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# A NEW CLASS OF DITERPENES FROM *EREMOPHILA DECIPIENS*

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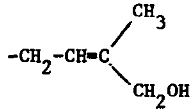
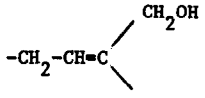
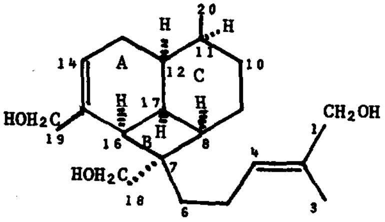
We report the structure assignment for the diterpene triol (1) which possesses the new tricyclic "decipiane" skeleton. The triol which was obtained from the neutral acetone extract of *Eremophila decipiens* shows nmr signals[1] for tert. $CH_2OH$, $CH_3CH$- and two olefinic groups assigned part structures A and B following multiple resonance studies.

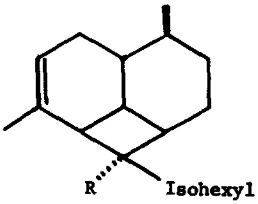
A

$-CH_2-CH=C(CH_3)(CH_2OH)$

B

$-CH_2-CH=C(CH_2OH)-$

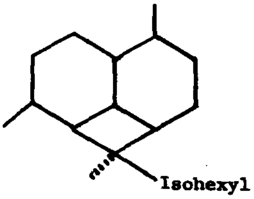
Deshielded coupled tertiary methine signals appear at δ3.17 (br d, J ∿ 9 Hz) and δ2.72 (d of d of d J ∿ J'∿ J" ∿ 9 Hz) and are assigned to the cyclobutyl protons at C 16 and C 17 respectively. Acetylation of 1 and treatment with Pd-$H_2$ gave the acetate (3) retaining the olefinic proton of group B. The alcohol (2) was oxidised ($CrO_3$-$C_5H_5N$) and the aldehyde (4) reduced (Wolff-Kishner) to the olefin (5) which on hydrogenation (Pt-AcOH) gave decipiane (6) $C_{20}H_{36}$ which is saturated and hence tricyclic. Quantities of the olefine (5) and the alcohol (2) were obtained by reduction of the neutral plant extract with Li-$NH_3$ followed by hydrogenation. This also gave the hydroxy ether (7) which was related to 1 by tosylation then KOtBu elimination to the allylic ether (9) which after reduction with Li-$EtNH_2$ and hydrogenation (Pd-C) gave the alcohol (2). The Jgem = 11.5 Hz for C $18H_2$ in the ether requires[2] a six or larger ring. This also follows



1



2 R = $CH_2OH$
3 R = $CH_2OAc$
4 R = CHO
5 R = $CH_3$



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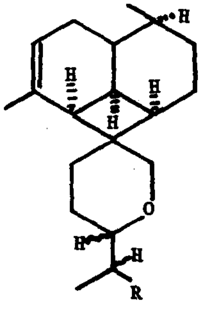
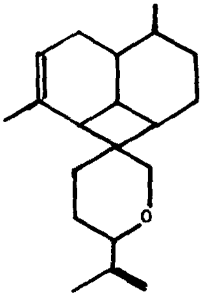
from $\nu_{max}$ 1720 $cm^{-1}$ for the lactone (10) which is available from 7 by LAH reduction of the tosylate to 8, hydrogenation of the 14-ene (Pt-AcOH) and then $RuO_4$-$IO_4^-$ oxidation[3]. The extension of group A to a $C_6$ side chain follows from mass spectra which show significant peaks for fission of C6:C7.



7 R = $CH_2OH$
8 R = $CH_3$



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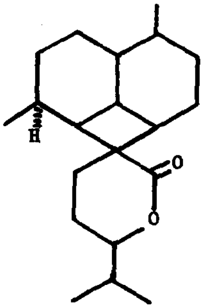

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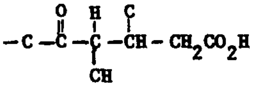
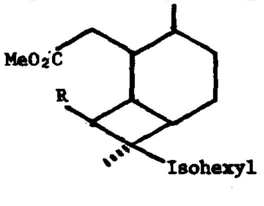
Ozonolysis of the acetate (3) and Zn reduction and methylation gave the keto ester (11) which epimerised to 12 on treatment with acid. The latter was oxidised with m-chloroperbenzoic acid and then hydrolysed and methylated to the diol ester which formed an ethylidene derivative (13). The hydroxy acid (14) was prepared similarly from (5) and oxidised (Jones) to the keto acid (15). DCl-AcOD on 15 gave the $d_1$ derivative and double resonance measurements on the keto acid (15) and this deuterium derivative identified the group

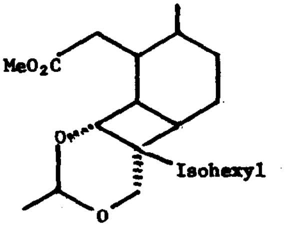


$$-C-\overset{O}{\overset{\|}{C}}-\underset{CH}{\overset{H}{C}}-\overset{C}{CH}-CH_2CO_2H$$

This delineation of ring A coupled with the $C_6$ side chain and tert. $CH_2OH$ leaves $CH_3CHC_2H_4$ unaccounted in the triol (1). Since this group cannot contain quaternary carbon the fully substituted centre α to carbonyl in 15 must carry the tert. $CH_2OH$. The cyclobutane ring follows from $\nu_{max}$ 1762 $cm^{-1}$ for the keto acid (15), the deshielded nature of the C16 and C17 protons throughout the series and mass spectra for 13, 14 and 15 which all show base peaks for fragments incorporating the side chain arising from fission of both C7:C8 and C16:C17.



