Pertanika J. Sci. & Technol. **18 (1)**: 77– 81 (2010)

ISSN: 0128-7680

© Universiti Putra Malaysia Press

Anthraquinones from *Cratoxylum aborescens* (Guttiferae)

G.C.L. Ee*, V.Y.M. Jong, M.A. Sukari, T.K. Lee and A. Tan
Department of Chemistry, Faculty of Science, Universiti Putra Malaysia,
43400 UPM, Serdang, Selangor, Malaysia
**E-mail: gwen@fsas.upm.edu.my*

ABSTRACT

Our continuing interest in anthraquinones from the Guttiferae family has led us to look at the genus *Cratoxylum*. A detailed chemical study on *Cratoxylum aborescens* resulted in the isolation of three anthraquinones, namely 1,8-dihydroxy-3-methoxy-6-methylanthraquinone (**1**), vismiaquinone (**2**) and vismione (**3**). These compounds were identified using 1D and 2D NMR spectroscopy. This is the first report on the chemistry of *Cratoxylum aborescens*.

Keywords: ***Cratoxylum aborescens*, Guttiferae, anthraquinones**

INTRODUCTION

Cratoxylum belongs to the Guttiferae family, but it is sometimes categorized under the family of Hypericaceae. It is a small genus which consists of a total of six species. The wood of *Cratoxylum* is used for construction of houses and farm huts. Meanwhile, poles from moderately big trees are used as beams, joists, rafters, and posts in farm hut construction (Pearce *et al*., 1987). The stem bark of the species is known to be used in traditional medicine (Bennet *et al*., 1993). The bark, roots, and leaves are reported to be used in folk medicine to treat fevers, cough, diarrhoea, itches, ulcers, and abdominal complaints (Lien *et al*., 1998). There are not many reports on the chemistry of the *Cratoxylum* species. However, some phytochemical studies on this genus have revealed the plant to be rich in flavonoids, xanthones, and triterpenoids (Iinuma *et al*., 1996; Bennett *et al*., 1993; Sia *et al*., 1995; Nguyen *et al*., 1998; Bennett and Lee, 1989). This paper describes the isolation and identification of three anthraquinones from *Cratoxylum aborescens*.

MATERIALS AND METHOD

Plant Material

The stem bark of *Cratoxylum aborescens* was collected from Sri Aman Sarawak, Malaysia. The plant materials were identified by Ms. Runi Sylvester from the Herbarium of Sarawak Forestry Department, Kuching, Sarawak, Malaysia.

General

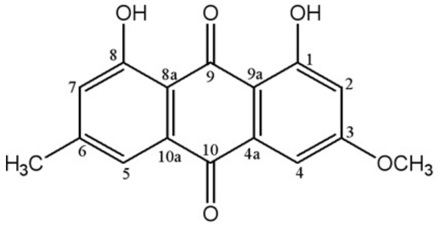
Infrared spectra were measured in KBr/NaCl pellet on a Perkin-Elmer FTIR Spectrum BX spectrometer. EIMS were recorded on a Shimadzu GCMS-QP5050A spectrometer. NMR spectra were obtained using a Unity INOVA 500MHz NMR/ JEOL 400MHz FT NMR spectrometer with tetramethylsilane (TMS) as its internal standard. Ultra violet spectra were recorded in $CHCl_3$ on a Shimadzu UV-160A, UV-Visible Recording Spectrophotometer.

