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A NEW 12a-HYDROXYELLIPTONE FROM THE STEMS OF *DERRIS MALACCENSIS*

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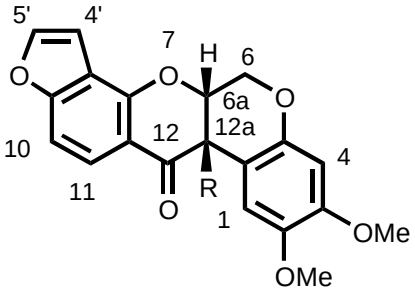
Abstract- A new rotenoid, 12a-hydroxyelliptone **(1)** and the known rotenoid 12-deoxo-12α-acetoxyelliptone **(2)** were isolated from the stems of *Derris malaccensis*. The structures were established by spectroscopic and chemical methods as well as by comparison with published data.

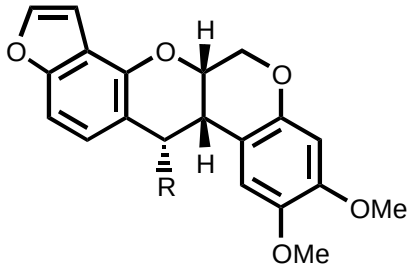
Many plants in the family Leguminosae, especially in the genera *Derris*, *Lonchocarpans*, *Millettia*, *Mundulea* and *Tephrosia* have been used as fish poison and insecticides.[1,2] These plants were often used by the native population to treat infestations of insect parasites and some other pests.[1] *Derris* plants are found throughout the tropical regions of Asia and East Africa and are widely used in cattle and sheep dips for the control of ticks and other ectoparasites.[1] It is currently used in horticulture against aphids, caterpillars, sawflies, wasps, raspberry beetles and red spiders.[1]

Derris malaccensis is a Thai plant locally known as “haang lai kaow”. The plant is used for pest control and fish poison[2,3] and has not been previously studied chemically. In this paper, we report the isolation and structural elucidation of a new rotenoid, 12a-hydroxyelliptone **(1)**, and the known rotenoid 12-deoxo-12α-acetoxyelliptone **(2)**.[4] A number of 12a-hydroxyrotenoid derivatives have recently been isolated.[5-11]

Compound **(1)** was isolated from the hexane extract of the plant after preparative TLC. The molecular formula of $C_{20}H_{16}O_7$ was established from the elemental analysis and MS spectrum exhibiting the molecular peak at *m/z* 368. It showed UV maxima ($CHCl_3$) at 281, 242 and 233 nm, and IR absorptions

($CHCl_3$) at 3450 (br, OH) and 1675 cm^{-1} (chelated C=O). The ^1H NMR spectrum showed a hydroxyl signal at δ 4.53, two aromatic singlets at δ 6.56 and 6.45, four aromatic proton signals at δ 7.87, 7.56, 7.17 and 6.95 which were reminiscent of 4,5-disubstituted benzofuran ring, and two methoxy singlets at δ 3.78 and 3.70. A pair of nonequivalent methylene proton signals at δ 4.70 and 4.56 and a methine proton doublet at δ 4.74 are similar to ABC system (δ 4.56, 1H, d, *J* = 12.0 Hz; δ 4.70, 1H dd, *J* = 12.0, 2.3 Hz; δ 4.74, 1H, d, *J* = 2.3 Hz) corresponding to a O-CH_2-CH-O segment. In agreement with the latter assignment, ^{13}C NMR spectrum of **1** showed methylene and methine carbon resonances at δ 64.0 and 76.8, respectively. The ^1H NMR spectrum of **1** is similar to that of elliptone **(5)** [12] except for a hydroxy group in place of the α-hydrogen at C-12a. The structure of **1** was further supported by the ^{13}C NMR spectrum which showed a quaternary carbon of C-12a at δ 67.9 as compared with δ 44.0 of **5**.[13] The aforementioned data suggested the structure of **1** as 12a-hydroxyrotenoid, the hydroxyl group could be acetylated by acetic anhydride in pyridine to give the corresponding acetate derivative **(3)**, $C_{22}H_{18}O_8$, which showed in its ^1H NMR spectrum the signal of an aliphatic acetyl group (δ 1.80), assigned to the group attached at 12a position.





1 12a-hydroxyelliptone, R = OH
3 12a-acetoxyelliptone, R = OAc
5 elliptone, R = H

2 12-deoxo-12α-acetoxyelliptone, R = OAc
4 elliptinol, R = OH

In the MS spectrum of **1**, two fragment ion peaks at *m/z* 160 and 208 resulting from cleavage between the B/C rings of 6a, 12a-saturated rotenoids revealing that ring D possessed benzofuran ring (*m/z* 160), and rings A and B had two methoxyl and one hydroxyl groups (*m/z* 208). Similar fragmentation was observed for acetate derivative **3** giving rise to two corresponding fragments at *m/z* 160 and *m/z* 250. The H-1 chemical shift value (δ 6.56) indicated that the B/C ring junction in **1** was *cis*.[14-15] The *cis* stereochemistry at 6a and 12a positions was also supported from the acetylation product of 12a-hydroxyroteniods. In the NMR spectrum, the 6a-H of 12a-acetoxyelliptone **(3)** was significantly shifted to lower field as compared to 6a-H of 12a-hydroxyroteniods **(1)**. This anisotropic effect is possible when 6a-H and acetoxy group are in the *cis* relationship, but we cannot conclude whether the above formula or its enantiomeric form represents its actual absolute configuration.[16,17] Compound **(2)** was identified to be 12-deoxo-12α-acetoxyelliptone **(2)** by comparison of its mp, $[\alpha]^{20}_D$, UV, IR, ^1H and ^{13}C NMR, and

