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CHARACTERIZATION OF 3β-HYDROXY-5α-CHOLESTA-9(11),20(22)-DIEN-23-ONE-6α-YL-β-D-6'-DEOXY GLUCOSIDE FROM THE STARFISH ACANTHASTER PLANCI

Younus M. Sheikh and Carl Djerassi

Department of Chemisty, Stanford University, Stanford, California 94305, U.S.A.

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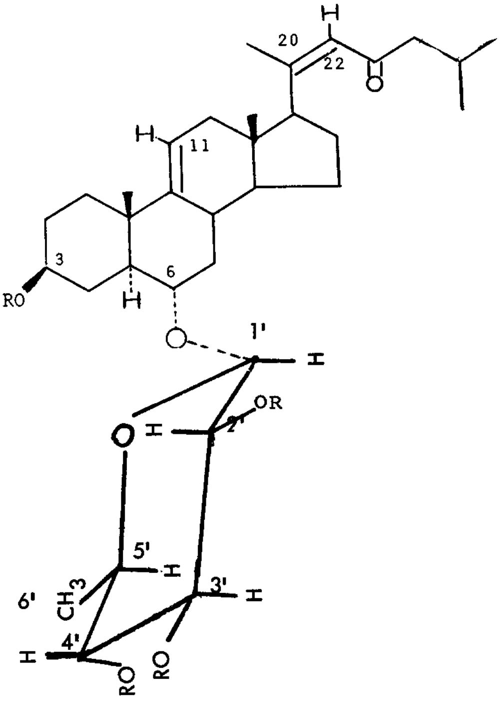
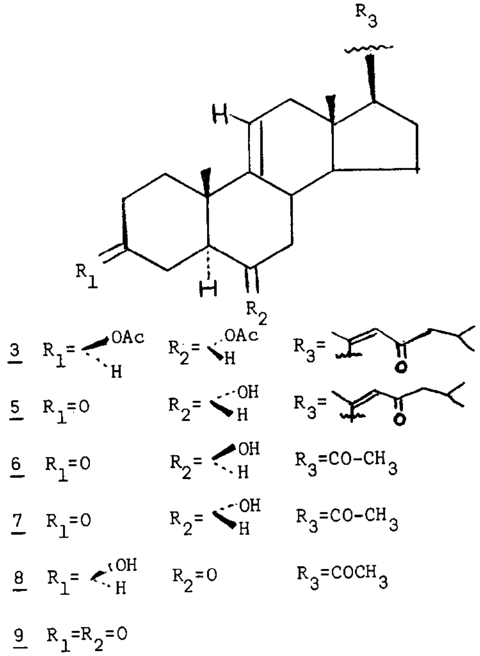
A recent report describing the isolation of 6α-hydroxy-3β-sulfo-oxy-5α-pregn-9(11)-en-20-one[1] from Asterias amurensis prompts us to report the characterization of the related 3β-hydroxy-5α-cholesta-9(11),20(22)-dien-23-one-6α-yl-β-D-6'-deoxy glucoside (2). This substance was isolated during our continuing search for presumable biogenetic precursors to 5α-pregn-9(11)-ene-3β, 6α-diol-20-one, the important constituent[2] from the starfish Acanthaster planci which we have recently converted[3] into corticosteroids such as cortisone.

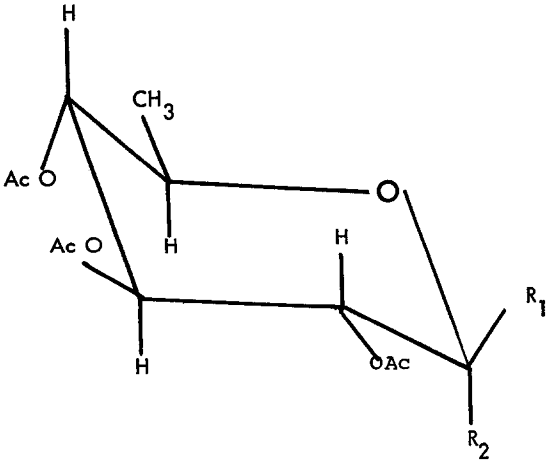
Hydrolysis (2N HCl/benzene) of the starfish saponin at 80° for 5 hr furnished a mixture which on fractionation by tlc over silica gel HF_{254} [rf, 0.48 ($CHCl_3$-MeOH 8:2); 0.08 (ϕH-Ac. 1:1)] followed by acetylation and multiple crystallization from methanol furnished the monoglycoside 1 [mp 222-4° (needles); $[\alpha]_D^{21}$ -14.5° (c, 1.37 $CHCl_3$), CD $\theta_{322.5}$ +1104, θ_{245} -17,670 (c, 0.43 in methanol); Anal. calcd for $C_{41}H_{60}O_{11}$: C, 67.61; H, 8.24. Found: C, 67.46; H, 8.16; M^+ 728]. Apparently the reason that the glycosidic linkage was not cleaved was due to the solubility of the product in benzene. The nmr spectrum of 1 depicted signals for two quaternary methyls 0.50, 0.96 (C-18,19 CH_3, s) an isopropyl, 0.94 (C-26,27 CH_3, d, J=7 Hz), a secondary methyl, 1.23 (C-6' CH_3, d, J=6 Hz), an olefinic methyl, 2.16 (C-21 CH_3, s), four acetates, 1.99, 2.00, 2.03 (s, 12H), two ether methine, 3.60 (C-5'H, t,t J=6 Hz, 9.5 Hz, 1H), 3.50 (C-6 H, b, 1H), two olefinic protons 5.34 (C-11H dt, 1H), 6.05 (C-22H, s, 1H) and a complex structure 4.50-5.30 (5H) which on careful analysis furnished two kinds of coupling constants (J=8.0 and 9.5 Hz) and was comprised of a doublet 4.53 (J=8.0 Hz, C-1'H), a triplet 4.71 (J=9.5 Hz, C-4'H) a doublet of doublets 4.80 J-8.0, 9.5 Hz, C-2'H) and a triplet 5.15 (J=9.5 Hz, C-3'H). The relatively large coupling constant[4] for the anomeric proton (C-1'H, J=8.0 Hz) firmly established the configuration at the



