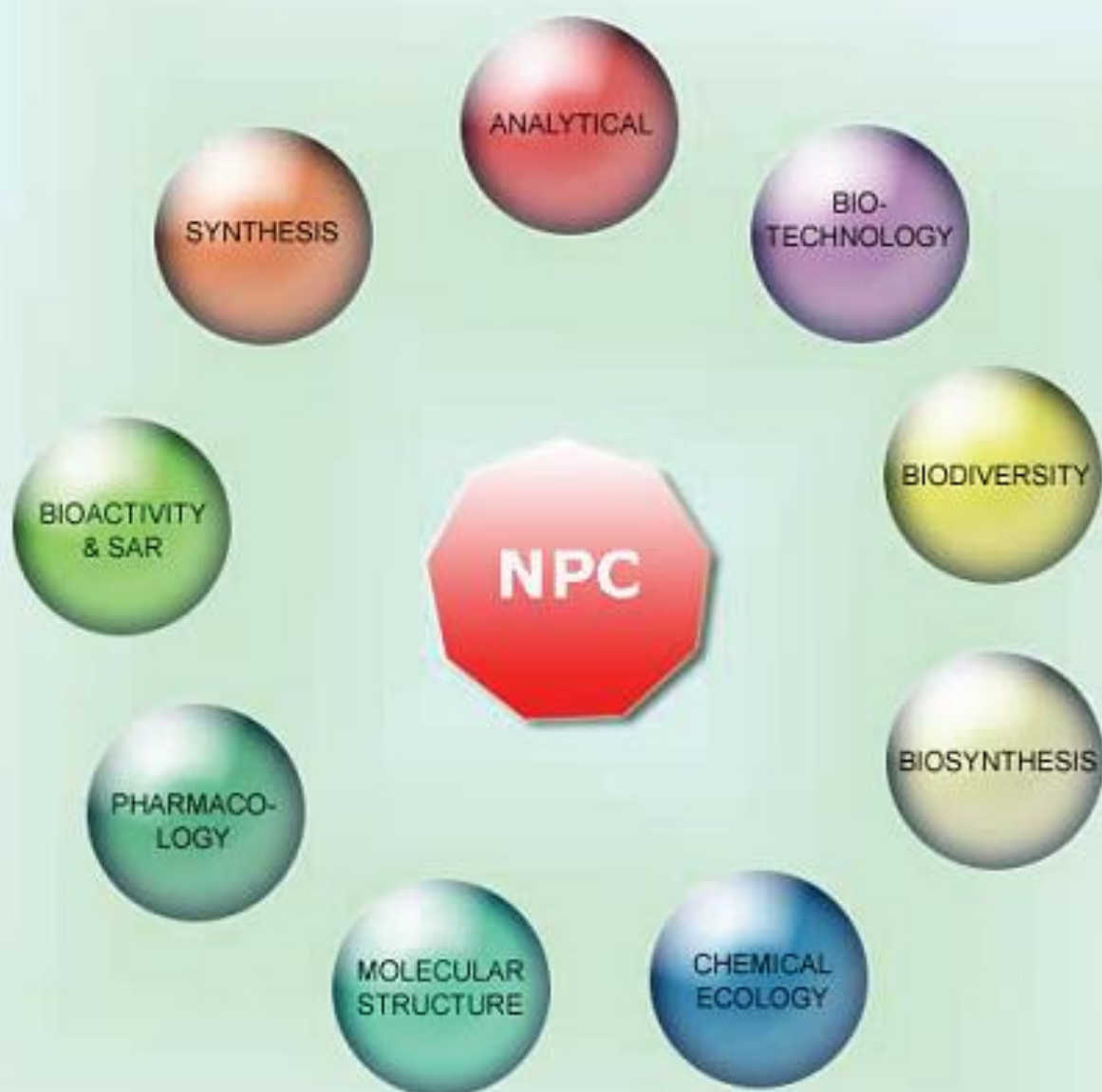


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## Constituents of Essential Oils from *Dasymaschalon bachmaensis* and *Phaeanthus vietnamensis*