MS data with published values.[4] The ^{1}H and ^{13}C NMR assignments of **2** were obtained through analysis of the ^{1}H-^{1}H and ^{1}H-^{13}C COSY spectra. Hydrolysis of **2** was accomplished by 50% NaOH in methanol to give elliptinol **(4)**.[4]

EXPERIMENTAL

General: MPs were determined on an electrothermal melting point apparatus (Electothermal 9100) and are uncorrected. Optical rotations were measured with a JASCO DIP-370 Digital Polarimeter. UV spectra were taken in EtOH on a JASCO Uvidex-650 double beam spectrometer. IR spectra were recorded in a chloroform solution on a JASCO A-302 spectrometer. MS spectra were measured on AEI-MS-902 instrument. ^{1}H, ^{13}C NMR spectra were recorded on Bruker AM400 at 400 or 100 MHz and Bruker ACF 200 at 200 or 50 MHz using TMS as internal standard.

Plant material: Stems of *D. malaccensis* were collected from Ubonradchathanee Province during 1990. Botanical identification was achieved through comparison with a specimen from the Forest Herbarium, Bangkok, Thailand. A herbarium voucher specimen is retained at the Faculty of Science, Ramkhamhaeng University, Bangkok, Thailand.

Extraction and Isolation: Dried powdered stems of *D. malaccensis* (1 kg) were extracted with hexane (7 L) at room temperature for 1 week. After filtration the extract was evaporated to give the residue (13.1 g). The stems left after hexane extraction were further extracted with EtOAc (6.5 L) and MeOH (7 L) each at room temperature for 1 week to give the residues (17.6 g and 104.0 g respectively). The residues from hexane extract and MeOH extract were each chromatographed on silica gel using hexane, $CHCl_3$ and increasing polarity of MeOH giving combined 12a-hydroxyelliptone **(1)** (209 mg) and 12-deoxo-12α-acetoxyelliptone **(2)** (313 mg).

12a-Hydroxyelliptone (1): Colorless needles (EtOH): mp >200 ˚C (decomp); $[\alpha]^{20}_{D}$ +24.6^{o} (*c* = 0.25, $CHCl_3$); IR ($CHCl_3$) ν_{max} cm^{-1} 3450 (OH), 1675 (C=O), 1617 (C=C); UV λ_{max} ($CHCl_3$) (log ε) 233 (4.6), 242 (2.3), 281 (0.7) nm; ^{1}H-NMR (400 MHz, $CDCl_3$): δ 3.70 (3H, *s*, OCH_3-2), 3.78 (3H, *s*, OCH_3-3), 4.53 (1H, *s*, 12a-OH, D_2O exchangeable), 4.56 (1H, *d*, *J* = 12.0 Hz, H-6β), 4.70 (1H, *dd*, *J* = 12.0, 2.3 Hz, H-6α), 4.74 (1H, *d*, *J* = 2.3 Hz, H-6a), 6.45 (1H, *s*, H-4), 6.56 (1H, *s*, H-1), 6.95 (1H, *dd*, *J* = 2.3, 1.1 Hz, H-4'), 7.17 (1H, *dd*, *J* = 8.6, 1.1 Hz, H-10), 7.56 (1H, *d*, *J* = 2.3 Hz, H-5'), 7.87 (1H, *d*, *J* = 8.6 Hz, H-11); ^{13}C-NMR (100 MHz, $CDCl_3$): δ 56.0 (OCH_3-3), 56.4 (OCH_3-2), 64.0 (C-6), 67.9 (C-12a), 76.8 (C-6a), 101.2 (C-4), 104.8 (C-4'), 107.1 (C-10), 108.7 (C-12b), 109.4 (C-1), 112.0 (C-8), 117.5 (C-11a), 124.0 (C-11), 144.0 (C-2), 145.0 (C-5'), 148.4 (C-4a), 151.2 (C-3), 156.0 (C-7a), 160.7 (C-9), 192.1 (C-12); EIMS *m/z* (rel. int.): 368 $[M]^{+}$ (11), 208 $[C_{11}H_{12}O_4]^{+}$ (100), 207 $[C_{11}H_{11}O_4]^{+}$ (44), 193 $[C_{10}H_9O_3]^{+}$ (10), 160 $[C_9H_4O_3]^{+}$ (8); Anal. Calcd for $C_{20}H_{16}O_7$: C, 65.24; H, 4.38. Found: C, 65.01; H, 4.19.

