

## Phenolics and diarylheptanoid from *Alpinia mutica*

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**Abstract.** Chemical extraction of the rhizomes of *Alpinia mutica* and purification afforded several compounds whose structures have been identified by spectroscopic methods. The compounds are pinocembrin, 5,6-dehydrokawain, flavokawin B, 1,7-diphenyl-5-hydroxy-6-hepten-3-one,  $\alpha$ -bergamotene,  $\beta$ -bisabolene, stigmasta-5-en-3-ol and stigmasta-5, 22-dien-3-ol.

**Abstrak.** Pengekstrakan kimia bagi rizom *Alpinia mutica* and penulenan menghasilkan beberapa sebatian yang strukturnya dikenal pasti dengan kaedah spektroskopi. Sebatian tersebut ialah pinosembrin, 5,6-dehidrokawain, flavokawin B, 1,7-difenil-5-hidroksi-6-hepten-3-on,  $\alpha$ -bergamotena,  $\beta$ -bisabolena, stigmasta-5-en-3-ol and stigmasta-5, 22-dien-3-ol.

### Introduction

*Alpinia mutica* Roxb, is one of the 23 species of *Alpinia* genus of the Zingiberaceae family [1]. The plants grow wild in Peninsular Malaysia especially in the southern parts of Malaysia, and is eaten as a stomachic [2]. Several papers have reported the isolation of diarylheptanoids from *Alpinia* species. These describe pungent diarylheptanoid from *Alpinia oxyphylla* [3], diarylheptanoids from *Alpinia officinarum* [4,5], and diarylheptanoids from the seeds of *Alpinia katsumudai* [6]. Phenolic compounds have also been reported from the *Alpinia* species, for example from the rhizomes of *Alpinia speciosa* [7]. As part of our systematic studies on the chemical constituents of Malaysian Zingiberaceae, we have investigated the rhizomes of *Alpinia mutica*. This paper reports the isolation and structural elucidation of the phenolics and diarylheptanoid from the rhizomes of *Alpinia mutica*.

### Experimental

<sup>1</sup>H-NMR were recorded in CDCl<sub>3</sub> with TMS as internal standard on a Varian EM 360 spectrometer operating at 60 MHz and on a Bruker AM 400 spectrometer operating at 400

MHz. <sup>13</sup>C NMR were recorded on the Bruker AM 400 operating at 100 MHz. TLC was performed on 0.25 mm Merck pre-coated plates F254 silica gel plates and CC was carried with Merck silica gel 70-230 and 230-400 mesh.

**Extraction and isolation.** Air-dried rhizomes of *A. mutica* (300 g) were extracted with chloroform in a Soxhlet apparatus. The excess solvent was evaporated in vacuo to give crude product (10 g). The crude (5 g) was then fractionated by using vacuum CC on silica gel with a petroleum ether-ether mixture gradient to give four fractions (A - D). Fraction A was purified by CC to give a mixture of  $\alpha$ -bergamotene (1) and  $\beta$ -bisabolene (2) (identified by GC-MS). Fraction B was purified by flash CC followed by recrystallisation to give chalcone flavokawin B (3) (80 mg). Fraction C was purified by repeated CC on silica gel to yield diarylheptanoid (4) (130 mg) and flavonoid pinocembrin (5) (20 mg), together with mixture of plant sterols (100 mg). Fraction D was recrystallised from a petroleum ether and ether to give 5,6-dehydrokawain (6) (1.1 g). The identification of  $\alpha$ -bergamotene,  $\beta$ -bisabolene, stigmasta-5-en-3-ol and stigmasta-5, 22-dien-3-ol was carried out by using GC-MS.