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The present paper reports the volatile compounds identified in the essential oils of *Dasymaschalon bachmaensis* N.S. Lý, T.H. Lê, T.B. Vương & N.Đ.Đỗ and *Phaeanthus vietnamensis* Bán (Annonaceae) grown in Vietnam. The essential oils were obtained by hydrodistillation from the leaf, stem and bark of the plants. The combined techniques of gas chromatography (GC) and gas chromatography coupled to mass spectrometry (GC-MS) were used for the analysis of the chemical constituents of the oil samples. The major constituents of the leaf oil of *D. bachmaensis* were limonene (25.7%), eugenol (11.5%),  $\alpha$ -phellandrene (11.3%) and benzyl benzoate (9.0%) while the stem contained benzyl benzoate (35.3%), (Z)-13-docosenamide (12.4%) and limonene (9.4%). In addition, (Z)-13-docosenamide (23.2%), limonene (25.3%) and  $\alpha$ -phellandrene (11.5%) were present in the bark. However, limonene (31.8%), (Z)-9-octadecamide (20.2%) and  $\alpha$ -phellandrene (13.8%) were the compounds occurring in higher amount in the leaf oil of *P. vietnamensis* while the bark was dominated by (Z)-9-octadecamide (57.4%) and benzyl benzoate (15.0%). The volatile constituents of both *D. bachmaensis* and *P. vietnamensis* are reported for the first time.

**Keywords:** *Dasymaschalon bachmaensis*, *Phaeanthus vietnamensis*, Terpenes, Amide.

*Dasymaschalon bachmaensis* N.S. Lý, T.H. Lê, T.B. Vương & N.Đ.Đỗ is a new species of Annonaceae from Vietnam [1]. The authors are not aware of any report on the chemical constituents and biological activities from the plants. On the other hand *Phaeanthus vietnamensis* Bán, an evergreen shrub or small tree that can grow from 2 - 10 m tall is a well-known medicinal plant which has been used for the treatment of various inflammatory diseases, non-specific conjunctivitis and gastro-intestinal disorders, and for disinfection of wounds [2]. The phytochemical compounds that were characterized from this plant were (7S,8R,8'R)-9,9'-epoxy-3,5,3',5'-tetramethoxylignan-4,4',7-triol, 8 $\alpha$ -hydroxyoplop-11(12)-en-14-one and (1R,2S,4S)-4-acetyl-2-[(E)-(cinnamoyloxy)]-1-methylcyclohexan-1-ol [3]. Some of the sesquiterpenes compounds of *P. vietnamensis* were the spathulenol, 1 $\alpha$ H,5 $\beta$ H-aromandendrane-4 $\beta$ ,10 $\alpha$ -diol, 1 $\alpha$ H,5 $\beta$ H-aromandendrane-4 $\alpha$ ,10 $\alpha$ -diol, 1 $\beta$ H,5 $\beta$ H-aromandendrane-4 $\alpha$ ,10 $\beta$ -diol, 3 $\alpha$ ,4 $\beta$ -dihydroxybisabol-1,10-diene and nerolidol [4] while the alkaloids were N-methyl-6,7-dimethoxyisoquinoline, N-methylcorydaldine, argentinine, atherosperminine, petalinemethine, 1S, 1'R(-)-7,7'-O'-dimethylgrisabine [5]. In addition, the alkaloid 1S, 1'R(-)-7-O-methylgrisabine was known for its antimicrobial property [6]. The authors are not aware of any information on the volatile constituents of these plants. The aim of the present study was to report the compounds identified in the essential oils of *D. bachmaensis* and *Phaeanthus vietnamensis* grown in Vietnam. In our previous communications, the chemical compounds identified in the essential oils of some flora of Vietnam were reported [7-9].

The yields of the essential oils were 0.15%, 0.10% and 0.20% (v/w; *D. bachmaensis*; leaf, stem and bark respectively) as well as 0.10% and 0.11% (v/w; *P. vietnamensis*, leaf and bark respectively), calculated on a dry weight basis. Oil samples were light yellow coloured. Thirty seven representing 99.2% of the volatile contents were identified in the leaf oil of *D. bachmaensis*. The major constituents of the oil were limonene (25.7%), eugenol (11.5%),  $\alpha$ -phellandrene (11.3%) and benzyl benzoate (9.0%). Thirty-two (99.6%) and twenty-three (99.9%) compounds were identified respectively in the stem and bark essential oils of *D. bachmaensis*. The main compounds of the stem oil were benzyl benzoate (35.3%), (Z)-13-docosenamide (12.4%), limonene (9.4%) and benzyl cinnamate (8.7%). The bark consisted mainly of (Z)-13-docosenamide (23.2%), limonene (25.3%),  $\alpha$ -phellandrene (11.5%) along with methyl eugenol (7.8%), (E)- $\beta$ -ocimene (7.3%) and p-cymene (6.4%). There is no readily available information on the volatile oils of *D. bachmaensis*. The present result therefore represents the first of its kind. However, the chemical constituents of essential oils from some *Dasymaschalon* species have been reported. The essential oil from the fruits of *D. trichophorum* [10] from China contained nerolidol (19.9%), caryophyllene (16.7%) and  $\beta$ -myrcene (9.3%) and exhibited strong antitumor activity against SPCA-1 human tumor cell line [10]. However,  $\beta$ -pinene (33.4%),  $\alpha$ -pinene (32.3%) and  $\beta$ -caryophyllene (10.5%) were the significant constituents of *D. rostratum* from Vietnam [7] while *D. longiusculum* contained were  $\alpha$ -pinene (28.9% and 12.5%, respectively),  $\beta$ -pinene (26.5% and 13.3%, respectively),  $\beta$ -myrcene (12.0% and 6.0%, respectively) for the leaf and stem [8]. The leaf

