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RESEARCH ARTICLE

Chemical composition of the essential oil of *Dysoxylum cauliflorum* Hiern (Meliaceae)

Wan Mohd Nuzul Hakimi Wan Salleh[1,*] Shamsul Khamis[2] and Alene Tawang[3]

[1]Department of Chemistry, Faculty of Science and Mathematics, Universiti Pendidikan Sultan Idris, 35900 Tanjung Malim, Perak, MALAYSIA
[2]School of Environmental and Natural Sciences, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, MALAYSIA
[3]Department of Biology, Faculty of Science and Mathematics, Universiti Pendidikan Sultan Idris, 35900 Tanjung Malim, Perak, MALAYSIA

*Corresponding author. Email: wmnhakimi@fsmt.upsi.edu.my

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Abstract

This study was designed to examine the chemical compositions of essential oils from *Dysoxylum cauliflorum* Hiern (Meliaceae). The essential oil was obtained by hydrodistillation and fully characterized by gas chromatography (GC-FID) and gas chromatography-mass spectrometry (GC-MS). Analysis of the essential oil resulted in the identification of 24 components, accounting for 90.4% of the total oil. The major components were δ-cadinene (28.2%), germacrene D (16.0%), β-caryophyllene (12.1%), caryophyllene oxide (5.5%), and globulol (4.2%).

Keywords: Meliaceae, *Dysoxylum cauliflorum*, essential oil, hydrodistillation, δ-cadinene

Introduction

The genus *Dysoxylum* (family Meliaceae), comprising about 80 species, is mainly distributed in tropical Asia, tropical and subtropical Australia, and Pacific Islands. Most species are trees with commercial values, many of them are widely used in timber industries for building construction, boxes, turnery, and ply-board (Sasidharan, 2004). In addition, many species in this genus have applications in folk medicine for the treatment of fever, rigid limbs, convulsions, haemorrhage, and facial distortion in children in some areas of Southeast Asia (Peng et al., 2008). *Dysoxylum cauliflorum* commonly known as *dedali*, *langga ayer* and *pokok parong* in Peninsular Malaysia, is distributed throughout Vietnam, Cambodia, Thailand, Peninsular Malaysia, Sumatra, Borneo, and the Philippines. It is found scattered and is rarely common, occurs up to 2000 m altitude in evergreen or rarely semi-deciduous, primary or sometimes secondary forest and re-growth (Perry and Metzger, 1980). It is characterized as a medium-sized tree up to 30 m tall and 50 cm in diameter. The grey bark is smooth and lenticellate, while the leaves are imparipinnate and consist of 5 to 6 pairs of leaflets. The flowers are intensely fragrant of almonds and musk. The fruits are solitary or in the cluster, ovoid, and glabrous (Ma et al., 2018). A poultice made from its fruit is used to treat rheumatism, whereas a poultice from the root is effective against abdominal pains (Cragg et al., 2006). Phytochemical investigation on the extract of *D. cauliflorum* revealed the isolation of triterpenes, diterpenes, steroids, alkaloids, limonoids (Benosman et al., 2000; Zhou et al., 2015; Kumar et al., 2017; Wang et al., 2020) and shown antioxidant, cytoprotective, immunomodulatory, and antiplasmodial activities (Ting et al., 2011; Sofian et al., 2018). The literature search did not reveal any report on the essential oil composition of this species. As a continuation part of our systematic evaluation of the aromatic flora of Malaysia (Salleh et al., 2014a, 2014b, 2014c, 2015a, 2015b, 2015c, 2016a, 2016b, 2016c), we here report on the volatile components of *S. axillaris* leaves.

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Materials and Methods

Plant material

Sample of *Dysoxylum cauliflorum* was collected from Gambang, Pahang in September 2019, and identified by Dr. Shamsul Khamis from Universiti Kebangsaan Malaysia (UKM). The voucher specimen (SK134/19) was deposited at UKMB Herbarium, Faculty of Science and Technology UKM.

Isolation and analysis of essential oil

The fresh leaf (250 g) was subjected to hydrodistillation in Clevenger-type apparatus for 4 hours. The essential oil obtained was dried over anhydrous magnesium sulfate and stored at 4-6°C. Gas chromatography (GC-FID) analysis was performed on an Agilent Technologies 7890B equipped with HP-5MS capillary column (30 m long, 0.25 µm thickness and 0.25 mm inner diameter). Helium was used as a carrier gas at a flow rate of 0.7 mL/min. Injector and detector temperatures were set at 250 and 280°C, respectively. The oven temperature was kept at 50°C, then gradually raised to 280°C at 5°C/min and finally held isothermally for 15 min. Diluted samples (1/100 in diethyl ether, v/v) of 1.0 µL were injected manually (split ratio 50:1). The injection was repeated three times and the peak area percent were reported as means ± SD of triplicates. Gas chromatography-mass spectrometry (GC-MS) analysis was recorded using a Hewlett Packard Model 5890A gas chromatography and a Hewlett Packard Model 5989A mass spectrometer. The GC was equipped with an HP-5 column. Helium was used as carrier gas at a flow rate of 1 mL/min. The injector temperature was 250°C. The oven temperature was programmed from 50°C (5 min hold) to 280°C at 10°C/min and finally held isothermally for 15 min. For GC-MS detection, an electron ionization system, with an ionization energy of 70 eV was used. A scan rate of 0.5 s (cycle time: 0.2 s) was applied, covering a mass range from 50-400 amu.

