

ANALYSIS OF ESSENTIAL OILS OF LEAVES, STEMS, FLOWERS AND RHIZOMES OF *ETLINGERA ELATIOR* (JACK) R. M. SMITH

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Abstract

The essential oils from leaves, stems, flowers and rhizomes of *Etingera elatior*, an aromatic plant that are widely used in traditional medicine and as a flavour in local dishes were extracted. The essential oils were extracted using the hydrodistillation method and analysed by GC-MS. The percentage yield of volatile constituents of the leaves, stems, flowers and rhizomes were 0.0735%, 0.0029%, 0.0334% and 0.0021%, respectively. The leaf essential oil contained β -pinene (19.7%), caryophyllene (15.36%) and (*E*)- β -farnesene (27.90%) as major compounds whereas the stem essential oil were largely dominated by 1,1-dodecanediol diacetate (34.26%) and (*E*)-5-dodecane (26.99%). The essential oils of the flowers and rhizomes contained the major compounds 1,1- dodecanediol diacetate (24.38% and 40.37% respectively) and cyclododecane (47.28% and 34.45% respectively).

Abstrak

Minyak pati daripada daun, batang, bunga dan rizom *Etingera elatior*, tumbuhan beraroma yang digunakan secara meluas dalam perubatan tradisional dan sebagai perasa dalam masakan tempatan diekstrak. Minyak pati tersebut diekstrak menggunakan kaedah penyulingan hidro dan dianalisa menggunakan GC-MS. Peratusan minyak yang diekstrak daripada daun, batang, bunga dan rizom adalah masing-masing 0.0735%, 0.0029%, 0.0334% dan 0.0021%. Minyak pati daripada daun mengandungi β -pinena (19.7%), karyofilena (15.36%) dan (*E*)- β -farnesena (27.90%) sebagai sebatian utama manakala minyak pati daripada batang didominasi sebatian 1,1-dodekanadiol diasetat (34.26%) dan (*E*)-5-dodekana (26.99%). Minyak pati daripada bunga dan rizom mengandungi sebatian utama 1,1- dodekanadiol diasetat (masing-masing 24.38% dan 40.37%) dan siklododekana (masing-masing 47.28% dan 34.45%).

Introduction

Zingiberaceae species are represented throughout the tropical and subtropical regions mainly Asiatic in distribution. The Indo Malayan region is the centre of diversity for the Zingiberaceae. Of the 50 genera and 1500 species known in the world, at least 20 genera and 300 species are found in Malaysia [1]. *Etingera elatior* (Jack) R. M. Smith has had numerous generic designations through the years: *Alpinia*, *Phaeomorina*, *Nicolaia*, and *Elettaria* [2]. It is previously known as *Nicolaia speciosa* Horans or *Phaeomeria speciosa* Horans.. *Etingera elatior* (Jack) R. M. Smith is native to Sumatra, Indonesia and it has been found in many places throughout Southeast Asia. It is commonly known as 'kantan' among Malaysians. It is used traditionally as flavouring and medicine. These traditional uses may be explained by the presence of biologically active volatile constituents. There were several previous studies reported that *Etingera elatior* possess significant biological activities [1,3]. The study by Zoghbi et al. reported the major components identified in the oils of inflorescence and inflorescence axis of *Etingera elatior* from Brazil were dodecanol (42.5%, 34.6%), dodecanal (14.5%, 21.5%) and *a*-pinene (22.2%, 6.3%), respectively [4]. The aim of this study was to analyze the volatile constituents of essential oils of *Etingera elatior* (Jack) R. M. Smith from different parts of the plant namely leaves, stems, flowers and rhizomes by gas chromatography and mass spectrometry. The study of these essential oils may provide interesting raw material for the application of aromatherapy and flavour [5].

Experimental

Plant material

The fresh *Etingera elatior* (Jack) R. M. Smith was collected at Kampung Paya, Kepala Batas, Penang. The plant was identified by Mr Yeoh of University of Malaya and transported to Universiti Teknologi MARA research laboratory for essential oil extraction.

