BJP

Bangladesh Journal of Pharmacology

Research Article

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A Journal of the Bangladesh Pharmacological Society (BDPS) **Bangladesh J Pharmacol 2010; 5: 13-16**
Journal homepage: www.banglajol.info
Abstracted/indexed in Academic Search Complete, Agroforestry Abstracts, Asia Journals Online, Bangladesh Journals Online, Biological Abstracts, BIOSIS Previews, CAB Abstracts, Current Abstracts, Directory of Open Access Journals, EMBASE/Excerpta Medica, Google Scholar, HINARI (WHO), International Pharmaceutical Abstracts, Open J-gate, Science Citation Index Expanded and Social Sciences Citation Index
ISSN: 1991-0088

Chemical constituents of essential oils from aerial parts of *Adenosma capitatum* and *Limnophila aromatica*

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Article Info

Received: 20 December 2009
Accepted: 22 April 2010
Available Online: 3 May 2010

DOI: 10.3329/bjp.v5i1.4019

Cite this article:
Bhuiyan MNI, Akter F, Chowdhury JU, Begum J. Chemical constituents of essential oils from aerial parts of *Adenosma capitatum* and *Limnophila aromatica*. Bangladesh J Pharmacol. 2010; 5: 13-16.

Abstract

The essential oils were isolated by hydrodistillation from the aerial parts of *Adenosma capitatum* and *Limnophila aromatica* and were analyzed by gas chromatography mass spectrometry (GC-MS). Forty six and thirty components were identified, representing 98.8 and 99.3% of the total oils respectively. Oil of *A. capitatum* rich in limonene (24.7%), fenchone (21.6%) and 2-carene (17.6%). On the other hand, *L. aromatica* rich in Z-ocimene (39.2%), terpinolene (17.2%) and camphor (12.9%).

Introduction

Adenosma capitatum (Bentham) Bentham ex Hance. belongs to the family Scrophulariaceae is a medicinal herb available throughout the world (Hooker, 1885). The anti-oxidant activity of *A. capitatum* was evaluated through its inhibiting ability in peroxidation lipid in cell culture. This result is valid for next research on chemical and bioassay based on its anti-oxidant competency (Huong and Bao, 2004). Ji and Pu (1985) reported that the main components in the *A. indianum* are α-pinene, β -pinene, limonene, p-cymene, 1,4-cineol, linalool, fenchone, o-methylanisole and 8-guaiene.

Limnophila aromatica (Lamk.) Merr. (Syn. *Limnophila chinensis* var. *aromatica*) also belongs to the same family Scrophulariaceae is native to Southeast Asia used as a spice and medicinal herb (Philcox, 1970). It is used in Vietnamese cuisine and also cultivated for use as an aquarium plant. The plant was introduced to North America in the 1970s due to Vietnamese immigration following the Vietnam War. *L. aromatica* has a flavor and aroma reminiscent of both lemon and cumin. Several species of *Limnophila* are found in silent waters Southeast Asia; some of them are common aquarium plants in the West. Rich soups of that kind are commonly eaten as a full meal in South East Asia. In Vietnam, they are typically served not with rice but with fresh French white bread (Kuebel and Tucker, 1988). In Asia, it is employed to treat many ailments. In China, it is used for the treatment of intoxication and pain. In Indochina, to treat wounds, in Malaysia, chiefly as a poultice on sore legs, but also to promote appetite and as an expectorant to clear mucus from the respiratory tract and to treat fever, and in Indonesia, as an antiseptic or cleanser for worms. The plant is also used in Asia for menstrual problems, wounds, dysentery, fever, elephantiasis and indigestion (Yamazaki, 1985). The previous report on the oil of this species found d-limonene and d-perillaldehyde from Formosa (Fujita and Yamashita, 1942). The leaves contain about 0.1% essential oil, whose main component is limonene. Among the other constituents identified in the oil are perillaldehyde, α-pinene, β-pinene, (E)-β-ocimene, (Z)-β-ocimene, 1-octen-3-ol, cis-limonene oxide, trans-limo-

