6-OXO-6a, 12a-DEHYDRO-α-TOXICAROL, A 6-OXO-DEHYDROROTENONE FROM THE ROOTS OF *DERRIS OBLONGA* BENTH

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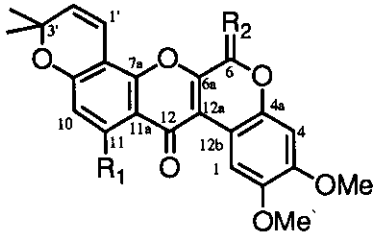
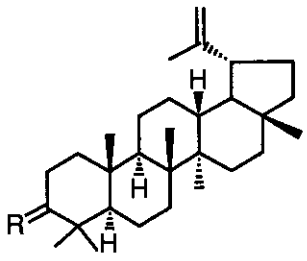
Absract --------- A 6-oxodehydrorotenone, 6-oxo-6a,12a-dehydro-α-toxicarol, together with nineteen known compounds containing sugar, triterpenes, isoflavones, anthraquinones, rotenone, dehydrorotenones, 12a-hydroxyrotenones, coumestans, coumaronochromones and pterocarpen, were isolated from the roots of *Derris oblonga*, and characterized on the basis of spectral and chemical evidence.

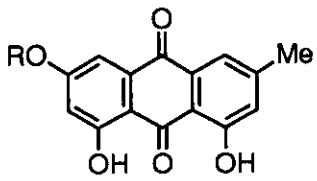
Derris laxiflora, D. oblonga, and *D. trifoliata* are the only three species of *Derris* indigenous to Taiwan. Two flavone glycosides were isolated from the roots of *D. trifoliata*.[1] Flavones, flavonols, chalcones, dihydrochalcones, isoflavans, rotenones, stilbenes, coumarins, aurones, pterocarpans, coumestans, triterpene, glycosides, and other interesting components have been observed from other species of *Derris*.[2-8] In connection with our interest in flavonoids and in view of the biological activity of the root,[3] chemical studies on *D. laxiflora* were undertaken in our laboratory.[9,10]
In the previous reports,[11-13] we described the isolation of five new compounds, oblongin **(1)**, oblonginol **(2)**, 6a,12a-dehydro-β-toxicarol **(3)**, derricarpin **(4)**, and 12-deoxo-12a-acetoxyelliptone **(5)** together with a known compound, 6a,12a-dehydro-α-toxicarol **(6)** from the ethanol extract of the root of *D. oblonga*. In this paper, we wish to describe the detailed isolation of ethanol extract of the roots of this plant, from which nineteen known compounds, lupenone **(7)**,[14] β-amyrin **(8)**,[9] lupenol **(9)**,[9] physcion **(10)**,[15] 6a,12a-dehydrodeguelin **(11)**,[16] 6a,12a-dehydrorotenone **(12)**,[17] villosol **(13)**,[18] sumatrol **(14)**,[17] maackiain **(15)**,[19] toxicarol isoflavone **(16)**,[20] 6-hydroxy-6a,12a-dehydro-α-toxicarol **(17)**,[21] tephrosin **(18)**,[22] 12a-hydroxyrotenone **(19)**,[5] 11-hydroxytephrosin **(20)**,[23] daidzein



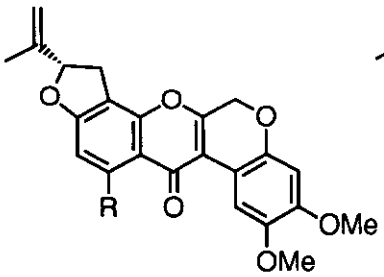
6 R_1 = OH, R_2 = H_2
11 R_1 = H, R_2 = H_2
17 R_1 = OH, R_2 = H, OH
26 R_1 = OH, R_2 = O
27 R_1 = OAc, R_2 = O



7 R = O
9 R = β-OH,H



10 R = Me
23 R = H



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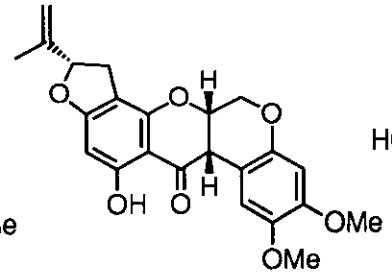
13 R =OH



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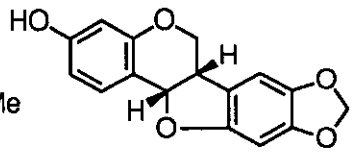

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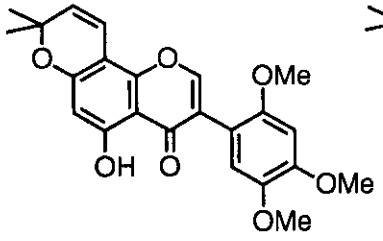
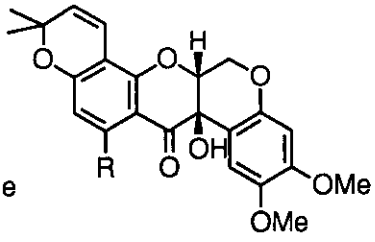
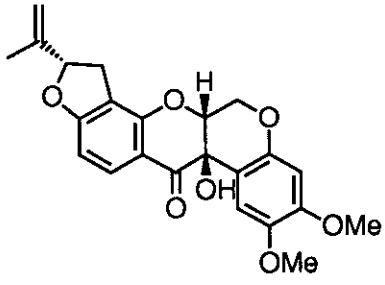


