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Bangladesh J. Sci. Ind. Res. **46(3)**, 385-388, 2011

BANGLADESH JOURNAL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

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Constituents of Volatile Oils from *Limnophila aromatica* and *Adenosma capitatum*

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Abstract

The essential oils isolated from the aerial parts of *Limnophila aromatica* (Lamk.) Merr. and *Adenosma capitatum* (Benth) Benth ex Hance were analyzed by GC-MS. Twenty nine and forty two components were identified, representing 99.3 and 98.6% of the total oils respectively. Oil of *L. aromatica* rich in Z-ocimene (39.2%), terpinolene (17.2%) and camphor (12.9%). On the other hand, *A. capitatum* rich in limonene (24.7%), fenchone (21.6%) and 2-carene (17.6%).

Key words : *Limnophila aromatica, Adenosma capitatum,* Essential oils, Z-ocimene, Limonene.

Introduction

Limnophila aromatica (Lamk.) Merr. (Syn. *Limnophila chinensis* var. *aromatica*) also belongs to the 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 (Kuebel and Arthur, 1988). *L. aromatica* has a flavor and aroma reminiscent of both lemon and cumin. Several species of *Limnophila* are found in silent waters of Southeast Asia; some of them are common aquarium plants in the West. The plant is also used in Asia for menstrual problems, wounds, dysentery, fever, elephantiasis and indigestion (Anon., 1962). The leaves contain about 0.1% volatile oil, whose main component is limonene. Among the other compounds identified in the oil are perillaldehyde and an unusual monoterpenoid ketone, cis-4-caranone (Tucker *et al.*, 2002). My-Linh *et al.* (2004) reported that uncommon 8-oxygenated flavonoids found from *L. aromatica.*

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

Regarding volatile oils of *L. aromatica* and *A. capitatum,* 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 *L. aromatica* and *A. capitatum* grown in Bangladesh.

Materials and Methods

Plant material

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

Extraction of essential oils

Aerial parts were harvested and air-dried for about 3 days. The oils were obtained by hydrodistillation for 4 hrs in a

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Clevenger-type apparatus (Clevenger, 1928). The oil yields (calculated per weight of dried material) were 1.0% for *L. aromatica* and 1.1% for *A. capitatum*. 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 oils 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 (30m x 2.5mm; 0.25m film thickness), coated with DB-5 (J&W); column temperature 100^{o}C (2 min) to 250^{o}C at the rate of 3^{o}C/min; carrier gas, helium at constant pressure of 90Kpa. Acquisition parameters full scan; scan range 40-350 amu. 2 µl of the diluted samples (1ml oil in 50 ml solvent) were injected.

Identification of the compounds

Compounds were identified on the basis of mass spectral data of the peaks compared with NIST library. Percentage composition was computed from GC peak areas on DB-5 column.

Results and Discussions

The essential oils from the aerial parts of *L. aromatica* and A. *capitatum* were analyzed by GC-MS (Table I and II). Z-Ocimene was detected as the main component (39.21%) in the essential oil of *L. aromatica* followed by terpinolene (17.24%), camphor (12.89%), β-myrcene (9.48%), limonene (3.75%), caryophyllene (3.06%), α-caryophyllene (2.88%), α -pinene (2.36%) and β -farnesene (1.37%). *A. capitatum* oil contains 42 compounds of which the major is limonene (24.74%) followed by fenchone (21.59%), 2-carene (17.64%), trans-octahydro-7a-methyl-1H-indene-1-one (14.32%), γ-terpinene (3.04%), β-bisabolene (2.80%), fenchyl alcohol (2.08%), phytol (1.89%), α -caryophyllene (1.62%), caryophyllene (1.14%) and 2-cyclohexen-1-one, 3-methyl-6-(1-methyle ethelidene) (1.04%). The study reveals that composition of two oils differs from the earlier reports published in the literature (Ji & Pu, 1985 and Tucker *et al* 2002) and may, therefore be treated as different chemotypes. On the basis of above fact it may be concluded that *L. aromatica* and *A. capitatum* growing widely in Bangladesh, may be utilized as a source for the isolation of natural ocimene and limonene respectively. Limonene is common in cosmetic products, used in food manufacturing and