Received: 9 April 2008
Accepted: 17 March 2009

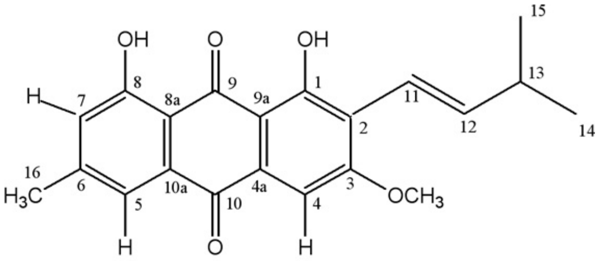
*Corresponding Author

Extraction and Isolation

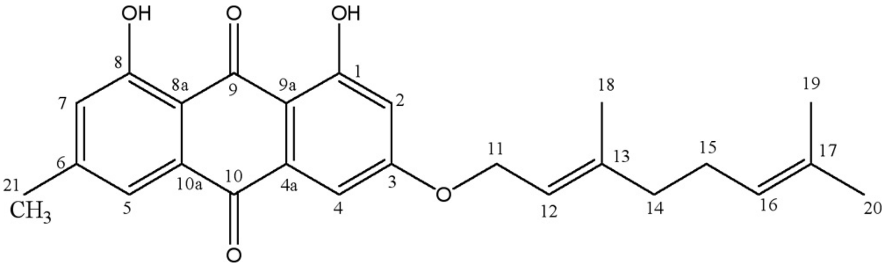
The air-dried and powdered stem bark of *Cratoxylum aborescens* (2.5 kg) was successively extracted with hexane, chloroform, and methanol at room temperature. The extracts were evaporated to dryness under reduced pressure to yield 15.8 g, 39.5 g, and 30.6 g of hexane chloroform and methanol extracts, respectively. Each of the crude extracts was subjected to a series of column chromatography over silica gel columns, using a stepwise gradient system (hexane/chloroform, chloroform/ethyl acetate, and ethyl acetate/methanol). The column chromatography of the hexane extract gave vismiaquinone (**2**) (6 mg) and vismione (**3**) (5 mg) (3). Meanwhile, the methanol extract gave 10 mg of 1,8-dihydroxy-3-methoxy-6-methylanthraquinone (**1**).



(1)



(2)



(3)

Vismiaquinone (**2**) - orange crystals, m.p. 200-202ºC (Lit. 202-204ºC, Lourdes *et al.,* 1981). UV (EtOH) λ_{max} nm: 276.0, 445. IR ν_{max}: 3448, 2924, 2854, 1626, 1476. EI-MS m/z: 352, 337, 309, 297, 283, 267, 237, 211, 189, 168, 161, 152, 138, 115, 89, 63 and 41. ^{1}H NMR (400 MHz, $CDCl_3$): δ 12.96 (s, 1H, 1-OH), δ 12.11 (s, 1H, 8-OH), δ 7.62 (s, 1H, H-5), δ 7.42 (s, 1H, H-4), δ 7.07 (s, 1H, H-7), δ 6.92 (dd, J = 16.5, 7.3Hz, 1H, H-12), δ 6.65 (d, J = 16.5Hz, 1H, H-11), δ 4.05 (s, 3H, 3-OMe), δ 2.52 (m, 1H, H-13), δ 2.45 (s, 3H, H-16), δ 1.14 (s, 3H , H-14), δ 1.14 (s, 3H , H-15). ^{13}C NMR (100 MHz, $CDCl_3$): δ 191.5 (C-9), δ 182.0 (C-10), δ 163.0 (C-3), δ 162.5 (C-8), δ 162.1 (C-1), δ 148.4 (C-6), δ 146.8 (C-11), δ133.2 (C-10a), δ 132.1 (C-4a), δ 124.4 (C-7), δ 121.1 (C-5), δ 120.0 (C-2), δ 115.8 (C-12), δ 113.8 (C-8a), δ 110.6 (C-9a), δ 103.4 (C-4), δ 56.3 (3-OMe), δ 33.4 (C-15), δ 29.7 (C-13), δ 22.5 (C-14), δ 22.2 (C-16).

1,8-dihydroxy-3-methoxy-6-methylanthraquinone (**1**) - orange powder, m.p. 207-209ºC. (Lit. 210ºC, Kitanaka *et al*., 1985). UV (EtOH) λ_{max} nm: 273.6, 445.0. IR ν_{max}: 3442, 1628, 1478, 1370. EI-MS m/z: 284, 255, 241, 241, 227, 213, 198, 185, 167, 151, 128, 106, 89, 77, 69, 51, 41. ^{1}H

NMR (400 MHz, $CDCl_3$): δ 12.31 (s, 1H, OH-1), δ 12.11 (s, 1H, 8-OH), δ 7.62 (s, 1H, H-5), δ 7.36 (d, J = 2.7Hz, H-4), δ 7.08 (s, 1H, H-7), δ 6.68 (d, J = 2.7Hz, 1H, H-2), δ 3.94 (s, 3H, 3-OMe), δ 2.45 (s, 3H, 6-CH_3). ^{13}C NMR (100 MHz, $CDCl_3$): δ 190.8 (C-9), δ 182.0 (C-10), δ 166.5 (C-3), δ 165.1 (C-1), δ 162.5 (C-8), δ 148.4 (C-6), δ135.2 (C-10a), δ 133.2 (C-4a), δ 124.5 (C-7), δ 121.3 (C-5), δ 113.6 (C-8a), δ 110.2 (C-9a), δ 108.2 (C-4), δ 106.7 (C-2), δ 56.1(3-OMe), δ 22.1 (6-CH_3).

