The Structure of Spirosupinanonediol, a Triterpenoid bearing a Novel Skeletal System from *Euphorbia supina*

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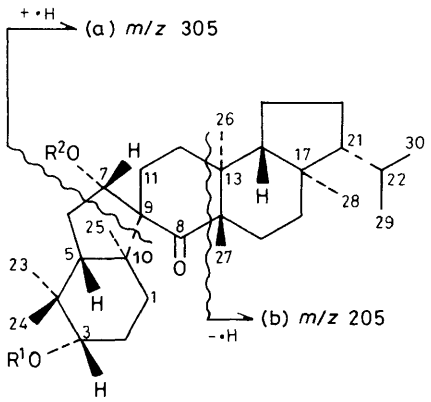
The structure of spirosupinanonediol, a new triterpenoid isolated from *Euphorbia supina* Rafin., has been established by spectral and *X*-ray analysis as 7(8→9)*abeo*-9*S*-D : C-*friedo*-B′ : A′-neogammaceran-8-one-3*S*,7*S*-diol, with a novel skeletal system for which the name spirosupinane is proposed.

Euphorbia supina Rafin., an annual weed which is native to North America, is found abundantly in untended gardens in Japan.[1] The latex of this plant causes a slight skin inflammation (urtication or prickling pain). Previously, *E. supina* has been reported to contain octacosanol, sitosterol, and triterpene alcohols.[2,3] Re-examination of the neutral benzene extract of the dried whole herb on silica-gel column chromatography led to the isolation of a novel triterpenoid, named spirosupinanonediol (**1**), from the fractions eluted with benzene–chloroform (3 : 1 to 1 : 1). This paper deals with the structure elucidation of (**1**).

Spirosupinanonediol (**1**), crystallized from ethyl acetate,



(1) $R^1 = R^2 = H$
(2) $R^1 = R^2 = Ac$
(3) $R^1 = p\text{-}BrC_6H_4CO$, $R^2 = H$
(4) 3,7,8-trione

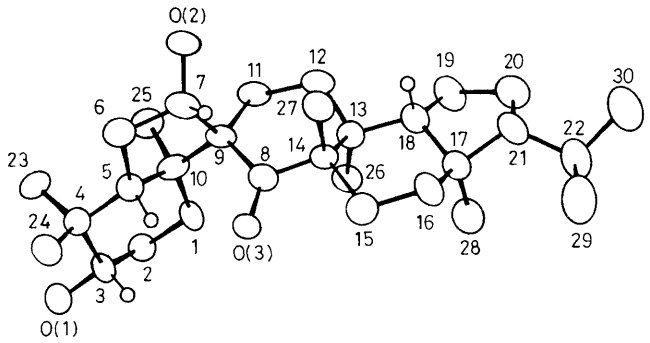


Figure 1. Molecular structure of spirosupinanonediol (**1**) non-solvate. Except for C(3), C(5), C(7), and C(18), hydrogen atoms have been omitted for clarity.

analysed as $C_{30}H_{50}O_3 \cdot CH_3CO_2C_2H_5$, m.p. 248—250 °C, $[\alpha]_D^{23}$ −3.8° (*c* 1.74, $CHCl_3$). On evacuation at 200 °C, it degenerated to the non-solvate (M^+ at *m/z* 458.3730, $C_{30}H_{50}O_3$). The mass spectrum displayed characteristic peaks at *m/z* 440 $(M - H_2O)^+$, 422 $(M - 2H_2O)^+$, 397 $(440 - C_3H_7)^+$, 369 $(397 - CO)^+$, 305 $(C_{20}H_{33}O_2)^+$ (a), and 205 $(C_{15}H_{25})^+$ (b). That (**1**) possessed a keto- and two secondary hydroxy-groups but bore no double bond was confirmed by its i.r. [$\nu_{max.}$ (KBr) 3542 and 1676; $\nu_{max.}$ ($CHCl_3$) 3620, 3600, and 1680 cm^{-1}] and ^{13}C n.m.r.† spectra. In the ^1H n.m.r. spectrum,† (**1**) showed signals due to six tertiary and two secondary methyl groups. These data suggested that (**1**) is a saturated pentacyclic triterpene keto-diol bearing an isopropyl group. However, the ^{13}C n.m.r. spectrum† of (**1**) showed six quarternary carbon signals indicative of the presence of a new carbon skeleton different from those of lupane, hopane, and all the migrated hopanes found hitherto in nature.[4] One of the two hydroxy-groups in (**1**) suffered a little steric hindrance, which was proved by the fact that despite the formation of the diacetate (**2**), m.p. 216—219 °C, $\nu_{max.}$ (KBr) 1740, 1686, 1250, and 1235; $\nu_{max.}$ (CCl_4) 1740, 1732, and 1688 cm^{-1}, (**1**) gave only mono-*p*-bromobenzoate (**3**), m.p. 285—286 °C. Oxidation of (**1**) with Sarett reagent afforded the trione (**4**), m.p. 238—241 °C, $\nu_{max.}$ (KBr) 1746, 1700, and 1683; $\nu_{max.}$ (CCl_4) 1740, 1710, and 1687 cm^{-1}, which contained a five-membered ring ketone.