11 R = βCOMe
12 R = αCOMe



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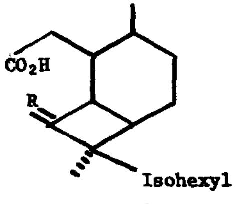
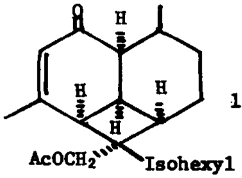


14 R = $^{H}_{OH}$
15 R = O

Entry to ring C followed allylic oxidation of the acetate (3) using $CrO_3$-$C_5H_5N$ in $CH_2Cl_2$[4]

leading to 16 in which H17 retains its three large couplings, indicating retention of configuration at C12. Reduction of 16 with Li-$NH_3$ gave cyclohexanone 17 which was converted into the lactone (18) under Baeyer-Villiger conditions. In contrast allylic oxidation of the ether (8) followed by Li-$NH_3$ reduction gave the ketone (19) which epimerised to 20 on exposure to acid. Oxidation of this epimer with m-chloroperbenzoic acid gave the C12βH lactone (21). After hydrolysis of 18, methylation and rebenzoylation gave 22 which was oxidised to the ketone (23 $\nu_{max}$ 1700 $cm^{-1}$). The substitution of C9, C10 and C11 followed from bromination of 23 with $Ph\overset{+}{N}Me_3\ Br_3^{-}$ and LiCl-DMF debromination which gave the conjugated ketone (24, $\nu_m$ 1685 $cm^{-1}$) whose nmr spectrum showed olefinic methyl (δ 1.82) coupled to olefinic proton (δ 6.64) further coupled to ring methylene ($J_{AX} + J_{BX} = 8$ Hz). The fusion of ring C to cyclobutane is strongly supported by mass spectra of 23 and 24, both of which show major fragments corresponding to fission of the C7:C8 and C16:C17 bonds.



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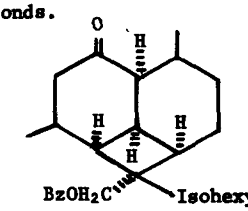
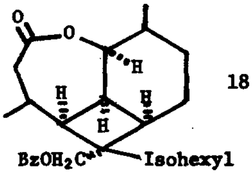


17



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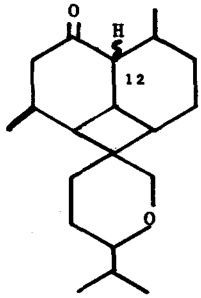
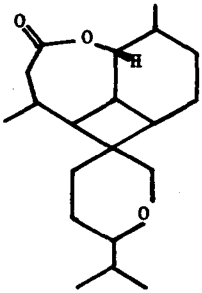


19 12αH
20 12βH



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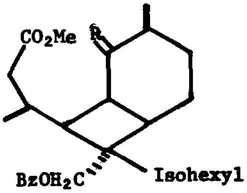
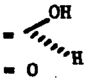
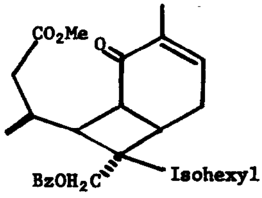


22 R = 

23 R = O



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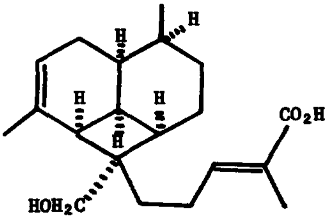

25

**Stereochemistry.** Pending determination of the absolute configuration C18 is arbitrarily assigned the α configuration as drawn for **1**. The formation of the *cis*-ethylidene derivative (**13**) after epimerisation of C16 requires C16H to be α in **1**. Since the keto acid (**15**) is stable to exchange conditions with DCl-AcOD the B:C fusion must be the more stable[5] *cis*. The driving force for inversion of C16 in **11** clearly follows if the acetyl group is *cis* to ring C and its substituents. The α configuration of C12H is evident from its resonance (br d, $J \sim 4$Hz) in the lactone (**18**) since if the AC rings were *trans* fused the C12H:C17H dihedral is restricted to ∿180°. In support of this assignment the C12βH epimeric lactone (**21**) and the derived hydroxy acid both show resonance for the C12H as broadened triplets ($J_{AX} + J_{BX} \sim 18$ Hz) consistent with contiguous axial protons at C11, C12 and C17. The configuration of the secondary methyl also follows from its heavy deshielding (-23 Hz) on oxidation of **3** to **16** since Dreiding models show that only a β methyl readily adopts a coplanar orientation with the carbonyl.

Finally positive NOE in (**1**) between the C16, C17 and C18 protons support the configurations assigned to these positions and mutual enhancements for the C1 and C4 protons require the E configuration of the side chain double bond.

The relative configuration which has been assigned to **1** has been confirmed by X-ray crystallographic examination[6] of the co-occurring hydroxy acid (**25**) which is related to **1** through **2** by hydrogenolysis and hydrogenation.

## References

1. Nmr spectra were measured using a Varian A60A and Brucker HX90 spectrometer for $CCl_4$,$CDCl_3$ and $C_5D_5N$ solutions. Multiple resonance studies include decoupling and homonuclear INDOR.
2. R.C. Cookson, T.A. Crabb, J.J. Frankel and J. Hudec, *Tetrahedron Supplement*, No.7,355(1966).
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6. E.N. Maslen, P.N. Sheppard, A.C. Willis and A.H. White, to be published.