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Essential Oil Composition of *Platostoma menthoides* (L.) A. J. Paton whole plant

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Abstract: *Platostoma menthoides* (L.) A. J. Paton (Syn: *Geniosporum prostratum* (L) Benth. *Geniosporum tenuiflorum*) is an aromatic annual herb found in India and Sri Lanka belonging to the family Lamiaceae. Hydrodistillation of the plant collected from the North Central province in Sri Lanka, yielded 0. 5% (v/w) of a light yellow colored fragrant oil. The oil was analyzed by GC-FID and GC-MS. A total of 74 components accounting for 85.01 % of the oil were identified by comparison of their mass spectra with those in the NIST and WILEY libraries and their retention indices with published values. These compounds included sesquiterpene hydrocarbons (55.80 %), monoterpene hydrocarbons (14.77 %), oxygenated monoterpenes (8.82 %) and oxygenated sesquiterpenes (17.62 %). The main components of the oil were β-caryophyllene (37.01 %), limonene (8.45 %), bornyl formate (5.57 %), α-humulene (4.70 %) and caryophyllene oxide (5.82 %). It also contained a small amount of the methoxychromene precocene 1 (0.23 %), an insect anti-juvenile hormone which has not been reported widely from the Lamiaceae or the genus *Platostoma*.

Key words: *Platostoma menthoides,* β-caryophyllene, limonene, precocene 1.

Introduction

Platostoma menthoides (L.) A. J. Paton (Syn: *Geniosporum prostratum* (L) Benth. *Geniosporum tenuiflorum*) is an aromatic annual herb belonging to the family Lamiacace found in India and Sri Lanka [1-4]. In Sri Lanka it is distributed in the dry zone [5]. It bears a spike of purple flowers during the period from late December to late February. *P. menthoides* has been recorded under the category of *Least Concern* in the National Red List of Sri Lanka [6]. Although there are no records about the usage of this plant in Sri Lanka it has been used traditionally in India for the common cold and as a febrifuge for children [7]. The antipyretic activity of the plant has been evaluated [8]. It has been reported to be a hyper-accumulator of copper [9]. We report here for the first time, the composition of the essential oil of *Platostoma menthoides*.

Experimental

Plant material

The whole plant of *Platostoma menthoides* was collected during the flowering stage in February 2016 from Tantirimale, in the North Central part of Sri Lanka (8^0 34' 22'' N, 80^0 15' 30" E). A voucher specimen (voucher number 52-008-01) was labeled and deposited in the Research and

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Development Laboratory of Link Natural Products. The specimen was identified by the National Herbarium, Peradeniya, Sri Lanka.

Chemicals

Alkane standard solution (C8–C20) was purchased from Sigma Aldrich Company, Germany.

Extraction of essential oil

Fresh whole plants (1 kg) were cut into small pieces and hydrodistilled with 6 L of water in a 10 L round bottom flask for 7 h using a Clevenger apparatus to obtain the oil. The distillation was carried out in triplicate. The oil was dried over anhydrous sodium sulfate and stored at -4°C in refrigerator.

Analysis of the oil

GC-FID analysis of essential oil was carried out an Agilent7890A system equipped with a FID and a HP-5 MS fused silica capillary column with a 5 % Phenyl-methylpolysiloxane stationary phase (30 m x 0.25 mm i.d., 0.25 µm film thickness). Helium (99.999 %) was used as carrier gas at a flow rate of 1 mL/min. Injector and detector temperature were set at 220°C and 290°C respectively. Oven temperature was programmed as follows: Held at 40°C for 5 min, then ramped at 5°C/min to 220°C, then ramped at 10°C/min up to 280°C and held at 280°C for 5 min. The samples were injected using the split mode (1:50). The injection volume was 1.0 µL of a 5 % (w/w) solution of oil in ethyl acetate. Each of the oils from the three hydrodistillations was injected in triplicate. Percentage composition was calculated by normalization of the area under each peak.

