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TETRAPRENYLTOLUQUINOLS FROM *CYSTOSEIRA* SPP.

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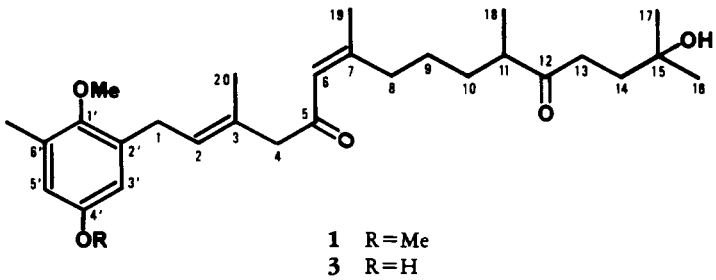
ABSTRACT.—The lipid fractions of three *Cystoseira* species have been analyzed, and one known and two previously unreported tetraprenyltoluquinols have been isolated. Their structures have been determined by spectral analysis and chemical correlation.

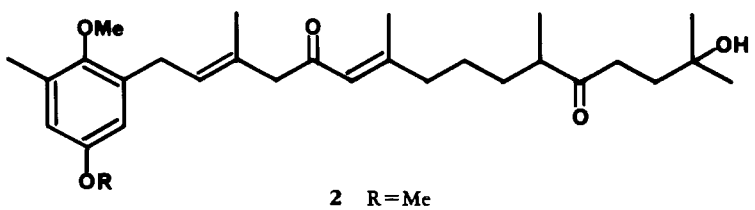
As part of our phytochemical investigation of the brown algae of the genus *Cystoseira* (Cystoseiraceae), from which a variety of compounds of mixed biogenesis (tetraprenyltoluquinols) have been isolated (1), we have now examined three further species, namely *Cystoseira compressa* (Desf.) Bory, *Cystoseira platyramosa* Ercegovic, and *Cystoseira dubia* Val.

While *C. compressa* did not contain detectable amounts of metabolites of this class, from the CH_2Cl_2 extract of *C. platyramosa* a compound was isolated that was identified with the previously described cystalgerone (2,3), based on the comparison of chromatographic and spectral properties with those of a reference sample.

Chromatographic purification of the lipid extract from *C. dubia*, a deep-water species, gave compounds **1** and **2**, whose ^{1}H-nmr spectra were very similar, respectively, to those of **3** and **4**, a pair of geometrical isomers previously isolated from *Cystoseira sauvageauana* (4). In both cases the only significant difference was the presence of an additional resonance (δ 3.68 s both in **1** and **2**) assignable to a second methoxyl group. This was confirmed by the presence of the appropriate resonance (55.5 ppm for the *E* and 54.8 for the *Z* isomer) in the ^{13}C-nmr spectra (5). From the above data it was inferred that the metabolites **1** and **2** from *C. dubia* are the 4′-OMe derivatives of **3** and **4**, respectively. Definite proof of the structure was obtained from the identity of the physical properties ([α], ir, uv,



1 R=Me
3 R=H



2 R=Me
4 R=H

ms) of the *C. dubia* metabolites with those of the MeI/K_2CO_3 methylation of **3** and **4**.

EXPERIMENTAL

GENERAL METHODS.—Eims were determined at 70 eV on a Kratos MS-50S instrument. Uv and ir spectra were recorded on Perkin-Elmer model 330 and model 684 spectrophotometers, respectively. Nmr spectra were measured on a Bruker AC-250 instrument, operating at 250 and 62.9 MHz for ^{1}H and ^{13}C, respectively. Multiplicities of ^{13}C-nmr resonances were determined by DEPT experiments. Optical rotations were determined with a Perkin-Elmer 141 polarimeter using a 10-cm microcell. Preparative liquid chromatography (plc) was carried out on a Jobin-Yvon LC Miniprep (LiChroprep Si 60, 25–40 μ as the stationary phase).

PLANT MATERIAL.—*C. dubia* and *C. platyramosa* were collected by scuba diving at ca. 25 m depth at Acicastello, Sicily, in May 1988. *C. compressa* was harvested at the same locality and in the same period at 1 m depth. Voucher specimens were deposited at the Herbarium of the Department of Botany, Catania, Italy.

EXTRACTION AND PURIFICATION.—The air-dried and ground alga (200 g) was extracted three times with CH_2Cl_2 at room temperature with continuous stirring and the extract evaporated under reduced pressure. The oily residue was subjected to open cc on Si gel with a stepwise gradient of Et_2O in C_6H_{14} as the eluent. Fractions were examined by tlc and appropriately pooled. The pooled fractions were further purified by cc or hplc.

No tetraprenyltoluquinol could be detected in the extract from *C. compressa*.

From *C. platyramosa* a single tetraprenyltoluquinol was isolated (140 mg, 0.07% dry wt) which had spectral properties (ir, uv, ms, ^{1}H and ^{13}C nmr, [α]) identical with those of an authentic sample of cystalgerone available from previous work.

C. dubia gave fractions containing tetraprenyltoluquinols, which were subjected to hplc (Whatman, Partisil M9 10/25, 1% iPrOH in CH_2Cl_2) to afford **1** (20 mg, 0.01% dry wt) and **2** (16 mg, 0.008% dry wt).