Hydrodistillation

1 kg of plant part were chopped into small pieces and subjected to hydrodistillation using the Clavenger apparatus for 4-5 hours [6]. The essential oils were isolated by extraction of the distillate with dichloromethane and its percentage yield was calculated.

GC-MS analysis

The essential oils were analyzed using GC-MS model Agilent 19091S-433 series: 70eV with capillary column (30m X 250 μ m X 0.25nm) at intermediate polarity. The carrier gas is Helium; the pressure is 8.71 psi, flow 1.0 m³/min, and average velocity 37 cm/s. The temperature of the column initially 60 °C (2 min hold) 60-120 °C (2 min hold) with temperature programming 3 °C/min and 120 – 270 °C (2 min hold) with temperature programming 2 °C/min and injection temperature of 250 °C.

The total ion chromatogram obtained was autointegrated by ChemStation and the constituents were identified by comparison with published mass spectra database (Wiley, 1990).

Results and Discussion

Percentage yield

The percentage yield of essential oils of leaves, stems, flowers and rhizomes were 0.0735%, 0.0029%, 0.0334% and 0.0021% respectively.

GC-MS analysis

A total of fifty one components were identified in the essential oils of the leaves, stems, flowers and rhizomes of *E. elatior*.

(*E*)- β -farnesene (27.90%), β -pinene (19.7%) and caryophyllene (15.36%) were the major compounds of the essential oil in the leaves of *E. elatior*. 1,1 dodecanediol diacetate (34.26%) and (*E*)-5 dodecane (26.99%) were the major compounds in the stem oil of *E. elatior* while 1,1-dodecanediol diacetate (24.38%, 40.37%) and cyclododecane (47.28%, 34.45%) were the major compounds in the essential oils of the flowers and rhizomes. Zoghbi et al. reported that *a*-pinene, dodecanol, dodecanal were the major compounds in the flower oil of *E. elatior* with 42.4%, 14.5 % and 22.2 % respectively [4].

a-Pinene, cyclododecane and 1,1-dodecanediol diacetate were identified in the essential oils of all parts of *E. elatior*. β -pinene, *a*-terpineol, *a*-caryophyllene, *trans*-nerolidol, caryophyllene and camphor were in the essential oils of all parts of *E. elatior* except rhizomes. 2, 3-dihydroxypropyl elaidate, (*Z*)-9-octadecenoic acid, 2, 3-dihydroxypropyl ester and oleic acid were present in the essential oils of all parts of *E. elatior* except the leaves.

Sesquiterpenes hydrocarbons dominated the essential oils of the leaves of *E. elatior* with 48.85% whereas oxygenated monoterpenes derivatives were the major type of compounds in the essential oils of the stems and rhizomes of *E. elatior* with 53.99% and 47.28% respectively. Monoterpenes hydrocarbons were the major type of compounds present in the essential oils of the flowers of *E. elatior* with 47.20%. The results were summarized in Table 1 and Figure 1. Figure 2 illustrates the chemical structures of several major compounds in the essential oils of *E. elatior*.

As a conclusion, major compounds in the essential oils depend on the part of plant studied. Overall, monoterpenes hydrocarbons present as major compounds in the essential oils of *E. elatior* (Jack) R. M. Smith.