Flavokawin B (1). Yellow needles, m.p. 94-94°C (lit. [7] 91.5-92.0°C). IR  $\nu_{\max}$   $\text{cm}^{-1}$ : 3440, 2950, 1630 1590;  $^1\text{H}$  NMR:  $\delta$  3.83 and 3.91 (each 3H, s, OMe), 5.97 (1H, d,  $J = 2$  Hz, H-5'), 6.11 (1H, d,  $J = 2$  Hz, H-3'), 7.34-7.61 (5H, m, phenyl protons), 7.80 (1H, d,  $J = 16$  Hz, H-8), 7.90 (1H, d,  $J = 16$  Hz, H-9), and 14.24 (1H, s, OH). EIMS:  $m/z$  (rel. int.) 284  $\text{C}_{17}\text{H}_{16}\text{O}_2$  [ $\text{M}^+$ ] (78), 207(100).

1,7-Diphenyl-5-hydroxy-6-hepten-3-one (2). Pale yellow crystals, m.p. 60-61°C (lit. [6] 59.5-50.5°C). IR  $\nu_{\max}$   $\text{cm}^{-1}$ : 3450, 1720, 1610, 1500, 1460 and 1370.  $^1\text{H}$  NMR:  $\delta$  2.72 (2H, br. d, H-4), 2.80 (2H, t,  $J = 6$  Hz, H-1), 2.95 (2H, t,  $J = 6$  Hz, H-2), 4.75 (1H, q,  $J = 6$  Hz, H-5), 6.20 (1H, dd,  $J = 16$  and 6 Hz, H-6) and 6.65 (1H, d,  $J = 16$  Hz, H-7), and 7.15-7.40 (10H, m, phenyl protons). EIMS:  $m/z$  (rel.int) 280,  $\text{C}_{19}\text{H}_{20}\text{O}_2$  [ $\text{M}^+$ ] (17), 262 (9), 175(18), 148 (26), 133 (52), 105 (80), 91 (100), 77 (27).

Pinocembrin (3). Colourless needles, m.p. 204-205°C (lit. [6] 205-207°C). IR  $\nu_{\max}$   $\text{cm}^{-1}$ : 3400, 3050, 1630, 1595 1580, 1470, and 1360;  $^1\text{H}$  NMR ( $\text{C}_6\text{D}_6$ ):  $\delta$  3.75 (3H, s, OMe), 5.40 (1H, d,  $J = 2$  Hz, H-3), 3.15 (1H, dd,  $J = 13$  and 17 Hz, H-3), 5.49 (1H, dd,  $J = 3$  and 13 Hz, H-2), 6.02 (2H, s, H-6 and H-8), 7.40 (5H, m, phenyl protons), and 12.05 (1H, s, OH at C-5); EIMS:  $m/z$  (rel.int.) 256,  $\text{C}_{15}\text{H}_{12}\text{O}_4$  [ $\text{M}^+$ ] (100), 255 (50), 238 (10), 179 (80), 124 (42), 104 (24), 77 (20).

5,6-Dehydrokawain (4). Pale yellow crystals, m.p. 139-140°C (lit. [7] 136.5-137.5°C). IR  $\nu_{\max}$   $\text{cm}^{-1}$ : 3040, 1730, 1610, 1560, 1460.  $^1\text{H}$  NMR ( $\text{C}_6\text{D}_6$ ):  $\delta$  3.75 (3H, s, OMe), 5.40 (1H, d,  $J = 2$  Hz, H-3), 5.85 (1H, d,  $J = 2$  Hz, H-5), 6.40 (1H, d,  $J = 16$  Hz, H-4), 7.30 (5H, m, phenyl protons), and 7.40 (1H, d,  $J = 16$  Hz, H-8). EIMS:  $m/z$  (rel. int.) 288,  $\text{C}_{14}\text{H}_{12}\text{O}_3$  [ $\text{M}^+$ ] (100), 200(52), 157(55), 77(50), 69(42).

