

RESEARCH ARTICLE

Essential oil composition of *Strychnos axillaris* Colebr. (Loganiaceae)

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Abstract

The essential oil composition from the leaves of *Strychnos axillaris* Colebr. (Loganiaceae) growing in Malaysia was examined for the first time. The essential oil was obtained by hydrodistillation and fully characterized by gas chromatography (GC-FID) and gas chromatography-mass spectrometry (GC-MS). In total, 15 components were identified in the essential oil, which made up 87.2% of the total oil. The essential is composed mainly of α -ionone (20.2%), β -ionone (19.5%), bicyclogermacrene (19.2%), and geranyl acetate (10.2%).

Keywords: Loganiaceae, *Strychnos axillaris*, essential oil, ionone, GC-MS

Introduction

The Loganiaceae is a pantropical angiosperm family in the order Gentianales consisting of 16 genera and approximately 460 species, distributed in all tropical areas of the world, as well as reaching some subtropical areas (Francis and Suseem, 2016). The genus *Strychnos*, the largest genus of the family Loganiaceae, as tropical woody plants, consists of about 394 species. Meanwhile, 25 species occur in the Malaysian region. The flowers are small and usually white or creamy white in colour (Bisset, 1974). Several are important sources of drugs or poisons: strychnine, from the seeds of *S. nux-vomica* and other species; and curare, from the bark of *S. toxifera* and other species (Bisset and Phillipson, 1976). *Strychnos* was already being used medicinally in China in the 14th Century. It has been prescribed as a stomachic, febrifuge, vermifuge, anticholeric and tonic and to treat sores, wounds, eczema and snake bites in Indonesia and the Philippines. In India, the seeds have been used to obstinate vomiting, to treat cholera, diarrhoea, asthma, dropsy, rheumatism, paralytic and neuralgic affections. In Australia, the fruit pulp of *S. lucida* has been used to treat a variety of skin complaints. *S. wallichiana* is used in Vietnam to treat rabies, leprosy, and as an aphrodisiac (Guo et al., 2018; Patel et al., 2017). *S. axillaris* is commonly known as *gajah tarik* in Malaysia. It grows naturally in woodlands, mixed forests, deciduous woodlands and lowlands. It has been used in Peninsular Malaysia in the preparation of arrow poison; its leaves have been used in India as a suppurative and the seeds internally as a febrifuge (Valadeau, 2010). The chemical analyses of *S. axillaris* revealed the presence of phenolic and iridoid glucosides (Itoh et al., 2008). Meanwhile, *S. axillaris* has not been previously studied for its essential oil. As a continuation part of our systematic evaluation of the aromatic flora of Malaysia (Salleh et al., 2014a, 2014b, 2014c, 2015, 2016a, 2016b, 2016c), we here report the volatile components of *S. axillaris* leaves.

Materials and Methods

Plant material

Sample of *Strychnos axillaris* was collected from Gambang, Pahang in September 2019, and identified by Dr. Shamsul Khamis from Universiti Kebangsaan Malaysia (UKM). The voucher specimen (SK22/18) was deposited at UKMB Herbarium, Faculty of Science and Technology UKM.

Isolation and analysis of essential oil

The fresh leaf (340 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 μ m 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 μ L were injected manually (split ratio 50:1). The injection was repeated three times and the peak area percent were reported as means \pm 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 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 list of chemical components identified in the essential oil is shown in Table 1. The essential oil yielded 0.17% calculated from the fresh weight of the leaves. The GC-FID (Figure 1) and GC-MS analysis of the essential oil revealed the presence of 15 chemical components with the composition of 87.2%. The main fractions in the essential oil were sesquiterpene hydrocarbons (58.9%), followed by oxygenated monoterpenes (19.5%). The most abundant components of the essential oil were α -ionone (20.2%), β -ionone (19.5%), bicyclogermacrene (19.2%), and geranyl acetate (10.2%). The other minor components detected in the essential oil in more than 2% were nerol (2.5%), α -terpineol (2.4%), (*E*)-nerolidol (2.4%), linalool (2.2%), geraniol (2.2%) and eugenol (2.0%). On the other hand, monoterpene hydrocarbons and oxygenated sesquiterpenes made up a minor fraction in the oil which constituted 1.3% and 2.4% of the total oil, respectively. The genus *Strychnos* is still poorly explored as far as its essential oil composition is concerned. A review of the existing literature on essential oils of the genus *Strychnos* revealed the presence of few studies reporting from *S. spinosa* (Hoet et al., 2006) and *S. cocculoides* (Shoko et al., 2013). In comparison to