Table 1. Chemical Composition of the Essential Oils of *E. elatior*

Chemical Compounds	Retention times	Percentage (%)			
		Leaves	Stems	Flowers	Rhizomes
Monoterpenes hydrocarbons					
<i>a</i> -Thujene	5.73	0.03	-	-	-
<i>a</i> -Pinene	5.93	6.00	1.55	6.30	0.51
Camphene	6.36	0.11	-	-	-
Sabinene	7.15	0.13	-	-	-
β -Pinene	7.26	19.17	0.35	0.10	-
β -Myrcene	7.73	2.49	-	-	-
<i>a</i> -Terpinolene	8.63	0.06	-	-	-
1,3,8- <i>p</i> -Menthatriene	8.98	0.04	-	-	-
<i>D</i> -Limonene	9.09	-	-	0.33	-
<i>a</i> -Terpinene	10.25	0.15	-	-	-
(<i>E</i>)-5-dodecene	29.52	-	26.99	-	-
1,2-dimethylcyclooctane	30.29	-	1.53	-	-
Cyclododecane	36.70	1.57	3.23	40.32	34.45
Total		29.75	33.65	47.05	34.96
Oxygenated monoterpene derivatives					
Eucaplytol	9.12	3.85	0.84	-	-
2-ethyl fenchol	12.65	0.27	-	-	-
Camphor	13.74	0.12	0.33	0.15	-
Borneol	15.04	4.24	-	-	-
Dihydrocavreol	15.34	0.55	-	-	-
<i>a</i> -Terpineol	16.03	1.84	1.71	0.58	-
Decanal	16.53	-	16.53	3.62	-
Formic acid, decyl ester	19.85	-	-	1.31	-
2-Undecanone	20.39	-	0.65	0.79	-
1,1-dodecanediol, diacetate	25.81	1.45	34.26	24.38	47.28
Total		12.32	54.32	30.83	47.28
Sesquiterpene hydrocarbons					
Copaene	23.75	-	0.61	-	-
β -Elemene	24.78	0.34	-	-	-
9-Octadecenal	25.18	-	-	0.45	-
1-Cyclohexylnonene	25.18	-	0.69	-	-
Caryophyllene	26.14	15.36	6.60	4.45	-
<i>a</i> -Caryophyllene	27.90	1.46	0.42	0.27	-
(<i>Z</i>)- β -Farnesene	28.24	-	0.51	0.30	-
(<i>E</i>)- β -Farnesene	28.36	27.90	-	-	-
(<i>Z</i>)-3-Hexadecene	30.46	-	-	3.72	-
(+)- <i>d</i> -Cadinene	31.73	-	1.10	-	-
1,13-Tetradecadiene	40.44	-	-	0.72	-
1-Heptadecene	94.50	-	-	0.04	-
Total		45.06	9.93	9.95	-
Oxygenated sesquiterpenes derivatives					
Dodecamethyl cyclohexasiloxane	21.64	-	0.14	0.11	-
<i>Trans</i> nerolidol	34.23	0.68	1.57	0.80	-
Caryophyllene oxide	34.84	-	1.08	-	-
1-Hexadecanol	41.06	-	1.06	-	-
Total		0.68	3.85	0.91	-
Miscellaneous compounds					
(<i>E</i>)-2-Hexenal	30.46	-	-	4.37	-
Eicosane	69.44	-	0.32	-	-
Heptadecyl oxirane	74.26	-	0.64	-	-
Dodecanoic acid, tetradecyl ester	80.05	-	-	0.44	-
Elaidic acid	86.82	-	-	0.43	-
Octadec-9-enoic acid	95.25	0.16	-	-	-
2,3-dihydroxypropyl octadec-9-enoate (glyceryl palmitoleate)	97.22	-	0.24	0.04	0.45
Oleic acid	97.50	-	0.31	0.25	0.52
Glyceryl monooleate	99.33	-	0.24	0.05	0.12
Total		0.16	1.75	5.58	1.09

