Phytochemistry, 1976, Vol. 15, pp. 797–798 Pergamon Press. Printed in England

A NEW COMPOUND, 21α-HYDROXYFRIEDEL-4(23)-EN-3-ONE AND OTHER TRITERPENOIDS FROM *PHYLLANTHUS RETICULATUS**

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(*Received* 17 *September* 1975)

Key Word Index—*Phyllanthus reticulatus*; Euphorbiaceae; triterpenoids; 21α-hydroxyfriedel-4(23)-en-3-one; friedelin; friedelan-3β-ol; glochidonol; 21α-hydroxyfriedelan-3-one; betulinic acid; sitosterol.

Abstract—The petrol extracts of the stems and leaves of *Phyllanthus reticulatus* both gave friedelin and sitosterol, and that of the former also friedelan-3β-ol, glochidonol, 21α-hydroxyfriedelan-3-one and a new compound, which was proved to be 21α-hydroxyfriedel-4(23)-en-3-one. The ethanol extract of the stems yielded betulinic acid.

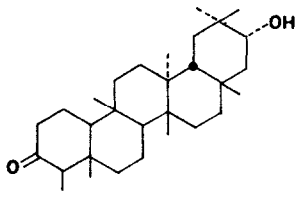
INTRODUCTION

A considerable number of *Phyllanthus* species have been examined. Several have been shown to contain alkaloids and lignans, while six have been found to yield triterpenoids: lupeol from *P. distichus* [1] and *P. emblica* [2,3], lupenone also from the latter [3], phyllanthol from *P. engleri* [4] and *P. acidus* [5] which also contained β-amyrin, betulinic acid from *P. discoides* [6], and two new friedelane derivatives from *P. muellerianus* [7]. We report here the triterpenoid constituents from both the stems and leaves of the second Hong Kong species, *Phyllanthus reticulatus* Poir.

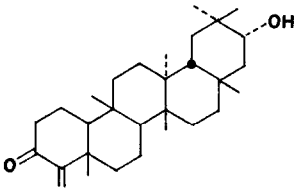
RESULTS AND DISCUSSION

Column chromatography of the petrol extracts of the stems of *P. reticulatus* on alumina gave in succession friedelin, friedelan-3β-ol, sitosterol, glochidonol, 21α-hydroxyfriedelan-3-one (**1**), and a new compound (**2**). Glochidonol has formerly been isolated only from *Glochidion* species*, also of the tribe Phyllantheae of the Euphorbiaceae family. Compound **1** was first obtained from *Siphonodon australe* (Celastraceae) by Courtney *et al.* [8,9]. This is its second isolation. It gave in its NMR spectrum a signal at δ 3·69 (1H, *q*, $J_{ax/eq}$ 6 Hz, $J_{ax/ax}$ 10 Hz) for the axial β-H at C-21.

Compound **2**, $C_{30}H_{48}O_2$ (M^+ at *m/e* 440) gave positive results to both the tetranitromethane test and Liebermann–Burchardt reaction. It revealed in its IR spectrum a hydroxy group, which was shown to be secondary and equatorial by a signal at δ 3·70 (1H, *q*, $J_{ax/eq}$ 6 Hz, $J_{ax/ax}$ 10 Hz) in its NMR spectrum, very similar to that given by **1**. A conjugated carbonyl group was shown in both the IR and UV spectra of **2**, which was also indicated by two weakly coupled one proton singlets at δ 5·90 and 6·10 in its NMR spectrum, suggesting the system $H_2C{=}C{-}C{=}O$. The terminal double bond was further proved by ozonolysis of **2**, yielding formaldehyde, identified as its dimedone-adduct. This together with seven tertiary Me signals at δ 0·71–1·20, led us to propose the structure of **2** to be 21α-hydroxyfriedel-4(23)-en-3-one, which was supported by strong peaks characteristic of friedelane derivatives with the functional groups at the required positions, at *m/e* 300, 285, 271, 203, 191, 189 and 139 in its MS [10,11].



(**1**)



(**2**)

Structure **2** was finally confirmed by catalytic hydrogenation of **2** to give a ketol, identical with **1**. Compound **2** appears to be the first member of the friedelane series having a terminal double bond, and it is also the first pentacyclic triterpene with an α-substituted α,β-unsaturated carbonyl function.

