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Full Length Research Paper

Essential oils analysis of the rhizomes of *Alpinia conchigera* Griff. and leaves of *Alpinia malaccensis* (Burm. f.) Roscoe from Bangladesh

Mohammad Nazrul Islam Bhuiyan*, Jasim Uddin Chowdhury, Jaripa Begum and Nemai Chandra Nandi

BCSIR Laboratories, Chittagong-4220, Chittagong, Bangladesh.

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The essential oils obtained by hydrodistillation of the rhizomes of *Alpinia conchigera* Griff. and leaves of *Alpinia malaccensis* (Burm. f.) Roscoe were analysed by gas chromatography mass spectrometry (GC-MS). 74 compounds were identified in *A. conchigera* rhizome oil among them, 40 had not been detected previously. The major chemical class was terpenoids, with eucalyptol (25.85%), chavicol (25.08%), β-pinene (6.71%) and caryophyllene (3.38%), as the major components. *A. malaccensis* leaves yielded 47 identified constituents: the majority were terpenoids, but the oil was clearly dominated by α-phellandrene (31.80%), eucalyptol (13.76%), O-cymene (11.45%), β-pinene (11.34%) and limonene (6.44%). The compositions of both oils varied qualitatively and quantitatively.

Key words: *Alpinia conchigera*, *Alpinia malaccensis*, GC-MS analysis, essential oil composition, eucalyptol, α-phellandrene.

INTRODUCTION

Alpinia conchigera Griff. (Syn. *Languas conchigera* Burkill) and *Alpinia malaccensis* (Burm. f.) Roscoe (syn. *Maranta malaccensis* Burm. f.) are two species of the genus *Alpinia* which belongs to the family Zingiberaceae. *A. conchigera* is a herb commonly found growing in damp, open spaces. The slender rhizome of this plant is stimulating, diaphoretic and regulatory in uterine hemorrhage. It is used to treat bronchitis, jaundice, headache, vertigo, and metritis. It is also used as external treatment for rheumatism and arthritis (Holttum, 1950). *A. conchigera* showed antibacterial and antifungal activities on human skin (Soonthornpalin et al., 1986; Wasuwat et al., 1986). *A. conchigera* showed anti-inflammatory activity (Lee et al., 2006).

The major components in rhizome oil of *A. conchigera* are β-sesquiphellandrene (20.5%), β-bisabolene (12.1%) and 1, 8-cineole (11.6%) (Sirat et al., 1995). Anita et al. (2000) reported the rhizome oil of *A. conchigera* in which bicyclo 4,1,11-trimethyl-8-methlene-undec-4-ene and β-bisabolene are the major components. According to Wong et al. (2005), *A. conchigera* rhizome oil contained terpenoids, with β-bisabolene (28.9%), 1, 8-cineole (15.3%) and β-caryophyllene (10.0%) as the major components. *A. conchigera* is rich in β-sitosterol, stigmasterol, cardamomin, chalconaringenin 2 '-O-methyl ether, alpinetin and naringenin 5-0-methyl ether (Le et al., 2007).

A. malaccensis is cultivated as an ornamental in Bangladesh, Bhutan, India, Indonesia (Java), W. Malaysia, Myanmar and Thailand. It grows to over 4 meters tall. It is slow to spread sideways. This beautiful tropical plant is becoming a popular tropical houseplant as well as a landscape plant in warmer climates. It will become a very beautiful and elegant plant. Its seeds are very rare. The plant is barely-rooted. It has long lush green leaves, which have fragrance. In November and December the flowers emerge above the leaves enclosed in a conical sheath, which splits to reveal a sumptuous cluster of fat pink and white buds. Arranged like a

*Corresponding author. E-mail: Nazrul119@yahoo.com. Tel: +88-01552404192.

Christmas tree, the lowest ones open first to reveal a yellow, mouth-like interior, vividly veined in bright red. The leaves are olive green, subtly striped with lime green lines and silky hairy beneath, reaching almost 1 m long. It does not flower if it gets frost. The plant dies with freezing temperatures. In cold climates, rhizomes can be dug up and stored indoors for the winter in vermiculite. As a houseplant, it must have bright light and humid conditions. They do well in any good garden soil that is rich in organic matter and with regular feeding with a balanced fertilizer, the plant stays healthy. This plant usually has few pest problems but the leaves get brown on the edges if the soil is not kept moist or if touched by frost. It requires consistently moist soil; the soil is not allowed to be dry before watering. Part shade is ideal for this plant; it appreciates some afternoon shade in hot summer climates. It is used in Bangladesh for sores and emetic purposes. *A. malaccensis* is used to cure wounds and sores (pounded rhizome), it is chewed together with betel nut to make the voice strong and clear (rhizome), it is applied on gastralgia with tympanites (decoction of the fruit or the crushed seed) and it is used for bathing feverish people (Smith, 1990; Kress et al., 2005). *A. conchigera* and *A. malaccensis* extracts showed antimicrobial and antioxidant activities (Habsah et al., 2000). Regarding *A. malaccensis*, there appears to be no published work on the essential oil constituents. Nor et al. (2005) reported that *A. malaccensis* var. *nobilis* is rich in (E)-Methyl Cinnamate. There are no previous references in literature about these two Bangladeshi oils. The objective of the present study was to examine the constituents of the rhizome oil of *A. conchigera* and *A. malaccensis* leaf oil in details, and to compare the results obtained for these plants with those reported earlier.

