

STUDIES OF AUSTRALIAN SOFT CORALS. VI<sup>1</sup> - A NEW CEMBRANOLIDE DITERPENE

FROM THE SOFT CORAL *LOBOPHYTUM CRASSUM*

(Coelenterata, Anthozoa, Octocorallia, Alcyonacea)

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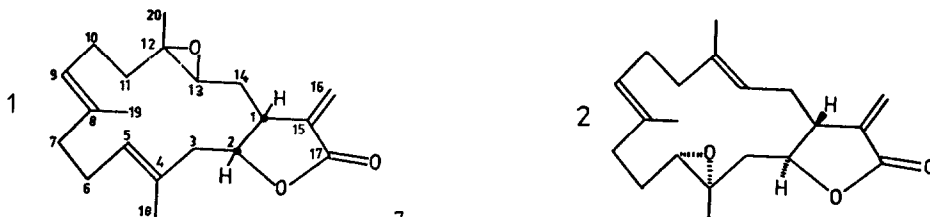
Dichloromethane extraction of a freeze dried sample of the soft coral *Lobophytum crassum*<sup>+</sup> followed by rapid silica gel chromatography of the extract, afforded as the major terpenoid component, the diterpene whose structure we show to be 1. [An oil, 0.5% yield:  $[\alpha]_D -103^\circ$  (C, 0.04%,  $\text{CHCl}_3$ ); IR:  $\nu_{\text{max}}$  (nujol) 1760 (C=O), 1660 (C=C)  $\text{cm}^{-1}$ ; UV:  $\lambda_{\text{max}}$  (EtOH) 210 (6540) nm; NMR: pmr ( $\text{CDCl}_3$ )  $\delta$  1.24(3H,s), 1.40(2H,m), 1.60(3H,s), 1.70(3H,s), 2.40(6H,m), 2.80(2H,m), 4.10(1H,ddd,J 3.2,7.0,9 Hz), 5.00(2H,m), 5.84(1H,d,J 3 Hz), 6.20(1H,d,J 3.5 Hz); cmr ( $\text{CDCl}_3$ ) 15.5(q), 17.0(2q), 24.2(t), 24.9(t), 32.3(t), 37.8(t), 39.0(t), 44.5(d), 45.2(t), 60.1(s), 63.0(d), 79.9(d), 122.5(t), 124.5(d), 129.3(s), 130.3(d), 134.5(s), 140.0(s), 169.6(s), ppm; MS:  $M^+$  316.203 ( $\text{C}_{20}\text{H}_{28}\text{O}_3$  requires 316.204)].

The diterpene 1 was isomeric with the reported<sup>2</sup> cembranolide diterpene lobophytolide 2, and by comparison of the IR, UV and NMR spectral values for 2, compound 1 appeared to contain a  $\gamma$ -lactone-conjugated *exo*-methylene group as in 2. This was confirmed by the formation of a crystalline pyrazolone derivative from 1 on treatment with diazomethane<sup>3</sup>, and the following double resonance experiments. Irradiation at  $\delta$  2.80 in the pmr spectrum of 1 collapsed the pair of doublets at  $\delta$  6.20, 5.84 to singlets, simultaneously with the collapse of the signal at  $\delta$  4.10 to a doublet of doublets (J 3.2,9 Hz). One of the protons at  $\delta$  2.80 was thus the methine proton (H-1) coupled to the *exo*-methylene group (H<sub>2</sub>-16) and the lactonic methine proton (H-2). Irradiation at  $\delta$  2.40 caused the lactonic methine proton (H-2) to collapse to a doublet (J 7 Hz). Clearly the methylene at  $\delta$  2.40 was allylic<sup>4</sup>.

The cmr spectrum of 1 contained signals for 7  $\text{sp}^2$  carbons (4 singlets, 2 doublets and 1 triplet)<sup>5</sup>. The molecular formula  $\text{C}_{20}\text{H}_{28}\text{O}_3$  required 7 degrees of unsaturation, thus indicating that the molecule was tricyclic. The lactone accounted for one ring; an epoxide was indicated (pmr:  $\delta$  2.80,1H,m, and  $\delta$  1.24,3H,s<sup>4</sup>; cmr: 63,d; 60.1,s ppm<sup>5</sup>) identifying a second ring. Based on precedents in the soft coral literature<sup>6</sup>, it was assumed that the compound was cembranoid.

A two proton multiplet centred near  $\delta$  5 in the pmr spectrum was assigned to two vinyl methine protons, and the two methyl singlets at  $\delta$  1.60, 1.70 were obviously vinylic. Irradiation at  $\delta$  5.0 caused the methyl resonances to sharpen considerably confirming that the two double bonds were tri-substituted, whilst irradiation near  $\delta$  2.4 caused the broad multiplet at  $\delta$  5 to become two broadened

<sup>+</sup> Tentative classification; Registered sample number G10728. Queensland Museum, Brisbane, Australia. Sample collected at Feather Reef, off Innisfail, North Queensland.



singlets at  $\delta$ 5.15, 4.95. Micro-ozonolysis<sup>7</sup> afforded one mole of laevulinolaldehyde (by comparison with squalene). Hydrogenation afforded a crystalline hexahydroderivative<sup>3</sup>. Double resonance experiments on a  $\text{Eu}(\text{fod})_3$  shifted spectrum of 1 confirmed that the epoxymethine proton (H-13) and the methine H-1 (both originally coincident at  $\delta$ 2.8) were each coupled to the same methylene group (H<sub>2</sub>-14) resonating at  $\delta$ 1.40 in the unshifted spectrum. Structure 1 thus represents the only cembranolid diterpene which fits the spectral and chemical data. It is thus an isolobophytolide.

The coupling constants between the protons adjacent to the ring fusion in 1 ( $J_{1,2}$  7 Hz;  $J_{1,16}$  *cis* 3 Hz;  $J_{1,16}$  *trans* 3.5 Hz) more closely resembled the corresponding values reported for eunicin (*cis* ring fusion by X-ray)<sup>8</sup> than for lobophytolide (*trans* ring fusion by X-ray)<sup>2</sup>. The diterpene 1 was thus tentatively assigned the *cis* ring fusion.

The majority of cembranoid diterpenes so far reported from the genus *Lobophytum* possess the  $\gamma$ -lactone, conjugated *exo*-methylene functionalisation of the terminal isopropyl grouping<sup>2,9</sup>.

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