The complete structure and stereochemistry was provided by single crystal *X*-ray analyses of both (**1**) and (**3**).

Crystal data: (**1**), ethyl acetate solvate, $C_{35}H_{58}O_5$, M = 546.84, orthorhombic, space group $P2_12_12$, a = 14.743(4), b = 16.187(4), c = 13.367(4) Å, U = 3190(2) Å^3, D_m = 1.101(3), D_x = 1.076 g cm^{-3}, Z = 4; compound (**3**), $C_{37}H_{54}O_4Br$, M = 642.75, orthorhombic, space group $P2_12_12_1$, a = 13.035(3), b = 7.154(2), c = 35.624(8) Å, U = 3322(1) Å^3, D_m = 1.274(3), D_x = 1.284 g cm^{-3}, Z = 4. A total of 3075 and 3267 independent reflection intensities up to 2θ = 130°, for (**1**) and (**3**) respectively, were measured on a Rigaku automatic four-circle diffractometer with graphite-monochromated Cu-K_α radiation. Among them, 2473 and 2879 reflections with $F \geq 3\sigma(F)$, for (**1**) and (**3**), were used for the structure determination and refinements. The structure of (**1**) was solved by direct methods and that of (**3**) by the heavy atom method. Hydrogen atoms and solvents of crystallization were located from a difference Fourier synthesis. The structures were refined by the block-diagonal least-squares to R = 0.084 for (**1**) and 0.072 for (**3**).‡ The absolute structure of (**3**) was unequivocally determined using the abnormal dispersion effects of bromine atoms. The molecular structure of (**1**) is shown in Figure 1.

Spirosupinanonediol is a migrated fernane derivative having the novel 7(8 → 9)*abeo*-9*S*-D : C-*friedo*-B′ : A′-neogammacerane skeleton, for which the name spirosupinane is proposed. The unusually low carbonyl frequency found in (**1**) is unusual in the environment of the molecular structure shown. Careful inspection of the i.r. spectra of (**1**), (**2**), and (**4**) in dilute solution (0.004 M, in $CHCl_3$ or CCl_4) gave conclusive evidence that in this ring-system the carbonyl groups at C-8 exhibit substantially lower frequencies than those expected for cyclohexanones.

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† ^1H (270 MHz) and ^{13}C (67.8 MHz) N.m.r. spectra were measured in $CDCl_3$ (Me_4Si). Spirosupinanonediol (**1**) non-solvate: δ_H 0.78, 0.82, 0.88, 0.89, 1.00, and 1.26 (each 3H, s, 6Me), 0.83 and 0.89 (each 3H, d, *J* 6.5 Hz, 2Me), 2.69 (1H, dd, *J* 6.2 and 14.5 Hz, H-5), 3.48 (1H, dd, *J* 7.0 and 10 Hz, H-3), and 4.24 (1H, dd, *J* 6.0 and 12.0 Hz, H-7); δ_C 15.84, 15.49, 16.76, 17.39, 19.41, 22.00, 22.89, and 29.80 (each q), 19.52, 21.68, 26.35, 28.25, 28.39, 30.06, 30.95, 34.73, and 34.90 (each t), 30.67, 47.68, 51.57, and 59.69 (each d), 37.98, 39.25, 42.79, 49.84, 53.87, and 60.44 (each s), 76.88 and 79.27 (each d, 2CHOH), and 218.69 (s, C=O).

‡ The atomic co-ordinates for this work are available on request from the Director of the Cambridge Crystallographic Data Centre, University Chemical Laboratory, Lensfield Road, Cambridge CB2 1EW. Any request should be accompanied by the full literature citation for this communication.