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THE STRUCTURE OF JEGOSAPOGENIN: 21-TIGLOYL-BARRINGTOGENOL C

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A recent communication[1] on the structure of jegosapogenol have prompted us to report our own observations concerning to the structure of jegosapogenin, a major acid-hydrolysis product of jegosaponin obtained from pericarps of Styrax japonica SIEB. et ZUCC. (Japanese, "Egonoki"). In this paper, we assign the structure 21β-tigloyloxy-3β,16α,22α,28-tetrahydroxy-olean-12-ene (I) (=21-tigloyl-barringtogenol C**) to jegosapogenin.

Jegosapogenin (I), $C_{35}H_{56}O_6$***, mp. 263-265°, $[\alpha]_D$ + 9.3° (c, 1.0 in pyridine) was obtained by acid hydrolysis of jegosaponin in addition to glucose, rhamnose, and glucuronic acid**** (identified by GLC of their trimethylsilyl derivatives[2] and by TLC on Avicel cellulose[3]). Among several previous workers concerning to the glycone part of jegosaponin, only Matsunami recognized the existence of rhamnose additionally to glucose and glucuronic acid[4]. According to him, the composition consists of two equivalents of glucose, one each of rhamnose and glucuronic acid.

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** The structure of barringtogenol C was first proposed as 3β,16α,21α,22β,28-pentahydroxy-olean-12-ene by Barua and Chakrabarti[5], and later on revised as possessing 21β,22α-glycolic function in ring E by showing its identity with theasapogenol B whose structure was established independently by Yosioka et al.[6] Here we use the name barringtogenol C for this structure instead of theasapogenol B because of its precedency.

*** All the compounds described with chemical formulae gave satisfactory analytical data. Melting points were taken on Yanagimoto micromeltingpoint apparatus (a hotstage type) and recorded uncorrected.

**** Quantitative analysis for the sugar composition is now in progress.

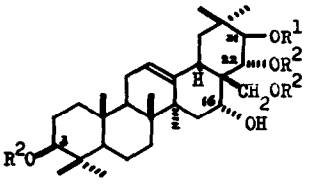
In all other papers[1,7], two equivalents each of glucose and glucuronic acid were described. In our repeated experiments using purified crystalline jegosaponin, rhamnose was definitely found supporting Matsunami's work.

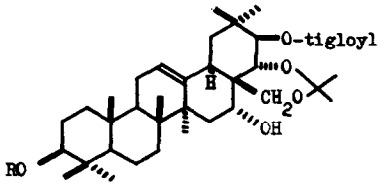
A conjugated ester linkage in jegosapogenin was disclosed by its infrared spectrum in KBr, (1690, 1265 cm^{-1}) and also was confirmed by alkaline hydrolysis yielding tiglic acid (detected by GLC) and a triterpene named jegosapogenol (II), $C_{30}H_{50}O_5$, mp. 277-282°, $[\alpha]_D$ + 10.5° (c, 1.0 in pyridine), whose identity with barringtogenol C[5] (=theasapogenol B[6]) was achieved by their direct comparison (mixed mp., $[\alpha]_D$, IR, and TLC) and also by comparison of their tetraacetyl derivatives (mixed mp., $[\alpha]_D$, IR, and TLC). Furthermore, the NMR spectrum of triacetyljegosapogenin (III), $C_{41}H_{62}O_9$, mp. 280-283°, $[\alpha]_D$ + 19.6° (c, 0.8 in $CHCl_3$), prepared by acetylation of I with acetic anhydride and pyridine at room temperature, reveals the existence of tigloyl moiety by the signals of one olefinic proton at τ 3.17 (m)[8] and of two methyls attached to a double bond (Table 1). The structure of tigloylbarringtogenol C for jegosapogenin has now become apparent. The inertness of one hydroxyl function for usual mild acetylation excludes C_{16}-OH in I from the possible location of tigloyl moiety.

On treatment with acetone and anhydrous $CuSO_4$, I afforded mainly an acetonide (IV), $C_{38}H_{60}O_6$, mp. 175-177°, $[\alpha]_D$ + 16.6° (c, 1.0 in $CHCl_3$), which was further derived to a monoacetylacetonide (V), $C_{40}H_{62}O_7$, mp. 232-234°, $[\alpha]_D$ + 26.8° (c, 0.5 in $CHCl_3$), by acetic anhydride and pyridine at room temperature. As shown in Table 1, IV lacks a characteristic NMR signal pattern ascribable to an axial proton at C_3 with acyloxy function (cf. τ 5.52 in V) and C_3-OH could consequently be eliminated from tiglate linkage formation in I. Finally the correctness of C_{21}-tigloyloxy function was verified by the following evidence.