## Results

Compound (1) obtained as yellow needles, has the molecular formula  $\text{C}_{17}\text{H}_{16}\text{O}_2$  and it shows a strong UV absorption maximum at 343 nm that is characteristic of a chalcone. The IR showed a strong hydroxyl absorption of phenolic group at  $3440\text{ cm}^{-1}$ . The  $^1\text{H}$  NMR spectrum agrees with that of chalcone flavokawin B,

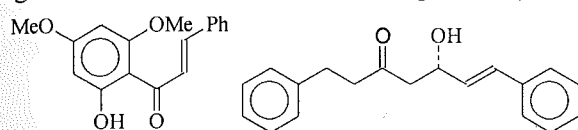
which has been previously isolated from *A. speciosa* [7] and *Piper methysticum* [8]. The assignment is supported by the presence of two methoxyl groups at  $\delta$  3.83 and 3.91, two aromatic protons at  $\delta$  5.97 and 6.11 for H-3' and H-5' and the  $\alpha,\beta$ -unsaturated olefinic protons at  $\delta$  7.80 and 7.90 as a set of doublets for which  $J = 16$  Hz.

Compound (2) was obtained as colourless crystals. It has the molecular formula of  $\text{C}_{15}\text{H}_{12}\text{O}_4$  and it shows a strong hydroxyl and carbonyl absorptions at  $3450$  and  $1720\text{ cm}^{-1}$  in the IR spectrum. The  $^1\text{H}$  NMR spectrum reveals styryl protons signals at 6.20, dd ( $J$  16 and 6 Hz) and 6.65 to a proton adjacent to a hydroxyl group at C-5 and a broad singlet at  $\delta$  3.07 that is attributed to a hydroxyl proton. A set of triplets at  $\delta$  2.80 and 2.95 was assigned to the four methylene protons at C-1 and C-2 and a peak at  $\delta$  2.72, d,  $J$  6 Hz was assigned to methylene protons at C-4. These data were in agreement with 1,7-diphenyl-5-hydroxy-6-hepten-3-one previously reported from *Alpinia katsumudai* [6].

Compound (3) obtained as yellow crystals, shows a strong carbonyl and hydroxyl group at  $1620$  and  $3450\text{ cm}^{-1}$  in the IR spectrum. It has a molecular formula of  $\text{C}_{15}\text{H}_{12}\text{O}_4$ ,  $\text{M}^+ = 256$ , in the high resolution mass spectrum. The  $^1\text{H}$  NMR showed a characteristic ABX pattern at  $\delta$  2.83 (1H, dd,  $J = 3$  Hz and 17 Hz),  $\delta$  3.15 (1H, dd,  $J$  13 and 17 Hz) and  $\delta$  5.49 (1H, dd,  $J$  3 and 13 Hz) for a flavonon type skeleton. This is supported by the presence of phenyl group at  $\delta$  7.40 and two aromatic protons H-6 and H-8 at  $\delta$  6.00. A singlet at  $\delta$  12.00 was assigned to a hydroxyl proton at C-5, was deshielded due to the chelation with the carbonyl group. Based on the physical and spectral properties, compound (3) was identified as pinocembrin [6].

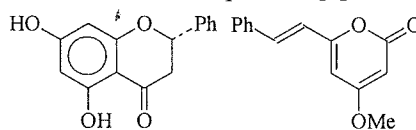
Compound (4) obtained as pale yellow crystals has the molecular formula  $\text{C}_{14}\text{H}_{12}\text{O}_3$ ,  $\text{M}^+ = 288$ , as shown in the MS spectrum. The  $^1\text{H}$  NMR reveals methoxyl group at  $\delta$  3.78 and the olefinic signals of an  $\alpha,\beta$ -unsaturated carbonyl group at  $\delta$  6.48 and 7.46 with coupling constants of 16 Hz. A small doublet each at  $\delta$  5.45 and 5.85 with small coupling constants of 2 Hz is attributed to H-3 and H-5. These data are in

agreement with 5,6-dehydrokawain previously



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isolated from *A. speciosa* [7].



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