nene oxide, linalool, bornyl acetate, (Z)-β-farnesene, α-humulene, α-terpineol, borneol, caranyl acetate, perillyl acetate, trans-shisool and an unusual monoterpenoid ketone, cis-4-caranone and trans-4-caranone (Tucker et al., 2002). My-Linh et. al. (2004) reported that uncommon 8-oxygenated flavonoids found from *L. aromatica.* Regarding *A. capitatum* and *L. aromatica,* essential oils, no work is available in our country. So, the work has been undertaken to study the chemical components of essential oils obtained from aerial parts of *A. capitatum* and *L. aromatica* grown in Bangladesh respectively.

Materials and Methods

Plant material

Fresh aerial parts of *A. capitatum* and *L. aromatica* were collected from the plants grown in the campus of BCSIR Laboratory, Chittagong during June 2007. Two-voucher specimens (Y-463 and Y-464) were deposited in the herbarium of BCSIR Laboratory, Chittagong.

Extraction of essential oil

Both aerial parts were harvested and air-dried for about one week. The oils were obtained by hydrodistillation for 4 hours in a Clevenger-type apparatus (Clevenger, 1928; Bhuiyan et al., 2009). The oil yields (calculated per weight of dried material) were 1.1% for *A. capitatum* and 1.0% for *L. aromatica*. The oil samples were stored in air-tight containers after drying them over anhydrous sodium sulfate for GC-MS analysis.

GC-MS analysis

The essential oil from aerial parts of *A. capitatum* and *L. aromatica* were analyzed by GC-MS electron impact ionization (EI) method on GC-17A gas chromatograph (Shimadzu) coupled to a GC-MS QP 5050A mass spectrometer (Shimadzu); fused silica capillary column (30 m x 0.25 mm; 0.25 mm film thick-ness), coated with DB-5 (J & W); column temperature 100°C (2 min) to 250°C at the rate of 3°C/min; carrier gas, helium at constant pressure of 90 Kpa. Acquisition parameters full scan; scan range 40-350 amu.

Identification of the compounds

Compound identification was done by comparing the NIST library data of the peaks. Percentage composition was computed from GC peak areas on DB-5 column.

Results and Discussion

The essential oils from the aerial parts of *A. capitatum* and *L. aromatica* are presented with chemical constituents in Table I. *A. capitatum* oil contains 46 constituents of which the major is limonene (24.7%). Other notable constituents are fenchone (21.6%), 2-carene (17.6%), Z-octahydro-7a-methyl-1H-indene-1-one (14.3%), y-terpinene (3.0%), β-bisabolene (2.8%), fenchyl alcohol (2.1%), phytol (1.9%), α-caryophyllene (1.6%), caryophyllene (1.1%) and 2-cyclohexen-1-one, 3-methyl-6-(1-methyle ethelidene (1.0%). According to GC-MS analysis under the conditions described above, Z-ocimene was detected as the main component (39.2%) of this essential oil of *L. aromatica*. The remaining constituents are terpinolene (17.2%), camphor (12.9%), b -myrcene (9.5%), limonene (3.8%), caryophyllene (3.1%), L-caryophyllene (2.9%), a-pinene (2.4%) and b-farnesene (1.4%). The study reveals that composition of two oils differs from the earlier reports published in the literature and may, therefore be treated as different chemotypes (Ji and Pu, 1985; Fujita and Yamashita, 1942; Tucker et al., 2002). On the basis of above fact it may be concluded that *A. capitatum* and *L. aromatica*, growing widely in Bangladesh, may be utilized as a source for the isolation of natural limonene and ocimene respectively. Limonene is common in cosmetic products, used in food manufacturing and some medicines, e.g., bitter alkaloids, as a flavoring; it is also used as botanical insecticide. It is added to cleaning products such as hand cleansers to give a lemon-orange fragrance. As it is combustible, limonene has also been considered as a biofuel. In perhaps its most exciting application, limonene is useful for recycling polystyrene. In the 1990s, researchers at Sony discovered that limonene dissolves polystyrene, which can be recovered after boiling off the limonene (Mann et al., 1994). Besides, it is worth noting that the oil of *A. capitatum* and *L. aromatica* have been reported to be used in folk medicine in the treatment of menstrual problems, rheumatism, wounds, dysentery, fever, elephantiasis and indigestion.

