Phytochemistry, 1976, Vol. 15, pp. 985–986. Pergamon Press. Printed in England.

TRITERPENOIDS FROM TWO *MALLOTUS* SPECIES: A NOR-TRITERPENE AND TWO NEW ACIDS*

WAI-HAAN HUI and MAN-MOON LI
Department of Chemistry, University of Hong Kong, Hong Kong

(*Received* 26 *November* 1975)

Key Word Index—*Mallotus paniculatus*, *M. hookerianus*; Euphorbiaceae; triterpenoids; 29-nor-21α*H*-hopane-3, 22-dione; friedelin; friedelan-3β-ol; 3-oxours-12-ene-27,28-dioic acid; 3β,28-dihydroxyurs-12-en-27-oic acid.

Abstract—The carbonyl compound, previously isolated from the stems of *Mallotus paniculatus*, has been proved to be 29-nor-21α*H*-hopane-3,22-dione. The light petrol extracts of both the leaves and stems of *M. hookerianus* have been found to contain friedelin, friedelan-3β-ol and sitosterol, and the ethanol extract of the former two new triterpene acids, 3-oxours-12-ene-27,28-dioic and 3β,28-dihydroxyurs-12-en-27-oic acids.

INTRODUCTION

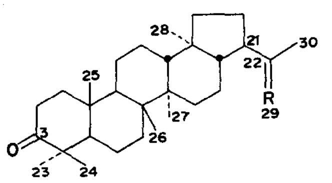
Two *Mallotus* species have formerly been investigated for triterpenoids. *M. philippinensis* has been shown in India to contain acetylaleuritolic acid, lupeol and betulin 3-acetates, and α-amyrin [1]. Our work on *M. paniculatus* (Lam.) Muell.-Arg. [2] has proved that the leaves and stems both yielded friedelin and friedelan-3β-ol, and also an unidentified carbonyl compound, the structure of which is reported in this paper. The present work describes also an investigation of the neutral and acidic triterpenoids of another *Mallotus* species, *M. hookerianus* Muell.-Arg., which has not previously been examined.

RESULTS AND DISCUSSION

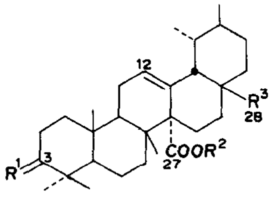
The carbonyl compound (**1**) [2] had molecular formula $C_{29}H_{46}O_2$ (M^+, *m/e* 426). It showed two C=O groups [ν_{max} 1708 and 1698 cm^{-1}, δ 2.17 (3H, *s*, C$\underline{H}_3$CO) and δ 2.40 (2H, *m*, C$\underline{H}_2$CO)] but no C=C absorption in its IR spectrum. The presence of 6 tertiary Me resonances (δ 1.07–0.72) and absence of proton signals at δ > 4.0 suggested a nor-triterpene. The hopane skeleton was indicated as the chemical shifts of the tertiary Me signals agreed well with those shown in moretenone (**2**) as follows:

	C-23	C-24	C-25	C-26	C-27	C-28
(**1**)	1.07	1.03	0.93	1.03	0.96	0.72
(**2**)	1.08	1.02	0.94	1.02	0.94	0.68

Compound (**1**) is therefore 29-nor-21α*H*-hopane-3, 22-dione which was further proved by characteristic mass fragments at *m/e* 383, 220, 205, 191, 177 and 149 [3] [4], and confirmed by its formation from (**2**) by ozonolysis. (**1**) is the first naturally occurring nor-triterpene of the isohopane series, though it has formerly been prepared from (**2**) [4]. (**1**) is a genuine natural product and not an artifact arising from epimerisation of the unstable 21β*H*-isomer through prolonged chromatography, as it could also be isolated from a crude extract by preparative TLC. The ethanol extracts of both the stems and leaves of the same plant were examined for triterpene acids. No such compounds could be isolated.



(**1**) R = O
(**2**) R = CH$_2$



(**3**) R^1 = O, R^2 = Me, R^3 = COOMe
(**4**) R^1 = αH, β-OH, R^2 = Me, R^3 = COOMe
(**5**) R^1 = O, R^2 = H, R^3 = COOH
(**6**) R^1 = αH, β-OH, R^2 = Me, R^3 = CH$_2$OH
(**7**) R^1 = αH, β-OAc, R^2 = Me, R^3 = CH$_2$OAc
(**8**) R^1 = αH, β-OH, R^2 = H, R^3 = CH$_2$OH

The light petrol extracts of both the leaves and stems of *M. hookerianus* yielded friedelin, friedelan-3β-ol and sitosterol, and the subsequent ethanol extract of the leaves gave an acidic fraction, which on methylation afforded two methyl esters separable by column chromatography.

