius neglectus*.

Plant Name

Hedeoma mandoniana Wedd., Lamiaceae.

Source

Hedeoma mandoniana is known in Bolivia as 'muña negra;' this species occurs in Bolivia at an altitude between 3,200 and 4,000 m. An infusion is used to treat migraine (1) and the essential oils of fresh leaves prepared by the Quechuas Indians are used as insecticide and as a repellent (2). Aerial parts of *H. mandoniana* were collected by Antonio Vilaseca (University of Cochabamba) in different localities (Tiraque C and Larati), near Cochabamba, department of Cochabamba, Bolivia (altitude from 3,200-3,500 m) at flowering stage in February 1995 and May 1995. Voucher specimens were deposited at the Herbarium of University of Cochabamba.

Plant Part

Aerial parts were hydrodistilled in a French-pharmacopae-type apparatus for 3 h producing oils in 1.5-1.8%. The oils thus obtained were dried over anhydrous sodium sulfate.

Previous Work

We have reported the oil composition and the insecticidal activity against the Chagas' disease vectors of various plants called 'muña' in Bolivia (3). In review of the results obtained in this study, it was decided to reinvestigate the oil composition of new samples of *H. mandoniana* and their eventual insecticidal activities against the triatominae bugs, *Triatoma infestans* and *Rhodnius neglectus*.

Present Work

GC/MS analysis was performed in the Faculty of Pharmacy, Angers, France and was carried out on an ATI UNICAM 610 gas chromatograph combined with an ATI UNICAM 120 mass spectrometer under the following conditions: column BPX5 (25 m x 0.22 mm, 1 µm film thickness) programmed from 60°C (5 min) to 250°C (10 min) at 3°C/min; gas carrier: helium (15 Psi); ionizing voltage: 70 eV; injector temperature: 240°C; detector temperature: 250°C. Four samples were 1/10 diluted (v/v) in hexane or chloroform before injection (0.3-0.5 µL).

Components identification was based on comparison of the mass spectra and retention indices with those given by the literature (4).

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Table I. Chemical composition of six essential oils of *Hedeoma mandoniana*

Components	Retention Indices BPX5	Retention Indices DB-5	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
α-thujene	933	931	0.2	0.3	t	0.3	0.3	0.1
α-pinene	941	939	0.6	1.1	0.8	0.6	0.9	2.3
camphene	957	953	t	0.3	t	0.1	0.1	t
sabinene	983	983	1.3	2.0	1.8	1.4	1.4	1.3
1-octen-3-ol	990	978	0.3	0.4	0.5	0.2	0.5	0.9
β-pinene	990	980	0.6	0.9	0.9	0.7	0.8	1.0
myrcene	995	991	t		t	t	0.1	t
α-phellandrene	1017	1005				0.1	t	t
δ-3-carene	1022	1011			t	t	t	
p-cymene	1037	1026	1.5	2.0	0.2	2.5	2.7	0.8
limonene	1040	1031	0.6	0.7	0.7	0.4	0.8	1.3
β-phellandrene	1043	1031	t		t	0.1		
1,8-cineole	1045	1033	10.2	12.5	14.3	9.2	9.7	14.0
(Z)-β-ocimene	1051	1040	0.2	0.3	0.1	0.2	0.3	t
γ-terpinene	1069	1062	t	0.1	t	0.1	0.1	t
cis-linalool oxide†	1085	1074	t	0.1	0.2	0.1	0.1	0.1
1-nonen-3-ol	1090	1078			0.1			
terpinolene	1096	1088				t	t	
trans-linalool oxide†	1101	1088	t	0.1	0.2		t	t
α-pinene oxide	1105	1095	0.8	1.0	0.7			0.9
isoamyl isovalerate	1107	1103		t	0.1	0.4		
linalool	1112	1098	9.6	9.3	11.6	7.5	11.3	8.9
1-octen-3-yl acetate	1113	1110		9.3	11.6	7.5	11.3	8.9
α-campholenal	1147	1125						t
trans-pinocarveol	1166	1139		t	0.1			
menthone	1175	1154	0.3	0.4	0.5	0.2	0.7	1.5
menthofuran	1183	1164	t	0.1	t	0.1	t	t
isomenthone	1186	1164	5.1	4.9	5.5	2.6	3.1	3.2
isopulegone˙	1199	1175	7.9	6.8	8.6	4.5	7.0	7.3
terpinen-4-ol	1203	1177	0.1		t		0.2	0.2
p-cymen-8-ol	1211	1183	t					0.2
α-terpineol	1219	1189	0.4	0.6	0.6	0.2	0.7	0.9
myrtenol	1224	1194		0.1	0.3		0.1	0.2
pulegone	1272	1237	43.1	37.5	40.4	39.9	46.5	43.2
carvone	1276	1242						t
isobornyl acetate	1305	1285		0.2				
thymol	1316	1290	3.4	3.0	t	5.2	3.4	t
carvacrol	1325	1298	0.2	0.2	t	0.4	0.1	t
trans-carvyl acetate	1343	1337		0.3				
α-terpinyl acetate	1362	1350						1.3
thymyl acetate	1366	1355		t	0.1	0.4		0.2
carvacryl acetate	1376	1371		t		0.1		
neryl acetate	1386	1365						0.1
α-copaene	1392	1376	0.1	t		t	t	0.1
β-bourbonene	1405	1384	0.2	0.2	0.3	0.4	0.2	0.1
β-caryophyllene	1443	1418	1.1	0.9	0.9	0.8	1.0	0.3
β-gurjunene	1450	1432				t	t	0.1
aromadendrene	1462	1439						2.2
α-humulene	1480	1454			0.2	t	t	t
allo-aromadendrene	1485	1461		0.1	0.3	0.1	t	0.5
germacrene D	1510	1480		t	t	0.1	t	t
bicyclogermacrene	1519	1494	0.1	0.2	0.2	0.5	t	
γ-cadinene	1540	1513	t	0.1	0.1	0.1	0.2	0.1
(Z)-nerolidol	1573	1534	0.1			0..1	0.8	0.2
germacrene D-4-ol	1607	1574	t	0.2		0.4	0.1	0.2
spathulenol	1612	1576	1.2	1.3	t	2.3	0.7	0.7
caryophyllene oxide	1619	1581	0.4	0.8	t	0.9	0.5	1.8