Table 1: Essential oil constituents of *D. bachmaensis* and *Phaeanthus vietnamensis*.

Compounds <sup>a</sup>	RI <sup>b</sup>	RI <sup>c</sup>	<i>D. bachmaensis</i> <sup>a</sup>			<i>P. vietnamensis</i> <sup>a</sup>	
			Leaf	Stem	Bark	Leaf	Bark
$\alpha$ -Thujene	930	913	04	-	0.3	0.5	-
$\alpha$ -Pinene	939	932	18	-	0.8	1.8	-
Sabinene	976	964	28	0.7	1.8	2.9	-
$\beta$ -Myrcene	990	988	17	0.7	2.0	2.0	-
$\alpha$ -Phellandrene	1006	1004	11.3	3.9	11.5	13.8	-
$\alpha$ -Terpinene	1017	1014	06	0.2	0.8	0.9	-
<i>p</i> -Cymene	1026	1020	70	2.1	6.4	7.6	-
Limonene	1032	0130	25.7	9.4	25.3	31.8	-
( <i>E</i> )- $\beta$ -Ocimene	1052	1044	5.0	2.2	7.3	6.5	-
$\gamma$ -Terpinene	1061	1056	0.8	0.3	1.4	1.4	-
$\alpha$ -Terpinolene	1090	1089	05	0.2	0.8	0.9	-
Linalool	1100	1100	07	0.6	0.9	0.8	-
<i>alpha</i> -Ocimene	1120	1128	0.1	-	-	-	-
<i>p</i> -Menthyl-1,5-dien-8-ol	1165	1170	0.1	-	-	-	-
Terpinen-4-ol	1177	1177	11	0.6	2.3	2.9	-
$\alpha$ -Terpineol	1189	1188	0.2	-	-	1.0	-
( <i>E</i> )-2,6-Dimethyl-3,5,7-octatriene-2-ol	1202	1208	04	-	0.3	-	-
Pulegone	1248	1244	-	-	-	0.3	-
Nerol	1250	1249	1.2	2.0	-	-	-
Geraniol	1270	1273	07	-	1.0	1.3	-
Linalyl propionate	1316	1315	-	-	0.4	-	-
Bicyclohexene	1327	1337	19	0.7	-	-	0.9
Bisphenol	1356	1356	11.5	2.4	1.2	0.9	-
$\beta$ -Cubebene	1388	1387	0.2	1.0	-	-	-
$\beta$ -Elemene	1391	1389	0.5	0.2	-	-	-
Methyl eugenol	1407	1407	02	0.2	7.8	2.2	-
$\alpha$ -Humulene	1454	1452	0.1	-	-	-	-
$\alpha$ -Elemene	1460	1469	-	0.3	-	-	-
$\alpha$ -Anthrone	1485	1484	-	0.2	-	-	-
Germaene D	1485	1485	16	-	0.2	-	3.0
Bicyclogermacrene	1500	1500	15	0.7	-	-	2.0
2,4-Bis(1,1-dimethylethyl)-Phenol	1513	1511	0.1	-	-	-	1.4
$\delta$ -Cadinene	1525	1522	-	-	-	-	1.2
Eugenol acetate	1526	1524	0.3	-	-	-	-
Elemol	1550	1548	0.4	3.0	-	-	1.2
Guaiol	1601	1234	0.3	0.6	-	-	-
$\alpha$ -Muurolol	1646	1646	-	0.4	-	-	-
$\beta$ -Eudesmol	1651	1648	-	0.5	-	-	-
$\alpha$ -Cadinol	1654	1652	0.1	0.8	-	-	-
Bulnesol	1672	1672	-	0.2	-	-	-
Benzyl benzoate	1760	1760	90	35.3	1.2	-	15.0
<i>B</i> -Phenyethyl benzoate	1840	1841	-	6.3	-	-	-
1,2-Benzenedicarboxylic acid	1917	1917	02	1.4	0.5	-	8.0
Floricane	2000	2000	-	-	-	-	0.5
Benzyl cinnamate	2096	2092	2.3	8.7	-	-	4.9
Octadecanoic acid	2188	2182	0.1	-	-	-	1.9
( <i>Z</i> )-9-Octadecamide	2378	2376	6.6	1.4	25	20.2	57.4
( <i>Z</i> )-13-Docosenamide	2649	2640	-	12.4	23.2	-	-
<b>Total</b>			<b>99.2</b>	<b>99.6</b>	<b>99.9</b>	<b>99.7</b>	<b>97.4</b>
<b>Monoterpene hydrocarbons</b>			<b>57.7</b>	<b>19.7</b>	<b>58.4</b>	<b>71.1</b>	<b>-</b>
<b>Oxygenated monoterpenes</b>			<b>16.2</b>	<b>5.8</b>	<b>13.6</b>	<b>8.6</b>	<b>-</b>
<b>Sesquiterpene hydrocarbons</b>			<b>5.8</b>	<b>3.1</b>	<b>0.2</b>	<b>-</b>	<b>7.1</b>
<b>Oxygenated sesquiterpenes</b>			<b>0.8</b>	<b>6.5</b>	<b>-</b>	<b>-</b>	<b>1.2</b>
<b>Fatty acids</b>			<b>0.1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>2.4</b>
<b>Benzene compounds</b>			<b>11.6</b>	<b>51.7</b>	<b>1.7</b>	<b>-</b>	<b>29.3</b>
<b>Amide</b>			<b>6.6</b>	<b>13.8</b>	<b>25.7</b>	<b>20.2</b>	<b>57.4</b>
<b>Others</b>			<b>0.4</b>	<b>-</b>	<b>0.3</b>	<b>-</b>	<b>-</b>

