The Structures and Absolute Configurations of Seven Alkaloids from *Elaeocarpus sphaericus*

By S. R. JOHNS, J. A. LAMBERTON, A. A. SIOUMIS, H. SUARES, and R. I. WILLING

(*Division of Applied Chemistry, C.S.I.R.O., Box* 4331, *G.P.O., Melbourne, Victoria,* 3001, *Australia*)

Summary The structures and absolute configurations of seven isomeric alkaloids, (—)-isoelaeocarpiline (I), (+)-elaeocarpiline (2), and five new alkaloids (3,4,5,6, and 7) from *Elaeocarpus sphaericus* have been determined.

THE structure of (—)-isoelaeocarpiline (1) and the structure of (+)-elaeocarpiline (2) apart from the relative configuration at C-16, have previously been reported, when these alkaloids were isolated from *Elaeocarpus dolichostylis*.[1] The absolute configuration (7*R*,8*S*,9*S*,16*S*) of (1), now obtained as the major alkaloid from *E.sphaericus* (Gaertn.) K. Schum., has been determined by oxidation of (1) with aqueous $KMnO_4$ to *S*-(—)-methylsuccinic acid, the absolute configuration of which corresponds to that of C-16 in (1).

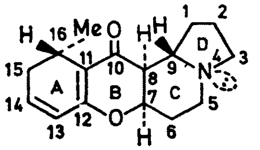
Dehydrogenation of (1) over Pd/C in benzene gives a mixture of 7*R*,8*S*,9*S*-(−)-isoelaeocarpine, $[\alpha]_D$ − 120° ($CHCl_3$) and 7*R*,8*S*,9*S*,16*S*-(−)-dihydroisoelaeocarpiline, $[\alpha]_D$ − 219° ($CHCl_3$).

A third alkaloid, $C_{16}H_{21}NO_2$, (+)-epi-isoelaeocarpiline (3) m.p. 98—100°, $[\alpha]_D$ + 340° ($CHCl_3$), M^+ 259, has spectroscopic properties closely similar to those of (1) with the exception of the chemical shift of 16-Me [δ 0·99 compared with δ 0·85 in the spectrum of (1)].† Dehydrogenation of (3) over Pd/C gives a mixture of 7*S*,8*R*,9*R*-(+)-isoelaeocarpine, $[\alpha]_D$ + 108° ($CHCl_3$) and 7*S*,8*R*,9*R*,16*S*-(+)-dihydroepi-isoelaeocarpiline, $[\alpha]_D$ + 140° ($CHCl_3$). As the n.m.r. spectrum indicates that the relative configuration at C-16 is opposite to that of (1), the absolute configuration of (3) can be represented by 7*S*,8*R*,9*R*,16*S*.

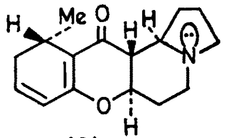
The close similarity between the o.r.d. spectra of (+)-elaeocarpiline (2) and (+)-epi-isoelaeocarpiline (3) and of dihydro-(2) and dihydro-(3) indicates that the C-16 and C-8 asymmetric centres, which are associated with the absorbing chromophores, have the same absolute configuration. From previous work[1] the configuration at the C-7, C-8, and C-9 centres of (2) was known to be 7-H,8-H, *trans*-diaxial, 8-H,9-H *trans*-diaxial, and the absolute configuration of (2) can therefore be represented by 7*R*,8*R*,9*R*,16*S*. Dehydrogenation of (2) over Pd/C gives a mixture of 7*R*,8*R*,9*R*-(+)-elaeocarpine, $[\alpha]_D$ + 206° ($CHCl_3$) and 7*R*,8*R*,9*R*,16*S*-(+)-dihydroelaeocarpiline, $(\alpha]_D$ + 317° ($CHCl_3$).

The fourth alkaloid, (−)-epielaeocarpiline (4), m.p. 70—74°, $[\alpha]_D$ − 396° ($CHCl_3$), $C_{16}H_{21}NO_2$, M^+ 259, has spectral properties closely similar to those of (2) except in the chemical shift of 16-Me [δ 0·85 compared with δ 0·95 for (2)]. Dehydrogenation over Pd/C gives a mixture of 7*S*,8*S*,9*S*-(−)-elaeocarpine, $[\alpha]_D$ − 210° ($CHCl_3$), and 7*S*,-8*S*,9*S*,16*S*-(−)-dihydroepielaeocarpiline, $[\alpha]_D$ −318° ($CHCl_3$). The relative stereochemical difference at C-16 then indicates the absolute configuration 7*S*,8*S*,9*S*,16*S* for (4).

