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SAIKOGENIN E, A GENUINE SAPOGENIN OF BUPLEURUM ROOTS

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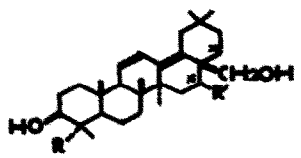
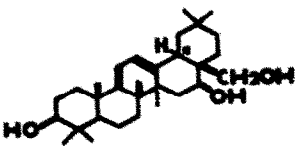
Previously we reported (1) on the structure of saikogenin A, which was obtained as a sapogenin of saikoside Ia, a saponin of the roots of Bupleurum falcatum L.(柴胡). An only ambiguous position of a secondary hydroxyl (16β or 22β) in our formula of saikogenin A has been proved to be located at 16β by Kubota et al.(2) shortly after the publication of our report. The complete structure of saikogenin A has been illustrated by Kubota et al. in relation with other sapogenins, saikogenins C, D, and B, which were isolated by them along with longispinogenin from the hydrolysate of Bupleurum saponin.



(I) Saikogenin A R=CH_2OH, R'= ═O

(II) Saikogenin C R=CH_3, R'= ═O

(III) Saikogenin D R=CH_2OH, R'= ---OH



(IV) Saikogenin B*

* The β-configuration of H at $C_{(18)}$ was indicated by Dr.T.Kubota in his private communication.

The purified saikoside II, one of the main saponins of Bupleurum roots, showed no remarkable UV- absorption above 210 mμ, whereas saikogenin C, m.p. 301°** which was obtained by the acid hydrolysis of saikoside II gave UV-absorptions of heteroannular diene at 241, 250 and 260 mμ. It would, therefore, be reasonable to assume that saikogenin C would be an artifact. The present study deals with a genuine sapogenin isolated from saikoside II fraction, which has now been designated saikogenin E.

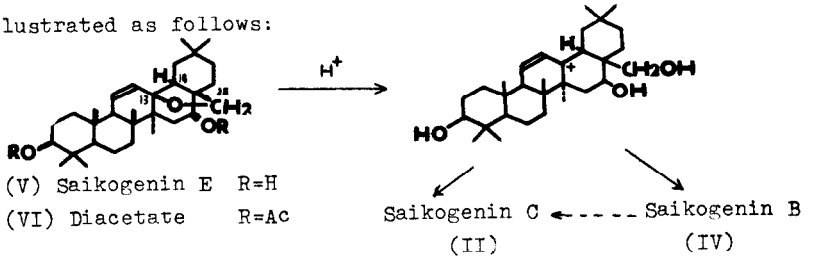
Saikogenin E was obtained from the saponin by the Smith degradation(3) carried out as follows: The sugar moiety of saikoside II was cleaved by the oxidation with periodate, and the aldehydic product was reduced with $NaBH_4$ to an alcoholic compound which was hydrolysed under a mild condition using 0.1 n H_2SO_4 in methanol at room temperature to afford an aglycone (saikogenin E). The same aglycone was also formed by heating the aldehydic intermediate with 5% KOH.

Saikogenin E (V), $C_{30}H_{48}O_3$, m.p. 289° (decomp.), $[\alpha]_D^{20}$ + 112° (c=0.5 in $CHCl_3$) shows no UV-absorption above 210 mμ indicating the absence of conjugated double bonds. On heating V with 5% H_2SO_4 for 30 mins. on a boiling water bath, saikogenin C (II) was afforded. As the mother liquour of saikogenin C showed UV absorption at 281 mμ (homoannular diene), saikogenin C was also likely formed from saikogenin E by the action of acid. On acetylation with acetic anhydride and pyridine at room temperature, V yielded a diacetate (VI), $C_{34}H_{52}O_5$, m.p. 213°,

** Saikogenin C was identified with Kuboka's specimen by a mixed fusion and comparison of IR spectra and thin layer chromatograms.

$[\alpha]_D^{23}$ + 117.7° (c=1.1 in $CHCl_3$), which revealed the absence of unblocked hydroxyl in the IR spectrum and the nonexistence of conjugated double bonds by the UV-absorption. The n.m.r.spectrum (measured at 100 Mc in $CDCl_3$) of V indicated the presence of 7 tertiary methyls (τ 8.91~9.23), a methylene adjacent to an ether linkage (τ 6.90 and 6.11 coupling in AB type, J=7.7 c.p.s.) and olefinic protons (τ 4.59 and 4.17 coupling in AB type, J= 11.5 c.p.s.) with small doubled coupling in the former signal, J = 3 c.p.s.). The n.m.r. spectrum (measured at 60 Mc in $CDCl_3$) of VI showed 2 acetyl groupings (τ 8.01 (s)) in addition to the presence of the same systems as shown in V (τ 6.84 and 6.07 coupling in AB type (J = 7.5 c.p.s.) and τ 4.65 and 4.18 coupling in AB type (J = 10.5 c.p.s.)). The signals at τ 6.78 (m) and 5.78 (m) in the n.m.r. apectrum of V shifted to 5.60 (m) and 4.60 (m), in that of VI , respectively. It would indicate that the hydroxyls of V are secondary locating at 3β and 16β, in the correlation with saikogenin C.

The above mentioned results led to a conclusion that the ether linkage in saikogenin E must be located between $C_{(28)}$ and a tertiary carbon atom at the position 13. Saikogenin E has now been formulated as (V), and the formation of saikogenins C and B is illustrated as follows:



(V) Saikogenin E R=H
(VI) Diacetate R=Ac

From the biosynthetical point of view, the configuration at $C_{(18)}$ is likely to be β since longispinogenin is occurring in the same plant.(2)

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