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Chemical composition of *Premna serratifolia* L. leaf essential oil growing in Vietnam

Thành phần hóa học tinh dầu lá của *Premna serratifolia* L. ở Việt Nam

Le Thi Mai Hoa[a], Vu Thi Hien[b], Vo Thanh Thuong[c], Le Thi Thanh Truc[c], Nguyen Thi Thu[c], Prabodh Satyal[d], Bui Van Nguyen[e], Nguyen Huy Hung[f*], William N. Setzer[g]
Lê Thị Mai Hoa[a], Vũ Thị Hiền[b], Võ Thanh Thương[c], Lê Thị Thanh Trúc[c], Nguyễn Thị Thu[c], Prabodh Satyal[d], Bùi Văn Nguyên[e], Nguyễn Huy Hùng[f], William N. Setzer[g]

[a]*Faculty of Pharmacy, Vinh Medical University, 161 Nguyen Phong Sac, Vinh, 461150, Vietnam*
[a]*Khoa Dược, Đại học Y Khoa Vinh, số 161 Nguyễn Phong Sắc, Vinh, 461150, Việt Nam*
[b]*Faculty of Hydrometeorology, Ho Chi Minh City University of Natural Resources and Environment, Ho Chi Minh City 700000, Vietnam*
[b]*Khoa Khí tượng, Đại học Tài nguyên và Môi trường Thành phố Hồ Chí Minh, Thành phố Hồ Chí Minh, 700000, Việt Nam*
[c]*Department of Pharmacy, Duy Tan University, Da Nang, 550000, Vietnam*
[c]*Khoa Dược, Trường Y - Dược, Trường Đại học Duy Tân, Đà Nẵng, 550000, Việt Nam*
[d]*Aromatic Plant Research Center, 230 N 1200 E, Suite 100, Lehi, UT 84043, USA*
[d]*Trung tâm Nghiên cứu Thực vật thơm, 230 N 1200 E, Suite 100, Lehi, UT 84043, Mỹ*
[e]*University of Khanh Hoa, 01 Nguyen Chanh, Nha Trang, Khanh Hoa, 650000, Viet Nam*
[e]*Đại học Khánh Hòa, số 01 Nguyễn Chánh, Nha Trang, Khánh Hòa, 650000, Việt Nam*
[f]*Center for Advanced Chemistry, Institute of Research and Development, Duy Tan University, Da Nang, 550000, Vietnam*
[f]*Trung tâm Hóa Tiên tiến, Viện Nghiên cứu và Phát triển, Trường Đại học Duy Tân, Đà Nẵng, 550000, Việt Nam*
[g]*Department of Chemistry, University of Alabama in Huntsville, Huntsville, AL 35899, USA*
[g]*Khoa Hóa học, Đại học Alabama tại Huntsville, Huntsville, AL 35899, Mỹ*

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Abstract

The essential oil extracted from the leaves of *Premna serratifolia* underwent hydrodistillation using a Clevenger-type apparatus and was subsequently subjected to analysis through gas chromatography coupled with mass spectrometry (GC/MS). The predominant compounds in the essential oil were those with sesquiterpene skeletons, in both hydrocarbon and oxygenated forms. Notable constituents included caryophyllene oxide, accounting for 23.4% of the oil, (*E*)-β-caryophyllene at 15.5%, as well as phytol (6.9%), α-copaene (5.5%), and δ-cadinene (4.4%).

Keywords: Lamiaceae; sesquiterpenoids; caryophyllene oxide; β-caryophyllene.

[*]*Corresponding author:* Nguyen Huy Hung
Email: nguyenhuyhung@duytan.edu.vn

Tóm tắt

Tinh dầu được chiết xuất từ lá *Premna serratifolia* trải qua quá trình chưng cất thủy phân bằng thiết bị loại Clevenger và sau đó được phân tích thông qua sắc ký khí kết hợp với phép đo phổ khối (GC/MS). Các hợp chất chiếm ưu thế trong tinh dầu là những hợp chất sesquiterpene, ở cả dạng hydrocarbon và oxy hóa. Thành phần chính bao gồm caryophyllene oxit, chiếm 23,4% trong dầu, (*E*)-β-caryophyllene ở mức 15,5%, cũng như phytol (6,9%), α-copaene (5,5%) và δ-cadinene (4,4%).

Từ khóa: Lamiaceae; sesquiterpene; caryophyllene oxide; β-caryophyllene.

1. Introduction

Premna serratifolia L. (Syn. *Premna integrifolia* Linn.) is a tree, 2-7 meters tall. Leaves are oval-shaped, base nearly heart-shaped and often asymmetrical, upper surface hairless, underside sparsely hairy, five-veined. The inflorescence is at the top of the branch, panicle form with many small white flowers. The fruits are 3-4 mm wide, black when ripe [14]. The tree grows in tropical to subtropical coastal regions including Asia, Africa, Australia and the Pacific [9]. Some morphological features, such as leaf shape and size, and inflorescence size and calyx form, vary over different geographical distribution areas [9,19].