RESULTS AND DISCUSSION

Vismione (**3**) was obtained from the n-hexane extract as yellow crystals with a melting point of 141-143°C (Lit. 141-143 °C, Mohamed *et al.,* 1993). The mass spectrum showed the presence of a molecular ion peak at m/z 406, corresponding to the molecular formula, $C_{25}H_{26}O_5$. The existence of hydroxyl groups was confirmed by the strong IR absorption observed at 3438 cm^{-1} in the IR spectrum. The absorption observed at 2928 cm^{-1} was due to the carbon hydrogen stretching for the methyl group. The absorption at 1626 cm^{-1} was due to the carbonyl groups. The UV spectrum gave maximum absorptions at 267.5 and 456.0 nm.

The ^1H NMR spectrum revealed signals for aromatic protons at δ 6.67 (1H, d, J= 2.8 Hz) and δ 7.36 (1H, d, J= 2.8 Hz) for H-2 and H-4, and also two singlets at δ 7.61 for H-5 and δ 7.07 for H-7. An olefinic methyl proton signal, at δ 1.78 (3H, s) for H-18 and the geminal-dimethyl protons, at δ 1.61 (3H, s) for H-19 and δ 1.67 (3H, s) for H-20, in addition to the methyl proton signals at δ 2.45 (3H, s) for H-21 were also observed. The ^1H NMR spectrum also exhibited two sets of methylene proton signals at δ 2.11 (2H, m) and δ 2.13 (2H, m) and these were attributed to H-14 and H-15. Beside that, another methylene proton signal also appeared at δ 4.67 (2H, d, J= 6.4Hz) for H-11. Two vinyl methine proton signals appeared at δ 5.47 (1H, t, J = 6.4Hz) for H-12 and δ 5.09 (1H, t, J = 6.9Hz) for H-16. The signal of the methylene proton (δ 4.67) of the chain, which appeared in the relatively low field region, indicated that the geranyl group is oxygenated. The ^1H NMR spectrum also showed the presence of two hydroxyl groups at δ 12.29 (OH, s) and δ 12.13 (OH, s). There are 25 carbon signals from the ^{13}C NMR spectrum. Two typical conjugated carbonyl groups were observed at δ 190.7 for C-9 and δ 182.1 for C-10. The resonances at δ 165.1 (C-1) and δ 162.5 (C-8) were due to the oxygenated aromatic carbons.

In the ^1H-^1H COSY spectrum, the olefinic proton at δ 4.67 for H-11 was correlated to the proton at δ 5.47 for H-12. Six methine, three methylene, four methyl, and twelve tertiary carbon signals were observed from the DEPT spectrum, supporting the structure of vismione.

From the HMBC spectrum, ^3J correlations were observed between H-21 (δ 2.45) and C-5 (δ 121.2), as well as between H-21 (δ 2.45) and C-7 (δ 124.4). HMBC also gave ^2J correlations between the peak at H-21 (δ 2.45) and C-6 (δ 148.4).

The HMBC spectrum correlated all the protonated carbons to their respective protons. The chelated hydroxyl group (1-OH) was correlated to three aromatic carbons, namely C-1 (δ 165.1), C-2 (δ 107.5), and C-9a (δ 110.1). Another chelated hydroxyl group (8-OH) was also correlated to the three aromatic carbons, which are C-7 (δ 124.4), C-8 (δ 162.5), and C-8a (δ 113.7). Hence, compound 3 was assigned vismione, previously isolated from *Psorospermum febrifugum* (Mohamed *et al.,* 1993). The ^1H, ^{13}C NMR assignments and the HMBC correlations are shown in Table 1.

TABLE 1
^{1}H NMR (400 MHz, CDCl3), ^{13}C NMR (100 MHz, CDCl3)
& HMBC assignments of Vismione (3)

