The Constitution of Grandifoliolenone, a Novel Triterpenoid from *Khaya grandifoliola*

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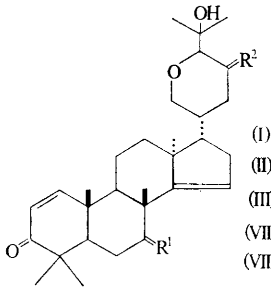
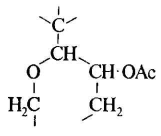
The proposed[1] biogenetic pathway to furanoid triterpenes from euphol or tirucallol precursors has received strong support from the isolation of a variety of compounds which represent intermediate stages on such a route. We now record the isolation of grandifoliolenone which marks another important stage of elaboration. In this the side-chain is not degraded but oxygenation at C-7 and methyl migration from C-14 to C-8 have taken place.

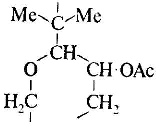
Grandifoliolenone (I), $C_{32}H_{48}O_6$, was obtained with other triterpenoids[2] from a sample of the



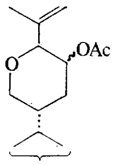
(I) R¹ = H,α-OAc; R² = H,OH
(II) R¹ = H,α-OAc; R² = H,OAc
(III) R¹ = H,α-OAc; R² = O
(VII) R¹ = R² = O
(VIII) R¹ = H,α-OH; R² = H,OH



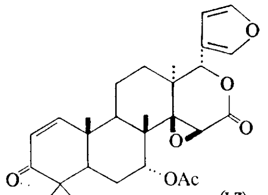
(IVa)



(IVb)



(V)



(VI)

heartwood of *Khaya grandifoliola* as a colourless gum. On acetylation it yielded a crystalline diacetate (II), $C_{34}H_{50}O_7$, m.p. 172—175° $[\alpha]_D$ −12°, the constitution of which was assigned on the following evidence. Its n.m.r. spectrum exhibits resonances attributable to seven tertiary C-methyl groups (τ 8·81, 8·85, 8·94, 6H each and 9·03 3H), two secondary acetate groups (τ 8·01, 8·10, singlets, 3H each and τ 4·86, 5·10, broad singlet and multiplet respectively, 1H each), three ethereal protons (τ 6·89 doublet, J = 9 c./sec.; 6·06, 6·49, broadened doublets, J = 12 c./sec., 1H each), a vinylic proton (τ 4·75, broad singlet, 1H) and an $\alpha\beta$-unsaturated ketone (τ 2·92, 4·23, doublets, J = 10 c./sec., 1H each). Double resonance experiments convincingly demonstrated that the secondary ethereal proton and one –C*H*OAc (at τ 5·10) are vicinal while the multiplicity of the latter indicates that it has additional spin–spin couplings to an adjacent methylene group. That this acetate derives from a secondary hydroxyl group in the parent (I) was demonstrated by the oxidation of (I) to the dione (III), $C_{32}H_{46}O_6$, m.p. 70—75°; in its n.m.r. spectrum the resonance of the ethereal proton has shifted to lower field (τ 6·43) and collapsed to a sharp singlet. This leads to part structure (IVa) which can be expanded to (IVb) by taking into account the dehydration of the diacetate (II) with thionyl chloride in pyridine. The n.m.r. spectrum of the product (V), $C_{34}H_{48}O_6$, m.p. 202—205°, which has no hydroxylic absorption in the i.r., reveals an exomethylene group (τ 5·02, singlet, 2H), a vinylic methyl group (τ 8·23, broad singlet, 3H) and three ethereal protons (τ 6·27, doublet, J = 8 c./sec.; 6·10, 6·42, broadened doublets, J = 12 c./sec., 1H each). The downfield shift experienced by the first of these ethereal protons shows that it is now allylic. The part structure (IVb) fits readily into the side-chain of a tetracyclic triterpene skeleton as in bourjotinolone A.[3]

The trisubstituted double bond can be predicted on biogenetic grounds to be Δ^7 or Δ^{14} in a butyrospermol or *apo*-euphol skeleton respectively. That the second of these alternatives must apply is evident from o.r.d. measurements, $[\Phi]_{400}$ −1,155°; $[[\Phi]_{357}$ −3,470°; $[\Phi]_{313}$ +9,850; $[\Phi]_{287}$ +8,100° in (II) [*cf.*, $[\Phi]_{400}$ ± 0°; $[\Phi]_{360}$ −2,530°; $[\Phi]_{313}$ +9,110°; $[\Phi]_{280}$ +9,110° in gedunin (VI)[4]]. Comparison with gedunin is admissible since the substitution of the enone necessitates its placing in ring A and the chemical shift values [τ 2·92 and 4·23 in (II)] of the vinylic protons show[5] it to be a Δ^1-3-ketone rather than a Δ^2-1-ketone.

The conclusion as to the nature of the skeleton is reinforced by the following n.m.r. evidence which indicates oxygenation at C-7 and a Δ^{14}-olefin in grandifoliolenone and its derivatives. Conversion of grandifoliolenone (I) in which the –C*H*OAc resonates as a broad singlet at τ 4·78 into the trione (VII), $C_{30}H_{42}O_5$, m.p. 222—226°, *via* the triol (VIII), $C_{30}H_{46}O_5$, m.p. 248—252°, produces an appreciable change in the chemical shift of the olefinic proton (from τ 4·66 to 4·13). Such a difference has excellent precedents[6] in the furanoid series. The axial (α) orientation of the C-7 acetate group in grandifoliolenone can be assigned on the basis of the multiplicity of the –C*H*OAc resonance (vs).

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