Trans diaxial proton signals appearing at τ 4.35d, 6.10d(J=11 cps), and 4.36d, 6.13d(J=11 cps) in IV and V respectively (Table 1), indicate that the acetonide linkage of IV is formed between one primary hydroxyl and one of glycolic function. The feasible formation of acetonide bonding and the coupling constant (J=11 cps) due to C_{21}-H, C_{22}-H of IV and V reasonably indicate that the secondary hydroxyl joined to acetonide should be located at C_{22} rather than C_{21}. For, to form seven membered acetonide linkage between C_{17}-CH_2OH and C_{21}-OH, less favored boat or twist boat conformation of ring E is needed and moreover if the acetonide were actually formed, the large coupling constants of C_{21} and C_{22}-H in IV and V (vide supra) would not be observed (one of possible conformations can be illustrated as in Fig. 1.). In addition, the deshielded chemical shifts of C_{16}-H in IV and V appearing at τ 5.18 and 5.20, can be understood by considering the anisotropic effect* of neighbouring oxygen function

* See the footnote in lit. 3).





(I) R^1=tigloyl, R^2=H
jegosapogenin
(II) R^1=R^2=H : jegosapogenol
=theasapogenol B =barringtogenol C
(III) R^1=tigloyl, R^2=Ac

(IV) R=H
(V) R=Ac

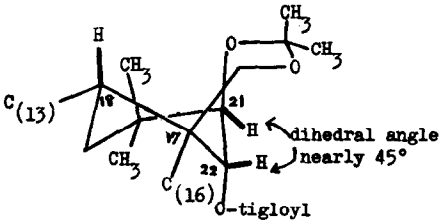


Fig. 1 Unlikely constitution for IV

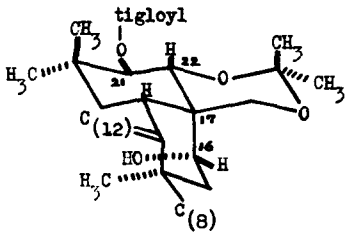
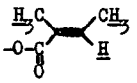


Fig. 2 Probable conformation of IV,V

Table 1. (τ value at 60 Mc. in $CDCl_3$)

	(III)	(IV)	(V)
	8.20(3H,d.,J=6cps.) 8.17(3H,br.s.) 3.17(1H,m.)	8.18(3H,d.,J=6cps.) 8.16(3H,br.s.) 3.16(1H,m.)	8.20(3H,d.,J=6cps.) 8.18(3H,br.s.) 3.20(1H,m.)
$>C_{(3)}\underline{H}OAc$	5.49(1H,t.-like)	——	5.52(1H,t.-like)
$>C_{(3)}\underline{H}OH$	——	6.74(1H,m.)	——
$=C_{(12)}\underline{H}$	4.64(1H,m)	4.69(1H,m.)	4.72(1H,m.)
$>C_{(16)}\underline{H}OH$	5.82(1H,m)	5.18(1H,m.)	5.20(1H,m.)
$\underline{H}-C_{(21)}-O$-tigloyl	R=Ac	R=-C(CH$_3$)$_2$ (O-)	R=-C(CH$_3$)$_2$ (O-)
$\underline{H}-C_{(22)}-OR$	4.38(1H), 4.57(1H) } ABq., J=11cps.	4.35(1H,d.), 6.10(1H,d.) } J=11cps.	4.36(1H,d.), 6.13(1H,d.) } J=11cps.
$-C_{(28)}\underline{H}_2OR$	R=Ac	R=-C(CH$_3$)$_2$ (O-)	R=-C(CH$_3$)$_2$ (O-)
	6.32(2H,br.s.)	6.49(2H,ABq.)	6.53(2H,ABq.)

attached to C_{22} in chair-formed 1,3-dioxane ring (Fig.2).

These results now reasonably support to connect tigloyl function to C_{21}-OH as I.

Due to the easy isomerisation of angeloyl moiety to tigloyl as postulated by Barton and de Mayo[9] and also by Kuhn and Loew[10] in their structural studies on icterogenin and protoaescigenin-ester, the possibility of angeloyl moiety in place of tigloyl in the genuine jegosapogenin is still remaining. To solve the problem, the soil bacterial hydrolysis[11] of jegosaponin has been undertaken along with the structural study of jegosaponin in this laboratory.

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