t = trace (< 0.05 %); †furanoid form; ˙correct isomer not identified

Table II. Insecticidal activity of six samples of *Hedeoma mandoniana* against *Rhodnius neglectus* and *Triatoma infestans* when topically applied (n = 12) exposure; dead triatomines total (percent)

Species of triatomines	Time of exposure (days)	Controls	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
Triatoma infestans	1	0/12	2/12	2/12	0/12	0/12	0/12	0/12
		(0)	(16.6)	(16.6)	(0)	(0)	(0)	(0)
	2	0/12	2/12	2/12	0/12	0/12	0/12	0/12
		(0)	(16.6)	(16.6)	(0)	(0)	(0)	(0)
	3	0/12	2/12	2/12	0/12	0/12	0/12	0/12
		(0)	(16.6)	(16.6)	(0)	(0)	(0)	(0)
	4	0/12	2/12	2/12	0/12	0/12	0/12	0/12
		(0)	(16.6)	(16.6)	(0)	(0)	(0)	(0)
	7	0/12	2/12	2/12	0/12	0/12	0/12	0/12
		(0)	(16.6)	(16.6)	(0)	(0)	(0)	(0)
	14	0/12	2/12	2/12	0/12	0/12	0/12	0/12
		(0)	(16.6)	(16.6)	(0)	(0)	(0)	(0)
Rhodnius neglectus	1	0/12	0/12	0/12	0/12	0/12	0/12	0/12
		(0)	(0)	(0)	(0)	(0)	(0)	(0)
	2	0/12	0/12	0/12	2/12	0/12	0/12	0/12
		(0)	(0)	(0)	(16.6)	(0)	(0)	(0)
	3	0/12	4/12	4/12	2/12	0/12	0/12	0/12
		(0)	(33.3)	(33.3)	(16.6)	(0)	(0)	(0)
	4	0/12	4/12	4/12	2/12	0/12	0/12	0/12
		(0)	(33.3)	(33.3)	(16.6)	(0)	(0)	(0)
	7	0/12	4/12	4/12	2/12	0/12	0/12	0/12
		(0)	(33.3)	(33.3)	(16.6)	(0)	(0)	(0)
	14	0/12	4/12	4/12	2/12	0/12	1/12	0/12
		(0)	(33.3)	(33.3)	(16.6)	(0)	(8.3)	(0)

Insecticidal Activity

Topical application of insecticide: For this test, 5th instars nymphs of *Triatoma infestans* Klug or *Rhodnius neglectus* Lent 1957, were held in laboratory conditions at 25°-30°C, 50-70% in the Tropical Medicine Department of Instituto de Investigaciones en Ciencias de la Salud, National University of Asuncion, Paraguay. (Relative humidity with 12:12 h light/dark periods.) The nymphs were synchronized chronologically and physiogically, i.e., only those that moulted to 5th instar in the same week were fed to repletion a week later. The test was carried out seven days after feeding. The treatment consisted a topical application, on the dorsal surface of the abdomen with 1 µL of the insecticide solution containing 50 mg of oil per mL in acetone, using a Hamilton (25 µL) mycrosyringe with a micro applicator. Twelve nymphs were treated each time at each concentration. Duplicate experiments were run two weeks apart. Insects in the control group were treated with 1 µL of acetone. The insects were maintained in clean vessels fitted with filter paper roosts and closed with nylon netting. The observations were performed during 14 days after treatment, recording insects alive, moribund and dead. Moribund insects were considered as dead at the time of reading.

Analysis of results: Mortality data calculated as average were sorted by hand. Statistical analysis of the proportions was performed using chi-square test of each exposure time and between two tests or the Fisher exact test when required.

Results and Discussion

The components of the oils are listed in Table I. All samples were characterized by a similar chemical composition and were particularly rich in monoterpenes (45-90%), mainly pulegone (40-90%), isopulegone, isomenthone, 1,8-cineole, 1-octen-3-ol in mixture with linalol. The oil compostion was not diffrent to those reported (3,5).

Tables II shows the insecticidal activities of the oils. Samples 1 and 2 were the most active of the six oils tested, but not significantly. *Rhodnius neglectus* specimens showed higher mortality rates than *T. infestans* ones. However, rates obtained with *Rhodnius* could be considered low in relation to the topical application design used. The constituents in the oils of *H. mandoniana*, such as caryophyllene oxide, carvone, limonene, linalool or some monoterpenes are described as having insecticidal or repellent properties (6,7), but it would seem that the triatomines are not sensitive to these compounds.

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