Triterpenoids from *Guarea glabra* (Meliaceae): a New Skeletal Class identified by Chemical, Spectroscopic, and *X*-Ray Evidence

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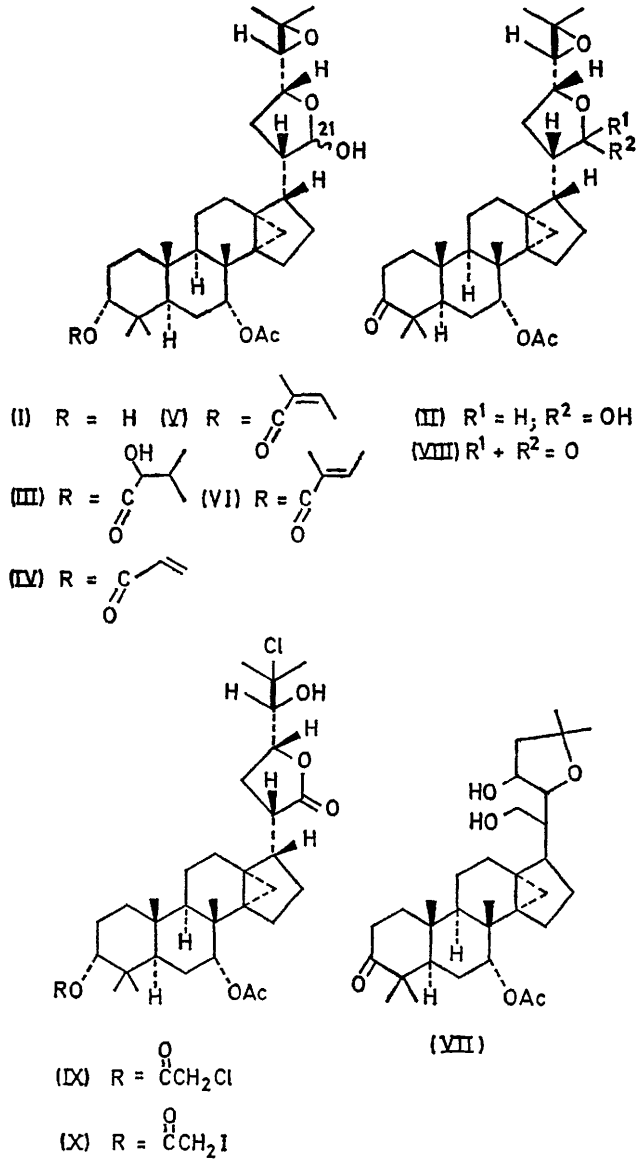
Summary Seven new triterpenoids from *Guarea glabra* are formulated as (I)—(VII) on the basis of chemical, spectroscopic, and *X*-ray evidence.

WE have obtained from the heartwood of *Guarea glabra* seven new triterpenoids, the structures of which are based on a novel pentacarbocyclic skeleton.

Glabretal(I), $C_{32}H_{50}O_6$, was isolated as a colourless gum. Its n.m.r. spectrum revealed the presence of six tertiary methyl groups, an axial secondary acetate, an axial secondary hydroxy-group, a trisubstituted epoxide, a hemiacetal ring,† and a cyclopropyl methylene group (τ 9·63 and 9·34, both d, J 5·5 Hz). Double resonance experiments convincingly demonstrated the vicinal nature of the epoxide proton and that attached to the singly oxygenated terminus of the hemiacetal ring. Oxidation of (I) furnished the keto-γ-lactone (VIII), m.p. 215—218°, $[\alpha]_D$ −36°. This evidence indicates that glabretal is a pentacarbocyclic triterpenoid with a side chain similar to that of turreanthin,[1] and suggests that it might be a cycloartane[2] derivative.

† (I)—(VI) were isolated as epimeric mixtures at C-21.

That the latter is not the case is shown as follows. Since the acetoxy-group is resistant to hydrolysis and yet oxygenation at C-3 is almost certain, the secondary alcohol is probably located at this position. However, the o.r.d. of



the corresponding ketone(II), m.p. 165—167°, (α + 25°) was found to be markedly different from that of a 3-keto-cycloartane (α *ca.* −75°).[3] At this stage, the heavy atom derivatives (IX), m.p. 213—216°, and (X), m.p. 184—185°, were prepared and submitted to *X*-ray crystallographic examination.

Both (IX) and (X) crystallize in the monoclinic space group $P2_1$ and are isomorphous with two molecules in the unit cell. For the dichloro-derivative (IX) a = 16·217(3), b = 7·321(2), c = 15·990(2) Å, β = 115·35(2)°; for the iodochloro-derivative (X) a = 16·736(2), b = 7·262(2), c = 16·127(5) Å, β = 115·54(2)°. Three-dimensional data were collected for both (IX) and (X) on a Hilger and Watts four-circle diffractometer. The structure of the iodochloro-derivative was solved first by the heavy-atom method. When all atoms were located and included in structure-factor calculations, R = 0·26 for 1040 data; no refinement was attempted. The co-ordinates thus obtained were then used with the data from the dichloro-derivative (IX) and refinement by Fourier and least-squares methods has lowered R to 0·126 for 1416 data.

The structure and relative stereochemistry of the molecules as determined by the *X*-ray analysis is as shown in (IX) and (X). Crystal decomposition during data collection precluded determination of the absolute stereochemistry by Bijvoet's method[4] but based on triterpenoid precedent it is virtually certain to be as shown in (IX) and (X) (no exception to the C-10 β-methyl configuration is known).

We have also isolated from *G. glabra* the related ketone (II), the α-hydroxyisovalerate (III), m.p. 198—200°, $[\alpha]_D$ −50°, and a mixture (composition *ca.* 1:1:1), m.p. 137—139°, $[\alpha]_D$ −61°, of the acrylate (IV), angelate (V), and tiglate (VI). All five compounds have been converted into the keto-lactone (VIII). A structure (VII) is tentatively assigned to a further oily constituent of the heartwood, on the basis of its chemical and spectroscopic behaviour.

At least two alternatives may be considered for the *in vivo* formation of glabretal and its congeners. This new skeletal species may mark the midway stage in the migration of a methyl group either (a) from C-14 to C-13 during the dammarane to tirucallane transformation or (b) from C-13 to C-14 as a subsequent step to the tirucallol–*apo*-tirucallol rearrangement.[2,5] At first sight alternative (a) appears preferable since it involves fewer rearrangement steps after cyclisation of the acyclic precursor. However, the presence of a C-7 axial acetoxy-group suggests alternative (b) since insertion of oxygen at this position in the limonoids and related compounds has been generally assumed to occur due to the presence of a 7,8 (or 8,9) double bond in a tetracyclic intermediate. These triterpenoids are therefore presumably formed by capture of the C-13 methyl group by a C-14 cation in an *apo*-tirucallane precursor.

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