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1-[2′,4′-Dihydroxy-3′-(3″-Methylbut-2″-enyl)-5′-(1‴-ethoxy-3‴-methylbutyl)-6′-methoxy]phenylethanone from *Acronychia pedunculata*

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Abstract

A new aryl ketone 1-[2′,4′-dihydroxy-3′-(3″-methylbut-2″-enyl)-5′-(1‴-ethoxy-3‴-methylbutyl)-6′-methoxy]phenylethanone was isolated from the leaves of *Acronychia pedunculata*. Its structure was determined directly by two-dimensional NMR spectroscopy and by comparison with the known compound 1-[2′,4′-dihydroxy-3′,5′-di-(3″-methylbut-2″-enyl)-6′-methoxy]phenylethanone isolated from the same source.

Keywords: *Acronychia pedunculata*; Rutaceae; Aryl ketone; 1-[2′,4′-Dihydroxy-3′-(3″-methylbut-2″-enyl)-5′-(1‴-ethoxy-3‴-methylbutyl)-6′-methoxy]phenylethanone

1. Introduction

Acronychia pedunculata (L.) Miq. is a small evergreen tree found in woodlands of Hong Kong where it is used for treating rheumatic pain in traditional medicine (Cheung, 1988). Historically, there has been some confusion regarding the taxonomic status of the genus *Acronychia* with regard in particular to the genera *Jambolifera*, *Bauerella* and *Sarcomelicope* (Hartley, 1974, 1975, 1982). The phytochemistry of the genus *Acronychia* is characterized by the occurrence of acridone and furoquinoline alkaloids, (Bowie, Cooks, Prager & Thredgold, 1967; Hlubuceck, Ritchie & Taylor, 1970; Lahey, McCamish & McEwan, 1969; Lamberton & Price, 1953; Prager & Thredgold, 1968, 1969; Sekiba, 1974; Xu & Xue, 1984) triterpenes (Fukuoka & Natori, 1972) and isoprenylated acetophenones (Banerji, Rej & Chatterjee, 1973; Biswas & Chatterjee, 1970; Govindachari, Sathe, Viswanathan, Pai & Rao, 1969). Alkaloids (de Silva, de Silva, Mahendran & Jennings, 1979), triterpenoids (Arthur, Chan, Loo, Tam & Tung, 1966) and acetophenones (Kumar, Karunaratne, Sanath & Meegalle, 1989; Lahey & Hutchins, 1961; de Silva et al., 1991; Wu et al., 1989) have all been isolated previously from *A. pedunculata*; we now report a new isoprenylated acetophenone derivative from this species.

2. Results and discussion

Extraction of the leaves of *A. pedunculata* followed by CC and HPLC yielded the novel compound 1-[2′,4′-dihydroxy-3′-(3″-methylbut-2″-enyl)-5′-(1‴-ethoxy-3‴-methylbutyl)-6′-methoxy]phenylethanone (**1**) as a major component. The molecular formula of **1** was determined as $C_{21}H_{32}O_5$ by HREIMS. Rigorous determination of the structure of **1** was achieved by consideration of the results of 1D-NMR (^{1}H, ^{13}C and DEPT) and 2D-NMR (HSQC, HMBC and ^{1}H-^{1}H COSY) experiments leading to unambiguous assignments of ^{13}C and ^{1}H resonances as reported in Table

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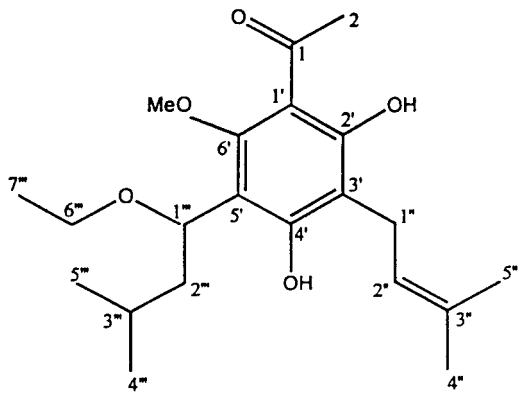
Table 1
NMR assignments for compounds **1** and **2**

