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GLYCOSIDES OF 20,22-SECO-FUROSTANE DERIVATIVES

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A variety of pregnane derivatives occur in many plants and they are assumed, for the most part, to be produced *via* 3β-hydroxypregn-5-en-20-one which is derived from cholesterol[*1] by hydroxylation at C_{20} and C_{22} followed by cleavage of the 17-side chain.[1] In the meantime it has recently been reported that 3β-hydroxypregna-5,16-dien-20-one 3-O-β-chacotrioside (I) was coexistent with dioscin (I') in the rhizomes of *Paris polyphylla* Sm.,[2] and that 2β,3α,4β-trihydroxy-5β-pregn-16-en-20-one (II), its 2- and 4-acetates (III and IV),[3] and 1β,2β,3α-trihydroxy-5β-pregn-16-en-20-one 1-O-α-L-arabinopyranoside (V)[4] were obtained together with diotigenin (II'),[5] its 2-[5a] and 4-acetates[6] (III' and IV'), neotokoronin (V')[7] and the prototype compounds (IV"[6] and V"[8]) of IV' and V' from the MeOH extracts of the fresh aerial parts of *Dioscorea tenuipes* Franch. et Savat. collected at the Ozeki Pass, Shiga,[*2] Japan.

It is of particular interest that I-V correspond to Marker's degradation products[3,10] from steroid saponins and sapogenins I'-V', respectively, and that they could be assumed to be formed in plants from spirostane[11] or furostane derivatives in a manner similar to the chemical conversion.

Now, two new glycosides, tentatively named substances U_3 (VI) and S_{3a} (VII), have been isolated from the above-mentioned MeOH extracts of *D.tenuipes*, and this communication concerns

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*1 It is known that sitosterol is also metabolized to give progesterone.[1]

*2 *D.tenuipes* has two types, identical in morphology but different in their constituent steroid sapogenins. One grows in the eastern part of Japan and other in the western part.[9]

characterization of VI and VII as the 20,22-seco analogs of the prototype furostanol glycoside (III")[*3] corresponding to III' and of V", respectively.

Substance U_3 (VI), a white powder, mp 116-117°, $[\alpha]_D^{21}$-65.3°(EtOH), $C_{35}H_{56}O_{13}$,[*4] negative with the Ehrlich reagent,[12] shows the IR and PMR[*4] spectra as follows. IR $\nu_{max}^{KBr}cm^{-1}$: 3400 (OH), 1730 (COOR), 1712 (C=O). PMR (δppm, in pyridine-d_5): 0.88 (3H, d, J=5.3 Hz, 27-CH_3), 1.01 (3H, s, 18-CH_3), 1.15 (3H, s, 19-CH_3), 2.02 (3H, s, CH_3COO), 2.14 (3H, s, CH_3CO), 4.74 (1H, d, J=7 Hz, 1'-H of sugar). VI was boiled with dil.HCl in aq.MeOH to give glucose (PPC) and II as identified by direct comparison (TLC, mixed mp, IR, PMR) with an authentic sample,[3] while with dil.KOH in aq.MeOH VI afforded II and a water-soluble substance. The latter was treated successively with AcOH, Ac_2O-pyridine, and diazomethane to yield a syrup (VIII), of which Rf value on TLC and PMR (in $CDCl_3$) and mass spectra were identical to those of δ-(β-D-glucopyranosyloxy)-γ-methylvaleric acid methylester tetraacetate.[10b] When VI was incubated with emulsin (37°, 6 hr), glucose was liberated and an ether-soluble product was afforded, which was purified on a silica gel column (eluent, $CHCl_3$-MeOH-water 9:1:0.1) to give a white powder (from AcOEt) (IX), mp 96-98°, $[\alpha]_D^{16}$+36.4°(EtOH), $C_{29}H_{46}O_8$. IR $\nu_{max}^{KBr}cm^{-1}$: 3400 (OH), 1735 (COOR), 1714 (C=O). PMR (δppm, in $CDCl_3$): 0.88 (3H, d, J=5.3 Hz, 27-CH_3), 1.02 (6H, s, 18- and 19-CH_3), 2.08 (3H, s, CH_3COO), 2.16 (3H, s, CH_3CO), 3.41 (1H, t, J=9 Hz, >C<u>H</u>OH), 3.45 (2H, d, J=5 Hz, -C<u>H</u>$_2$OH), 3.85 (1H, dd, J=10, 9 Hz, >C<u>H</u>OH), 4.78 (1H, m, CH_3COOC<u>H</u><), 5.48 (1H, m, -CH_2COOC<u>H</u><). IX was hydrolyzed with dil.KOH in aq.MeOH to give II. The PMR spectrum of IX is identical to those of III and III' in regard to the signals of the methine groups bearing acetoxyl and hydroxyl functions.

All the above data indicate that VI is 2β-acetoxy-16-[δ-(β-D-glucopyranosyloxy)-γ-methyl]-valeroxy-3α,4β-dihydroxy-5β-pregnan-20-one, that is the 20,22-seco analog of the prototype compound (III") of III'.

