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A NEW DITERPENOID WITH PIMARANE SKELETON

L. Canonica, B. Rindone and C. Scolastico
Istituto di Chimica Organica dell'Università
Centro Naz. Chim. Sost. Org. Nat. del CNR - Milano (Italy)
Koo Dong Han and Jae Hoon Kim
Natural Products Research Institute
Seoul National University, Seoul, Korea.

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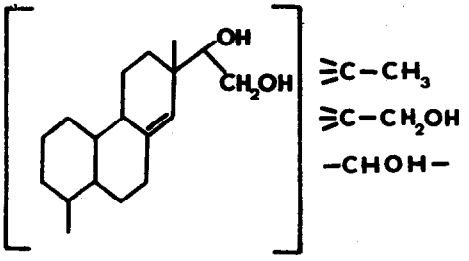
From Siegesbeckia pubescens Makino (Compositae) we could isolate 16,17--dihydroxy-16β-(-)-kauran-19-oic acid (I), already isolated by P. R. Jefferies and T. G. Payne from Beyeria spp.[1], and a new neutral compound (II), $C_{20}H_{34}O_4$, m.p. 192-193°(ethyl alcohol), $[\alpha]_D$ -22° (c=1% dioxane), ν_{max} 3325 cm^{-1} (OH), 1654 cm^{-1} (double bond); NMR (C_5D_5N), 1.26δ(3H, s, $\geqslant C-CH_3$), 1.14 δ (3H, s, $\geqslant C-CH_3$), 0.80 δ (3H, s, $\geqslant C-CH_3$), 3.4-4.4 δ (6H, complex signal), 5.15 δ (1H, b.s., $\geqslant C-CH=C-CH_2-$); MS 338, 320, 289, 277, 259, 241.

Acetylation with acetic anhydride and pyridine at room temperature affords a tetraacetate (III), $C_{28}H_{42}O_8$, ν_{max} 1725, 1660, 1250 cm^{-1}, while treatment with acetone and anhydrous $CuSO_4$ at room temperature yields a monoacetonide (IV), $C_{23}H_{38}O_4$, m.p. 164-165°, $[\alpha]_D$ -44°(c=1% $CHCl_3$)*.

Oxidation of (II) with HIO_4 in methanol gives formaldehyde and the aldehyde (V), $C_{19}H_{30}O_3$, ν_{max} 3400, 2700, 1718, 1660 cm^{-1}; NMR (table I).

Spectral features of compound (II) and its derivatives (III), (IV) and (V), together with isolation of pimanthrene by selenium dehydrogenation, suggest for it partial formula:



*Optical rotations were measured in chloroform solution unless otherwise stated.

In accord with this, oxidation of monoacetonide (IV) with Sarett reagent gives a ketoaldehyde (VI), $C_{23}H_{34}O_4$, m.p. 116-117°, $[\alpha]_D$ -46°; ν_{max} 1720, 1658 cm^{-1}. Its NMR spectrum (table I) shows, among other, two lines at 3.06 δ and at 2.83 δ (J=13.7 cps) (1H, part A of an AB system) which can be attributed to one proton of a methylenic group both allylic and adjacent to a carbonyl function. This fact locates the secondary hydroxyl function at C_6.

By treatment with p-toluensulphonyl chloride in pyridine, the monoacetonide (IV) is converted into a mixture of a monotoluen-p-sulphonate (VII), $C_{30}H_{44}O_6S$, a ditoluen-p-sulphonate (VIII), $C_{37}H_{50}O_8S_2$, and a cyclic ether (IX), $C_{23}H_{36}O_3$, which was resolved by chromatography on silica gel. In the NMR spectrum of (IX) the tertiary oxymethylene signals appear as an AB system centered at 3.90 δ and 3.23 δ (J=8 cps). This coupling constant indicates the presence of a five membered heterocyclic ring[2], thus suggesting the tertiary hydroxy--methyl group in compound (II) is at C_4 or at C_{10}.

Since the chemical shifts of the methyl groups of compound (II) and its derivatives (table I) are in accordance with those of diterpenoids with a pimarane skeleton[3], assuming a chair conformation for ring B in order to explain the shielding effect on C_{20}[4], the tertiary hydroxymethyl group should be at C_4.

The assignement of configuration at C_4 rests upon the chemical shift and multeplicity of the aldehydic proton of (VI) (singlet at 9.7 δ).

In a study of the NMR spectra of diterpenoids containing an aldehyde at C_4 and an axial proton at C_3[5] it has been shown that equatorial aldehydic protons appear at 8.9-9.3 δ as singlets, while axial aldehydic protons at 9.7-9.9 δ as doublets (J<3 cps). The value of the chemical shift of the aldehydic proton in (VI) therefore can be explained through a downfield shift due to the carbonylic function at C_6. Since it resonates at 10.1-10.4 δ in diterpenoids containing an axial aldehydic group at C_4 and a keto group at C_6[6,7], the aldehydic function in (VI) can be assumed equatorial.

Furthermore, aldehyde (V) with Jones reagent in acetone gives a ketodiacid (X), $C_{19}H_{26}O_5$, which yields the corresponding dimethylester (XI), $C_{21}H_{30}O_5$, by treatment with diazomethane. Saponification of (XI) with aqueous NaOH 2.5N in ethylenglycolmonomethylether in 3h at 150°, standard conditions for C_4 equatorial carbomethoxyl groups[8], affords an isomeric ketodiacid (XII) which exhibits an UV absorption maximum at 240 mμ.

