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10-OXO-, 10-HYDROXY-, AND 10-METHOXYCEMBRENES FROM THE SOFT CORAL *SARCOPHYTA ELEGANS*

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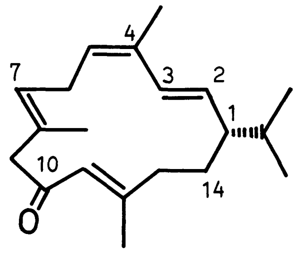
The structures and absolute configurations of three cembranoids, 10-oxo-, 10-hydroxy-, and 10-methoxycembrenes, isolated from the soft coral *Sarcophyta elegans*, are reported.

Further examination on a soft coral *Sarcophyta elegans*[1)] has resulted in the isolation of three cembrane diterpenoids, 10-oxocembrene (**1**), 10-hydroxycembrene (**2**), and 10-methoxycembrene (**3**), from the same sources (14 kg) as described in the previous report.[1)] The second compound, originally isolated from the Red Sea soft coral *Sarcophytum glaucum*,[2)] has now been assigned the structure (**2**) with correct stereochemistry and absolute configuration through the present work.

10-Oxocembrene (**1**, 204 mg), an oil, $C_{20}H_{30}O$ ($M^{+\cdot}$ 286.2325), $[\alpha]_D$ +313.9° (c 2.0, $CHCl_3$). IR ($CHCl_3$) 1685 and 1620 cm^{-1}. UV (EtOH) λ_{max} 235 nm (ε 14700). ^1H NMR ($CDCl_3$) δ 0.82 and 0.86 (both 3H, d, J=6.0 Hz), 1.64 (3H, t, J=1.5 Hz), 1.82 (3H, t, J=1.5 Hz), 2.10 (3H, d, J=1.0 Hz), 2.80 (1H, bd, J=12.5 Hz), 3.08 (1H, d, J=12.5 Hz), 3.10 (1H, m), 5.20 (1H, dd, J=16.0 and 8.0 Hz), 5.36 (1H, bd, J=10.0 Hz), 5.61 (1H, bt, J=8.0 Hz), 6.17 (1H, d, J=16.0 Hz), and 6.19 (1H, bs).

10-Hydroxycembrene (**2**, 607 mg), $C_{20}H_{32}O$ ($M^{+\cdot}$ 288.2469), mp 126.0-127.0 °C (light petroleum ether), $[\alpha]_D$ +155.0° (c 0.94, $CHCl_3$), had identical spectroscopic properties (Mass, IR, and ^{1}NMR) with those for the compound from *S. glaucum*.[2)]

10-Methoxycembrene (**3**, 107 mg), an oil, $C_{21}H_{34}O$ ($M^{+\cdot}$ 302), $[\alpha]_D$ +130.6° (c 1.0, $CHCl_3$). IR ($CHCl_3$) spectrum showed no hydroxyl absorption. ^1H NMR ($CDCl_3$) δ 0.82 and 0.87 (both 3H, d, J=6.0 Hz), 1.60 (3H, bs), 1.67 (3H, d, J=1.0 Hz), 1.78 (3H, t, J=1.5 Hz), 3.00 (1H, m), 3.27 (3H, s), 4.10 (1H, ddd, J=10.0, 8.5, and 5.0 Hz), 4.94 (1H, bd, J=9.0 Hz), 5.13 (1H, bd, J=11.0 Hz), 5.18 (1H, dd, J=15.5 and 9.0 Hz), 5.52 (1H, bt, J=8.0 Hz), and 6.05 (1H, d, J=15.5 Hz).



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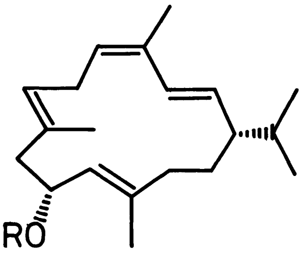
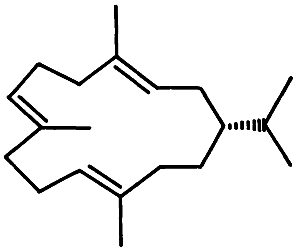


2: R=H, **3**: R=CH_3
4: R=Ac



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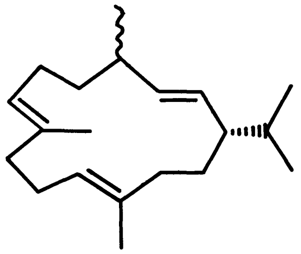


6 and **7**
(epimers at C_4)