<sup>a</sup> Elution order on HP-5MS column; <sup>b</sup> Retention indices on HP-5MS column; <sup>c</sup> RI (Lit.) Literature retention indices; <sup>d</sup> Identification by mass spectra, GC retention indices and comparison with literature data; <sup>e</sup> Standard deviation (SD = mean of triplicate analysis) were insignificant and were excluded from the Table; - = Not identified.

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and stem oils of *D. glaucum* [8] were rich in  $\alpha$ -pinene (14.4% and 10.5%, respectively),  $\beta$ -pinene (14.4% and 10.3%, respectively) and bicycloelemene (5.2% and 30.0%, respectively). The essential oil of *D. robinsonii* was composed of  $\alpha$ -copaene (12.7% and 16.6%, respectively), germacrene B (11.3% and 7.5%, respectively),  $\delta$ -cadinene (5.6% and 5.3%, respectively) for the leaf and stem [8]. The essential oil of *D. rostratum* was previously shown to consist mainly of olefins and exhibited strong antimicrobial effects [11]. It could be seen that the main compounds in the present oil samples namely limonene,  $\alpha$ -phellandrene, eugenol, benzyl benzoate, benzyl cinnamate and (*Z*)-13-docosenamide were not reported to be of dominant status in the previous data on other *Dasymaschalon* oils [7,8,10,11].

Nineteen (99.7%) and 12 (97.4%) compounds were identified respectively in the essential oils of the leaf and bark of *P. vietnamensis*. Limonene (31.8%), (*Z*)-9-octadecamide (20.2%) and  $\alpha$ -phellandrene (13.8%) were the compounds occurring in higher amount in the leaf oil. There were significant quantities of *p*-cymene (7.6%) and (*E*)- $\beta$ -ocimene (6.5%). None of the sesquiterpene compounds could be found in the oil. On the other hand, (*Z*)-9-octadecamide (57.4%), benzyl benzoate (15.0%) and 1,2-benzenedicarboxylic acid (8.0%) were the main constituents of the bark oil. Monoterpene compounds were not identified in the oil. Till moment, the volatile compositions of any of the *Phaeanthus* species have not been reported. The present result therefore was the first of its kind in the study of essential of *Phaeanthus* plants.

## Experimental

**Collection of plant species:** The leaves, stem and bark of *D. bachmaensis* and *P. vietnamensis* Ban were harvested from Bạch Mã, National Park, Thừa Thiên - Huế Province, Vietnam, in August 2012. Botanical identification was achieved by Dr. Dai DN. Voucher specimens DND 255 and DND 256, respectively have been deposited at the Botany Museum, Vinh University, Vietnam.

**Chemical analysis:** The experimental conditions and instruments used for GC and GC-MS analysis and compound identifications were reported in our earlier publications [7-9].

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