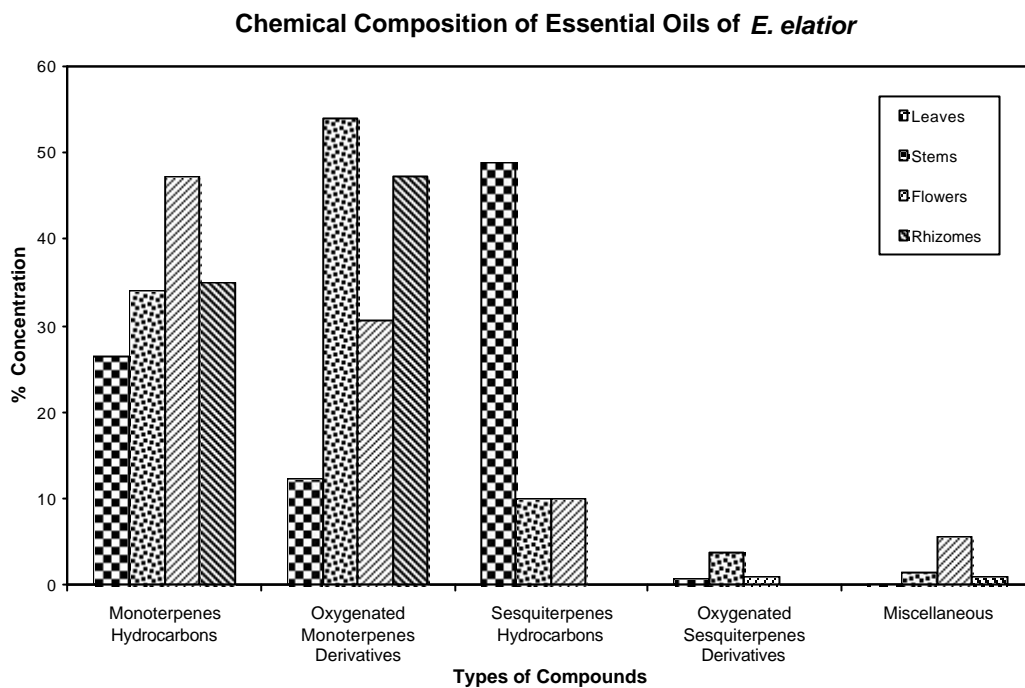


Figure 1. Chemical Composition of the Essential Oils of *E. elatior* (Jack) R. M. Smith

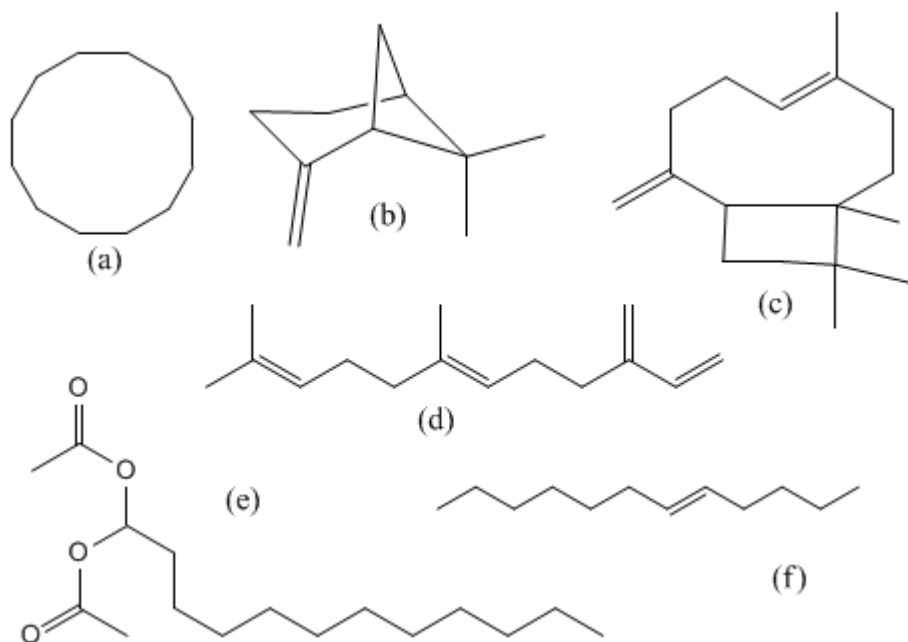


Figure 2: The Major Chemical Constituents of the Essential Oils of *E. elatior* (a) Cyclododecane, (b) β -Pinene, (c) Caryophyllene, (d) (E)- β -Farnesene, (e) 1,1-dodecandiyl diacetate and (f) (E)-5-Dodecene

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