Components of *Neolitsea aciculata* Koidz. Structures and Absolute Configuration of Litsealactone, Litseaculane, Zeylanine, and Zeylanane

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FURAN SESQUITERPENOIDS from the root and the trunk of *Neolitsea aciculata* Koidz† (Inugashi in Japanese) have been investigated, and ten compounds have been isolated. Five compounds out of the ten were known: linderane[1] (I), isolinderalactone[2] (II), linderalactone[1] (III), zeylanine[3] (VI), and neolinderane[3] (VIII). The remaining unknown compounds were named litsealactone (IV),

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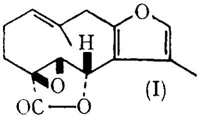
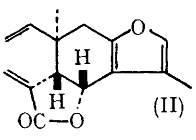
† Components of *Neolitsea zeylanica* Merr. have been investigated by Drs. B. S. Joshi, V. N. Kamat, and T. G. Govindachari.[3]

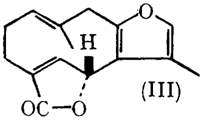
litseaculane (V), zeylanane (VII), pseudo-neolinderane, and linderadine.



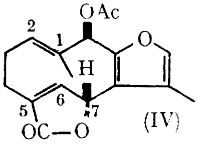
(I)



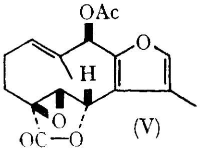
(II)



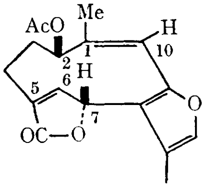
(III)



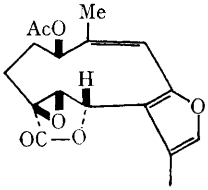
(IV)



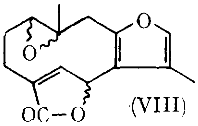
(V)



(VI)



(VII)



(VIII)

Litsealactone (IV), $C_{17}H_{18}O_5$, m.p. 157—159°, $[\alpha]_D$ +57·5°, showed the presence of an $\alpha\beta$-unsaturated-γ-lactone, an acetoxy-, and a furan group in the i.r. and a vinyl methyl (τ 8·64), a methyl on the furan ring (7·89), an acetoxy-group (7·82), two vinyl protons [4·70 (m) and 3·20 (d, J 2·0 c./sec.)], a proton on C(7) (4·17), and a proton on the carbon atom bearing the acetoxyl (3·70, s) in the ^{1}H n.m.r. spectrum (CDCl). When litsealactone was subjected to a Cope rearrangement, it afforded the starting material and isolitsealactone‡ (IX), m.p. 142—144°, $[\alpha]_D$ −242·9° in a ratio of 2 : 3. On reduction with $NaBH_4$, (IX) gave a dihydro-derivative (Xb), m.p. 161—163°, which was reduced with lithium aluminium hydride to give a triol (XI), m.p. 126—129°, $[\alpha]_D$ +51°. A mixture of diacetates of compound (XI) was reduced with sodium in liquid ammonia and ethanol. The product was shown to be identical with an authentic sample[2] (XII), m.p. 116—118°, $[\alpha]_D$ +29·6°, prepared from isolinderalactone (II). Moreover, the isomerisation to isolitsealactone (Cope rearrangement), suggests that the methyl at C(1) is *trans* to the hydrogen at C(2) in (IV), since neolinderalactone,[1] in which these groups are *cis* does not undergo this rearrangement. Hence, the absolute configurations of litsealactone (IV) and isolitsealactone (IX) are established, apart from the configuration of the acetoxy-group, which was established as follows. The i.r. spectrum of (Xa), m.p. 140—141° shows a H–O stretching band at 3613 cm.$^{-1}$ (0·042% solution in CCl_4). As this value suggests that hydrogen-bonding to the oxygen in the furan ring is weak or absent, the configuration of the hydroxy-group is tentatively assigned as β-axial in (Xa) and hence in litsealactone (IV).

Litseaculane (V), $C_{17}H_{18}O_6$, m.p. 145—146°, $[\alpha]_D$ +76·1°, was converted into litsealactone (IV) by the action of chromous chloride [*cf.* linderane[1,3] (I)]; the ^{1}H n.m.r. spectrum in $CDCl_3$ shows the proton signals on C(6) and C(7), τ 6·14 and 4·68, as singlets. As these values are in good agreement with those of linderane,[1] the epoxy-ring is assigned as β-oriented and litseaculane is ascribed the formula (V).

Zeylanane (VII), $C_{17}H_{18}O_6$, m.p. 150—152°, $[\alpha]_D$ +231·2°, showed the presence of a γ-lactone, an acetoxy-, and a furan group (i.r.). A maximum at 258 mμ (ϵ 5600) in the u.v. is due to a double bond conjugated with the furan ring. Furthermore, the ^{1}H n.m.r. data suggest that zeylanane is an epoxy-derivative of zeylanine (VI), and on treatment with chromous chloride, the product was identical with an authentic sample of zeylanine.§

When the desacetyl-product (XIII), m.p. 179—181° was hydrogenated with 10% Pd–charcoal in ethanol and the product treated with diazomethane, methyl esters, R_F 0·44 (XIVa) and R_F 0·35 (XIVb) resulted. One of these, R_F 0·44, was oxidised with chromium trioxide in pyridine to give a keto-ester (XV), m.p. 112—114°, $[\alpha]_D$ −17·2°. This compound was also obtained from linderane (I). Compound[4] (XVI) obtained from (I) was hydrogenated with Adams catalyst in methanol to give an oily carboxylic acid, which afforded two methyl esters, R_F 0·48 (XVIIa) and R_F 0·40