Identification of components

For identification of essential oil components, co-injection with the standards (major components) were used, together with correspondence of retention indices and mass spectra with respect to those reported in Adams (2007). Semi-quantification of essential oil components was made by peak area normalization considering the same response factor for all volatile components. Percentage values were the mean of three chromatographic analyses.

Results and Discussion

The essential oil had yielded 0.18% calculated from the fresh weight of the leaves. The identified essential oil components with their percentages are listed in order of their elution from the HP-5 column in Table 1. The GC and GC-MS analysis (Figure 1) of the essential oil revealed the presence of twenty-four chemical components, accounting for 90.4% of the total composition, and grouped into four classes, namely; monoterpene hydrocarbons, oxygenated monoterpenes, sesquiterpene hydrocarbons, and oxygenated sesquiterpenes. The essential oil was characterized by sesquiterpene hydrocarbons which constituted of twelve components, accounting for 66.3% of the total composition. Meanwhile, oxygenated sesquiterpenes, oxygenated monoterpenes, and monoterpene hydrocarbons were present in substantial amounts which accounting for 13.9%, 7.0%, and 3.2% of the total composition. The most abundant components presented in the essential oil were δ-cadinene (28.2%), germacrene D (16.0%), β-caryophyllene (12.1%), caryophyllene oxide (5.5%), and globulol (4.2%). The other minor components detected in the essential oil in more than 2% were linalool (2.1%), terpinen-4-ol (2.4%), α-terpineol (2.5%), δ-elemene (2.0%), and bicyclogermacrene (2.5%).

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Table 1. Chemical composition of *Dysoxylum cauliflorum* essential oil

No	RRI[a]	RRI[b]	Components	Percentage[c]	Identifications[d]
1	945	946	Camphene	1.5 ± 0.1	RI, MS
2	967	965	Sabinene	1.2 ± 0.2	RI, MS
3	984	985	Myrcene	0.5 ± 0.2	RI, MS
4	1082	1082	Linalool	2.1 ± 0.2	RI, MS
5	1149	1150	Terpinen-4-ol	2.4 ± 0.2	RI, MS
6	1185	1189	α-Terpineol	2.5 ± 0.2	RI, MS
7	1374	1374	α-Copaene	0.2 ± 0.1	RI, MS
8	1386	1385	δ-Elemene	2.0 ± 0.2	RI, MS
9	1409	1405	α-Cedrene	0.8 ± 0.2	RI, MS
10	1425	1420	β-Caryophyllene	12.1 ± 0.2	RI, MS, Std
11	1455	1453	α-Humulene	0.4 ± 0.1	RI, MS
12	1458	1458	Aromadendrene	1.6 ± 0.2	RI, MS
13	1478	1480	Germacrene D	16.0 ± 0.1	RI, MS, Std
14	1495	1495	Cadina-1,4-diene	0.5 ± 0.2	RI, MS
15	1500	1501	Bicyclogermacrene	2.5 ± 0.2	RI, MS
16	1502	1500	α-Muurolene	1.6 ± 0.1	RI, MS
17	1505	1505	*cis*-Calamenene	0.4 ± 0.2	RI, MS
18	1529	1530	δ-Cadinene	28.2 ± 0.2	RI, MS, Std
19	1570	1570	Globulol	4.2 ± 0.2	RI, MS
20	1580	1582	Caryophyllene oxide	5.5 ± 0.2	RI, MS
21	1592	1595	Viridiflorol	0.4 ± 0.2	RI, MS
22	1635	1635	t-Muurolol	0.6 ± 0.2	RI, MS
23	1640	1640	τ-Cadinol	1.8 ± 0.1	RI, MS
24	1652	1650	α-Cadinol	1.4 ± 0.2	RI, MS
			Monoterpene hydrocarbons	3.2 ± 0.1	
			Oxygenated monoterpenes	7.0 ± 0.1	
			Sesquiterpene hydrocarbons	66.3 ± 0.2	
			Oxygenated sesquiterpenes	13.9 ± 0.2	
			Total identified	90.4 ± 0.2	

[a]Linear retention index, experimentally determined using homologous series of C_6-C_{30} alkanes. [b]Linear retention index taken from Adams (2007). [c]Relative percentage values are means of three determinations ±SD. [d]Identification methods: Std, based on comparison with authentic compounds; MS, based on comparison with Wiley, Adams, FFNSC2, and NIST08 MS databases; RI, based on comparison of calculated RI with those reported in Adams, FFNSC2 and NIST08.

