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THE STEREPOLIDES: NEW ISOLACTARANES FROM *STEREUM PURPUREUM*

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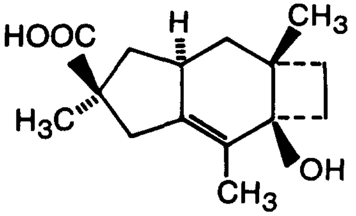
Abstract: Sterepolide and dihydrosterepolide, new sesquiterpenes isolated from the fungus *Stereum purpureum*, are assigned structures 4 and 7, respectively. The assignments are based mainly on spectroscopic studies and similarities to isolactarorufin (5). A possible mode of biogenesis of these isolactarane type sesquiterpenes is discussed.

We have recently reported[1] the structures of sterpuric acid (1) and related sterpurenes, a new type of sesquiterpenoid produced by the fungus *Stereum purpureum* (Pers. ex Pers.) Fr. Biosynthetic studies indicate that the sterpurenes are derived from farnesyl pyrophosphate *via* humulene and the protoilludanyl cation 2[2]. We now wish to report the isolation of two sesquiterpenes of the isolactarane (3)[3] type from *S. purpureum* and to comment on the possible biogenetic significance of this observation.

An ether solution of the neutral portion of the culture broth extract[1] deposited a small amount of crystalline material after several weeks standing. Tlc revealed that this consisted of two components which were separable on silica gel. The less polar component, mp 228-232°, for which we suggest the name sterepolide, possesses the formula $C_{15}H_{16}O_4$[4]. The more polar component, mp 210-212° has the formula $C_{15}H_{18}O_4$[4] and is named dihydrosterepolide[5].

Sterepolide is assigned structure 4 (absolute configuration not implied) on the basis of the following observations. The ir spectrum shows absorption at 1771 cm^{-1} (γ-lactone) and 1702, 1650 cm^{-1} (cyclopentenone). The uv spectrum shows λ_{max} 239 nm (ε 5,000), consistent with a fully substituted cyclopentenone[6]. The ^{13}C nmr spectrum shows a singlet at δ 175.1 (γ-lactone), and singlets at δ 210.8 (cyclopentenone), 165.4, 132.7 (β and α carbons of 2,3-disubstituted 2-cyclopentenone)[7]. The 400 MHz ^1H nmr spectrum consists of a series of well resolved peaks, which allow the assignment of all the hydrogens and their coupling partners (confirmed by double irradiation experiments). H_a appears as a singlet at δ 5.72. H_b is located at δ 4.55 (apparent triplet, J_{bc} = 8 Hz, J_{bd} = 8 Hz), H_c at δ 3.66 (apparent triplet, J_{cd} = 8 Hz), H_d at δ 3.52. The unusually low chemical shift for H_c is attributed to through space deshielding by the carbonyl group at C-1. The isolated methylene group at C-8 gives rise to an AB quartet centered at δ 2.95 (J = 20 Hz) and that at C-10 as a quartet centered at δ 2.43 (J = 18 Hz). The C-8 methylene group is deshielded by the lactone carbonyl. The



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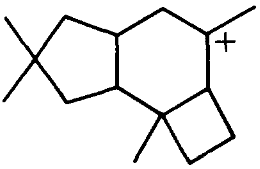

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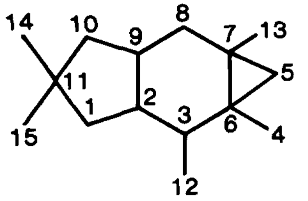

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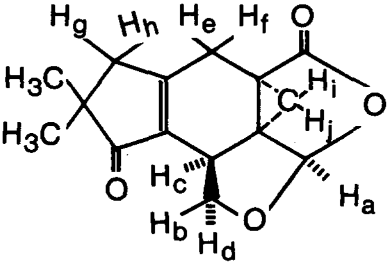

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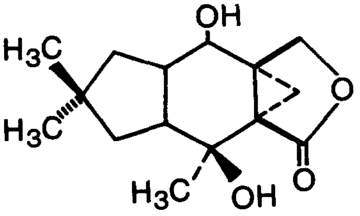

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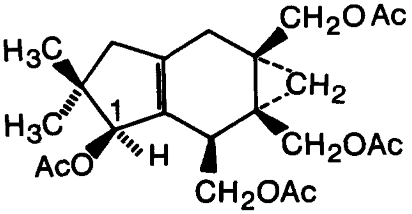

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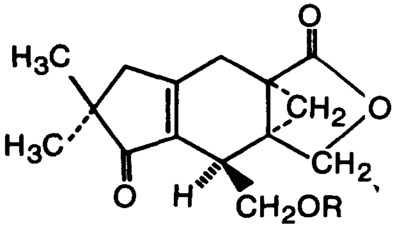
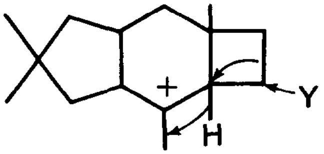


7 R = H

8 R = Ac



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cyclopropyl methylene group appears at δ 1.60 (q, J = 6 Hz) (δ 19.9 in the ^{13}C nmr spectrum) and the methyl singlets at δ 1.14 and 1.13.

