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CORDYLAGENIN, A NEW STEROIDAL SAPOGENIN DIOL FROM CORDYLINE CANNIFOLIA AND C.STRICTA

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Cordylagenin, a new steroidal sapogenin diol from the leaves of Cordyline cannifolia R.Br. and C.stricta Endl. (Agavaceae) has been shown to be 1β,3α-dihydroxy-5α,22α,25β-spirostane.

In a recent publication[1], one of us reported the presence of an unidentified steroidal sapogenin in the leaves of Cordyline cannifolia and C.stricta[2]. We now present evidence which shows that this sapogenin, to which we have assigned the trivial name cordylagenin, has the structure (1a).

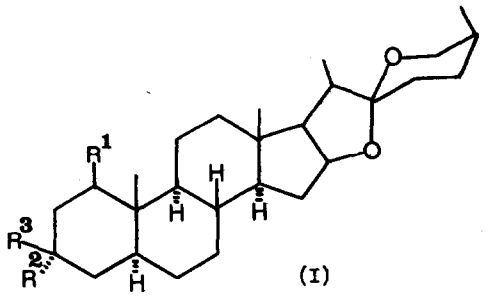
Cordylagenin (1a) $C_{27}H_{44}O_4$, (M^+, m/e 432), m.p. 216°, $[\alpha]_D$ -50° (c, 1.0; $CHCl_3$) was isolated as the major sapogenin from the leaves of C.cannifolia and C.stricta after treatment with acid. Strong absorption at 3450, 3400, 1080 and 1065 cm^{-1} in its infrared spectrum indicated the presence of hydroxy groups, and resonances at δ 4.07 (1H, m, $W_{\frac{1}{2}} \simeq 8.0$ Hz) and δ 3.79 (1H, q, $J \simeq 10.0$, 5.0 Hz) in the n.m.r. spectrum showed that the molecule contained two hydroxy groups with axial and equatorial conformations respectively. The 10- and 13- tertiary methyl groups were observed in the n.m.r. spectrum as singlets at δ 0.83 and δ 0.76 respectively, which shifted downfield to δ 2.62 and δ 1.10 on addition of tris (dipivalomethanato) europium. This indicated that the two hydroxy groups were located on ring A and suggested that cordylagenin was either 1β,3α-dihydroxy-5α-spirostane or 1α,3β-dihydroxy-5β-spirostane.

Acetylation of cordylagenin gave a diacetate (1b), $C_{31}H_{48}O_6$ (M^+, m/e 516.3415), m.p. 155°, $[\alpha]_D^{21}$ - 31.06° (c, 0.85; $CHCl_3$). High resolution mass spectrometric studies on this

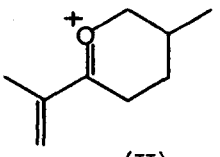
compound showed that the major fragment ions at m/e 139, 282, 373, and 444 arose from fragmentation of the spiroketal ring system with charge retention on the steroid nucleus or the heterocyclic fragment (II)[3]. This confirmed that the hydroxy groups were not located on rings E or F. The n.m.r. spectrum showed resonances at δ 0.75 (3H, s; 18-Me), δ 0.95 (3H, s; 19-Me), δ 0.97 (3H, d, J 6.0 Hz; 25β-Me), δ 1.07 (3H, d, J 6.0 Hz; 20-Me), δ 1.97 (3H, s; 1β-CH_3COO), δ 2.06 (3H, s; 3α-CH_3COO), δ 3.26 (1H, q, J $\simeq$ 11.0 and 2.0 Hz; 26-H), δ 3.93 (1H, q, J $\simeq$ 11.0 and 2.0 Hz; 26-H), δ 4.35 (1H, m, $W_{\frac{1}{2}} \simeq$ 20 Hz; 16-H), δ 4.88 (1H, q, J 10.5, 5.5 Hz) and δ 5.02 (1H, m, $W_{\frac{1}{2}} \simeq$ 8 Hz; 1α-H). Application of the Tori and Aono rules[4] for determining the chemical shifts of the 10- and 13- Me groups in steroidal sapogenins to cordylagenin and cordylagenin diacetate resulted in cordylagenin being assigned the 1β,3α-dihydroxy-5α-spirostane structure (1a), and this was in agreement with the observations of Meakins et al[5] on 1- and 3-substituted steroids. The chemical shifts of the 25-Me and 26-methylene protons and the multiplicity of the resonances of the latter in the n.m.r. spectrum of the diacetate showed that the 25-Me in cordylagenin had a β-configuration[6].

The above assignments were confirmed in the following manner. Partial hydrolysis of cordylagenin diacetate afforded the monoacetate (1c), $C_{29}H_{46}O_5$ (M^+, m/e 474), m.p. 238°, $[\alpha]_D$ -45° (c, 0.4; $CHCl_3$), δ 1.98 (3H, s; CH_3COO), δ 4.95 (1H, q, J 11.0 and 5.5 Hz; 1α-H). The preferential hydrolysis of the axial 3α-acetoxy group can be explained in terms of the larger steric compression experienced by the equatorial 1β-acetoxy group, which results from the "peri" effect of the 11-methylene group[7,8]. Jones oxidation of the monoacetate afforded the 5α-spirosta-1-en-3-one (III), $C_{27}H_{40}O_3$ (M^+, m/e 412.2982), m.p. 116°, $\nu_{max.}$ 1674 cm^{-1}, δ 5.85 (1H, d, J 10.5 Hz; 2-H), δ 7.13 (1H, d, J 10.5 Hz; 1-H), c.d. extrema 203, 234 and 340 nm ($\Delta_{max.}$ -8.69, + 10.39, - 0.93). The sign and magnitude of the observed Cotton effects of (III) were similar to those of 5α-cholesta-1-en-3-one; this indicated that cordylagenin had a 5α-spirostane structure. Catalytic hydrogenation of (III) over Adam's catalyst gave neotigogenin (1d), thus confirming all the stereochemical assignments.

Cordylagenin is a new member of the small group of naturally occurring 3α-hydroxy spirostanes, and is to the best of our knowledge the first 3α-hydroxy-5α-spirostane to be found in nature. We must also point out that the ratio of the intensities of the peaks at 900 and 922 cm^{-1} in the infrared spectra of cordylagenin and its derivatives varies con-

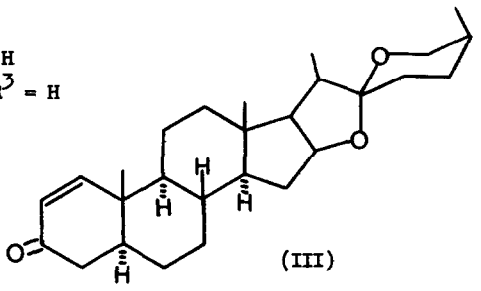


(I)



(II)

a) $R^1 = R^2 = OH$; $R^3 = H$
b) $R^1 = R^2 = CH_3COO$; $R^3 = H$
c) $R^1 = CH_3COO$; $R^2 = OH$; $R^3 = H$
d) $R^1 = R^2 = H$; $R^3 = OH$



(III)

siderably and so it is unwise to use this ratio in assigning[9] the conformation of the 25-methyl group in this molecule.

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