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Table I

Constituents of essential oils from *A. capitatum* and *L. aromatica*

SN.	Name of constituents in A, capitatum	%	Name of constituents in L, aromatica	%
1	γ-Terpinene	3.0	Triethyl carbinol	0.4
2	α-Thujene	0.1	Benzene	0.3
3	α-Pinene	0.5	2,4-Pentanedione	0.1
4	d-Camphene	0.8	3-Hexan-2-one	0.1
5	Thujene	0.1	5-N onenol-5-methyl	0.5
6	β-Pinene	0.1	α-Pinene	2.4
7	1-Octen-3-op	0.2	Camphene	0.3
8	3-Octanone	0.1	l-Octen-3-ol	0.7
9	β-Myrcene	0.2	Sabinene	0.5
10	3-Carene	0.3	β-Myrcene	9.5
11	2-Carene	17.6	2-Carene	0.5
12	Benzene-1-methyl-4-(1-methylethyl)	0.2	m-Mymene	0.2
13	Limonene	24.7	Limonene	3.8
14	Z-Ocimene	1.2	Z-Ocimene	39.2
15	Fenchone	21.6	g-Terpinene	0.3
16	Linalool	0.1	Terpinolene	17.2
17	1,3,8-p-Menthatriene	0.2	Acetic acid, tricyclo [4.4.0.0(3,8)] dec-9-en-4-yl ester	0.1
18	Fenchyl alcohol	2.1	Linalool	0.8
19	Bicyclo (3.2.1) oct-2-ene,3-methyl-4-methylene	0.5	3-Cyclohexene-1-carboxaldehyde	0.6
20	Carveol	0.3	(-) Camphor	12.9
21	Citral	0.1	p-Cymen-8-ol	0.3
22	p-Cymen-8-ol	0.1	1,3-Cyclohexadiene-1-methanol, 4-(1-methylethyl)-	0.4
23	β-Terpinyl acetate	0.2	Caryophyllene	3.1
24	2-Isopropyl benzaldehyle	0.2	β-Farnesene	1.4
25	Carveol	0.3	L-Caryophyllene	2.9
26	2-Cyclohexen-1-one, 2-methyl-5-(1- methylethenyl)	0.1	Demethoxy-ageratochromene	0.3
27	β-Phenethyl acetate	0.1	Caryophyllene oxide	0.7
28	3-Dodecyne	0.1	12-Oxabicyclo [9.1.0] dodeca-3,7-diene, 1,5,5,8- tetramethyl	0.4
29	2-Cyclohexen-1-one, 3-methyl-6-(1-methyle ethelidene)	1.0	2,6,10-Cycloundecatriene-1-one, 2,6,9,9-tetramethyl	0.2
30	Eugenol	0.1	Caryophyllene	0.2
31	Z-Octahydro-7 a-methyl-^{1}H-indene-1-one	14.3		
32	β-Elemene	0.1		
33	Caryophyllene	1.1		
34	α-Caryophyllene	1.6		
35	Demethyoxyageratocromene	0.0		
36	α-Bergamotene	0.1		
37	Patchoulene	0.1		
38	α-Farnesene	0.2		
39	β-Bisabolene	2.8		
40	!H-Benzene(4,5) furo 3,2) indole	0.1		

Table I

Constituents of essential oils from *A. capitatum* and *L. aromatica* (Continued)

SN.	Name of constituents in A, capitatum	%	Name of constituents in L, aromatica	%
41	β-Sesquiphellandrene	0.2		
42	1,5-Dodecadiene	0.1		
43	(E)-3-Hexenyl phenyl acetate	0.3		
44	^{2}H-Indene,1-ethylidene octahydro-7a- methyl,-cis	0.1		
45	3-Pinanone	0.9		
46	Phytol	1.9		

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