

SPECIALIA

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Structure of two biologically active sesquiterpenoid amino-quinones from the marine sponge *Dysidea avara*

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Summary. The structures of 2 minor constituents of the marine sponge *Dysidea avara*, which induce developmental aberrations in sea-urchin eggs, are described. The structures were confirmed also by a simple synthesis from avarol (1).

Recent experiments³ have revealed that avarol (1), previously⁴ isolated from *Dysidea avara*, and 2 other compounds (DA and DB), coexisting with 1 in the ethanol extracts of the same sponge, inhibit cell cleavage of the fertilized eggs from the sea-urchin *Sphaerechinus granularis*. This interesting property prompted us to study the structure of DA and DB.

Materials and methods. Melting points were determined with a Kofler-Hotstage apparatus and are uncorrected. IR-spectra were recorded with a Perkin-Elmer 360, UV-spectra with a Shimadzu-Bausch and Lomb spectrophotometer, PMR and CMR with a Varian XL-100 Instrument. Mass-spectra were obtained by the direct insertion technique with an AEI MS30 Spectrometer. DA and DB were extracted as previously described and purified by preparative TLC on silica gel (eluent CHCl₃-MeOH, 95:5, DB R_f=0.32, DA R_f=0.80).

Spectral data for DA and DB. DA. C₂₂H₃₁NO₂ (high resolution mass spectrometry); m.p. (hexane) 160–163 °C; MS 341 (M⁺, 15%), 326 (100%); UV (CH₃OH) 289 and 485 (Σ 4688 and 1065) nm; IR (CHCl₃) 3445, 1660, 1620, 1583 cm⁻¹; PMR (CDCl₃) 6.34 (H-6, s), 5.42 (H-3', s), 2.80 (CH₃-NH-, d, J=5 Hz, singlet after addition of DCl) δ; CMR (CDCl₃) 131.7 (C-6', d), 98.3 (C-3', d).

DB. C₂₂H₃₁NO₂ (high resolution mass spectrometry); m.p. (hexane) 153–155 °C; MS 341 (M⁺, 13%), 326 (100%); UV (CH₃OH) 288 and 486 (Σ 5029 and 2088) nm; IR (CHCl₃) 3445, 1660, 1630, 1580 cm⁻¹; PMR (CDCl₃) 6.41 (H-6', d, J=2 Hz), 5.51 (H-3', d, J=2 Hz), 2.84 (CH₃-NH-, d, J=5 Hz, singlet after addition of DCl) δ; CMR (CDCl₃) 138.9 (C-6', d), 97.6 (C-3', d), 29.2 (CH₃-NH-, q).

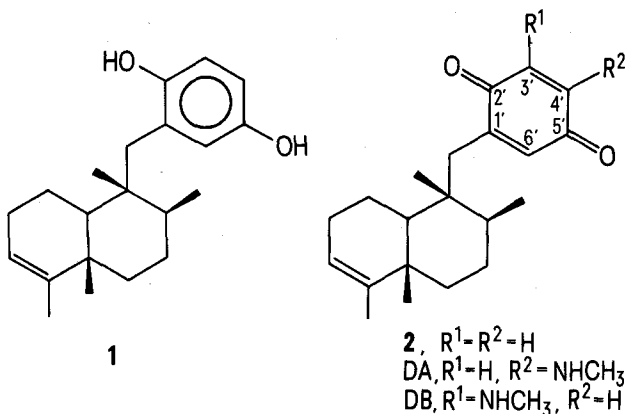
All signals due to the sesquiterpenoid part of avarol (1)^{4,5} are also present in the PMR- and CMR-spectra of DA and DB.

Synthesis of DA and DB. CH₃NH₂HCl (1 g) and pyridine (2 ml) were added to a solution of avarone (2) (200 mg), obtained by a Ag₂O oxidation of avarol (1), in ethanol-water (1:1, 400 ml). After 16 h the alcohol was evaporated and the remaining aqueous solution was extracted with chloroform; the extract was chromatographed on a silica gel column to give, by elution with CHCl₃, 2 compounds which the chromatographic and spectral properties showed to be identical with DA (50 mg) and DB (30 mg).

Results and discussion. The analysis of the spectral data of DA and DB strongly suggested 2 new compounds with structures containing the same sesquiterpenoid carbon skeleton of avarol (1) linked to a disubstituted benzoquinone ring; the 2nd substituent was localized on the basis of the PMR coupling constants exhibited by the quinone protons, while its nature was established by the above-described synthesis.

Experiments with freshly collected and rapidly extracted sponge revealed the presence of DA and DB in very small quantities, whereas when the sponge was exposed to air it turned rapidly red, and large amounts of DA and DB were recovered when the material was further extracted. This, together with the easy synthesis of DA and DB, suggests that these compounds may be formed during treatment of the sponge. Probably, as in the in vitro synthesis, the large amount of avarol present in the sponge, which is slowly oxidized by the air, reacts with amines thus giving rise to DA and DB.

The reported new compounds show a further case of prenyl quinones or quinols exhibiting biological activities such as other similar compounds that show fungicidal⁶, antimicrobial⁷, antimutagenic⁸ and, also, mitotic cell division inhibiting⁹ activity.



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