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DEOXYELEPHANTOPIN AND ITS INTERRELATION WITH ELEPHANTOPIN

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The chloroform extract of Elephantopus scaber from Taiwan ('mizumigiku' in Japanese) has afforded lupeol acetate and deoxyelephantopin, $C_{19}H_{20}O_6$, mp 198-200°, the structure of the latter being based on the evidence described in the following.

The uv spectrum (EtOH) of this compound showed end absorption whereas the ir spectrum (KBr) showed bands assignable to carbonyl groups (1766,1747, 1716 cm^{-1}) and double bonds (br, 1600 cm^{-1}). Extensive nmr decoupling experiments ($CDCl_3$) led to the arrangement of protons which fitted into a deoxyelephantopin structure as depicted in 1. For example, the signals of the 3- and 9-methylenes and 7-methine overlap and appear as two sets of absorptions centered around 2.9 ppm; irradiation at 2.9 ppm (i.e., 3-,9-,7-H) induced the following changes in nmr signals: 1-H multiplet became doublet, 2-H multiplet became doublet, 6-H double doublet became doublet, 8-H doublet of triplets became singlet, and 13'-H doublet became singlet.

Nmr Signals of Deoxyelephantopin

δ in ppm, J in Hz

1.83 15-H, d, $J_{15,5} = 1$

1.93 18-H, t, $J_{18,19} = J_{18,19'} =$ ca. 1

2.60-3.10 3-H, 7-H, 9-H, m

4.65 8-H, dt, $J_{8,7} = 10$

$J_{8,9} = J_{8,9'} = 3$

4.77 5-H, dd, $J_{5,6} = 10$, $J_{5,15} = 1$

5.13 6-H, dd, $J_{6,5} = 10$, $J_{6,7} = 8$

5.45 2-H, m, $J_{2,1} = 1.5$

5.64 19-H and 13-H, m

6.14 19'-H, m

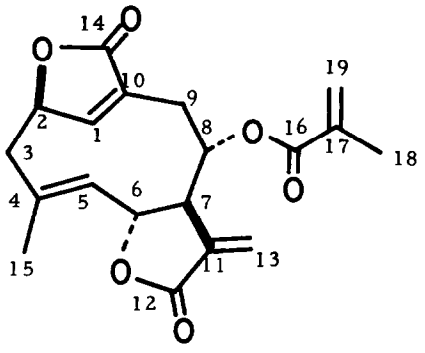
6.21 13'-H, d, $J_{13',7} = 3.5$

7.13 1-H, m

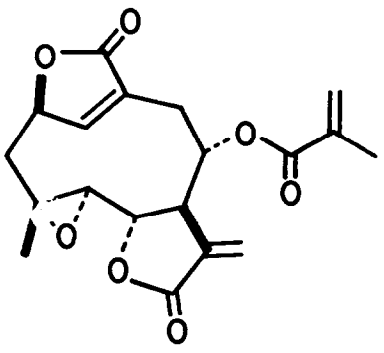
Structure 1 was conceived as a likely assignment in view of the botanical origin of the compound from the genus which had yielded elephantopin (2)[1-3] and of the similarity of the spectroscopic data to those of elephantopin (2). The structure was confirmed by selective epoxidation of deoxyelephantopin with p-nitroperbenzoic acid in methylene chloride (2 mg from 32 mg, stirring for 2 days at room temperature) to give elephantopin (2) (identical ir spectra). Furthermore, elephantopin (2) was converted to deoxyelephantopin (1) by a sequence which included treatment with zinc-copper couple, a reagent recently shown to effect direct reductive elimination of epoxides to olefins.[4]

Initially, an attempt was made to convert elephantopin (2) directly to deoxyelephantopin (1) by treatment with zinc-copper couple. However, the product was dihydrodeoxyelephantopin (3, 77%): $C_{19}H_{22}O_6$; mp 212-216° dec; nmr (acetone-d_6) δ 1.29 (d, J = 7 Hz, 13-H), 1.82 (br s, 15-H), 4.9 (m, 5-H), 7.5 (m, 1-H); ir (KBr) 1769, 1743, 1711, 1660, 1647, 1636 cm^{-1}; uv λ_{end}^{MeOH} 210 mμ, ε 17,600; obtained by reductive elimination of the epoxide ring with concomitant saturation of the conjugated methylene of the lactone ring.

The conversion was successfully executed via the amorphous bis-1-propanethiol adduct 4: $C_{25}H_{36}O_7S_2$; nmr ($CDCl_3$) δ 1.34 (s, 15-H), 7.6 (m, 1-H); ir (KBr) 1780, 1760, 1715, 1645 cm^{-1}; uv λ_{max}^{MeOH} 216 mμ, ε 24,000; mass spectrum m/e 512 (M^+); formed by treatment of 2 with 1-propanethiol and pH 9.2 buffer solution in tetrahydrofuran.[5] Treatment of 4 with zinc-copper couple in boiling ethanol gave deoxyelephantopin bis-1-propanethiol adduct 5: $C_{25}H_{36}O_6S_2$; mp 157-160°; nmr ($CDCl_3$) δ 1.85 (br s, 15-H), 4.7 (m, 5-H),



1



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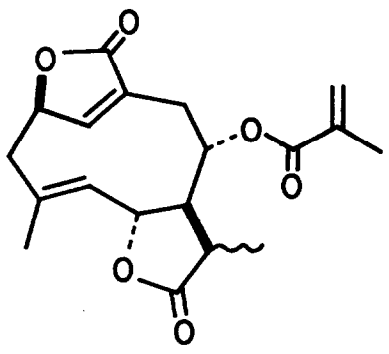

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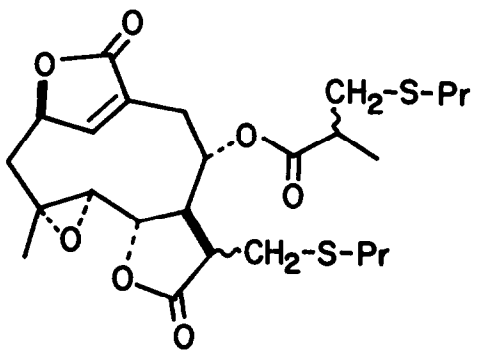

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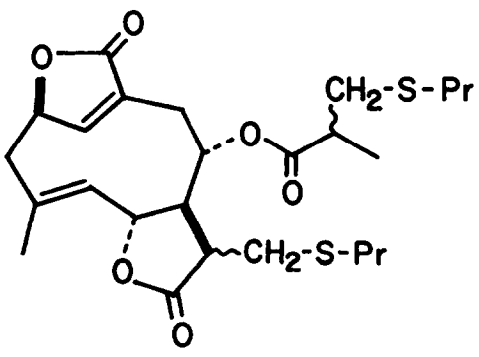

5

7.1 (m, 1-H); ir (KBr) 1775, 1747, 1715, 1638 cm^{-1}; uv λ_{max}^{MeOH} 210, ϵ 24,700; mass spectrum m/e 496 (M^+). When 5 was heated with methyl iodide in methylene chloride, deoxyelephantopin (1, overall yield 5%, identical tlc, ir and nmr spectra) was obtained.

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