MATERIALS AND METHODS

Plant material

Alpinia conchigera rhizomes and *Alpinia malaccensis* leaves were collected in June 2007 from the plants grown in the campus of BCSIR Laboratory, Chittagong. These specimens were identified at BCSIR Labs. Ctg. Voucher specimens (827 and 828, respectively) have been deposited in the herbarium of BCSIR Laboratory, Chittagong.

Extraction of essential oil

Fresh rhizomes of *A. conchigera* (250 g) and leaves of *A. malaccensis* (500 g) were separately homogenized with distilled water into slurry, which was hydro distilled by Clevenger-type glass apparatus for 4 h for isolation of oils. The oil samples were stored at 0°C in air-tight containers after drying them over anhydrous sodium sulfate and filtered before GC-MS analyses.

GC-MS analysis

The essential oils from rhizomes and leaves of *A. conchigera* and *A. malaccensis* were analyzed respectively 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 × 2.5 mm; 0.25 µm film thickness), coated with DB-5 (J and 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 with those reported in literature, mass spectra of the peaks with literature data. Percentage composition was computed from GC peak areas on DB - 5 columns without applying correction factors.

RESULTS AND DISCUSSION

Essential oils from the rhizomes and leaves of *A. conchigera* and *A. malaccensis*, respectively from Bangladesh were analyzed by GC-MS. The oil yields were 1.10 and 0.45% respectively. Tables 1 and 2 reported the composition of the rhizome and leaf oils of *A. conchigera* and *A. malaccensis*. According to GC-MS analysis under the conditions described above, eucalyptol was detected as the main component (25.85%) of the rhizome essential oil. The remaining constituents were chavicol (25.08%), β-pinene (6.71%), caryophyllene (3.38%), 4-terpineol (2.91%), camphene (1.54%), ℘ - terpinene (1.36%), 3-buten-2-ol, 4-(2, 6, 6-trimethyl-1-cyclohexen-1-yl) (1.13%) and eugenyl acetate (1.04%). On the other hand, *A. malaccensis* is rich in α-phellandrene (31.80%), eucalyptol (13.76%), O-cymene (11.45%), β-pinene (11.34%), limonene (6.44%), β-myrcene (5.65%), α-pinene (5.55%), camphene (2.78%), linalool (1.65%) and sabinyl acetate (1.43%). Results showed that the oils were complex mixture of numerous compounds, many of which were present in trace amounts. It is worth mentioning here that there is great variation in the chemical composition of leaves and rhizomes oils. α-phellandrene and eucalyptol are the main component in leaves and rhizomes oils. On the other hand, comparison of our oils composition with those reported from different places in the world earlier showed that our oil is really different from others. But it is very interesting to note that comparison of our results reported on the leaf and rhizome oils composition from the different places showed different results in the percentage content of some of the major and minor constituents. α-phellandrene and eucalyptol, which have been reported as major constituents in our oils as well as in almost all the leaves and rhizomes oils of the world were either absent or present in trace amounts in the oil reported. This confirms that the variation in the cultivar reported is not due to geographic divergence and ecological conditions but it is due to different chemotype from ours. On the basis of the above fact it may be concluded that *A. conchigera* and *A. malaccensis*, growing widely in

