The Structure of Cascarillin A, an Epoxy-furanoid Diterpene

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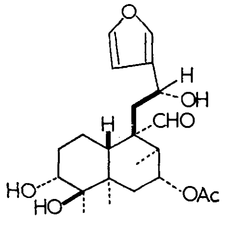
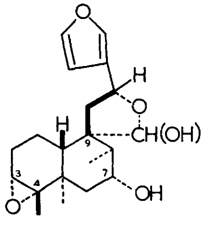
IN addition to cascarillin (I and the corresponding hemiacetal)[1–4] a second furanoid diterpene, cascarillin A, $C_{20}H_{28}O_5$, $[\alpha]_D -61°$ (in dimethylformamide), has been isolated by one of us (W.R.) from cascarilla bark. Structure (II) is suggested for it. The structure accounts for the variable melting point of cascarillin A (187—203°) as acetal formation will occur on heating. The β-substituted furan ring is shown by absorption at 1506 and 875 cm.$^{-1}$ The n.m.r. spectrum in pyridine has bands at τ 7·03 (H atom on an epoxide ring), 4·05 (singlet) (–O–C*H*–O), 4·47 (triplet, *J* 8·4 c./sec.) (H at C-12), and 5·87 (quartet [>C*H*(OH)].

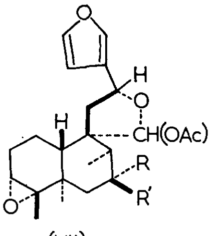
Treatment of cascarillin A with acid gave two known compounds (III)[3,4] and (IV)[3] and a third compound which must be produced by a non-concerted mechanism and which is given structure (V). Its n.m.r. spectrum indicates the presence of two tertiary methyl groups not on carbon carrying oxygen and the absence of an olefinic proton. The isolation of compounds (III) and (IV) indicates the carbon skeleton (including absolute stereochemistry) of cascarillin A (II), the presence of an oxide ring at C-3 and C-4, the β-substituted furan ring, the potential aldehyde group at C-9 and the presence and configuration of the oxygen atoms at C-7 and C-12. Since cascarillin A shows no carbonyl absorption in its infrared spectrum but strong hydrogen bonding the aldehyde group must be involved in hemiacetal formation. Oxidation of cascarillin A with chromic oxide–pyridine gave a



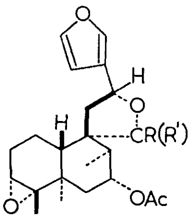
(I)



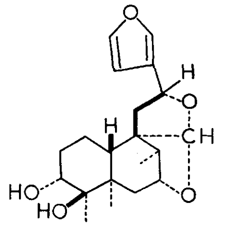
(II)



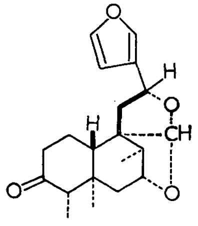
(VII)



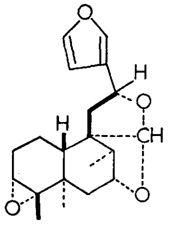
(VIII)



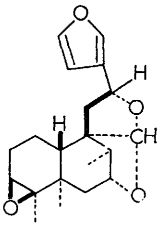
(III)



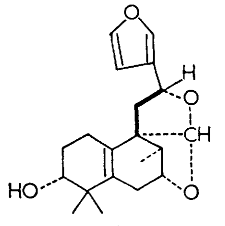
(IV)



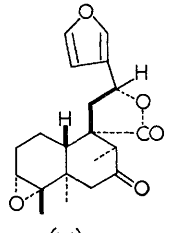
(IX)



(X)



(V)



(VI)

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[1] J. S. Birtwistle, D. E. Case, P. C. Dutta, G. Mathews, T. G. Halsall, H. D. Sabel, and V. Thaller. *Proc. Chem. Soc.*, 1962, 329.

[2] J. S. Birtwistle, D. E. Case, P. C. Dutta, G. Mathews, T. G. Halsall, A. W. Oxford, H. D. Sabel, and V. Thaller, forthcoming publication.

[3] D. E. Case, T. G. Halsall, and A. W. Oxford, Abstract of Papers, I.U.P.A.C. Symposium on 'The Chemistry of Natural Products', Kyoto, Japan, 1964, p. 54.

[4] *cf.* J. M. Robertson, *Proc. Chem. Soc.*, 1963, 235.

keto-γ-lactone (VI), $\nu_{\max.}$ 1760 and 1710 cm.$^{-1}$ (Nujol), $\lambda_{\max.}$ 2070 Å, ϵ 5900; 2840 Å, ϵ 52. These data show that the keto-group is not situated α- to the furan ring and indicates that the hemiacetal involves the oxygen at C-12.

Acetylation of cascarillin A at 20° (Ac_2O/Py.) gave two monoacetates (VII, R=OH, R′=H; VIII, R=OH; R′=H) oxidation of which afforded respectively the ketone (VII, R, R′=O) and the γ-lactone (VIII, R, R′=O). When the hemiacetal (VIII, R=OH, R′=H) was recrystallised from carbon tetrachloride the acetal (IX) was obtained from the mother liquors. It was not identical with the β-epoxy-acetal (X) already obtained[2] from the glycol (III) by treatment with toluene-*p*-sulphonyl chloride in pyridine. By elimination therefore the configuration of the epoxy-group in cascarillin A must be α. Attempts to prepare the acetal (IX) from cascarillin A with 0·1N acid or with *p*-cresol have failed; under these conditions acetal formation is accompanied by opening of the oxide ring.

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