A review of the existing literature on essential oils of the genus *Dysoxylum* revealed the presence of three studies from *D. malabaricum* (Mohan et al., 2010), *D. richii* (William et al., 1991), and *D. binectariferum* (Parcha et al., 2004). This study revealed that δ-cadinene and germacrene D were also shown to be the principal sesquiterpene components of the fruit's oil of *D. richii* which constituted 20.4% and 16.6%, respectively (William et al., 1991). Meanwhile, the wood oil of *D. malabaricum* gave α-muurolene (11.75%), whereas the leaf oil of *D. binectariferum* gave caryophyllene (18.73%) as the major component, which have also been identified in this study. Chemical differences in the essential oil composition of plant species concerning their geographical origins and harvesting season have been reported showing that the chemical and biological diversity of aromatic and medicinal plants depend on factors such as cultivation area, climatic conditions, vegetation phase, and genetic modifications. In fact, these factors influence the plant's

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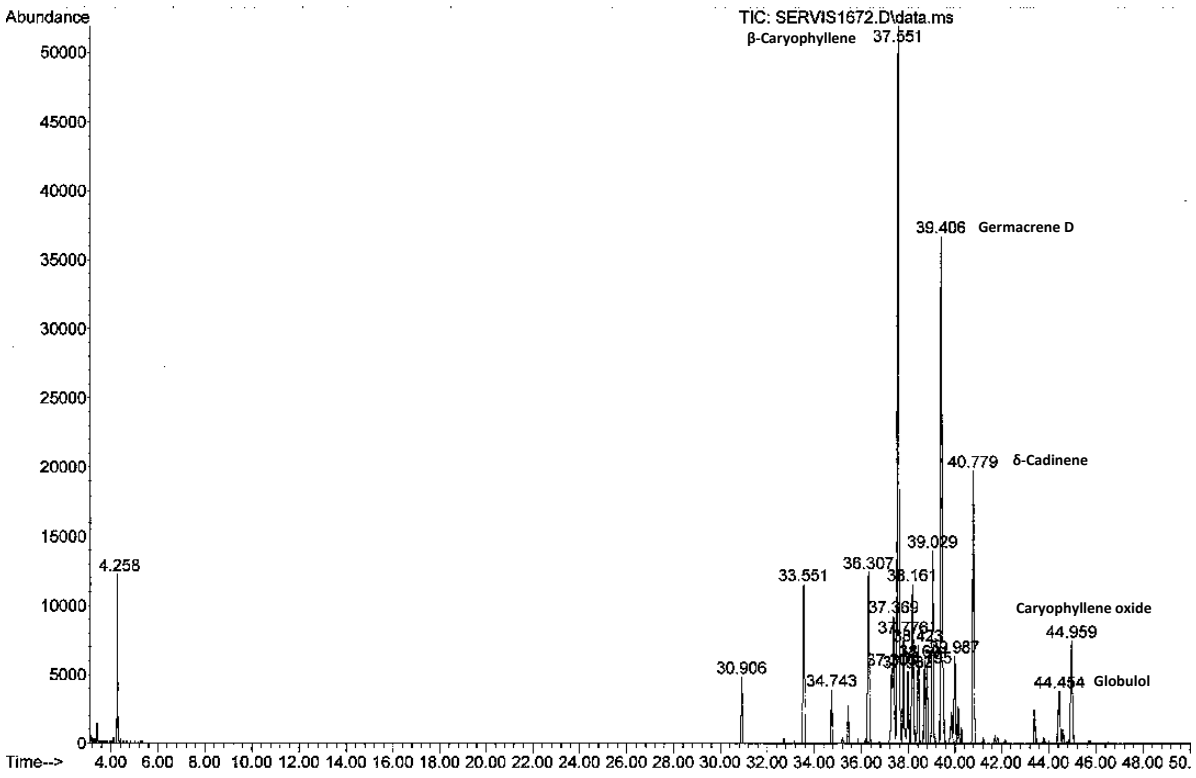
biosynthetic pathways and consequently, the relative proportion of the main characteristic components (Salleh et al., 2016).

Figure 1. TIC chromatogram of *Dysoxylum cauliflorum* essential oil



In conclusion, this is the first report of the chemical composition of the essential oil from *Dysoxylum cauliflorum.* These results may shed light on the phytochemistry of this unexplored species of the Flora of Malaysia. The second step will be to evaluate the biological activities of the essential oil in order to valorize this species with a special ecological character.

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CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

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