GC-MS analysis was carried out using an Agilent 7890 A GC system equipped with 5975C inert XL MSD Triple-Axis Detector, and HP-5 MS fused silica capillary with a 5 % Phenyl-methylpolysiloxane stationary phase (30 m x 0.25 mm i.d., 0.25 µm film thickness) capillary column . Temperature program was the same as for GC-FID. The MS inter phase temperature was 280°C. Mass Spectra were acquired in the EI mode at 70 eV within the range of 40.5 to 500 mass units. Each of the oils from the three hydrodistillations was injected once for GC-MS analysis.

The constituents of the oil were identified by comparing their mass spectra with mass spectra from the NIST and Wiley libraries and their RI indices with those in reference data [10-12] and published literature [13,14]. The RI indices were measured relative to C8-C20 n-alkanes under the same chromatographic conditions. using the method of Van Den Dool.

Results and discussion

The yield of the light yellow coloured fragrant oil was 0.5 % v/w. The result of the analysis of the oil is shown in Table 1. A total of 74 components representing 85.01% of the oil, were identified. These compounds included sesquiterpene hydrocarbons (55.80 %), monoterpene hydrocarbons (14.77 %), oxygenated monterpenes (8.82 %) and oxygenated sesquiterpenes (17.62 %). Only two diterpenes, phytol and *trans*-ferruginol were identified. The main components of the oil were β-caryophyllene (37.01 %), limonene (8.45 %), bornyl formate (5.57 %), α-humulene (4.70 %) and caryophyllene oxide (5.82 %).

The composition of the oil of *Platostoma menthides* as reported in this paper is quite different to those of other *Platostoma* sp. reported in the literature. Thus, germacrene-D (19.0 %), precocene 1 (11.0 %), α-humulene (7.0 %), β-caryophyllene (6.0 %) and 1-octen-3-ol (5.0 %) were reported to be the major compounds of the essential oil of *P. africanum* from Nigeria [15]. It is interesting to note that the oil of *P. menthoides* also contained a small amount of the methoxychromene precocene 1 (0.23 %), an insect antijuvenile hormone not reported widely in the Lamiaceae. Of the 44 species of the genus *Platostoma* it has been reported so far only from the essential oil of *P. africanum*. A higher percentage of β-caryophyllene (21.28 %) was reported from the essential oil of *P. africanum* collected from Togo with germacrene-D (25.0 %) being the major component [16]. Methyl eugenol (14.25 %), eugenol (10.78 %), β-elemene (9.78 %), %) and (*E*)-γ-bisabolene (7.64 %) were the other most abundant compounds in the oil. A different *Platostoma* species, namely, *Platostoma rotundifolium* (*Geniosporum rotundifolium*) from Camaroon also gave germacrene-D (26.8 %) and β-caryophyllene (23.0 %) as the major constitu-

Table 1. The chemical constituents of the essential oil of *Platostoma menthoides*