16



18 R = H
20 R = OH



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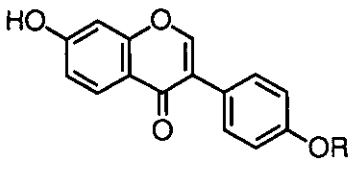

21 R = H
22 R = Me

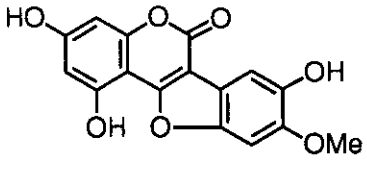

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Table I ^{1}H- and ^{13}C-nmr data (δ- value) of **26** and **6** (300 MHz, 75 MHz, $CDCl_3$)

H	26	6	C	26	6
1	8.77 s	8.23 s	6a	162.2	156.8
4	6.84 s	6.51 s	7a	160.8	159.2
6		4.95 s	8	100.8	100.5
10	6.30 s	6.25 s	9	162.2	162.3
1'	6.86 d (10.0)	6.62 d (10.0)	10	94.1	94.6
2'	5.63 d (10.0)	5.57 d (10.0)	11	150.6	150.8
4'	1.48 s	1.46 s	11a	100.8	100.6
5'	1.48 s	1.46 s	12	180.9 [a)]	179.2
OMe	3.92 s	3.84 s	12a	106.2	105.9
OMe	3.97 s	3.91 s	12b	109.9	109.9
OH	12.46 s	12.96 s	1'	114.3	114.3
C			2'	127.9	127.7
1	107.6	110.7	3'	79.0	79.8
2	145.2	144.1	4'	28.2	28.2
3	151.2	149.2	5'	28.4	28.2
4	99.6	101.0	OMe	56.1	55.9
4a	146.8	146.2	OMe	56.2	56.3
6	180.1 [a)]	64.7			

a : Assignment may be interchanged.

(21),[24] formononetin **(22)**,[25] emodin **(23)**,[15] 8-methoxycoumestrol **(24)**,[26] and sucrose **(25)**, together with a new rotenone derivative, 6-oxo-6a,12a-dehydro-α-toxicarol **(26)** were observed. The components of this plant are very interesting. They involve extensive different skeleton's structures including terpenens **(7, 8, 9)**, anthraquinones **(10, 23)**, isoflavones **(16, 21, 22)**, coumestans **(4, 24)**, coumaronochromones **(1, 2)**, pterocarpen **(15)**, rotenone **(14)**, dehydrorotenones **(3, 6, 11, 12, 13, 17, 26)**, 12a-hydroxyrotenones **(18, 19, 20)**, deoxorotenone **(5)**, and sugar **(25)**. The structural elucidation of new compound 6-oxo-6a,12a-dehydro-α-toxicarol **(26)** based on the following evidence.

6-Oxo-6a,12a-dehydro-α-toxicarol **(26)** was obtained as orange red needles, mp 289-291 °C. Elemental analysis gave its molecular formula as $C_{23}H_{18}O_8$, and mass spectral fragmentation

provided peaks at 422 (M^+, 16%), 407 (M^+-CH_3, 100%), 391 (19%), and 203 (20%). The ultraviolet spectrum exhibited absorption bands at λ_{max}^{MeOH} (log ε) : 272 (4.22), 304 (4.07), and 328 (3.94) nm. Compound **(26)** shows the ir spectrum absorptions at 3400, 1740, 1650, 1580, and 1520 cm^{-1} attributable to hydroxy, lactone, ketone, and aromatic functionalities, respectively. The ^{1}H-Nmr spectrum (Table I) of **26** shows singnal at δ 3.92 and 3.97 (each 3H, s) for two phenolic methyl ethers, δ 6.30, 6.84 and 8.77 (each 1H, s) for three aromatic protons, and δ 12.46 (1H, s) for a chelated phenolic proton. The signal at δ 8.77 is a characteristic signal of H-1 in dehydrorotenone which suffers deshielding effect by the C-12 carbonyl group.[27-29] The doublets at δ 5.63 and 6.86 (each 1H, d, J = 10.0 Hz), and the singlet at δ 1.48 (6H, s) are characteristic of the *cis* double bond and gem-dimethyl group of a 2,2-dimethylchromene moiety.[9,30] The ^{1}H-Nmr spectrum of **26** is similar to that of 6a,12a-dehydro-α-toxicarol **(6)** (Table I) except for the presence of a carbonyl group in **26** in place of methylene group. The 2,2-dimethylchromene group was assigned as been fused onto a neighboring ring at the C-8 and C-9 positions based on the following evidence. Compound **(26)** was converted to its monoacetate **(27)** [ν_{max}^{KBr} 1770, 1740, and 1640 cm^{-1}; δ 2.47 (3H, s) and 6.96 (1H, d, J = 10.0 Hz, H-1')]. The downfield (0.10 ppm)[9,31-33] shift of H-1' in **27** compared with H-1' in **26**, the presence of 2.8% nuclear Overhauser effect between H-10 and AcO-11 in **27**, and ^{13}C-Nmr spectrum (Table I) of **26** are all the evidence for supporting the assigned structure. The chemical correlation between **26** and **6** was achieved as follows. Compound **(26)** was produced from **6** by the oxidation with fresh manganese dioxide.[18] The proposed structure was also supported by the ms spectral fragmentation.[34,35]