The configuration at C_6 is provided by the obtainment of a C_6 epimeric monoacetonide (XIII), $C_{23}H_{38}O_4$, on $NaBH_4$ reduction of (VI) in aqueous tetra-

hydrofuran. This monoacetonide (XIII) is reconverted in (VI) by Sarett oxidation. The conclusion is drawn, therefore, that the C_6 hydroxyl group in (XIII) must have the axial configuration since the complex hydride reduction of (VI) is sterically controlled by the 1,3-axial substituents in C_4 and in C_{10}.

The configuration of C_{13} is probably the same as in darutigenol (XIV)[9], a diterpenoid isolated from Siegesbeckia orientalis: the shielding effect on the tertiary methyl group at C_{10} in the derivatives of compound (II) having a carbonyl function at C_{13} suggests a cis relation between these two centers.

All these results can be rationalized in terms of the structure (II) or its mirror image.

The absolute configuration depicted in formula (II) seems however to be the most probable: co-occurrence of 16,17-dihydroxy-16β-(-)-kauran-19-oic acid (I) and compound (II) in Siegesbeckia pubescens is remiscent of the recent finding[10] that (-)pimaradiene (XV) is the precursor of (-)kaurane skeleton.

Table I

Compounds		C_{13}	C_{10}	C_4	$C_{(18)}-H_2$		$C_{(14)}-H$
III	$CDCl_3$	0.95s	0.91s	1.04s	4.10d	3.94d (J=10.8)	5.15bs
IV	"	0.92s	0.78s	1.04s	3.73d	3.34d (J=12)	5.08bs
V	"	1.04s	0.70s	1.07s	3.69d	3.34d (J=11)	5.22bs
VI	"	0.93s	0.68s	1.24s	-CHO 9.7s		5.22bs
IX	"	0.95s	0.88s	1.00s	3.90d	3.23d (J=8)	5.04bs
XI	"	1.16s	0.51s	1.31s	-		5.45bs
XIII	"	0.93s	1.01s	1.04s	?	206,195 cps (J=11)	5.12bs

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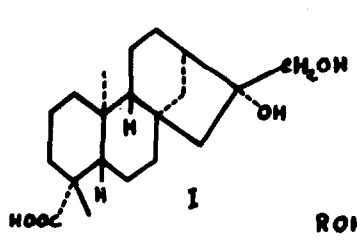
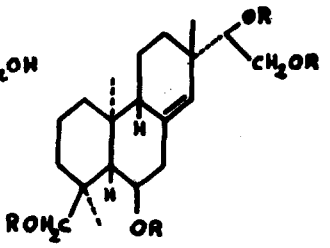
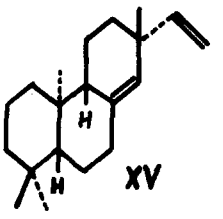


I



II R=H
III R=CH3CO



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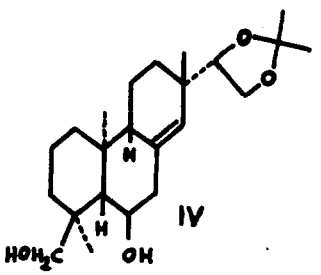

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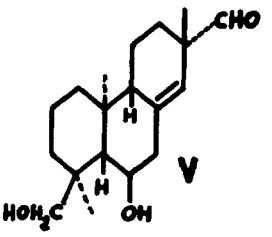

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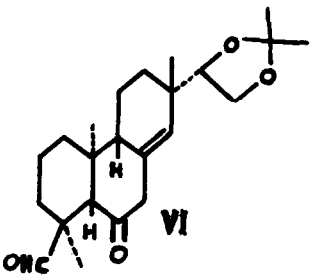
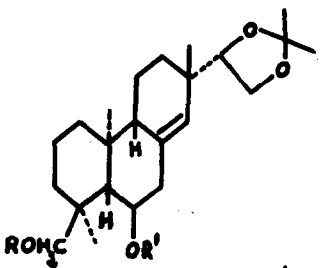
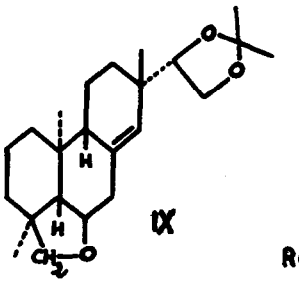


VI



VII R=C6H3SO2 R'=H
VIII R=R'=C6H3SO2



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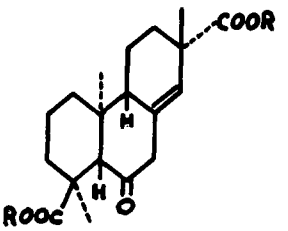
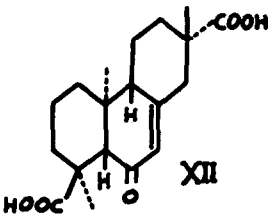
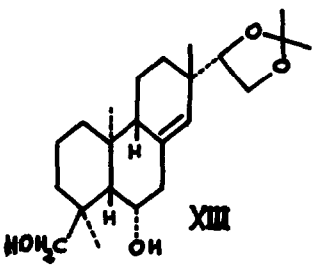


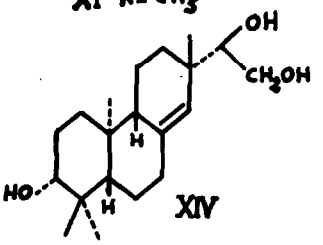
X R=H
XI R=CH3



XII



XIII



XIV