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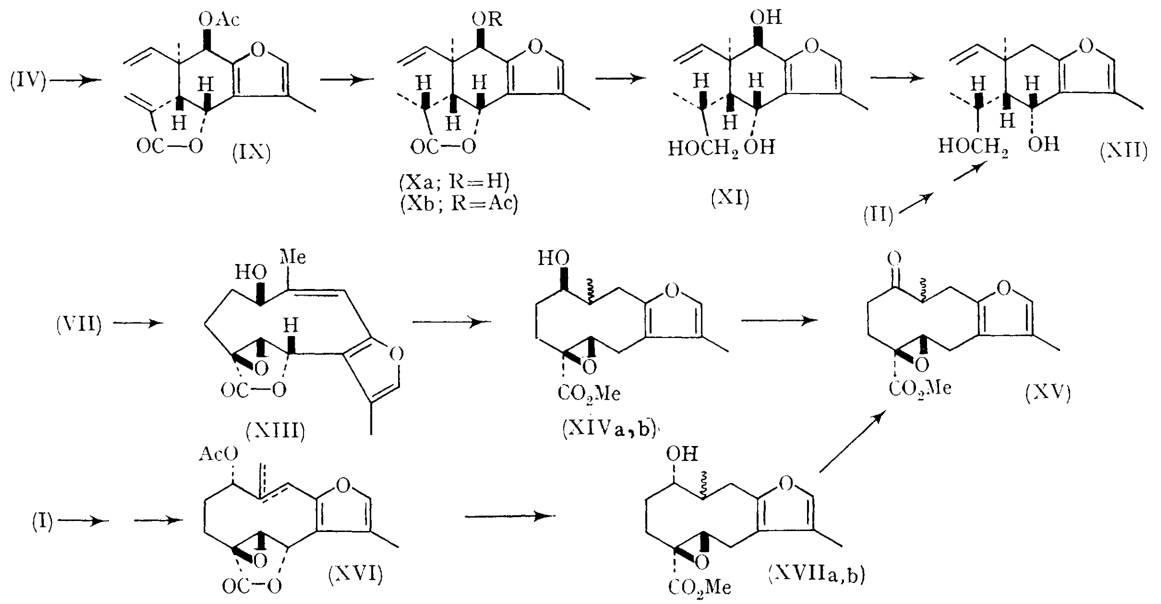
‡ This compound gave satisfactory physical data (^{1}H n.m.r., i.r., u.v., and mass spectra) for the structure given.

§ The authors thank Dr. B. S. Joshi for identifying zeylanine.

(XVIIb), by hydrolysis followed by treatment with diazomethane. Oxidation of (XVIIa) with chromium trioxide in pyridine gave the keto-ester (XV), m.p. 111—113°, $[\alpha]_D$ −15°. Moreover, as the ^1H n.m.r. spectrum of (VII) in $CDCl_3$ shows the proton signals on C(6) and C(7) at τ 5·91 and 4·68 as singlets, and the epoxy-ring in linderane (I) has the β-configuration,[1] the lactonic oxygen of (VII) should possess the α-configuration.



Complete saturation of the methyl protons at C(1) in (VII) by double irradiation causes an increase (about 20%) in the signal intensity of the vinyl proton at C(10). This intramolecular nuclear Overhauser effect[1,5][¶] confirms that the methyl and the hydrogen are *cis*.

The configuration of the acetoxy-group at C(2) is thought to be β because of the recovery of *dextrorotatory* α-phenylbutyric acid in 32% optical yield by the Horeau technique,[6] on treatment of desacetylzeylanine[3] with α-phenylbutyric anhydride.

From these results, the absolute configuration of zeylanine and zeylanane can be represented by the formulae (VI) and (VII), respectively.

Neolinderane (VIII), $C_{15}H_{16}O_4$, m.p. 182—183°, $[\alpha]_D$ +32·2°, was shown to be identical with the authentic sample[3] (supplied by Dr. B. S. Joshi) by comparison of the i.r. and the ^1H n.m.r. spectra, and the $[\alpha]_D$ values, and by mixed melting point.

The structures and absolute configuration of *pseudo*-neolinderane, $C_{15}H_{16}O_4$, m.p. 200—202°, $[\alpha]_D$ +90·3° and linderadine, $C_{15}H_{16}O_5$, m.p. 130—132°, $[\alpha]_D$ −68·7°, and the absolute configuration of neolinderane (VIII) are now under investigation.

(*Received, May 27th*, 1968; *Com.* 670.)

[¶] This effect was observed by use of a Varian HA-100 spectrometer; see following Communication.

[1] K. Takeda, I. Horibe, M. Teraoka, and H. Minato, *Chem. Comm.*, 1968, in the press.

[2] K. Takeda, I. Horibe, and H. Minato, *Chem. Comm.*, 1968, 378.

[3] B. S. Joshi, V. N. Kamat, and T. G. Govindachari, *Tetrahedron*, 1967, **23**, 261, 267, 273.

[4] K. Takeda, H. Minato, and I. Horibe, *Tetrahedron*, 1963, **19**, 2307.

[5] F. A. L. Anet and A. J. R. Bourn, *J. Amer. Chem. Soc.*, 1965, **87**, 5250; M. C. Woods, H. C. Chiang, Y. Nakadaira, and K. Nakanishi, *ibid.*, 1968, **90**, 522; M. Ohtsuru, M.Teraoka, K. Tori, and K. Takeda, *J. Chem. Soc.* (*B*), 1967, 1033 and references therein.

[6] A. Horeau, *Tetrahedron Letters*, 1961, 506; 1962, 965; N. H. Fischer and T. J. Mabry, *Chem. Comm.*, 1967, 1235.