EXPERIMENTAL

Melting point were determined on a Yanagimoto micromelting point apparatus and are uncorrected. Ir spectra were recorded on a Perkin-Elmer 781 spectrophotometer. ^{1}H- and ^{13}C-Nmr spectra were run on a Brucker AM 300 at 300 MHz in $CDCl_3$ solution with tetramethylsilane(TMS) as an internal standard. Chemical shifts are given in δ-value and coupling constants (J) are given in hertz (Hz). EI-ms and uv spectra were taken on a JEOL JMS-100 spectrometer and Hitachi U-3200 spectrophotometer, respectively.

Extraction and Isolation

The roots of *Derris oblonga* were crushed into small pieces and dried at 50 °C to give 6.1 kg of raw material, which was extracted with 95% ethanol (80 l) three times (8 h each time) at 60 °C. The combined extracts were evaporated *in vacuo* to give residue (293 g), which was subsequently subjected to partition with ether and H_2O (each 1 l). The upper layer provided a black viscous mass (270 g). The aqueous layer was partitioned with butanol (1 l) to yield butanol soluble layer which was purified on a Diaion HP-20 and Sephadex LH-20 chromatography to give sucrose **(25)** (2.6 g) only. The ether soluble fraction (100 g) was subjected to column chromatography on silica gel with hexane-$CHCl_3$, $CHCl_3$ and $CHCl_3$-MeOH gradient solvent systems. After repeatedly chromatographed on silica gel, $AgNO_3$-coated silica gel, and Sephadex LH-20, the hexane-$CHCl_3$(6 : 4) eluent gave lupenone **(7)** (18 mg), the $CHCl_3$ eluent gave β-amyrin **(8)** (34 mg), lupenol **(9)** (162 mg), 6-oxo-6a,12a-dehydro-α-toxicarol **(26)** (16 mg), physcion **(10)** (26 mg), 6a,12a-dehydrodeguelin **(11)** (16 mg), 6a,12a-dehydrorotenone **(12)** (14 mg), 6a,12a-dehydro-α-toxicarol **(6)** (253 mg), 12-deoxo-12α-acetoxyelliptone **(5)** (18 mg), villosol **(13)** (12 mg), sumatrol **(14)** (23 mg), 6a,12a-dehydro-β-toxicarol **(3)** (12 mg), derricarpin **(4)** (18 mg), maackiain **(15)** (38 mg), toxicarol isoflavone **(16)** (26 mg), 6-hydroxy-6a,12a-dehydro-α-toxicarol **(17)** (15 mg), tephrosin **(18)** (50 mg), 12a-hydroxyrotenone **(19)** (30 mg), and 11-hydroxytephrosin **(20)** (5.76 g). The 5% MeOH/$CHCl_3$ eluent yielded daidzein **(21)** (11 mg), formononetin **(22)** (182 mg), emodin **(23)** (21 mg), oblongin **(1)** (18 mg), oblonginol **(2)** (35 mg), and 8-methoxycoumestrol **(24)** (16 mg).

6-Oxo-6a,12a-dehydro-α-toxicarol (26) : mp 289-291 °C. Ir (KBr)(ν cm^{-1}) : 3400, 1650, 1570, 1510, 1255, 1040, 870, 820, 775. ^1H- and ^{13}C-Nmr ($CDCl_3$) : Table I. *Anal.* Calcd for $C_{23}H_{18}O_8$: C, 65.40; H, 4.30. Found : C, 65.58; H, 4.22.

Acetylation of 26 with Acetic Anhydride

Compound **(26)** (5 mg) was allowed to react with Ac_2O (1.0 ml) in pyridine (1.0 ml) at 60 °C overnight. Usual work-up gave monoacetate **(27)** (4 mg) [mp 263-266 °C. Ir (KBr)(ν cm^{-1}) : 1770, 1740, 1640, 1610, 1500, 1280, 1180. ^1H-Nmr ($CDCl_3$) δ 1.51 (6 H, s), 2.47, 3.94, 3.99 (each 3H, s), 5.72, 6.96 (each 1H, d, J = 10.0 Hz, H-1', H-2'), 6.54, 6.87, 8.88 (each 1H, s, H-4, H-10, H-1).

Oxidation of 6 With Manganese Dioxide

Compound **(6)** (5 mg) and excess MnO_2 (50 mg) in 20 ml of CH_2Cl_2 was heated under reflux for 3 days. The reaction mixture was purified on silica gel preparative thin layer chromatography (hexane:$CHCl_3$=1:4) to yield **26** (3 mg).

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