The less polar ester (**3**), $C_{32}H_{48}O_5$ (M^+, *m/e* 512) contained one carbonyl function [ν_{max} 1710 cm^{-1}, δ 2.40 (2H, *m*, C$\underline{H}_2$CO)], two COOCH$_3$ groups [ν_{max} 1748, 1735, 1200 cm^{-1}, δ 3.63 (6H, *s*)], and a trisubstituted double bond [ν_{max} 1660, 840 cm^{-1}, δ 5.70 (1H, perturbed *q*, *J* 3 and 4 Hz, C=C$\underline{H}$–CH$_2$)], 4 tertiary and 2 secondary (partly obscured) Me signals at δ 0.83–1.04 suggested the urs-12-ene structure. Characteristic mass fragments at *m/e* 306 and 247 indicated that both COOMe groups were in rings C–E (C-27 and C-28); and at *m/e* 205 revealed the C=O group in rings A or B. Ester (**3**) was finally proved to be dimethyl 3-oxours-12-ene-27,28-dioate by its synthesis through oxidation of dimethyl

---

* Part 13 in the series "An Examination of the Euphorbiaceae of Hong Kong". For Part 12, see Hui, W. H., Li, M. M. and Wong, K. M. (1976) *Phytochemistry* **15**, 797.

quinovate (dimethyl 3β-hydroxyurs-12-ene-27,28-dioate) (**4**) with Jones reagent. The acid, 3-oxours-12-ene-27,28-dioic acid, (**5**) $C_{30}H_{44}O_5$, ν_{max} 1700 (C=O), 3550–2500 (broad) (COOH), 1640, 830 cm^{-1} (C=CH), *m/e* 484, 278, 233 (base peak) 205 and 163, was obtained by hydrolysis of (**3**) with KOH in diethylene glycol.

The more polar ester (**6**), $C_{31}H_{50}O_4$ (M^+, *m/e* 486) contained 2 OH functions (ν_{max} 3450), a trisubstituted double bond (ν_{max} 1650, 820), and a COOMe group (ν_{max} 1720, 1215 cm^{-1}, δ 3.63, 3H, *s*). It yielded a diacetate (**7**), $C_{35}H_{54}O_6$ (M^+, *m/e* 570, ν_{max} 1750, 1240 cm^{-1}, δ 2.04, 6H, *s*). One of the OH functions was primary and axial [δ 3.22 and 3.52 (1H ea., *d*, *J* 11 Hz), diacetate, δ 3.65 and 4.08], the other being secondary and equatorial [δ 3.23 (1H, *q*, *J* 7 and 9 Hz), diacetate δ 4.48]. The urs-12-ene structure was again indicated in (**6**) by signals at δ 5.57 (*q*, *J* 3 and 4 Hz), and δ 0.77–1.01 (4 tertiary and two secondary Me protons). Mass fragments of (**6**) and (**7**) at *m/e* 278 and 320 respectively indicated that the COOMe and CH_2OR^3 (R^3 = H or Ac) groups were both in rings C–E (i.e. at C-27 and C-28), and a species at *m/e* 247 (base peak) for both compounds suggested the latter group being at C-28 [4]. The ester (**6**) was proved to be methyl 3β, 28-dihydroxyurs-12-en-27-oate by its oxidation with chromic acid at 100° followed by methylation to give a product identical with (**3**), and by its synthesis from dimethyl quinovate (**4**) through $LiAlH_4$ reduction, when the COOMe group at C-28 was preferentially reduced [5]. (**6**) on hydrolysis with KOH in diethylene glycol, gave the acid 3β,28-dihydroxyurs-12-en-27-oic acid (**8**), $C_{30}H_{48}O_4$, ν_{max} 3620, 3440 (OH), 3500–2580 (broad) (COOH), 1650, 830 cm^{-1} (C=CH), *m/e* 472, 262, 233 (base peak), 207 and 163.

Both acids (**5**) and (**8**) were also isolated by fractional recrystallization of the original acid mixture from acetone, (**5**) being the less soluble component. (**5**) and (**8**) are both new compounds, though their methyl esters, (**3**) and (**6**) respectively, have formerly been prepared [5] [6].

EXPERIMENTAL

IR spectra were recorded for KBr discs; NMR spectra in $CDCl_3$ were determined at 60 MHz using TMS as internal standard. Light petrol had bp 60–80°. Known compounds were identified by TLC, mmp, IR and MS spectral comparisons with authentic samples.

Mallotus paniculatus. The formerly reported carbonyl compound (**1**) [2] had mp 272–273° (from MeOH), $[\alpha]_D$ + 29.2°.

Isolation of (**1**) *by preparative TLC.* Air-dried stems (0.5 kg) were extracted with boiling EtOH for 4 days. The extract was distilled to give a dry residue (2.5 g), which was repeatedly extracted with boiling petrol. The extracts on concentration after removal of plates of friedelan-3β-ol (0.03 g), was separated by preparative TLC, to give friedelin, friedelan-3β-ol, then a fraction (3 mg), mp 273–274° (from MeOH) identical with (**1**).

