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TRITERPENE HYDROCARBONS FROM OLEANDRA WALLICHII

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In a previous communication (1) we had reported the isolation of a new pentacyclic triterpene alcohol amongst other terpenic constituents from O. neriifolia. In this communication, the isolation and constitutive studies in two triterpene hydrocarbons isolated from Oleandra wallichii (Hook) Pr., a sister species of O. neriifolia, growing in the Khasia and Jayantia ranges of the Eastern Himalayas, are reported.

The extractive from the cold benzene percolate of the shade-dried powdered rhizomes was partitioned between dilute alcohol (85 per cent) and n-hexane; and the n-hexane soluble fraction on chromatography (neutral alumina) yielded, besides other constituents, two triterpene hydrocarbons. Though critical investigations with them finally revealed their identity with hopene-II (2) and neohopa-11, 13(18)-diene (3), the derived hydrocarbons prepared in the course of studies in the chemistry of related triterpenoids, in view of their isolation for the first time from nature, trivial names, wallichiene and wallichienene are being proposed for the O. wallichii hydrocarbons.

Wallichiene:

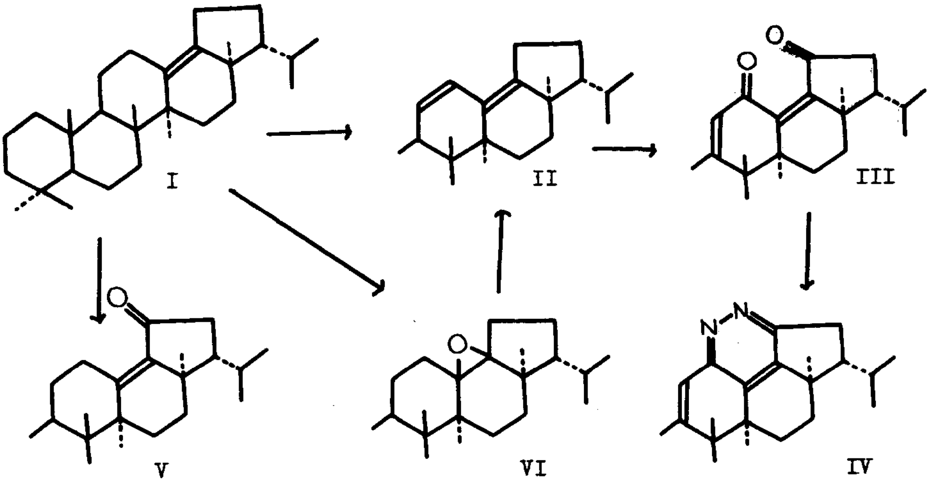
The hydrocarbon wallichiene, $C_{30}H_{50}$, m.p. 196-197°; $(\alpha)_D$ ±0°; (mol. wt. 410, mass spectra) was freely soluble in n-hexane and gave positive LB, Noller's and TNM tests; ν^{KBr}_{max} 1381 & 1370 (gem-dimethyl), 1210 and 1195 (a quaternary gem-dimethyl) and 1175 & 1149 (isopropyl) cm^{-1}; NMR spectra:(τ) methyl signals equivalent to 24 protons at 9.2, 9.15, 9.11, 9.00 and 8.90 and no signal for olefenic protons. The IR spectra also indicated the absence of a trisubstituted double bond in wallichiene.

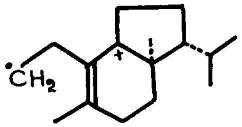
Wallichiene on oxidation with selenium dioxide in acetic acid yielded a mixture of products which on chromatography over alumina gave, (i) a hydrocarbon, $C_{30}H_{48}$, m.p. 210-212°; $(\alpha)_D$ +43°, $\lambda_{max}^{cyclohexane}$ 246, 256 and 265 mμ (presumably a hetero-annular conjugated diene), and (ii) a dark red diene-dione, $C_{30}H_{44}O_2$, m.p. 294-298°; $\lambda_{max}^{alcohol}$ 300 mμ; ν_{max}^{KBr} 1720 (s), 1660 and 1585 (m) cm^{-1} indicating it to be an $\alpha\beta,\alpha'\beta'$-unsaturated dione. The course of selenium dioxide oxidation of wallichiene appeared similar to that of oleanenes in which case also the end product has been found to be a diene-dione (4).

The formation of a diene-dione from wallichiene through the intermediate conjugated diene on oxidation with selenium dioxide inter alia suggested the tetra-substituted double bond in wallichiene at C-13 (18) and the diene-dione may, therefore, be assumed to have the part structure III. The diene-dione also yielded a pyridazine derivative (IV) evidenced by its UV absorption, λ_{max} 232 and 283 mu, lending further support to the proposed structure.

Wallichiene (I) when oxidised with monoperphthalic acid gave the epoxide (VI), $C_{30}H_{50}O$, m.p. 199-201°; $(\alpha)_D$ +45°, which when treated with HCl gas in chloroform gave the corresponding diene (II), m.p. 210-212°; $(\alpha)_D$ +42°; $\lambda_{max}^{cyclohexane}$ 246, 256 and 265 mμ (log ε 4.39, 4.43 and 4.33 respectively). Similar transformation are now well known in the triterpenoid series (3,5). The resultant diene (II) on hydrogenation in cyclohexane in presence of Adam's catalyst gave back the parent hydrocarbon, wallichiene.

Though the data recorded above, strongly indicates a tetra-substituted double bond (possibly at C-13(18)) similar to that in δ-amyrin, the biogenetic and chemo-taxonomic considerations would suggest a hopane or a modified hopane skeleton for the hydrocarbon and, therefore, wallichiene can reasonably be expected to have the neohopane (3) carbon skeleton.