12a-Acetoxyelliptone (3): Colorless needles (EtOH): mp >230 ˚C (decomp); $[\alpha]^{20}_{D}$ +11.3^{o} (*c* = 0.25, $CHCl_3$); IR ($CHCl_3$) ν_{max} cm^{-1} 1736 (C=O), 1680 (C=C), 1617 (C=C); UV λ_{max} ($CHCl_3$) (log ε) 235 (3.9),

238 (3.1), 242 (2.4), 280 (0.7) nm; ^{1}H-NMR (200 MHz, $CDCl_3$): δ 2.16 (3H, *s*, 12a-$OCOCH_3$), 3.75 (3H, *s*, OCH_3-2), 3.80 (3H, *s*, OCH_3-3), 4.39 (1H, *dd*, *J* = 12.0, 1.0 Hz, H-6β), 4.68 (1H, *dd*, *J* = 12.0, 2.3 Hz, H-6α), 5.59 (1H, *m*, H-6a), 6.47 (1H, *s*, H-4), 6.85 (1H, *s*, H-1), 6.88 (1H, *dd*, *J* = 2.3, 1.0 Hz, H-4'), 7.16 (1H, *dd*, *J* = 8.0, 1.0 Hz, H-10), 7.55 (1H, *d*, *J* = 2.3 Hz, H-5'), 7.92 (1H, *d*, *J* = 8.0 Hz, H-11); ^{13}C-NMR (50 MHz, $CDCl_3$): δ 21.4 ($OCOCH_3$), 55.9 (OCH_3-3), 56.3 (OCH_3-2), 63.8 (C-6), 73.2 (C-6a), 74.8 (C-12a), 100.8 (C-4), 103.2 (C-12b), 104.8 (C-4'), 107.1 (C-10), 110.8 (C-1), 113.6 (C-8), 117.2 (C-11a), 124.4 (C-11), 144.2 (C-2), 145.1 (C-5'), 149.5 (C-4a), 151.9 (C-3), 154.8 (C-7a), 160.6 (C-9), 170.0 (COO), 186.1 (C-12); EIMS *m/z* (rel. int.): 410 $[M]^+$ (11), 250 $[C_{13}C_{14}O_5]^+$ (43), 208 $[C_{11}H_{12}O_4]^+$ (100), 207 $[C_{11}H_{11}O_4]^+$ (43), 160 $[C_9H_4O_3]^+$ (6); Anal. Calcd for $C_{22}H_{18}O_8$: C, 64.39; H, 4.42. Found: C, 64.13; H, 4.52.

12-Deoxo-12α-acetoxyelliptone (2): Colorless needles (EtOH): mp 153-155 ˚C (decomp) (lit.,[4] mp 150-152 ˚C); $[\alpha]^{20}_D$ –320.5^o (*c* = 0.5, $CHCl_3$); IR ($CHCl_3$) ν_{max} cm^{-1} 1726 (O-C=O), 1620 (C=C); UV λ_{max} ($CHCl_3$) (log *ε*) 250 (3.07), 258 (2.80), 292 (1.76) nm; ^{1}H-NMR (400 MHz, $CDCl_3$): δ 1.80 (3H, *s*, 12-$OCOCH_3$), 3.67 (1H, *dd*, *J* = 4.9, 4.7 Hz, H-12a), 3.84 (6H, *s*, OCH_3-2 and OCH_3-3), 4.33 (1H, *dd*, *J* = 10.5, 4.9 Hz, H-6β), 4.53 (1H, *t*, *J* = 10.5 Hz, H-6α), 5.00 (1H, *m*, H-6a), 6.43 (1H, *s*, H-4), 6.70 (1H, *s*, H-1), 6.87 (1H, *dd*, *J* = 2.2, 1.0 Hz, H-4'), 7.11 (1H, *dd*, *J* = 8.0, 1.0 Hz, H-10), 7.21 (1H, *d*, *J* = 8.0 Hz, H-11), 7.55 (1H, *d*, *J* = 2.2 Hz, H-5'); ^{13}C-NMR (100 MHz, $CDCl_3$): δ 21.0 ($OCOCH_3$), 37.0 (C-12a), 56.0 (OCH_3-3), 57.0 (OCH_3-2), 64.5 (C-6), 67.0 (C-12), 69.5 (C-6a), 101.0 (C-4), 104.0 (C-4'), 105.5 (C-10), 109.0 (C-12b), 111.5 (C-8), 112.5 (C-1), 117.5 (C-11a), 127.0 (C-11), 144.0 (C-2), 144.5 (C-5'), 147.0 (C-4a), 149.0 (C-3), 149.5 (C-7a), 157.0 (C-9), 170.0 (COO); EIMS *m/z* (rel. int.): 396 $[M]^+$ (7), 192 $[C_{11}H_{12}O_3]^+$ (100), 191 $[C_{11}H_{11}O_3]^+$ (23); Anal. Calcd for $C_{22}H_{20}O_7$: C, 66.66; H, 5.09. Found: C, 66.74; H, 4.95.

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