The petrol extract of the leaves of the same plant gave only friedelin and sitosterol. Both the stems and the leaves, after extraction with petrol, were further extracted with ethanol and the extract tested for acidic triterpenoids. Only betulinic acid was isolated from the stem extract.

* Part 12 in the series "An Examination of the Euphorbiaceae of Hong Kong." For Part 11, see Hui, W. H., and Li, M. M. (1976) *Phytochemistry* **15**, 561.

EXPERIMENTAL

IR spectra were recorded for KBr discs; NMR spectra in $CDCl_3$ were determined at 60 MHz using TMS as internal standard; UV spectra were in 95% EtOH, and optical rotations in $CHCl_3$ solns. Petrol had bp 60–80°. Known compounds were identified by TLC, mmp, IR and MS comparisons with authentic samples.

Extraction and isolation of compounds. Milled air-dried stems of *Phyllanthus reticulatus* (9 kg) were extracted 2× at room temp. with petrol for 10 days. Combined extracts were distilled to give a dry residue (176 g), which was chromatographed on alumina (3·7 kg). Elution with petrol gave needles of friedelin (2·0 g), mp 260–261°, then prisms of friedelan-3β-ol (5 mg), mp 282–283°; and with petrol–C_6H_6 (1:1) needles of sitosterol (0·4 g), mp 139–140°. Elution with C_6H_6 first yielded needles of glochidonol (0·4 g), mp 229–231° (from C_6H_6), [acetate, mp 190–192° (from $CHCl_3$–MeOH)], then needles of 21α-hydroxyfriedelan-3-one [**1**, 0·05 g], mp 268–270° (from $CHCl_3$–MeOH), $[\alpha]_D$ − 31·5° [lit. mp 264–268°, $[\alpha]_D$ − 32°], M^+ at *m/e* 442, IR ν_{max} cm^{-1}: 3540 (OH), 1720 (C=O), and finally needles of 21α-hydroxyfriedel-4 (23)-en-3-one [**2**, 0·025 g], mp 265–266° (from MeOH), $[\alpha]_D$ + 53·0° (Found: C, 82·0; H, 11·0. $C_{30}H_{48}O_2$ requires: C, 81·8; H, 11·0%), IR ν_{max} cm^{-1}: 3400 (OH), 1680, 1620, 920 ($H_2C=C-C=O$), UV λ_{max} nm: 232 (ϵ 13,500).

Ozonolysis of **2**. A soln of **2** (0·012 g) in $CHCl_3$ (30 ml) was ozonized at 0° for 1 hr. The mixture was steam distilled into a soln of dimedone in MeOH to give a product which on recrystallization from aq MeOH afforded long needles of dimedone–formaldehyde adduct, mp 188–189°.

Hydrogenation of **2**. A soln of **2** (0·01 g) in $CHCl_3$ (10 ml) was shaken with Adam's catalyst in H_2 for 1 hr. The product was recrystallized from $CHCl_3$ to give needles (7 mg), mp 267–269°, M^+ at *m/e* 442, IR ν_{max} cm^{-1}: 3546, 1720, identical with **1**. The residue (18 g) of the petrol extract of the leaves (1 kg) was chromatographed on alumina (400 g). Elution with petrol yielded friedelin (0·05 g); elution with petrol–C_6H_6 (1:1) gave sitosterol (0·1 g). The stems were then extracted with 95% EtOH twice at room temp for 10 days and combined extracts evaporated to give a dry residue. After repeated extraction with Et_2O, the combined ethereal solns were thoroughly extracted with 1M NaOH. The aq layer was acidified, the ppt. (9 g) formed was methylated with CH_2N_2 in Et_2O, and the dried product (9·5 g) was applied to a column of alumina (200 g). Elution with petrol–C_6H_6 (1:1) gave prisms of methyl betulinate (0·03 g), mp 228–230°. The leaves were similarly investigated, no acidic material could be isolated.

Acknowledgements—The authors wish to thank the Committee on Higher Degrees and Research Grants, University of Hong Kong, for financial assistance, Professor J. L. Courtney, for the gift of a sample of 21α-hydroxyfriedelan-3-one, and the staff of the Government Herbarium, Hong Kong, for identification of plant material.

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