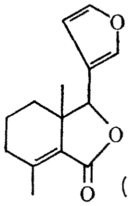
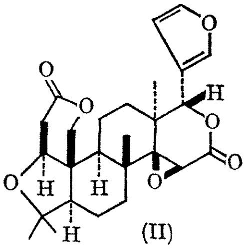
The Structure and Absolute Configuration of Fraxinellone, a Biogenetically Intriguing Terpenoid from *Dictamnus albus L.*

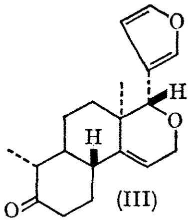
By P. COGGON and A. T. MCPHAIL
(*Department of Chemistry, Duke University, Durham, North Carolina, U.S.A.*)
and R. STORER and D. W. YOUNG*
(*School of Molecular Sciences, University of Sussex, Brighton, Sussex,* BN1 9QJ)

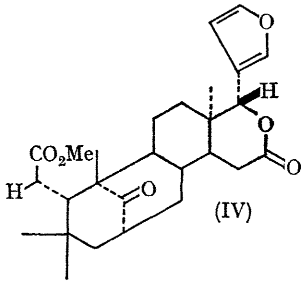
Summary The absolute configuration of fraxinellone has been established by means of an *X*-ray study on a bromo-derivative, and is consistent with the theory that the compound arises in Nature by degradation of a limonoid bitter principle.

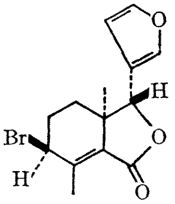
THE structure (I) was suggested for the lactone fraxinellone, $C_{14}H_{16}O_3$, by Pailer *et al.*[1] on the basis of mass-spectral and deuteriation studies. The similarity of the structure (I) to the upper half of the limonin[2,3] molecule (II) led these workers to suggest that fraxinellone was a degraded limonoid bitter principle, a suggestion which was supported by the fact that dictamnolactone, a co-metabolite in *Dictamnus albus L.*, had been shown to be identical with limonin.[4]


(I)


(II)


(III)


(IV)


(V)

Moss[5] and Dreyer[6] have more recently reiterated the hypothesis that fraxinellone is derived biosynthetically from a limonoid by loss of rings A and B and of C-16. A more obviously degraded limonoid bitter principle is the compound odoratin (III) in which the limonin ring B is still extant. The structure[7] (III), based in the main on mass-spectral work, can be obtained biogenetically from carapin (IV) by β-diketone and reverse Michael cleavages. Dreyer[8] had reinforced this biogenetic speculation by showing by o.r.d. studies that the absolute configuration of odoratin is identical with that of the limonoids.

The structure of fraxinellone is less obviously related to the limonoids than is that of odoratin. The molecular formula might suggest a member of the sesquiterpene series, although there is no obviously related known sesquiterpene. If fraxinellone were limonoid in origin, the two asymmetric centres might be expected to have the same absolute stereochemistry as the corresponding centres in the limonoids and so, as a first step to studying the biosynthesis of fraxinellone, we decided to determine the relative and absolute stereochemistry of a bromo-derivative, using *X*-ray methods.

Fraxinellone bromide, obtained by *N*-bromosuccinimide treatment of the lactone, crystallizes in the monoclinic system, space group $P2_1$, with two molecules of $C_{14}H_{15}BrO_3$ in a unit cell of dimensions $a = 9{\cdot}98$, $b = 8{\cdot}00$, $c = 9{\cdot}73$ Å, $\beta = 119{\cdot}3°$. *X*-Ray intensity data were collected by means of equi-inclination Weissenberg photographs. The structure was solved by the heavy atom method,[9] and the atomic co-ordinates and anisotropic thermal parameters were refined by full-matrix least-squares calculations. The present R value for 1023 independent observed structure amplitudes is 11·7%. The absolute configuration of the bromide (V) was determined by Bijvoet's method,[10] based on the anomalous dispersion of the Cu-K_α radiation by the bromine atom, and is consistent with biosynthesis from the limonoid bitter principles. Feeding experiments are in hand to elucidate this point more fully.

(*Received, May* 30*th,* 1969: *Com.* 765.)

---

[1] M. Pailer, G. Schaden, G. Spiteller, and W. Fenzl, *Monatsh.*, 1965, **96**, 1324.
[2] D. H. R. Barton, S. K. Pradhan, S. Sternhell, and J. F. Templeton, *J. Chem. Soc.*, 1961, 255.
[3] S. Arnott, A. W. Davie, J. M. Robertson, G. A. Sim, and D. G. Watson, *J. Chem. Soc.*, 1961, 4183.
[4] M. S. Schechter and H. L. Haller, *J. Amer. Chem. Soc.*, 1940, **62**, 1307.
[5] G. P. Moss, *Planta Med., Suppl.*, 1966, 86.
[6] D. L. Dreyer, *Fortschr. Chem. org. Naturstoffe*, 1968, **26**, 190.
[7] W. R. Chan, D. R. Taylor, and R. T. Aplin, *Chem. Comm.*, 1966, 576.
[8] D. L. Dreyer, *Tetrahedron*, 1968, **24**, 3273.
[9] J. M. Robertson and I. Woodward, *J. Chem. Soc.*, 1937, 219; 1940, 36; G. A. Sim, in "Computing Methods and the Phase Problem in *X*-Ray Crystal Analysis," ed. R. Pepinsky, J. M. Robertson, and J. C. Speakman, Pergamon, Oxford, 1961, p. 227.
[10] J. M. Bijvoet, A. F. Peerdeman, and A. J. van Bommel, *Nature*, 1951, **168**, 271.