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ZOANTHAMINONE, A NEW ALKALOID FROM A MARINE ZOANTHID

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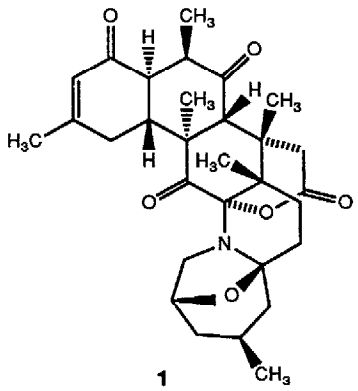
Summary: An unusual alkaloid, zoanthaminone (**1**) has been isolated from a marine zoanthid. Its structure has been established by using X-ray crystallographic and spectroscopic techniques.

As a part of our studies on the chemical constituents of marine organisms found in the Arabian Sea, we investigated an unidentified colonial zoanthid of the genus *Zoanthus* and have isolated a new alkaloid, zoanthaminone (**1**), along with the previously known alkaloids zoanthamine (**2**) and zoanthamide (**3**).[1-3] The compounds were isolated[4] by extensive solvent-solvent fractionation of the ethanolic extracts followed by column and circular plate chromatography on silica gel to afford colorless crystals of zoanthaminone (**1**) , $[\alpha]_D$ +30° (c = 0.1, $CHCl_3$) and compounds **2** and **3**.



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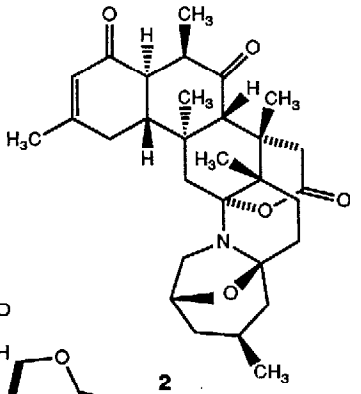

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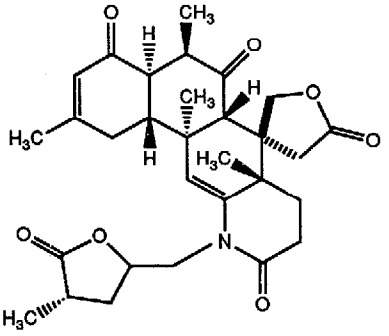

3

Zoanthaminone (**1**) had a UV absorption maximum at 238 nm (CH_3OH). The IR spectrum ($CHCl_3$) displayed three distinct carbonyl absorptions at 1765, 1725 and 1670 cm^{-1}, which indicated the presence of two ketones and a δ-lactone.[5] High resolution mass spectrometry indicated that zoanthaminone (1) had the molecular formula $C_{30}H_{39}NO_6$ (*m/z* 509.2882, calcd. 509.2863). There were also major fragment ions at *m/z* 414, 358 and 135 (100%).

The structure was conclusively elucidated by X-ray diffraction. Zoanthaminone (**1**) crystallized in the orthorhombic space group $P2_12_12_1$ with **a** =12.677, **b** = 14.248, **c** = 14.572 Å, Z=4. All unique reflections were collected ($2\theta \leq 112°$) using θ:2θ scans with graphite monochromated Cu-K$\bar{\alpha}$ radiation (1.54178 Å). Of the 1968 unique reflections, 1891 (96%) had $|F_o| \geq 3\sigma(F_o)$ and were judged observed. The structure was solved by direct methods and refined with anisotropic heavy atoms and isotropic riding hydrogens by full-matrix least-squares techniques to final discrepancy index of 0.046 (R_w = 0.056) for the observed data.[6] A computer generated perspective drawing of final x-ray model is given in Figure 1 below.

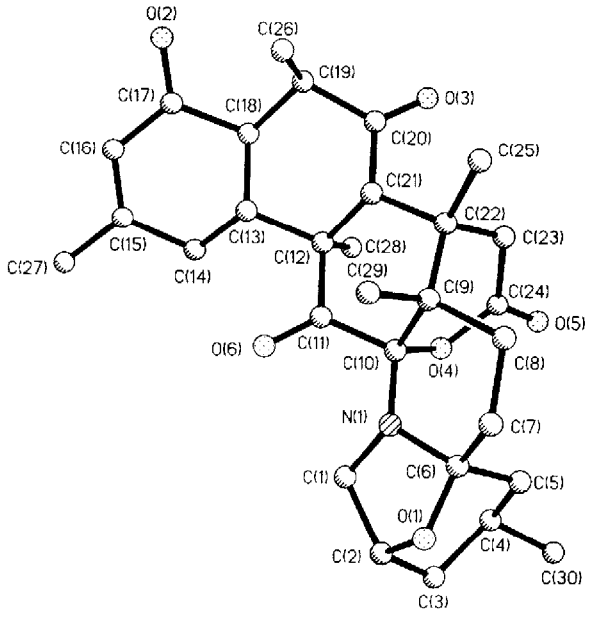

Figure 1. A computer generated perspective drawing of the final x-ray model. Hydrogens are omitted for clarity and no absolute configuration is implied.

The ^{1}H-NMR[7] (300 MHz, $CDCl_3$) spectrum showed four quaternary methyl signals at δ 0.97, 1.08, 1.26 and 2.01 and two doublets at δ 0.88 ($J_{30,4}$ = 6.5 Hz) and 1.15 ($J_{26,19}$ = 6.6 Hz) for the two secondary methyls which were assigned to the 30 and 26 methyl protons respectively. A doublet

of doublets at δ 3.99 ($J_{1\beta,1\alpha}$ = 8.0 Hz, $J_{1\beta,2}$ = 7.4 Hz) was assigned to the C-1β proton, while C-1α proton appeared as a multiplet at δ 3.00. In the 2D COSY-45° spectrum the double doublet at δ 3.99 for the C-1β proton showed coupling with the C-1 and C-2 protons at δ 3.00 and 4.53 respectively. The C-2 proton also showed coupling with C-3 protons at δ 1.55. The 30-Me protons were coupled to H-4 at δ 2.28 which in turn was coupled with C-3 and C-5 protons.