Crude substance S_3,[5a] a mixture of at least four compounds S_{3a-d}, was acetylated and fractionated over a silica gel column (eluent, hexane-AcOEt 1:1) to give the most polar component, the acetate (X) of S_{3a} (VII), as colorless needles (from MeOH), mp 153-155° (decomp.), $[\alpha]_D^{31}$+29.2°($CHCl_3$), $C_{56}H_{80}O_{25}$, negative with the Ehrlich reagent. IR $\nu_{max}^{KBr}cm^{-1}$:

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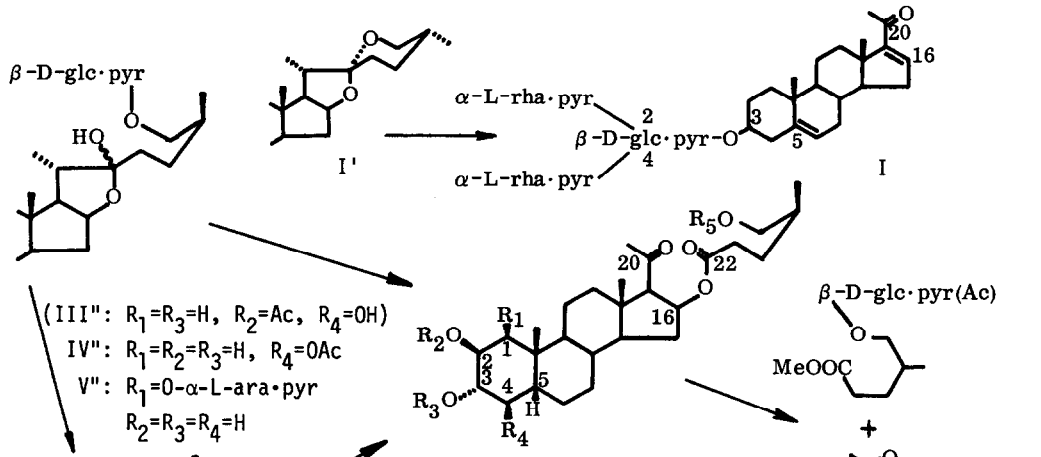
*3 The most likely substance has been detected on TLC but not isolated yet.

*4 Analytical data were in good agreement with the molecular formula indicated. PMR spectra were determined at 60 MHz with TMS as an internal reference.

1745 (COOR), 1718 (C=O). PMR (δ ppm, in $CDCl_3$): 0.90 (3H, d, J=6 Hz, $C\underline{H}_3CH<$), 1.02 (3H, s, 18-CH_3), 1.13 (3H, s, 19-CH_3), 1.99-2.09 (27H, $CH_3COO\times9$), 2.14 (3H, s, CH_3CO), 4.48 (1H, d, J=7 Hz, 1'-H of sugar), 4.54 (1H, d, J=7Hz, 1'-H of sugar), 4.8-5.7 (9H, $CH_3COOC\underline{H}< \times8$, $-CH_2COOC\underline{H}<$). Hydrolysis of X with dil.KOH in aq.MeOH provided a BuOH-soluble white powder and a water-soluble product. The former was treated with Ac_2O-pyridine to give an acetate as colorless needles (from hexane), mp 117-120°(decomp.), $[\alpha]_D^{21}$-48.9°(EtOH), which was identical in all respects to the peracetate (XI) derived from V. The water-soluble portion was treated in the same way as in the case of VI and the product was identified with VIII.



II': $R_1=R_2=R_3=H$, $R_4=OH$
III': $R_1=R_3=H$, $R_2=Ac$, $R_4=OH$
IV': $R_1=R_2=R_3=H$, $R_4=OAc$
V': $R_1=O$-α-L-ara·pyr
$R_2=R_3=R_4=H$

VI: $R_1=R_3=H$, $R_2=Ac$, $R_4=OH$
$R_5=\beta$-D-glc·pyr
VII: $R_1=O$-α-L-ara·pyr
$R_2=R_3=R_4=H$
$R_5=\beta$-D-glc·pyr
IX: $R_1=R_3=R_5=H$, $R_2=Ac$
$R_4=OH$
X: $R_1=O$-α-L-ara·pyr(Ac)
$R_2=R_3=Ac$, $R_4=H$
$R_5=\beta$-D-glc·pyr(Ac)

II: $R_1=R_2=R_3=H$, $R_4=OH$
III: $R_1=R_3=H$, $R_2=Ac$, $R_4=OH$
IV: $R_1=R_2=R_3=H$, $R_4=OAc$
V: $R_1=O$-α-L-ara·pyr
$R_2=R_3=R_4=H$
XI: $R_1=O$-α-L-ara·pyr(Ac)
$R_2=R_3=Ac$, $R_4=H$

Therefore, taking the co-occurrence of VII with V, V' and V" into account, X is considered to be the peracetate of VII which is regarded as 16-[δ-(β-D-glucopyranosyloxy)-γ-methyl]-valeroxy-1β,2β,3α-trihydroxy-5β-pregnan-20-one 1-O-α-L-arabinopyranoside, namely the 20,22-seco analog of V".

VI and VII correspond to the key intermediates in the Marker's conversion of III' or III" and V' or V" into III and V, respectively, and their coexistence seems to support the assumption that the spirostane or furostane derivatives are degraded in an analogous way in plants.

The present findings may suggest not only the metabolic transformations of steroid saponins and sapogenins which had so far been unexplained,[11] but also another biosynthetic route for the plant pregnane derivatives.

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