The ^{1}H NMR features of the three compounds listed above were very similar to those of cembrene from *Sinularia mayi*,[3] except for the signals at δ 6.19 (1H, bs) due to the β-proton on an α,β-unsaturated ketone in **1**, 4.52 (1H, ddd, J=10.0, 8.0, and 5.0 Hz) assigned to the secondary alcohol methine proton in **2**, and 3.27 (3H, s) and 4.10 (1H, ddd, J=10.0, 8.5, and 5.0 Hz) due to a secondary methoxyl group in **3**, hence the cembranoid structures,[4] **1**, **2**, and **3**, which were chemically interrelated, were proposed. Oxidation of **2** with Cornforth reagent gave an α,β-unsaturated ketone, $[\alpha]_D$ +345.0° (c 0.75, $CHCl_3$), and treatment of **2** with CH_3I and NaH in THF afforded the methyl ether, $[\alpha]_D$ +192.1° (c 1.1, $CHCl_3$). The reaction products obtained were identical in all respects with the natural compounds, **1** and **3**, respectively. To confirm the cembrane skeleton of **2** and to determine the chirality at C_1, conversion of **2** to dihydrocembrene-A (**5**) and dihydrocembrenes (**6** and **7**) was attempted using the acetate (**4**)[5] prepared from **2** by acetylation (Ac_2O/Py): Reduction of **4** (101 mg) with Li in $EtNH_2$ (-78 °C), followed by separation using argentation TLC (15% $AgNO_3$-SiO_2), gave three hydrocarbon isomers, $C_{20}H_{34}$ ($M^{+\cdot}$ 274), **5** (23.8 mg), **6** (8.2 mg), and **7** (21.8 mg), whose spectral data (Mass, IR, and ^{1}H NMR) showed the good coincidence with those for the products[6] which were derived from (-)-cembrene-A and mukulol acetate by similar reduction (Li/liq. NH_3). The hydrocarbons, **5**, **6**, and **7**, exhibited $[\alpha]_D$ -7.4°, +55.0°, and +149.5°, respectively, whose rotations were parallel with those (-17.8°, +82.9°, and +155°)[6] of reported, thus establishing the absolute configuration at C_1 of **2** to be *S*. Due to the flexibility of the 14-membered ring, configuration of the hydroxyl group of **2** could not be determined from dihedral-angle coupling analysis, the *p*-bromobenzoyl ester of **2** was therefore submitted for X-ray diffraction analysis,[7] which defined the *R* configuration at C_{10} and also the absolute structure shown in **2**. With this characterization of **2**, the structures of **1** and **3** were securely assigned as drawn in figures.

References

1) Y. Uchio, M. Nitta, M. Nakayama, T. Iwagawa, and T. Hase, Chem. Lett., 1983, 613.

2) Y. Kashman, E. Zadock, and I. Neeman, Tetrahedron, 30, 3615 (1974); Y. Kashman, A. Groweiss, S. Carmely, Z. Kinamori, D. Czarkie, and M. Rotem, Pure Appl. Chem., 54, 1995 (1982).

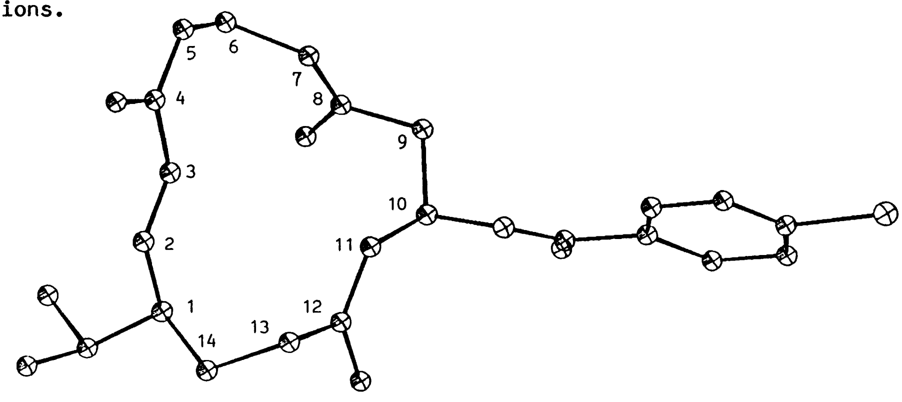
3) Y. Uchio, H. Nabeya, M. Nakayama, S. Hayashi, and T. Hase, Tetrahedron Lett., 22, 1689 (1981).

4) These assignments are also supported by the ^{13}C NMR spectra.

5) $C_{22}H_{34}O_2$ ($M^{+\cdot}$ 330), $[\alpha]_D$ +106.3° (c 1.43, $CHCl_3$): IR ($CHCl_3$) 1725 and 1245 cm^{-1}; ^{1}H NMR ($CDCl_3$) δ 2.02 (3H, s) and 5.72 (1H, ddd, J=11.0, 8.5, and 5.0 Hz).

6) R. S. Prasad and S. Dev, Tetrahedron, 32, 1437 (1976).

7) Crystal data of the *p*-bromobenzoate: $C_{27}H_{35}O_2Br$, mp 117.0-118.0 °C, orthorhombic (EtOH), space group $P2_12_12_1$, *a*=6.294(4), *b*=18.980(20), *c*=21.325(20) Å, and *Z*=4. The structure was solved by heavy atom method and refined by full-matrix least-squares calculation to *R*=0.099 and R_w=0.109 on the 1373 reflections.



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