The plant grows wild or is grown as a spice. The plant is used in Vietnamese traditional medicine for purposes such as good remedy for urination, increasing lactation for women, treating dysentery, good use for digestion and treating rheumatism [14]. In addition, the leaves of this species have been used as a spice in many dishes.

The composition of the non-volatile compounds of P. serratifolia has been previously published and includes lignans [23-26], iridoids [12,13], flavonoids [4], steroid [6], triterpenoids [4,6], alkaloids [8], and diterpenoids [11, 27, 28].

The objective of this research is to identify the chemical composition of essential oil found in *P. serratifolia* leaves, with the aim of enhancing our understanding of its utility. This investigation is an integral component of a broader exploration into the chemical constituents of essential oils derived from indigenous *Premna* species in Vietnam.

2. Materials and methods

2.1. Plant material

Fresh leaves of *P. serratifolia* were gathered from a coastal area on the Son Tra Peninsula in Da Nang City in September 2019 (coordinates: 16° 05′ 53″ N, 108° 16′ 01″ E, elevation 4 meters). Dr. Do Ngoc Dai verified the tree's identity. The freshly collected plant material was stored at a laboratory temperature of 25°C, and a fan was employed to facilitate water evaporation, thereby preventing alterations in the chemical composition of the essential oils. Four kilograms of freshly harvested leaves were finely chopped and subjected to hydrodistillation over a five-hour period, utilizing a Clevenger-type apparatus. This process yielded an essential oil with an extraction efficiency of 0.02%. The resulting essential oil was subsequently dehydrated using sodium sulfate (Na_2SO_4) and then carefully stored in sealed glass vials at a temperature of 4°C.

2.2. Gas chromatography / mass spectrometry (GC/MS)

Gas chromatographic- mass spectral analyses was carried out using a Shimadzu GCMS-QP2010 Ultra instrument in electron impact (EI) mode, where the electron energy was set at 70 eV. The scan range spanned from 40 to 400 atomic mass units, acquiring data at a rate of 3.0 scans per second [16]. The GC column applied in this study was a ZB-5ms fused silica capillary column provided by Phenomenex, Torrance,

CA, USA, featuring a stationary phase of (5% phenyl)-polymethylsiloxane and a film thickness of 0.25 µm. Helium served as the carrier gas, with a column head pressure set at 552 kPa and a flow rate of 1.37 mL/min. The injector and ion source were maintained at a constant temperature of 260 °C. For the GC oven temperature program, the initial temperature was established at 50 °C, with a subsequent linear increase at a rate of 2 °C per minute until it reached 260 °C. To facilitate the analysis, the essential oil was dissolved in CH_2Cl_2 to create a 5% solution, from which 0.1 µL was introduced into the system utilizing a 30:1 split ratio. Compound identification was executed based on retention index and mass spectral fragmentation patterns, with comparisons to established databases [1, 10, 20, 22].

3. Results and discussion

GC/MS analysis identified 68 compounds from leaf essential oil of *P. serratifolia*, accounting for 93.7% of the total components. Sesquiterpene compounds were dominant in essential oils. The main ingredients include caryophyllene oxide (23.4%), (*E*)-β-caryophyllene (15.5%) along with phytol (6.9%), α-copaene (5.5%) and δ-cadinene (4.4%) (Table 1).

Al-Reza et al. (2016) [3] and Rahman et al. (2016) [21] reported the chemical composition from Premna integrifolia Linn leaves collected in Bangladesh. Both articles reported the same results, according to which the main chemical components included phytol, α-humulene, spathulenol (27.3, 14.2, 12.1%, respectively), and were followed by ingredients such as 1-octen-3-ol (8.2%), eugenol (6.7%), and phenylethyl alcohol (5.8%). In addition to differences in geographical origin, both the timing of plant sampling and the use of gas chromatography columns vary.

Table 1. Chemical composition of *Premna serratifolia* essential oil

RI_{calc}	RI_{db}	Compound	%
934	932	α-Pinene	0.2
950	950	Camphene	0.1
972	971	Sabinene	0.1
978	978	β-Pinene	0.3
989	989	Myrcene	0.1
1025	1025	*p*-Cymene	0.3
1029	1030	Limonene	0.9
1031	1031	β-Phellandrene	tr
1032	1032	1,8-Cineole	0.1
1035	1034	(*Z*)-β-Ocimene	tr
1046	1045	(*E*)-β-Ocimene	0.1
1099	1101	Linalool	0.3
1180	1180	Terpinen-4-ol	0.1
1195	1195	α-Terpineol	tr
1283	1282	Bornyl acetate	0.1
1288	1287	Dihydroedulan IA	tr
1294	1294	Dihydroedulan IIA	0.2
1346	1349	α-Terpinyl acetate	0.1
1347	1348	α-Cubebene	0.1