The ^{13}C-NMR spectrum[8] (100 MHz, $CDCl_3$) of zoanthaminone (**1**) showed 30 carbon resonances. The multiplicity of carbon was determined by DEPT and GASPE[9,10] experiments. The spectrum showed the presence of six methyl, seven methylene and nine methine signals. The peaks due to the δ-lactone carbonyl and the C-20 carbonyl appeared at δ 171.03 and 210.52 respectively. The peaks at δ 197.75, 125.83, 162.17 and 22.91 were characteristic of the β-methylenone functionality.

The zoanthaminone (1) is the sixth member of a new class of alkaloids of unknown biosynthetic origin.[1-3] As pointed out by the earlier workers, the most plausible biogenesis would be through a rearranged triterpene.

Acknowledgments

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References and Notes

1. C. B. Rao, A. S. R. Anjaneyulu, N. S. Sarma, Y. Venkateswarlu, R. M. Rosser, D. J. Faulkner, M. H. M. Chen and J. Clardy, *J. Am. Chem. Soc.*, **106**, 7983 (1984).

2. C. B. Rao, A. S. R. Anjaneyulu, N. S. Sarma, Y. Venkateswarlu, R. M. Rosser and D. J. Faulkner, *J. Am. Chem. Soc.*, **50**, 3757 (1985).

3. C. B. Rao, D. V. Rao, V. S. N. Raju, B. W. Sullivan and D. J. Faulkner, *Heterocycles*, **28**, 103 (1989).

4. Fresh animal (an unidentified zoanthid of the genus *Zoanthus*, 40 kg) was homogenized with an ultra-turax homogenizer under 95% CH_3OH. Specimens are available from the H. E. J. Research Institute of Chemistry. The extract was filtered and concentrated under reduced pressure to a gum. The latter was partitioned between water (500 ml) and pet.ether (40-60°)

(500 ml) and then between water (500 ml) and EtOAc (500 ml) repeatedly. The EtOAc fraction was concentrated under vacuum and the residue (200 g) was subjected to column chromatography on silica gel. Elution was carried out using pet. ether and acetone (6:4) as the solvent system. This afforded a fraction containing three alkaloids. These were further purified by circular plate chromatography (Chromatotron) using pet. ether and EtOAc (6:4) as the solvent system to afford the three alkaloids namely zoanthaminone (**1**), zoanthamine (**2**) and zoanthamide (**3**).

5. E. Pretsch, T. Clerc; J. Seibl, and W. Simon, *Tables for the Structural Explanation of Organic Compounds with Spectroscopic Methods*, 2nd Ed., Springer-Verlag, Berlin, p. 145 (1981).

6. Archival X-ray crystallographic data have been deposited with and can be ordered from the Cambridge Crystallographic Data Centre, University Chemical Laboratory, Lensfield Road, Cambridge, CB2 1EW, U.K. Please give a complete literature citation when ordering.

7. ^{1}H-NMR (300 MHz, $CDCl_3$) : δ 0.88 (d, $J_{30,4}$ = 6.5 Hz, CH_3-30), 0.97 (s, CH_3-28), 1.02 (m, H5α), 1.08 (s, CH_3-25), 1.15 (d, $J_{26,19}$ = 6.6 Hz, CH_3-26), 1.26 (s, CH_3-29), 1.55 (m, H-3), 1.57-1.90 (m, CH_2-7 and 8), 1.83 (m, H-5β), 2.01 (s, CH_3-27), 2.10 (m, CH_2-14), 2.28 (m, H-4), 2.53 (d, $J_{23\alpha,23\beta}$ = 20.5 Hz, H-23α), 2.58 (dd, $J_{18,13}$ = 13.4, $J_{18,19}$ = 5.3 Hz, H-18), 2.89 (dd, $J_{13,18}$ = 13.8, $J_{13,14}$ = 3.8 Hz, H-13), 3.00 (m, H-1α), 3.01 (m, H-19), 3.34 (s, H-21), 3.99 (dd, $J_{1\beta,1\alpha}$ =8.0, $J_{1\beta,2}$ =7.4 Hz, H-1β), 4.12 (d, $J_{23\beta,23\alpha}$ = 20.5 Hz, H-23β), 4.53 (m, H-2), 5.89 (bs, H-16).

8. ^{13}C-NMR (100 MHz, $CDCl_3$) : δ 48.17 (C-1), 74.56 (C-2), 38.53 (C-3), 24.55 (C-4), 43.99 (C-5), 90.62 (C-6), 30.93 (C-7), 24.24 (C-8), 43.54 (C-9), 103.46 (C-10), 202.73 (C-11), 36.79 (C-12), 45.68 (C-13), 29.91 (C-14), 162.17 (C-15), 125.83 (C-16), 197.75 (C-17), 48.66 (C-18), 48.66 (C19), 210.52 (C-20), 53.82 (C-21), 38.50 (C-22), 35.21 (C-23), 171.03 (C-24), 17.24 (C-25), 13.54 (C-26), 22.91 (C-27), 20.79 (C-28), 15.98 (C-29), 21.72 (C-30).

9. A. Bax, R. Freeman, *J. Magn. Reson.*, **42**, 164 (1981).

10. Atta-ur-Rahman, *Nuclear Magnetic Resonance Spectroscopy*, Springer-Verlag, New York, p. 202 (1986).

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