The fifth alkaloid, (+)-epialloelaeocarpiline (5), $C_{16}H_{21}NO_2$, m.p. 136—137°, $[\alpha]_D$ + 139° ($CHCl_3$), M^+ 259, has a dienone chromophore [λ_{max} (EtOH) 325 nm (ε 8150), 239 (5430), and 228 (5630), and signals from two double-bond protons at δ 5·82 and δ 6·25]. A three-proton doublet at δ 0·94 confirms the presence of the 16-Me, and a broad multiplet at δ 4·22 (7-H) indicates that 7-H,8-H are *trans*-diaxial. Dehydrogenation over Pd/C gives a complex mixture of four components from which 7*S*,8*R*,9*R*-(+)-isoelaeocarpine‡ has been isolated, and when (5) is chromatographed on silica-gel t.l.c. plates, isomerization occurs to give a mixture of (5) and 7*S*,8*R*,9*R*,16*S*-(+)-epi-isoelaeocarpiline (3).‡ The apparently anomalous situation that (5) with a broad multiplet for 7-H typical of *trans*-diaxial 7-H,8-H is converted into (3) with a *cis*-BC ring junction can be explained by the formulation of (5) as the C-8 epimer of (3). Inspection of molecular models indicates that (5) would assume a preferred conformation with a *cis*-CD ring junction. Its conversion into (3) can proceed by enolization and epimerization at C-8 with a subsequent chair-to-chair inversion of the ring C that changes the CD ring junction from *cis* to *trans* and requires inversion of the nitrogen configuration. The absolute configuration of (5) can therefore be represented as 7*S*,8*S*,9*R*,16*S*.



(1)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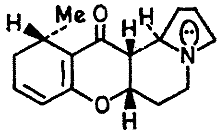
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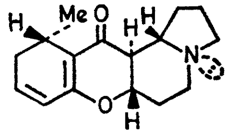
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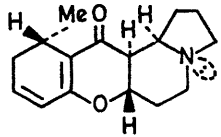
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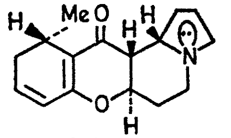
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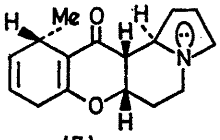
(7)

The sixth alkaloid, (−)-alloelaeocarpiline (6), has not been obtained entirely free from all other isomers. The n.m.r. spectrum is closely similar to that of (+)-epialloelaeocarpiline (5) except in the chemical shift of 16-Me (δ 0·89). Chromatography on silica-gel t.l.c. plates gives a mixture of (6) and (−)-isoelaeocarpiline (1), $[\alpha]_D$ − 400° ($CHCl_3$), and by the same arguments used to explain the epimerization of (5) at C-8, (6) must be the C-8 epimer of (1) with a *cis*-CD ring junction. The absolute configuration of (6) can therefore be represented as 7*R*,8*R*,9*S*,16*S*.

The seventh alkaloid, (+)-pseudoepi-isoelaeocarpiline (7), $[\alpha]_D$ +222° ($CHCl_3$), $C_{16}H_{21}NO_2$, M^+ 259, has not been obtained crystalline but gives a crystalline picrate, m.p. 230—235° (decomp.). Alkaloid (7) has an $\alpha\beta$-unsaturated carbonyl group (λ_{max} (EtOH) 275 nm (ε 7600), and hydrogenation over Pt_2O gives 7*S*,8*R*,9*R*,16*S*-(+)-dihydroepi-isoelaeocarpiline. The n.m.r. spectrum of (7) is similar to that of (3) with a narrow multiplet at δ 4·55 (7-H) and a three-proton doublet at δ 1·13 (16-Me). The signals from the double-bond protons of (7) are different, however, and can be analysed as a pair of AB doublets with small vicinal and allylic couplings consistent with a C-14,C-15 double bond (δ_{H14} 5·53, δ_{H15} 5·74, $J_{14,15}$ 10 Hz, $J_{13,14}$ 3 Hz, $J_{15,16}$ 4 Hz). The absolute configuration (7*S*,8*R*,9*R*,16*S*) is therefore the same as in (3).

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† All n.m.r. spectra were measured at 100 MHz in $CDCl_3$ solution, and chemical shifts are relative to $SiMe_4$.

‡ Isolated in small amounts by preparative t.l.c. Sign of $[\alpha]_D$ determined, but not accurate magnitude.

[1] S. R. Johns, J. A. Lamberton, and A. A. Sioumis, (a) *Chem. Comm.*, 1968, 1325; (b) *Austral. J. Chem.*, 1969, **22**, 793.