The similarity of the above spectral properties with those reported for isolactarorufin (5)[8] is noteworthy. Of concern was the fact that the protons of the cyclopropane methylene are at especially low field (δ 1.60), although this is also the case with isolactarorufin (5)[8]. However, reduction of sterepolide with LAH followed by acetylation of the crude product provided the tetraacetate 6 (configuration at C-1 assigned on the basis that reduction occurs from the less hindered side). The ^{1}H nmr spectrum of 6 is in complete agreement with the assigned structure[5], and most importantly, the cyclopropyl methylene protons appear at δ 0.66 (q, J = 5 Hz). The assignment of the relative stereochemistry of sterepolide is based on the fact that in this tightly fused ring system, all other configurations involve considerable angle strain.

Dihydrosterepolide is assigned structure 7. The ir and uv spectra are similar to those of sterepolide[9]. Acetylation affords the monoacetate 8[10]. The ^{1}H nmr spectrum of 7 is similar to that of sterepolide (4), except that the one proton singlet at δ 5.72 in 4 is replaced by a two proton signal at δ 4.48 (q, J = 9 Hz) in 7. The signal for the hydroxymethyl group (C-12) appears at δ 3.79 (ddd, J_{gem} 11 Hz, J_{vic} 3.5 and 5 Hz), shifted to δ 4.27 in 8. Reduction of dihydrosterepolide (7) with LAH followed by acetylation provided the tetraacetate 6, along with its C-1 epimer. The formation of the C-1 epimer of 6 in this case is taken as further evidence for the location of the ketonic carbonyl at C-1 rather than C-10 (complexation of the reducing species with the C-12 hydroxyl).

To the best of our knowledge, the sterepolides represent only the second and third naturally occurring compounds possessing the isolactarane skeleton[3,8], the other being isolactarorufin (5). The co-occurrence of the sterepolides and the sterpurenes[1] (e.g., 1), suggests the possibility that the isolactarane skeleton may be derived biogenetically *via* the sterpurane cation (9) as indicated by the arrows in 9. This possibility has been suggested[8] (and rejected, prior to the discovery of the sterpurenes) previously[11,12].

References and Notes

1. W.A. Ayer, M.H. Saeedi-Ghomi, D. van Engen, B. Tagle, and J. Clardy. Tetrahedron, in press.
2. W.A. Ayer and M.H. Saeedi, in preparation (see also reference 5).
3. W.A. Ayer and L.M. Browne. Tetrahedron, in press.
4. Because of the small quantities of material available, molecular formulas were determined by high resolution mass spectrometry. Molecular weights were confirmed by chemical ionization mass spectrometry.

5. Complete details of the isolation and characterization of the sterepolides may be found in the Ph.D. thesis of M.H. Saeedi-Ghomi, University of Alberta, 1981. Microfiche copies are available from the Thesis Division, National Library of Canada, 395 Wellington Street, Ottawa, K1A 0N4.
6. A.I. Scott. Interpretation of the ultraviolet spectra of natural products. Pergamon Press, Oxford. 1969. pp 66, 232.
7. J.B. Stothers. Carbon-13 nmr spectroscopy. Academic Press, New York. 1972 pp 193, 289, 290, 300.
8. W.M. Daniewski, M. Kocór, and S. Thoren. Polish J. Chem. **52**, 561 (1978).
9. Ir: 3450, 1760, 1695, 1640 cm^{-1}. Uv: 238 nm (ε 5,100).
10. Mp 168-169°. Ir: 1755, 1690, 1645 cm^{-1}.
11. We acknowledge with gratitude the financial support of the Natural Sciences and Engineering Research Council of Canada, and thank Dr. Y. Hiratsuka, Northern Forest Research Centre, Edmonton, for slant cultures of *S. purpureum* (strain C-663).
12. This work was presented at the XIV Congresso Latinoamericano de Quimica, San Jose, Costa Rica, Feb. 1-7, 1981.

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