1376	1377	α-Copaene	5.5
1378	1379	(*E*)-β-Damascenone	0.1
1382	1383	*cis*-β-Elemene	0.1
1384	1382	β-Bourbonene	0.2
1388	1387	7-*epi*-Sesquithujene	0.3
1390	1390	*trans*-β-Elemene	1.7
1402	1405	Sesquithujene	0.2
1405	1405	(*Z*)-β-Caryophyllene	0.2
1407	1406	α-Gurjunene	0.3
1420	1417	(*E*)-β-Caryophyllene	15.5
1429	1427	γ-Elemene	0.2
1433	1433	*trans*-α-Bergamotene	0.6
1435	1436	α-Guaiene	0.2
1438	1438	Aromadendrene	0.4
1452	1452	(*E*)-β-Farnesene	0.3
1456	1455	α-Humulene	3.5
1460	1457	*allo*-Aromadendrene	2.3
1475	1478	γ-Muurolene	0.4
1481	1480	*ar*-Curcumene	1.6
1488	1491	Eremophilene	1.1
1490	1492	β-Selinene	1.1
1497	1497	α-Selinene	0.5
1499	1500	α-Muurolene	0.3
1502	1505	α-Bulnesene	0.1
1508	1508	β-Bisabolene	1.8
1513	1512	γ-Cadinene	0.4
1518	1518	δ-Cadinene	4.4
1521	1519	*trans*-Calamenene	0.3
1541	1541	α-Calacorene	1.1
1561	1560	(*E*)-Nerolidol	1.5
1562	1560	β-Calacorene	0.8
1577	1576	Spathulenol	1.1
1586	1587	Caryophyllene oxide	23.4
1589	1590	Globulol	0.2
1613	1613	Humulene epoxide II	2.3
1619	1618	α-Corocalene	0.2
1629	1632	Muurola-4,10(14)-dien-1α-ol	0.6
1640	1636	Caryophylla-4(12),8(13)-dien-5β-ol	0.6
1659	1663	*cis*-Calamenen-10-ol	2.2
1661	1665	Intermedeol	0.4
1667	1670	*trans*-Calamenen-10-ol	1.6
1675	1677	Cadalene	2.1
1689	1688	α-Bisabolol	0.2
1703	1701	10-*nor*-Calamenen-10-one	0.4
1842	1841	Phytone	0.8
1994	1994	Manoyl oxide	1.6

2108	2109	Phytol	6.9
2300	2300	Tricosane	0.2
2500	2500	Pentacosane	0.2
		Monoterpene hydrocarbons	2.1
		Oxygenated monoterpenoids	0.6
		Sesquiterpene hydrocarbons	45.9
		Oxygenated sesquiterpenoids	35.0
		Diterpenoids	8.5
		Others	1.6
		Total identified	93.7

RIcalc refers to the retention indices calculated by referencing a homologous series of n-alkanes on a ZB-5ms column. Ridb stands for retention indices acquired from well-established databases (Adams, 2017; FFNSC 3, n.d.; NIST17, 2017; Satyal, 2015) [1, 10, 20, 22]. tr = "trace" (< 0.05%).

In comparison to previously published articles on the chemical composition of essential oils derived from Premna species in Vietnam [16], there is a noticeable trend towards the prevalence of sesquiterpene compounds. The findings of our study revealed a significant presence of phytol, which aligns with observations in other species such as *P. angolensis*, *P. quadrifolia* [2], *P. barbata* [7], *P. latifolia* [18], *P. microphylla* [29] and *P. odorata* [5].

Phytol is a natural compound that has been shown to have many beneficial medicinal effects for health. Phytol has shown effects in controlling microorganisms such as antibacterial, antibiotic, and anti-infective properties. Phytol has shown anti-proliferative activities such as cytotoxic, anti-tumor, anti-mutagenic and anti-teratogenic. Phytol has shown effects on the nervous system such as anti-convulsant, anti-anxiety, anti-depressant [17]. Furthermore, phytol has been reported to have anti-inflammatory, immune-enhancing, and antioxidant activities. Therefore, the medicinal effects in traditional medicine of *P. serratifolia* may be that phytol was one of the compounds responsible.

4. Conclusions

The essential oil compositions from leaves of *Premna serratifolia* are characterized by caryophyllane sesquiterpenoids, specifically, caryophyllene oxide (23.4%) and (*E*)-β-caryophyllene (15.5%). In addition, *P. serratifolia* essential oil contains phytol as a main component, which suggests that studies on activities related to the nervous system such as Alzheimer's disease may yield interesting results.

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Conflicts of interest

The authors declare no conflicts of interest.

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