COMPOUND **1**.—Oily, $[\alpha]^{20}D$ +1.02 (c = 0.9, EtOH); ir ν max (film) cm^{-1} 3420, 1703, 1685, 1610; uv λ max (EtOH) 222 nm (ε = 13600), 244 (ε = 11000), 283 (ε = 3000); hreims $[M-H_2O]^+$ 454.3078, calcd for $C_{29}H_{42}O_4$, 454.3083; ms *m/z* (%) 454 (4), 436 (5), 366 (6), 285 (10), 253 (11), 220 (50), 205 (46), 189 (24), 175 (14), 165 (100), 151 (20), 147 (16), 135 (52), 119 (12), 91 (20), 43 (9), 41 (14); ^{1}H nmr (250.13 MHz, TMS, δ in $CDCl_3$) 6.48 (2H, bs, H-3′ and H-5′), 5.96 (1H, s, H-6), 5.29 (1H, t, J = 7.5 Hz, H-2), 3.68 (3H, s, 4′-OMe), 3.62 (3H, s, 1′-OMe), 3.30 (2H, d, J = 7.5 Hz, H-1), 3.01 (2H, s, H-4), 2.21 (3H, s, 6′-Me), 1.79 (3H, s, H-19), 1.69 (3H, s, H-20), 1.18 (6H, 2s, H-17 and H-16), 1.05 (3H, d, J = 7 Hz, H-18); ^{13}C nmr (62.9 MHz, TMS, ppm in $CDCl_3$) 215.8 s (C-12), 198.9 s (C-5), 159.9 s (C-7), 155.5 s (C-4′), 150.3 s (C-1′), 135.4 s, 131.8 s, 130.6 s (C-2′, C-6′, C-3), 127.9 d, 122.9 d (C-2, C-6), 113.0 d, 112.1 d (C-3′, C-5′), 68.4 s (C-15), 60.5 q (1′-OMe), 55.4 t (C-4), 54.8 q (4′-OMe), 46.1 d (C-11), 36.6 t, 36.1 t, 33.6 t, 32.9 t, 25.7 t (C-8, C-9, C-10, C-13, C-14), 29.3 q, 29.0 q (C-16, C-17), 28.9 t (C-1), 25.4 q (C-19), 16.5 q, 16.5 q, 16.4 q (C-18, C-20, 6′-Me).

COMPOUND **2**.—Oily, $[\alpha]^{20}D$ +1.16 (c = 1.1, EtOH); ir ν max (film) cm^{-1} 3435, 1698, 1680, 1610; uv λ max (EtOH) 224 nm (ε = 13400), 242 (ε = 12000), 282 (ε = 2800); hreims $[M-H_2O]^+$ 454.3080, calcd for $C_{29}H_{42}O_4$, 454.3083; ms *m/z* (%) 454 (6), 436 (7), 366 (8), 285 (11), 253 (15), 220 (55), 205 (50), 189 (30), 175 (16), 165 (100), 151 (22), 147 (25), 135 (60), 119 (16), 91 (20), 43 (12), 41 (28); ^{1}H nmr (250.13 MHz, TMS, δ in $CDCl_3$) 6.48 (2H, bs, H-3′ and H-5′), 5.97 (1H, s, H-6), 5.30 (1H, t, J = 7.5 Hz, H-2), 3.68 (3H, s, 1′-OMe), 3.60 (3H, s, 4′-OMe), 3.30 (2H, d, J = 7.5 Hz, H-1), 3.00 (2H, s, H-4), 2.20 (3H, s, 6′-Me), 2.05 (3H, s, H-19), 1.70 (3H, s, H-20), 1.18 (6H, 2s, H-16 and H-17), 1.07 (3H, d, J = 7 Hz, H-18); ^{13}C nmr (62.9 MHz, TMS, ppm in $CDCl_3$) 215.2 s (C-12), 199.3 s (C-5), 158.6 s (C-7), 155.5 s (C-4′), 150.3 s (C-1′), 134.7 s, 131.8 s, 130.8 s (C-2′, C-6′, C-3), 127.7 d, 122.5 d (C-2, C-6), 113.7 d, 112.7 d (C-3′, C-5′), 70.1 s (C-15), 60.5 q (1′-OMe), 5.55 q (4′-OMe), 55.4 t (C-4), 46.3 d (C-11), 41.1 t, 36.5 t, 36.2 t, 32.4 t, 25.1 t (C-8, C-9, C-10, C-13, C-14), 29.7 q, 29.4 q (C-16, C-17), 28.5 t (C-1), 19.2 q (C-19), 16.6 q, 16.6 q, 16.4 q (C-18, C-20, 6′-Me).

METHYLATION OF **3** AND **4**.—Methylation of **3** (MeI/K_2CO_3, Me_2CO, reflux temperature, 3 h) gave a compound whose spectral properties ([α], ir, uv, ms, ^{1}H and ^{13}C nmr) were indistinguishable from those of **1**. Analogous methylation of **4** gave a compound whose ^{1}H and ^{13}C nmr were superimposable with those of **2**.

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LITERATURE CITED

1. V. Amico, P. Neri, G. Oriente, and M. Piattelli, *Phytochemistry*, **28**, 215 (1989).
2. V. Amico, G. Oriente, M. Piattelli, and G. Ruberto, *Gazz. Chim. Ital.*, **114**, 169 (1984).
3. V. Amico, G. Giaccone, M. Piattelli, and G. Ruberto, *Phytochemistry*, **27**, 1069 (1988).
4. V. Amico, F. Cunsolo, M. Piattelli, and G. Ruberto, *Phytochemistry*, **24**, 2663 (1985).
5. R.S. Capon, E.L. Ghisalberti, and P.L. Jefferies, *Phytochemistry*, **20**, 2598 (1981).

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