Table 1. Constituents of leaf essential oil from *Alpinia malaccenis.*

Name of compounds	Percentage (%)
℘-Selinene	0.09
℘-Terpinene	0.27
1,3-Dionane	0.06
1H-Cycloprop (e) azulene, decahydro-1,1,7-trimethyl-4-methylene	0.04
2-Carene	0.18
2-Menthene	0.18
4-Terpineol	0.43
5-Nonaol, 5-methyl	0.19
Anethole	0.20
β-Caryophyllene	0.56
Benzaldehyde	0.03
Benzene, 1-methyl-4-(1-methylethyl)	0.06
Biisobutenyl	0.20
β-Myrcene	5.65
β-Pinene	11.34
β-Pinene oxide	0.28
Camphene	2.78
Caryophyllene oxide	0.21
cis, Piperitol	0.17
Cyclohexane, 2,4-diisopropyl-1, 1-dimethyl	0.05
Cyclohexanone, 2-(1-methyl-2-oxopropyl)	0.21
Eucalyptol	13.76
exo-2-Hydroxycimeole	0.51
Geraniol	0.11
Isothujol	0.28
α-Bulnesene	0.05
α-Caryophyllene	0.06
Ledol	0.05
Limonene	6.44
Linalool	1.65
α-Phellandrene	31.80
α-Pinene	5.55
α-Selinene	0.40
α-Terpinene	0.16
α-Thujene	0.44
m-Cymene	0.08
Ocimene	0.80
O-Cymene	11.45
Piperitone	0.11
Piperitone oxide	0.12
P-Menth-4(8)-en-9-ol	0.23
Sabinene	0.39
Sabinyl acetate	1.43
Terpinene-4-acetate	0.61
Thymol	0.23
trans-Pinocarveol	0.06
trans-Pulegone oxide	0.03

Table 2. Constituents of rhizome essential oil from *Alpinia conchigera.*

Name of compounds	Percentage (%)
℘ -Terpinene	1.36
(+) -4-Carene	0.68
(+) Globulol	0.44
δ-Cadinene	0.09
1.6.10-Dodecatriene,7,11-dimethy-3-methylene	0.06
14-Methyl-8-hexadecyn-1-ol	0.19
Citral	0.02
2-Decen-2-ol, (Z)	0.03
2-Methylnorbornane	0.13
3,4-Dihydrocoumarin, 4,4-dimethyl-6-hydroxy	0.45
3.7-Cyclounedeaaden-1-ol, 1,5,5,8-tetramethyl	0.06
3-Buten-2-ol, 4-(2,6,6-trimethyl-1-cyclohexen-1-yl)	1.13
3-Octen-1-ol (Z)	0.09
4-Chromanol	0.49
4-Terpineol	2.91
5-Nonanol,5-methyl	0.10
8-Heptadecene	0.25
β-Bisabolene	0.57
β-Elemene	0.10
Benzene	0.02
Bergamotol, Z,α-trans	0.88
Bicyclo [3,1,0] hexan-2-ol, 2-methyl-5-(1-methylethyl)	0.16
Bioyclo (5,2,0) nonane, 4-methylene-2,8,8,-trimethyl-2-vinyl	0.29
β-Linalool	0.41
β-Myrcene	0.96
β-Pinene	6.71
Camphene	1.54
Carvyl acetate	0.08
Caryophyllene	3.88
Caryophyllene oxide	0.18
Chavicol	25.0
Cinerone	0.02
Cinnamyl acetate	0.16
cis –Carvyl acetate	0.04
Cis –L-Bisabolene	0.93
cis –P-Mentha-2,8-dien-1-ol	0.04
cis-Piperitol	0.07
cis-Verbenol	0.05
Cycloisolongifolene, 4.5—dehydro	0.03
Dihydrochavicol	0.09
Eucalyptol	25.8
Eugenol	0.10
Eugenyl acetate	1.04
Fenchol	0.02
Germacrene D	0.50
Isoborneol	0.03
Isobornyl acetate	0.03
Juniper Camphor	0.08
α,4-Dimethylstyrene	0.04
α-Bergamotene	0.54

Table 2. Cont'd.

α-Bisabolol	0.23
trans –Muurolol	0.87
α-Caryophyllene	10.33
α-Durenol	0.05
α-Linalool	0.28
α-Muurolene	0.04
α-Panasinsen	0.25
α-Phellandrene	0.05
α-Pinene	2.59
α-Selinene	0.87
α-Thujene	0.42
Methyleugenol	0.09
Neryl acetate	0.80
Ningidrin	0.04
Ocimene	0.06
O-Cymol	0.61
Pseudolimonene	0.03
Sabinene	2.01
Terpinolene	0.25
Thymyl acetate	0.11
trans –Nerolidol	0.39
trans, trans-Farnesal	0.08
Trans-Carveol	0.10
Valencene	0.12

Bangladesh, may be utilized as a source for the isolation of natural α-phellandrene and eucalyptol. As a result of this study, the essential oils of *A. conchigera* and *A. malaccensis* have been extracted and their components identified. The high concentration of α-phellandrene and eucalyptol in leaf and rhizome oil respectively makes them useful in medicines because they exhibit anti-inflammatory (Lee et al., 2006), antioxidant and anti-microbial properties (Wasuwat et al., 1986; Soonthornpalin et al., 1986; Habsah et al., 2000). It is worth noting that the oils of *A. conchigera* and *A. malaccensis* have been reported to be used in folk medicine in the treatment of rheumatism and arthritis.

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