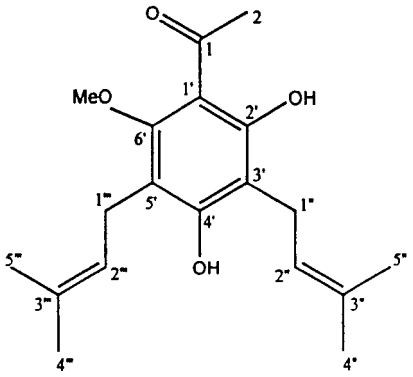
Atom	**1**				**2**	
	δ_C (mult.)[a]	δ_H[a]	Correlation from[b] ^{13}C to ^{1}H	Correlation from[c] ^{1}H to ^{1}H	δ_C (mult.)[a]	δ_H[a]
1	203.5 C	–	2.67	–	203.6 C	–
2	31.0 CH_3	2.67	–	–	31.1 CH_3	2.68
1′	108.2 C	–	13.60, 2.67	–	109.0 C	–
2′	160.9 C	–	13.60, 3.27	–	161.6 C	–
3′	114.7 C	–	9.84. 3.27	–	111.0 C	–
4′	162.3 C	–	9.84	–	160.7 C	–
5′	109.4 C	–	9.84	–	112.7 C	–
6′	160.5 C	–	3.72	–	159.2 C	–
1″	22.4 CH_2	3.27	–	5.20	22.8 CH_2	3.37
2″	123.2 CH	5.20	3.27, 1.77, 1.70	3.27	121.7 CH	5.22
3″	131.5 C	–	3.27, 1.77, 1.70	–	134.4 C	–
4″	25.71 CH_3	1.70	1.77	–	25.8 CH_3	1.73
5″	17.9 CH_3	1.77	1.70	–	17.9 CH_3	1.81
1‴	75.7 CH	5.00	–	1.80	21.8 CH_2	3.33
2‴	44.1 CH_2	1.80, 1.40	0.96, 0.95	5.00	122.3 CH	5.22
3‴	24.7 CH	1.84	0.96, 0.95	0.96, 0.95	134.6 C	–
4‴	21.7[d] CH_3	0.96[d]	0.95	1.84	25.8 CH_3	1.75
5‴	23.4[d] CH_3	0.95[d]	0.96	1.84	17.9 CH_3	1.81
6‴	65.7 CH_2	3.61, 3.52	1.23	1.23	–	–
7‴	15.1 CH_3	1.23	–	3.61, 3.52	–	–
6-OMe	62.6 CH_3	3.72	–	–	62.8 CH_3	3.70
2-OH	–	13.60	–	–	–	13.57
4-OH	–	9.84	–	–	–	6.27

[a] ^{13}C connected by 1 bond to ^{1}H determined by HSQC.
[b] 2- and 3-bond correlations determined by HMBC.
[c] ^{1}H-^{1}H correlations determined by ^{1}H-^{1}H COSY.
[d] Interchangeable within column.

1. In particular, correlations observed from the quaternary carbons C-2′/3′ to the 1″-methylene protons (as well as to the 2-OH and 4-OH protons) unambiguously placed the unmodified isopropenyl substituent at the 3′-position of the phenylethanone ring, thereby requiring that the modified isoprenyl substituent (1-ethoxy-3-methylbutyl) be situated at the 5′-position. The closely related known arylketone 1-[2′,4′-dihydroxy-3′,5′-di-(3″-methylbut-2″-enyl)-6′-methoxy]phenylethanone (Kumar et al., 1989) (**2**) (containing unmodified isoprenyl substituents at both positions 3′ and 5′ of the phenylethanone system was also isolated as a major component of the extract and its NMR resonances were independently assigned using the same methodology as for **1** (rigorous NMR assignments of **2** have not been reported previously). The NMR assignments for **2** are also given in Table 1 (2D-NMR correlations are not shown, but were similar to those given for **1**) and provided further conformation for the novel structure proposed for **1**. Compound **1** can formally be derived from compound **2** by addition of the elements of ethanol. It has sometimes been suggested that compounds containing an ethoxy group such as **1** may arise as artefacts during the extraction and purification procedures. Only highest quality (AR grade) solvents were used in this work, and we therefore believe that **1** is unlikely to be an artefact of extraction. Caryophyllene oxide was also isolated from the extract in large amounts.



1



2

3. Experimental

3.1. General

Chemical shifts are expressed in ppm (δ) relative to TMS as int. standard. All NMR experiments were run on a Bruker DRX 500 instrument with $CDCl_3$ as solvent. HSQC and HMBC experiments were recorded with 2048 data points in F_2 and 128 data points in F_1. EIMS (70 eV) spectra were recorded on a Finnigan-MAT 95 MS spectrometer. TLC plates were developed using *p*-anisaldehyde. HPLC separations were performed using a PREP-SIL 20 mm × 25 cm column, flow rate 8 ml/min.

Leaf tissue of *A. pedunculata* (1.15 kg) was collected in Plover Cove Country Park, New Territories, Hong Kong; a voucher specimen (GDB 98/5) has been deposited in the herbarium of the University of Hong Kong (HKU). The sample was ground to a fine powder under liq. N_2 and immediately extracted with CH_2Cl_2. The organic extract was then dried and evapd. under red. pres. to yield a dark green oil (22.9 g; 1.99% w/w) which was separated chromatographically. **1** (26.0 mg) by CC (30% EtOAc/hexane) followed by HPLC (R_t 15.30 min in 35% EtOAc/hexane); **2** (86.6 mg) by CC (30% EtOAc/hexane) followed by HPLC (R_t 25.24 min in 25% EtOAc/hexane).