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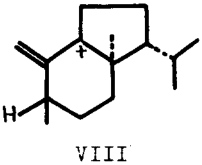
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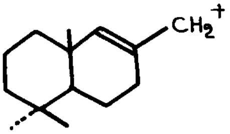
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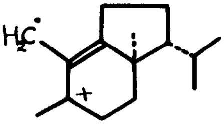
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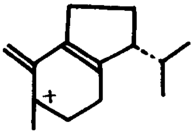
XI

Oxidation of wallichiene (I) with chromium trioxide in acetic acid yielded an $\alpha\beta$-unsaturated ketone (V), $C_{30}H_{48}O$, m.p. 248-251°; $(\alpha)_D$ +43°, designated as wallichienone. Wallichienone showed UV absorption at 251 mμ (ϵ 12, 860) and manifested in its IR spectra two carbonyl bands of considerable intensity at 1697 and 1615 cm^{-1} of which the latter was only slightly less intense than the former; while the band at 1697 cm^{-1} is indicative of a 5-membered ring ketone, that at 1615 cm^{-1} may be due to the double bond in conjugation with the carbonyl function. Jones and co-workers while studying the oxidation of hopene-I and hopene-II with sodium dichromate in acetic acid, found that one of the oxidation products of hopene-II was an

$\alpha\beta$-unsaturated ketone (5). The IR and UV characteristics of wallichienone (V) appeared to be very similar to those reported for the unsaturated ketone from hopene-II (loc. cit.). The oxidation of wallichiene to wallichienone also ruled out possibility of a lupane type E-ring.

The properties of wallichiene and its derivatives were thus found to be strongly suggestive of hopene-II structure for it which is supported by the cracking pattern in its mass spectra. The molecular ion peak M^+ in the mass spectra of wallichiene appeared at m/e 410. The successive peaks at m/e 395 and m/e 367 corresponding to the loss of 15 and 43 mass units have been attributed to the loss of one methyl from the isopropyl side chain and subsequent loss of the isopropyl side chain itself. The splitting of ring C and the formation of a retro-Diels-Alders fragment was found to be similar to that observed in the case of δ-amyrin (Olean-13(18)-ene). The base peak was observed at m/e 191 and other important peaks appeared at m/e 218 and 205. In analogy with the mechanism suggested by Djerassi and co-workers in the case of δ-amyrin (7), various fragments formed from the $M^+$of wallichiene would be VII (m/e 218), VIII (m/e 205) and the fragment IX (m/e 191) originating from the left hand side of the molecule. The appearance of a peak at m/e 189 of slightly less intensity has been attributed to the fragment XI, formed by the loss of the C-17 substituent from another ion X appearing at m/e 204, analogous to that observed in case of δ-amyrin (8). A significant feature in the mass spectra of wallichiene is the formation of a fragment, m/e 175 from the fragment m/e 218 (VII) with the loss of 43 mass units. This observation is explained by the appearance of a metastable ion, m/e 140.6 (calc. value 140.5). The loss of 43 mass units from fragment VII (218-175) corresponding to the isopropyl side chain confirmed the attachment of the isopropyl side chain to ring E. Thus the mass spectra of wallichiene supports the placement of the double bond at C-13 (18) and also the presence of an isopropyl side chain.

The identity of wallichiene with hopene-II (I) was finally confirmed by m.m.p. and superimposable IR spectra with that of an authentic sample (11). Hopene-II, derived from hydroxy hopane by dehydration and isomerisation (loc. cit.), does not appear to have been reported earlier from natural source.

Wallichienene:

Another triterpene hydrocarbon, wallichienene, $C_{30}H_{48}$, m.p. 210-212°; $(\alpha)_D$ +42°, was isolated from the rhizomes along with wallichiene, as a minor constituent. Wallichienene gave positive LB, Noller's and TNM tests; IR bands: 795 and 780 cm^{-1} (di-or tri-substituted double bond). The characteristic UV absorption at 246 ($\log\epsilon$ 4.37), 256 ($\log\epsilon$ 4.43) and 265 $m\mu$ ($\log\epsilon$ 4.33) was suggestive of a conjugated hetero-annular diene system. A comparison of the UV absorption of wallichienene with those of dehydro-neo-zeorininone (9) and olea-11, 13 (18)-diene showed close similarity. On hydrogenation in cyclohexane in presence of Adam's catalyst, wallichienene gave a dihydro product, $C_{30}H_{50}$, m.p. 196-197°; $(\alpha)_D$ ±0°. The dihydro-wallichienene still gave positive TNM test but did not manifest the characteristic triple absorption in its UV spectra and it has since been identified as hopene-II, through m.m.p. and superimposable IR spectra. Dihydro-wallichienene when treated with monoperphthalic acid gave an epoxide, $C_{30}H_{50}O$, m.p. 199-201°; $(\alpha)_D$ +45°, which on treatment with HCl gas in chloroform gave back the parent hydrocarbon, wallichienene. Wallichienene was finally identified as neo-hopa-11, 13(18)-diene (2) by m.m.p. and superimposable IR spectra with that of an authentic sample.(11)

The occurence of pentacyclic triterpenoids with heteroannular conjugated diene system in nature is comparatively rare; however, a few such dienes have recently been reported.(10) Wallichienene appears to be the first example of a triterpene diene being isolated from a fern.

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11. Authentic samples of hopene-II and neohopa-11,13(18)-diene were kindly supplied by Dr. Y.Tsuda of the University of Osaka, Japan.