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AN ANTIBACTERIAL QUINONE HYDROQUINONE PAIR FROM THE ASCOMYCETE, NECTRIA CORYLI*

M. S. R. Nair and Marjorie Anchel
The New York Botanical Garden
Bronx, New York 10458

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In a chemotaxonomic investigation of Nectria species by Doyle[1], it was observed that crude extracts of Nectria coryli yielded "brown crystals" with λ max 290 and 550 nm. After countercurrent distribution of the filtrate, the least polar fraction afforded a partially crystalline yellow material ("Compound 3") with a uv max at 285 nm. These compounds ** have now been identified as the hydroquinone (I) and the corresponding quinone (II), respectively, on the basis of the following evidence:

The "brown crystals", purified by recrystallization (charcoal), had mp 197-8° (EtOAc); λ max 287 nm (3040) and strong end-absorption (ϵ_{220}, 9000); λ max 3425 cm^{-1}. Analysis and ms established the molecular formula $C_{10}H_{14}O_4$. The nmr spectrum (acetone-d_6) showed singlets at δ 2.10 (6H), 3.67 (6H) and 6.7 (2H, exchangeable with D_2O). Acetylation (Ac_2O, NaOAc) afforded a diacetate, $C_{14}H_{18}O_6$, M.W. 282 (ms), mp 138-9° (EtOAc). This had λ max 273 nm (714), ν max 1760 cm^{-1} ($CH_3CO.O$-) and no absorption in the OH region. Nmr showed singlets at δ 2.06 (6H), 2.33 (6H) and 3.7 (6H). These data point to a dihydroxy-dimethoxyxylene structure for the parent compound.

Methylation of the phenolic hydroxyls[2] yielded a compound mp 77-9° λ max 277 nm (820), with no hydroxyl absorption in the ir. Its nmr spectrum showed only two signals: a singlet at δ 3.8 for 12 protons of the methoxy groups, and another at δ 2.2 for 6 protons of the methyl groups. This strongly indicated equivalence of the four methoxyl and of the two methyl groups, a requirement satisfied only by the p-xylene structure (III). Oxidation[3] of the parent compound yielded a quinone mp 131-2°, the nmr spectrum of which showed two signals, singlets of equal intensity at δ 4.0 and 1.93. Its uv spectrum was characteristic of p-benzoquinones, λ max 282 nm (11,400) and

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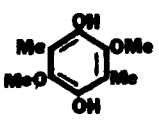
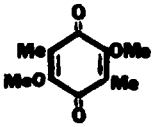
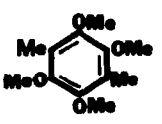
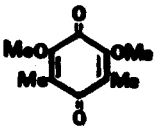
375 nm (300). This established the para position of the hydroxyls in the parent compound, and thus the orientation of all substituents as represented by I.


I


II


III


IV

"Compound 3" isolated from Bactria culture liquids was identical in all respects with the quinone mp 131-2°, and hence has the structure II. As expected, it yielded I on reduction.[3] This structure was further confirmed: Mass spectrum gave M.W. 196, with a strong M + 2 peak characteristic of quinones.[4] The fragmentation pattern was identical with that reported for II,[5] but it did not preclude the structure IV. (Although the quinones II and IV are apparently known,[5,6,7] neither their physical properties, except the mp of II, nor their syntheses have been published, as far as we can ascertain). However, the ir spectrum showed only two quinone peaks, at 1653 and 1610 cm^{-1}, while the less symmetrically substituted benzoquinone, IV, would be expected to show multiple bands.[8] A color test[6] distinguishing between II and IV also clearly indicated that the quinone had the structure II. A synthetic sample of II prepared from 2,5-dimethoxy-3,6-dinitro-p-xylene[9] by the method used for preparation of duroquinone from dinitrodurene [10] was identical in all respects (uv, ir, nmr) with the natural compound.

Both I and II inhibit the growth of Staphylococcus aureus in our tests, at a concentration of 1 μg per ml. The natural occurrence of I and II in the same organism is of interest in connection with the demonstrated coenzyme Q activity of II.[7]

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