3.2. 1-[2′,4′-dihydroxy-3′-(3″-methylbut-2″-enyl)-5′-(1‴-ethoxy-3‴-methylbutyl)-6′-methoxy]phenylethanone (*1*)

Oil. ^{1}H NMR δ: 13.60 (1H, s), 9.84 (1H, s), 5.20 (1H, tq, J = 6.5, 1.1 Hz), 5.00 (1H, dd, J = 9.6, 3.9 Hz), 3.72 (3H, s), 3.61 (1H, dq, J = 9.5, 7.0 Hz), 3.52 (1H, dq, J = 9.5, 7.0 Hz), 3.27 (2H, d, J = 6.5 Hz), 2.67 (3H, s), 1.77 (3H, s), 1.70 (3H, d, J = 1.1 Hz), 1.23 (3H, t, J = 7.0 Hz), 0.96 (3H, d, J = 6.5 Hz), 0.95 (3H, d, J = 6.5 Hz). HREIMS m/z (rel. int.): 364.2246 [M^+, calc 364.2250 for $C_{21}H_{32}O_5$] (6), 318 [M^+-C_2H_5OH] (65), 303 (95), 275 (30), 263 (26), 247 (100), 219 (42), 207 (28).

3.3. 1-[2′,4′-dihydroxy-3′,5′-di-(3″-methylbut-2″-enyl)-6′-methoxy]phenylethanone (*2*)

Oil. ^{1}H NMR δ: 13.57 (1H, s), 6.27 (1H, s), 5.22 (2H, m), 3.70 (3H, s), 3.37 (2H, d, J = 8.3 Hz), 3.33 (2H, d, J = 8.1 Hz), 2.68 (3H, s), 1.81 (6H, s), 1.75 (3H, d, J = 1.2 Hz), 1.73 (3H, d, J = 1.2 Hz). HREIMS m/z (rel. int.): 318.1825 [M^+, calc 318.1831 for $C_{19}H_{26}O_4$] (53), 303 (22), 275 (9), 263 (28), 247 (100), 219 (43), 207 (50).

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References

Arthur, H. R., Chan, R. P. K., Loo, S. N., Tam, S. W., & Tung, S. (1966). *Phytochemistry*, *5*, 379.
Banerji, J., Rej, R. N., & Chatterjee, A. (1973), *Ind. J. Chem.*, 693.
Biswas, G.K., & Chatterjee, A. (1970). *Chem. Ind.*, 654.
Bowie, J. H., Cooks, R. G., Prager, R. H., & Thredgold, H. M. (1967). *Aust. J. Chem.*, *20*, 1179.
Cheung, S. C. (1988). *Chinese medicinal herbs of Hong Kong*, *Vol. 4* (p. 62). Hong Kong: Commercial Press.
de Silva, L. B., de Silva, U. L. L., Mahendran, M., & Jennings, R. (1979). *Phytochemistry*, *18*, 1255.
de Silva, L. B., Herath, W. M., Liyanage, C., Kumar, V., Ahmad, V. U., & Sultana, A. (1991). *Phytochemistry*, *30*, 1709.
Fukuoka, M., & Natori, S. (1972). *Chem. Pharm. Bull.*, *20*, 974.
Govindachari, T. R., Sathe, S. S., Viswanathan, N., Pai, B. R., & Rao, U. R. (1969). *Ind. J. Chem.*, 873.
Hartley, T. G. (1974). *J. Arnold Arboretum*, *55*, 469.
Hartley, T. G. (1975). *J. Arnold Arboretum*, *56*, 164.
Hartley, T. G. (1982). *Aust. J. Bot.*, *30*, 359.
Hlubucek, J., Ritchie, E., & Taylor, W. C. (1970). *Aust. J. Chem.*, *23*, 1881.
Kumar, V., Karunaratne, V., Sanath, M. R., & Meegalle, K. (1989). *Phytochemistry*, *28*, 1278.
Lahey, F. N., & Hutchins, R. (1961). In *Symposium on Phytochemistry* (p. 121). Hong Kong: Hong Kong University Press.
Lahey, F. N., McCamish, M., & McEwan, T. (1969). *Aust. J. Chem.*, *22*, 447.
Lamberton, J. A., & Price, J. R. (1953). *Aust. J. Chem.*, *6*, 66.
Prager, R. H., & Thredgold, H. M. (1968). *Aust. J. Chem.*, *21*, 229.
Prager, R. H., & Thredgold, H. M. (1969). *Aust. J. Chem.*, *22*, 2627.
Sekiba, T. (1974). *Bull. Chem. Soc. Jpn.*, *47*, 2895.
Wu, T.-S., Wang, M.-L., Jong, T.-T., McPhail, A. T., McPhail, D. R., & Lee, K.-H. (1989). *J. Nat. Prod.*, *52*, 1284.
Xu, W.-H., & Xue, Z. (1984). *Huaxue Xuebao*, *42*, 899.