1 R = $-\overset{O}{\overset{\|}{C}}-CH_3$

2 R = H





4a R1 = H R2 = O Ac

4b R1 = O Ac R2 = H

anomeric carbon as β-D-C_1 and excluded the alternate α-D-C_1. The mass spectrum of 1 depicted significant peaks at m/e 671.3402 (1%, $C_{37}H_{51}O_{11}$, M^+-C_4H_9), 439.32105 (5%, $C_{29}H_{43}O_3$, M^+-$C_{12}H_{17}O_8$), 379 (24%, 439-CH_3COOH), 273.0969 (42%, $C_{12}H_{17}O_7$), 213.0769 (10%, $C_{10}H_{13}O_5$, 273-CH_3COOH), 171.0660 (14%, $C_8H_{11}O_4$, 213-C_2H_2O),153.05507 (36%, $C_8H_9O_3$, 213-CH_3COOH), 111.0440 (39%, $C_6H_7O_2$, 153-C_2H_2O) and 85.0654 (34%, $(CH_3)_2CH$-CH_2-$C{\equiv}\overset{+}{O}$). Both nmr and ms data are thus consistent with the presence of a 6-**deoxyglucose** portion (all sugar methines axial) attached to a C_{27} steroid carrying one hydroxyl, two triply substituted olefinic linkages and one ketone.

Hydrolysis (K_2CO_3-MeOH) of 1 furnished 2 [mp 127-30° (poor crystals from EtOH/H_2O), $[\alpha]_D^{21}$ -9.0° (c, 1.0, $CHCl_3$); ms, m/e 560 (M^+), 513 (560-C_4H_9), 475 (503-CO), 311, 297, 287 (M^+-side chain + 2H + $C_6H_{10}O_4$), 269 (287-H_2O), 85. Acid catalyzed hydrolysis of 2 followed by acetylation and purification of the resulting acetates gave 5α-cholesta-9(11),20(22)-dien-3β,6α-diol-23-one diacetate (3) [identical (tlc, ms. nmr) with authentic material[2]] and 4 (identical by gc, nmr, ms with 6-deoxy-D-glucose tetraacetate[5] (both β and α anomers)).

The attachment of the sugar moiety to the 6 -hydroxyl group could be established by CrO_3/Py oxidation of 2 followed by hydrolysis (HCl) and purification to provide a glassy monohydroxy diketone 5 [ms, m/e 412 (M^+), 402 (M^+-H_2O), 355 (M^+-C_4H_9), 285 (M^+-side chain + 2H),[6] 267 (285-H_2O), 225, 140 ($C_9H_{14}O$), 126, 85 (($CH_3)_2CH$-CH_2-$C{\equiv}O^+$)] which depicted C-11 olefinic proton and C-19 CH_3 signals at 5.44 and 1.20 δ in agreement (Table I) with the expected[7] values for a 3-oxo-6α-hydroxy system.

Table I

Chemical Shifts (δ values) of C-11 H and C-19 CH_3

Compound	C-11 H Observed	C-19 CH_3 Observed	C-19 CH_3 Calculated[7]
5	5.44	1.20	1.16
6	5.42[3]	1.35[3]	1.39
7	5.42[8]	1.14[8]	1.16
8	5.63[1]	0.91[1]	0.91
9	5.60[2]	1.10[2]	1.11

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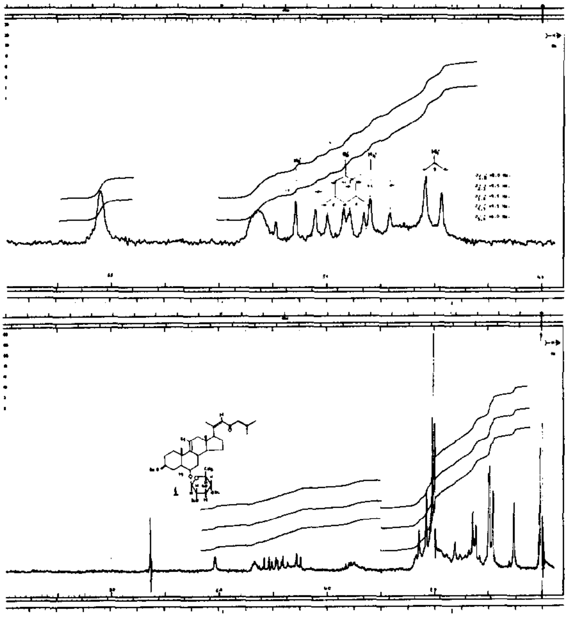

Fig. 1. 100 MHz Nmr spectrum of 1 in deuteriochloroform.

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