BJP

Bangladesh Journal of Pharmacology

Research Article

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A Journal of the Bangladesh Pharmacological Society (BDPS) **Bangladesh J Pharmacol 2008; 3: 69-73**
Journal homepage: www.banglajol.info
Abstracted/indexed in Academic Search Complete, 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, SCOPUS and Social Sciences Citation Index;
ISSN: 1991-0088

Volatile constituents of essential oils isolated from leaf and rhizome of *Zingiber cassumunar* Roxb.

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Article Info

Received: 14 May 2008
Accepted: 23 May 2008
Available Online: 23 May 2008

DOI: 10.3329/bjp.v3i2.844

Cite this article:
Bhuiyan MNI, Chowdhury JU, Begum J. Volatile constituents of essential oils isolated from leaf and rhizome of *Zingiber cassumunar* Roxb. Bangladesh J Pharmacol. 2008; 3: 69-73.

Abstract

The composition of the essential oils of *Zingiber cassumunar* Roxb. from Bangladesh was examined by gas chromatography mass spectroscopy (GC-MS). Sixty-four components were identified in leaf oil and 32 components were identified in the rhizome oil, accounting for 94.6 and 98.6% of the total yields, respectively. The main components in leaf oil were sabinene (15.0%), b-pinene (14.3%), caryophyllene oxide (13.9%) and caryophyllene (9.5%). On the other hand, rhizome oil contained triquinacene 1,4-bis (methoxy) (26.5%), (Z)-ocimene (22.0%) and terpinen-4-ol (18.5%). The compositions of both oils varied qualitatively and quantitatively.

Introduction

Zingiber cassumunar Roxb. synonyms, Zingiber purpureum Rosc., Zingiber cliffordiae, Zingiber montanum (J. König) Theilade (Family: Zingiberaceae) is used in folk medicine for the treatment of conditions such as inflammation, sprains, rheumatism, muscular pain, wounds and asthma, and as a mosquito repellant, a carminative, a mild laxative and an antidysenteric agent, cough and used as a cleansing solution for skin diseases (Oliveros, 1996). *Z. cassumunar* essential oil was found to exhibit absolute fungitoxic activity (Tripathi et al., 2008).

A number of pure compounds isolated from the plants have been shown to possess antimicrobial (Wasuwat et al., 1989; Giwanon et al., 2000; Habsah et al., 2000), topical and oral anti-inflammatory (Masuda and Jitoe, 1994; Kuroyanagi et al., 1980; Tuntiwachwuttikul et al., 1980, 1981; Panthong et al., 1990; Ozaki et al., 1991; Pongprayoon et al., 1996; Panthong et al., 1997; Jeenapongsa et al., 2003), antioxidative activity (Masuda and Jitoe, 1994; Kuroyanagi et al., 1980; Tuntiwachwuttikul et al., 1980, 1981; Kanjanapothi et al., 1987; Ozaki et al., 1991; Pongprayoon et al., 1997; Habsah et al., 2000) and antihistaminic effect (Piromrat et al., 1986) as well as activity as a smooth-muscle relaxant (Kanjanapothi et al., 1987). The rhizome oil of *Z. cassumunar* Roxb. from Malaysia was found to exhibit high activity against yeasts (Bin et al., 2003). Rhizomes of *Z. purpureum* Rosc. yield about 1.8% of a colorless volatile oil which contains terpinen-4-ol (45.4%) as its main constituent (Oliveros, 1996).

The essential oil obtained by hydrodistillation contained about 25% of these phenylbutanoids whereas the oil obtained by extraction with light petroleum had about 46%, with sabinene and terpinen-4-ol, trans-l-(3,4-dimethoxyphenyl)but-l-ene, trans-l-(3,4-dimethoxyphenyl) butadiene and trans-4-(3,4-dimethoxy-phenyl)but-3-ene-l-yl acetate as the main constituents (Taroeno et al., 1991). The main active chemical constituents of the rhizome oil are sabinene (27-34%), g-terpinene (6-8%), a-terpinene (4-5%), terpinen-4-ol (30-35%), and (E)-1-(3,4-dimethoxyphenyl)butadiene (DMPBD) (12-19%) (Pongprayoon et al., 1997). Jitoe et al. (1994) and Masuda and Jitoe, (1994) reported novel anti-oxidants, cassumunarin A, B, and C and Kishore and Dwivedi (1992) also

reported a potential fungitoxic agent like Zerumbone from *Z. Cassumunar*. Regarding *Z. cassumunar*, there is no work available in our country. The present study deals with the investigation of the chemical components in leaf and rhizome oils of *Z. cassumunar* grown in Bangladesh.