No.	Compound[a]	Composition %	RT (min)	RI
1	(*E*)-3-Hexen-1-ol	t	8.18	855
2	2-n -Butyl furan	0.40	9.52	891
3	Tricyclene	t	10.56	919
4	Thujene	t	10.81	925
5	α-Pinene	0.87	11.02	931
6	Camphene	0.30	11.55	945
7	Sabinene	0.16	12.50	971
8	β-Pinene	1.59	12.58	973
9	1-Octen-3-ol	0.42	12.77	979
10	3-Octanone	t	13.04	986
11	β-Myrcene	0.20	13.19	990
12	3-Octanol	t	13.34	994
13	α-Phellandrene	t	13.60	1001
14	α-Terpinene	t	14.03	1014
15	*p*-Cymene	0.23	14.31	1022
16	Limonene	8.45	14.48	1027
17	(*E*)- β -Ocimene	t	14.81	1037
18	β-Phorone	t	14.87	1039
19	Benzene acetaldehyde	t	14.95	1042
20	(*Z*)-β-Ocimene	0.20	15.15	1048
21	γ-Terpinene	0.44	15.48	1057
22	Terpinolene	0.12	16.45	1086
23	Lianalool	0.39	16.83	1098
24	1-Octen-3-yl-acetate	0.55	17.24	1111
25	Camphor	0.10	18.22	1143
26	Borneol	1.14	18.89	1164
27	Terpinen-4-ol	0.17	19.24	1176
28	α-Terpineol	0.13	19.64	1189
29	*trans*-Carveol	t	20.49	1218
30	Bornyl formate	5.57	20.78	1228
31	Carvone	t	21.20	1243
32	Bornyl acetate	t	22.41	1285
33	Dihydroedulan II	t	22.50	1288
34	1,5,5-Trimethyl-6-methylene-cyclohexene	t	23.83	1337
35	α-Cubebene	0.10	24.17	1350
36	Dehydro-ar-ionene	t	24.25	1353
37	Eugenol	t	24.33	1356
38	α-Ylangene	t	24.76	1372
39	α-Copaene	1.6	24.89	1377
40	β-damascenone	0.12	25.08	1384
41	β-bourbenene	0.21	25.13	1386
42	β-Elemene	0.94	25.30	1393
43	(*Z*)-β-Caryophyllene	t	25.70	1408
44	α-Barbatene	0.10	25.80	1412

table 1. (continued).

No.	Compound[a]	Composition %	RT (min)	RI
45	β-Caryophyllene	37.01	26.15	1426
46	*trans*-α-Bergamotene	0.18	26.40	1436
47	α-Guaiene	0.13	26.49	1440
48	*trans*- Geranyl acetone	t	26.78	1451
49	α-Humulene	4.70	26.92	1457
50	Precocene 1	0.23	27.06	1463
51	*cis*-Muurola-4(15),5 -diene	t	27.13	1465
52	Germacrene-D	0.67	27.58	1484
53	Bicyclogermacrene	0.37	27.96	1499
54	α-Farnesene	0.49	28.15	1507
55	γ-Cadinene	0.19	28.38	1516
56	δ-Cadinene	0.73	28.58	1525
57	Elemol	0.19	29.20	1551
58	Caryophyllene oxide	5.82	30.08	1588
59	Guaiol	2.39	30.36	1600
60	Humulene epoxide II	0.98	30.66	1613
61	Epicubenol	t	30.76	1618
62	Caryophylla-4(12),8(13)-dien-5β-ol	1.02	31.26	1640
63	α-Eudesmol	1.07	31.38	1645
64	β-Eudesmol	0.23	31.57	1654
65	α-Cadinol	0.55	31.65	1658
66	Bulnesol	1.67	31.94	1671
67	4(15),5,10(14)-Germacratrien-1-ol	0.19	32.36	1689
68	Eudesm-7(11)-en-4-ol	0.55	32.59	1699
69	(2*E*,6*E*)-Methylfarnesoate	t	34.27	1785
70	Hexahydrofarnesylacetone	t	35.23	1844
71	(5*E*,9*E*) farnesyl acetone	0.32	36.33	1918
72	n-Hexadecanoic acid	0.30	36.84	1957
73	Phytol	0.53	38.64	2110
74	*trans*-Ferruginol	t	40.87	2343
	Total	85.01		

t: trace (<0.1%), RI: Retention indices calculated: a : All compounds identified by MS and RI

ents of its essential oil along with β-gurjunene (10.1 %) [17]. In contrast, the essential oil of the same species from Tanzania gave a low amount of germacrene-D (3.71 %) and β-caryophyllene (2.09 %) with spathulenol (12.46 %) and α-terpineol (4.65 %) as the other major components [18].

Conclusions

The compositions of the essential oils of the genus *Platostoma* appears to vary depending on the species, possible genotypic variations and geographical and climatic factors. The essential oil of *P. menthoides* (L.) A. J. Paton from the North Central province in Sri Lanka is differentiated from other related oils by its relatively high level of β-caryophyllene and the presence of precocene 1.

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