Position	δ_H	δ_C	HMBC
1	-	165.1	-
2	6.67 (1H, d, *J* = 2.8 Hz)	107.5	165.1(C-1), 110.1 (C9a).
3	-	165.9	-
4	7.36 (1H, d, *J* = 2.8 Hz)	108.8	107.5 (C-2), 182.1 (C-10), 110.1 (C-9a).
4a	-	133.2	-
5	7.61(1H,s)	121.2	124.4 (C-7), 182.1 (C-10), 113.7 (C-8a), 22.1 (C-21).
6	-	148.4	-
7	7.07 (1H, s)	124.4	121.2 (C-5), 113.7 (C-8a), 22.1 (C-21).
8	-	162.5	-
8a	-	113.7	-
9	-	190.7	-
9a	-	110.1	
10	-	182.1	-
10a	-	132.0	-
11	4.67 (2H, d, *J* = 6.4 Hz)	65.8	165.9 (C-3), 117.9 (C-12), 142.9 (C-13).
12	5.47 (1H, t, *J* = 6.4Hz)	117.9	39.5 (C-14), 16.8 (C-18).
13	-	142.9	-
14	2.11 (2H,m)	39.5	117.9 (C-12), 26.2 (C-15).
15	2.13 (2H,m)	26.2	142.9 (C-13), 39.5 (C-14).
16	5.09 (1H, t, *J* = 6.9Hz)	123.6	-
17	-	132.0	-
18	1.78 (3H, s)	16.8	117.9 (C-12), 142.9 (C-13), 39.5 (C-14).
19	1.61 (3H, s)	17.7	123.6 (C-16), 132.0 (C-17), 25.7 (C-20).
20	1.67 (3H, s)	25.7	123.6 (C-16), 132.0 (C-17), 17.7 (C-19).
21	2.45 (3H, s)	22.1	121.2 (C-5), 148.4 (C-6), 124.4 (C-7).
1-OH	12.29 (OH, s)	-	165.1 (C-1), 107.5 (C-2), 110.1 (C-9a).
8-OH	12.13 (OH, s)	-	124.4 (C-7), 162.5 (C-8), 113.7 (C-8a).

1,8-dihydroxy-3-methoxy-6-methylanthraquinone (**1**) was obtained as orange powder, with a melting point of 207-209ºC (Lit. 210ºC, Kitanaka *et al.,* 1985). The spectral data for this compound are in agreement with published data (Kitanaka *et al.,*1985).

On the other hand, vismiaquinone (**2**) was obtained as orange crystals which melt at 200-202ºC (Lit. 202-204ºC, Lourdes *et al.,* 1981). The structure of this compound was deduced by comparing its spectral data with the ones available in the literature (Lourdes *et al.,* 1981).

ACKNOWLEDGEMENTS

We thank the Malaysian IRPA grant for the financial support, Dr Jegak Uli for collecting the plant samples and Mr Johadi Iskander for recording the NMR spectra.

REFERENCES

Bennet, G.J. and Lee, H.H. (1989). Xanthones from Guttiferae. *Phytochemistry*, *28*(4), 967-998.

Bennet, G.J., Harrison, L.J., Sia, G-L. and Sim, K-Y. (1993). Triterpenoids, tocotrienols and xanthones from the bark of *Cratoxylum cochinchinese*. *Phytochemistry*, *32*(5), 1245-1251.

Iinuma, M., Tosa, H., Ito,T., Tanaka, T. and Madulid, D.A. (1996). Two xanthones from roots of *Cratoxylum formosanum*. *Phytochemistry*, *43*(4), 1195-1198.

Kitanaka, S., Kitamura, F. and Tachio, M. (1985). Studies on the constituents of purgative crude drugs. XVII. Studies on the constituents of the seeds of *Cassia obtusifolia* Linn.The structures of two new anthraquinone glycosides. *Chemical and Pharmaceutical Bulletin, 33*(3), 1274-1276.

Lien, H.D.N. and Harrison, L.J. (1998). Triterpenoid and xanthone constituents of *Cratoxylum cochinchinese. Phytochemistry*, *50*, 471-476.

Lourdes, M.D., Goncalves and Mors, W.B. (1981). Vismiaquinone Isopenthnyl Substituted Anthraquinone from *Vismia Reichartiana*. *Phytochemistry, 20*, 1947-1950.

Mohamed A-S., Suwanborirux Abdul-Azim, K., Habib, M., Chang, C.J. and Cassady, J.M. (1993). Xanthones and Vismiones from *Psorospermum Febrifugum*. *Phytochemistry, 34*, 1413-1420.

Nguyen, L.H.D. and Harrison, L.J. (1998). Triterpenoid and xanthones constituents of *Cratoxylum cochinchinese*. *Phytochemistry*, *50*, 471-476.

Pearce, K.G., Amen, V.L. and Jok, S. (1987). An ethnobotanical study of an iban community of the Pantu sub-district, Sri Aman, Division 2, Sarawak. *The Sarawak Museum Journal, XXXVII*(58), 193-270.

Sia, G.L., Bennett, G.J., Harrison, L.J. and Sim, K.Y. (1995). Minor xanthones from the bark of *Cratoxylum cochinchinese*. *Phytochemistry, 38*(6), 1521-1528.