Materials and Methods

Plant material

The plant materials of *Z. cassumunar* were collected from the plants grown in the campus of BCSIR Laboratory, Chittagong during June 2007. One-voucher specimen (Y-694) was deposited in the herbarium of BCSIR Laboratory, Chittagong.

Extraction of essential oil

Samples of leaf was harvested from healthy, well-grown, two-year-old plants. Freshly leaf harvested samples (700 g) and the fresh rhizomes (600 or 73 g of dry rhizomes) was sliced into small pieces and ground in a blender. The material was subjected to hydrodistillation using a modified Clevenger-type glass apparatus for 4 hours for isolation of oils separately from the two parts. The oil samples were stored at 0°C in air-tight containers after drying them over anhydrous sodium sulfate, filtered and concentrated under reduced pressure at room temperature to obtain the essential oil for GC-MS analyses.

GC-MS analysis

The essential oil from leaf and rhizome of *Z. cassumunar* was 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 2.5 mm; 0.25 mm film thickness), coated with DB-1 (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 with those reported in literature, mass spectra of the peaks with literature data. Percentage composition was computed from GC peak areas on BP-I column without applying correction factors.

Results and Discussion

Essential oil from the leaf and rhizome of *Z. cassumunar* from Bangladesh were analyzed by GC-MS. The oil yields were 0.6 and 1.0% respectively. Table I reported the composition of the leaf and rhizome oil of *Z. cassumunar* from Bangladesh. According to GC-MS analysis under the conditions described above, sabinene was detected as the main component (15.0%) of the leaf essential oil. The remaining constituents, including b-pinene (14.3%), caryophyllene oxide (13.9%), caryophyllene (9.5%), g-pinene (6.3%), methyl p-methoxycinnamate (5.0%), triquinacene, 1,4, bis (methoxy) (3.8%) and camphene (3.6%), were present at low concentrations. The rhizome oil was rich in triquinacene,1,4-bis (methoxy) (26.5%), (Z)-ocimene (22.0%), terpinen-4-ol (18.5%), g-terpinene (3.9%), b-phellandrene (3.5%) and cis-sabinenehydrate (3.0%). A major part of the oil consists of monoterpenes with sabinene and terpinen-4-ol as main common constituents of all the reported oils in the world including ours (Taroeno et al., 1991; Oliveros, 1996; Pongprayoon et al., 1997). *Z. cassumunar* oil was found to contain sabinene and terpinen-4-ol as its major constituents, which are no doubt responsible for its antimicrobial activities (Giwanon et al., 2000; Wasuwat et al., 1989). The study reveals that composition of two oils differs from the earlier reports and may, therefore be treated as different chemotypes. On the basis of above fact it may be concluded that *Z. cassumunar*, growing widely in Bangladesh, may be utilized as a source for the isolation of natural sabinene and triquinacene, 1,4-bis (methoxy) respectively. In this study, the essential oil of *Z. cassumunar* has been extracted and its components identified. The high concentration of sabinene and triquinacene, 1,4-bis (methoxy) in leaf and rhizome oil makes it respectively potentially useful in the medicines because they exhibit antibacterial activities. However, further study has to be conducted.