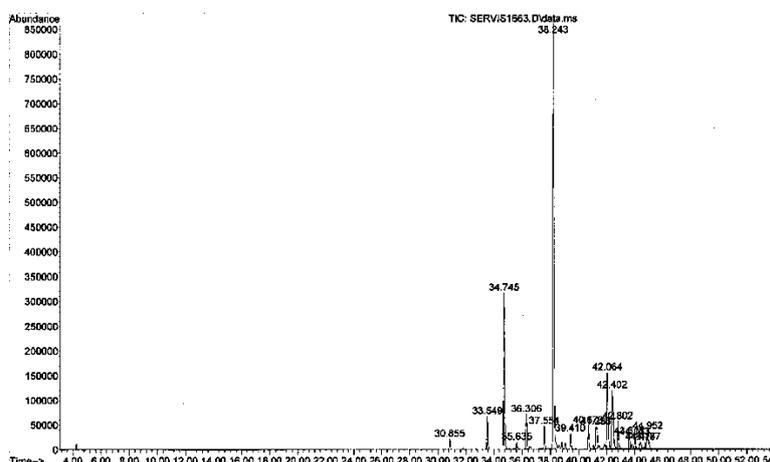
both studies, the leaf oil of *S. spinosa* was reported to show high amounts of palmitic acid (34.3%), whereas the fruit oil of *S. cocculoides* gave isobutyl acetate (53.2%) as the major component. However, these two components were not detected in the essential oil studied. The differences of the essential oil composition could be due to the different environmental and genetic factors, chemotypes and nutritional status of the plants, which may influence the oil composition (Salleh et al., 2016a).

Table 1. Chemical composition of *Strychnos axillaris* essential oil

No.	RRI ^a	RRI ^b	Components	Percentage ^c	Identifications ^d
1	1014	1015	α -Terpinene	0.5 \pm 0.1	RI, MS
2	1025	1029	Limonene	0.8 \pm 0.1	RI, MS
3	1095	1097	Linalool	2.2 \pm 0.2	RI, MS
4	1185	1189	α -Terpineol	2.4 \pm 0.2	RI, MS
5	1240	1245	Nerol	2.5 \pm 0.1	RI, MS
6	1271	1270	Geraniol	2.2 \pm 0.2	RI, MS
7	1374	1375	Eugenol	2.0 \pm 0.1	RI, MS
8	1435	1435	α -Ionone	20.2 \pm 0.1	RI, MS, Std
9	1497	1495	β -Ionone	19.5 \pm 0.1	RI, MS, Std
10	1529	1530	Bicyclogermacrene	19.2 \pm 0.2	RI, MS, Std
11	1563	1565	(<i>E</i>)-Nerolidol	2.4 \pm 0.2	RI, MS
12	1700	1700	Heptadecane	0.5 \pm 0.1	RI, MS
13	1720	1722	Dodecanal	1.1 \pm 0.1	RI, MS
14	1758	1755	Geranyl acetate	10.2 \pm 0.1	RI, MS
15	1945	1940	Phytol	1.5 \pm 0.2	RI, MS
Phenylpropanoid				2.0 \pm 0.1	
Monoterpene hydrocarbons				1.3 \pm 0.1	
Oxygenated monoterpenes				19.5 \pm 0.2	
Sesquiterpene hydrocarbons				58.9 \pm 0.2	
Oxygenated sesquiterpenes				2.4 \pm 0.1	
Others				3.1 \pm 0.1	
Total identified				87.2 \pm 0.1	

^aLinear retention index, experimentally determined using homologous series of C₆-C₃₀ alkanes. ^bLinear retention index taken from Adams (2007). ^cRelative percentage values are means of three determinations \pm SD. ^dIdentification 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.

Figure 1. GC chromatogram of *Strychnos axillaris* essential oil



The presence of α - and β -ionone in the oil could be used as a chemotaxonomic marker for this species. These compounds are extensively used as ingredients and building blocks in flavors and fragrances, as well as in the pharmaceutical industry (Lalko et al., 2007). Ionones and their derivatives are also known to possess important pharmacological properties, such as antileishmanial, anti-inflammatory, and antimicrobial activities (dos Santos Costa et al., 2007). In addition, recent studies have demonstrated the great potential of ionone derivatives as anticancer agents (Ansari and Emami, 2016). In conclusion, this is the first report of the chemical composition of the essential oil from *Strychnos axillaris* and the results of this study could contribute to the valorisation of this Malaysian aromatic and medicinal plant.

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CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

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