Table I: Chemical constituents of the essential oil from *L. aromatica*

Sl. No.	Name of Components	%
1.	Triethyl carbinol	0.44
2.	Benzene	0.25
3.	2,4- Pentanedione	0.12
4.	3-Hexan-2-one	0.08
5.	5-Nonenol-5-methyl	0.45
6.	α-Pinene	2.36
7.	Camphene	0.28
8.	l-Octen-3-ol	0.66
9.	Sabinene	0.45
10.	β - Myrcene	9.48
11.	2-Carene	0.52
12.	m-Cymene	0.16
13.	Limonene	3.75
14.	Z-Ocimene	39.21
15.	γ -Terpinene	0.31
16.	Terpinolene	17.24
17.	Acetic acid, tricyclo [4.4.0.0(3,8)] dec-9-en-4-yl ester	0.12
18.	Linalool	0.77
19.	3- Cyclohexene- 1- carboxaldehyde	0.57
20.	Camphor	12.89
21.	p-Cymen-8-ol	0.27
22.	1,3-Cyclohexadiene-1-methanol, 4-(1-methylethyl)-	0.36
23.	Caryophyllene	3.25
24.	β-Farnesene	1.37
25.	α-Caryophyllene	2.88
26.	Demethoxy-ageratochromene	0.30
27.	Caryophyllene oxide	0.66
28.	12-Oxabicyclo [9.1.0] dodeca-3, 7-diene, 1,5,5,8- tetramethyl-	0.43
29.	2,6,10-Cycloundecatriene-1-one, 2,6,9,9- tetramethyl	0.22

Table II: Chemical constituents of the essential oil from *A. capitatum*

Sl. No.	Name of Components	%
1.	γTerpinene	3.04
2.	α-Thujene	0.12
3.	α -Pinene	0.54
4.	d-Camphene	0.80
5.	Thujene	0.07
6.	β -Pinene	0.13
7.	1-Octen-3-op	0.18
8.	β -Myrcene	0.22
9.	3-Carene	0.30
10.	2-Carene	17.64
11.	Benzene-1-methyl-4-(1-methylethyl)	0.20
12.	Limonene	24.74
13.	Z-Ocimene	1.15
14.	Fenchone	21.59
15.	Linalool	0.14
16.	1,3,8-P-Menthatriene	0.15
17.	Fenchyl alcohol	2.08
18.	Bicyclo (3.2.1) oct-2-ene,3-methyl l-4-methylene	0.46
19.	Carveol	0.26
20.	Citral	0.09
21.	P-Cymen-8-ol	0.13
22.	β -Terpinyl acetate	0.15
23.	2-Isopropyl benzaldehyle	0.16
24.	Carveol	0.28
25.	β -Phenethyl acetate	0.06
26.	3-Dodecyne	0.08
27.	2-Cyclohexen-1-one, 3-methyl -6-(1-methyle ethelidene)	1.04
28.	Eugenol	0.09
29.	Trans-octahydro-7a-methyl -1H-indene-1-one	14.32
30.	β -Elemene	0.12
31.	Caryophyllene	1.14
32.	α-Caryophyllene	1.62
33.	α-Bergamotene	0.13
34.	Patchoulene	0.07
35.	α-Farnesene	0.16
36.	β-Bisabolene	2.80
37.	1H-Benzene(4,5) furo 3,2) indole	0.09
38.	β -Sesquiphellandrene	0.15
39.	Cis-3-Hexenyl phenyl acetate	0.32
40.	1H-indene,1-ethylidene octahydro-7a-methyl,-cis	0.08
41.	3-Pinanone	0.89
42.	Phytol	1.89

Table II to be Conutd.

some medicines, e.g., bitter alkaloids, as a flavoring; 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 the 1990s, researchers discovered that limonene dissolves polystyrene, which can be recovered by boiling (Mann *et al.,* 1994). 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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Received : August 18, 2010;
Accepted : December 05, 2010