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Table I

Constituents of essential oil from the leaf and rhizome of *Zingiber cassumunar*

SL. No.	Name of constituents in leaves	%	Name of constituents in rhizome	%
1	(-)Spathulenol	0.2	α-Thujene	0.7
2	(E)-Ocimene	1.2	α-Pinene	2.3
3	1.6.10-Dodecatriene, 7,11-dimethyl-3-methylene, (Z)	1.2	Camphene	0.4
4	3,4,5-Trimethoxybenzylchloride	0.1	(Z)-Ocimene	22.0
5	3-Cyclobexen-1-one, 3(hydroxymethyl)-6-(1-methylethyl)	0.2	β-Pinene	2.6
6	3-Cyclohexene-1-methanol	0.2	β-myrcene	1.6
7	Terpinen-4-ol	0.3	4-terpinyl acetate	2.1
8	5-Caranol, trans	0.1	m-Cymene	0.5
9	5-Nonaol,-5-methyl	0.2	β-Phellandrene	3.5
10	7-Hexadecenal	0.1	g-Terpinene	3.9
11	7-Oxabicyclo (2.2.1) hept-5-en-2-one	0.1	Cis-Sabinenehydrate	3.0
12	Apiol	1.4	2-Carene	0.8
13	Aromadendrene oxide	0.1	Borneol	0.2
14	Asaraldehyde	0.6	Terpinen-4-ol	18.6
15	β-Bisabolene	0.2	Terpinyl acetate	1.1
16	β-Elemene	0.2	Trans-Piperitol	0.3
17	Benzen-1-methyl, 4-(1-methylethyl)	0.6	Bornyl acetate	0.3
18	Bergamotol, z-a-trans	0.1	1,6,10-Dodecatrien,7,11-dimethyl-3-methylene (Z)	0.3
19	β-Linalool	0.4	Germacrene D	0.2
20	β-Myrcene	1.5	g-Selinene	0.3
21	Borneol	3.0	α-Selinene	0.1
22	Bornyl acetate	0.6	α-Bergamotene	0.4
23	β-Phellandrene	1.0	β-Bisabolene	0.1
24	β-Pinene	14.3	β-Sesquiphellandrene	2.5
25	β-Sesquiphellandrene	1.2	Methyleugenol	2.1
26	Camphene	3.6	Megastigmastriene	0.3
27	Caryophyllene	9.5	Lachnophyllum ester	0.6
28	Caryophyllene oxide	13.9	2-Allyl-1,4-dimethoxy-3-methyl benzene	1.7
29	Cedrene	0.4	Triquinacene,1,4-bis (methoxy)	26.5
30	Chamigrene	0.2	d-Cadinene	0.1
31	Cholestan-3-ol, 2-methylene-(3B,5L)	0.9	Juniper camphor	0.4
32	cis-Bicyclo (4.4.0) decan-1-ol-3-one	0.5	2-Propenoic acid, 3(4-methoxyphenyl), ethyl ester	0.3
33	Crypton	2.5		
34	Cubenol	0.1		
35	Cuminal	0.2		
36	Cuminol	0.2		
37	Curcumene	0.2		
38	Cyclohexanone, 3-ethenyl	0.2		
39	Cyclohexene, 5-methyl-3-(1-methylethenyl)	0.1		
40	Damascone	0.3		

Table I

Constituents of essential oil from the leaf and rhizome of *Zingiber cassumunar* (Continued)

SL. NO	Name of constituents in leaves	%	Name of constituents in rhizome	%
41	epi-13-Manool	0.1		
42	Eremophilene	0.1		
43	Isogeraniol	0.2		
44	Isolimonene	0.7		
45	Juniper camphor	0.4		
46	g-Caryophyllene	0.5		
47	g-Methylfuran	0.1		
48	Longipinocarvone	0.2		
49	g-Pinene	6.3		
50	Methyl p-methoxycinnamate	5.0		
51	Methylvanillin	0.6		
52	Myrtanal	0.1		
53	Ocimene	0.8		
54	Pentadecyne	0.5		
55	Phellandral	0.4		
56	Pinocarvone	0.1		
57	Pseudo Limonene	0.2		
58	Sabinene	15.0		
59	tau-Muurolol	0.2		
60	Tetracyclo [6.3.2.0(2.5),0(1,8)] tridecan-9-ol, 4,4-dimethyl	0.3		
61	trans-Nerolidol	0.3		
62	trans-Pinocarveol	0.3		
63	Triquinacene, 1,4, bis(methoxy)	3.8		
64	Triquinacene, 1,4,7-tris (methoxy)	0.8		

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