Partial synthesis of (**1**). Ozonized oxygen was passed into a soln of moretenone (**2**) (0.05 g) in $CHCl_3$ (25 ml) for 2 hr. The product was dissolved in light petrol and chromatographed on alumina (15 g). Elution with light petrol–C_6H_6 (1 : 1) gave plates of 29-nor-21αH-hopane-3,22-dione (0.03 g), mp 274–275° (from MeOH), identical with (**1**).

M. hookerianus. *Extraction and isolation.* Milled air-dried leaves of *M. hookerianus* (11 kg) were extracted 2 × at room temp. with light petrol for 10 days. The combined extracts were distilled to give a dry residue (40 g), which was chromatographed on alumina (800 g) in light petrol. Elution with light petrol gave needles of friedelin (0.015 g), mp 262–264°, then prisms of friedelan-3β-ol (0.01 g), mp 285–287°; with light petrol–C_6H_6 (1:1), needles of sitosterol (3.0 g), mp 138–140°. The residue (30 g) of the light petrol extract of the stems (19 kg) was chromatographed on alumina (800 g). Elution with light petrol yielded friedelin (1.0 g) and friedelan-3β-ol (0.3 g), with light petrol–C_6H_6 (1 : 1) sitosterol (2.0 g). The leaves were then 2 × extracted with 95% ethanol at room temp for 10 days. The combined extracts were distilled to give a dry residue which was thoroughly extracted with ether. The combined ethereal solutions were repeatedly shaken with NaOH solution (1 M). The aq. layers on acidification gave a solid mixture (5.5 g).

Separation of acid mixture. (a) The crude-mixture (0.5 g) on fractional recrystallization from acetone yielded fine needles of (**5**) (10 mg), mp 342–347° in the least soluble, and fine needles of (**8**) (15 mg), mp 262–268°, in the most soluble fractions. (b) The mixture (5.0 g) was treated with excess CH_2N_2 in ether, and the dried product (5.0 g) was chromatographed on alumina (100 g). Elution with light petrol gave plates of (**3**) (0.05 g), mp 156–157° (from aq. MeOH), $[\alpha]_D$ + 130.0°, (Found: C, 75.2; H, 9.45. Calc. for $C_{32}H_{48}O_5$: C, 75.0; H, 9.4%). Elution with $CHCl_3$ afforded needles of (**6**) (0.08 g), mp 157–158° (from aq. MeOH), $[\alpha]_D$ + 90.0°.

Hydrolysis of (**3**). (**3**) (0.05 g) was refluxed with a solution of 2 M KOH in diethylene glycol (25 ml) for 2 days. The soln on acidification gave a ppt. which was recrystallized from Me_2CO to give fine needles (0.02 g), mp 352–353°, identical with (**5**) obtained by recrystallization of the crude acid mixture.

Partial synthesis of (**3**). Dimethyl quinovate (**4**) (0.1 g) was oxidized with Jones reagent to give plates of dimethyl 3-oxours-12-ene-27,28-dioate (0.08 g), mp 155–156° (from aq. MeOH), identical with (**3**).

Hydrolysis of (**6**). (**6**) (0.06 g) was hydrolysed with KOH in diethylene glycol as for (**3**) to give fine needles (0.025 g), mp 283–285° (from MeOH), identical with (**8**) obtained from the crude acid mixture.

Acetylation of (**6**). (**6**) (0.03 g) on acetylation gave needles of (**7**), mp 113–115° (from aq. MeOH), $[\alpha]_D$ + 68.0°, (Found: C, 73.5; H, 9.4. $C_{35}H_{54}O_6$ requires C, 73.6; H, 9.5%).

Oxidation of (**6**). (**6**) (0.06 g) was treated with CrO_3 (0.3 g) and H_2SO_4 (5 M, 2 ml) in HOAc (50 ml) at 100° for 3 hr. The product was extracted in Et_2O, which was then extracted with NaOH (1 M). The alkaline soln was acidified to give a product which was methylated with diazomethane etherate and purified by preparative TLC to give plates (0.015 g), mp 154–156° (from aq. MeOH) identical with (**3**).

Partial synthesis of (**6**). Dimethyl quinovate (0.1 g) was refluxed with $LiAlH_4$ in dry ether (25 ml) for 2 hr to give needles of methyl 3β,28-dihydroxyurs-12-en-27-oate (0.08 g), mp 155–157°, which formed a diacetate, mp 112–115°, identical with (**6**) and (**7**) respectively.

Acknowledgements—The authors wish to thank the staff of the Government Herbarium, Hong Kong, for identification of plant materials; and the Committee on Higher Degrees and Research Grants, University of Hong Kong, for financial assistance.

REFERENCES

1. Bandopadhyay, M., Dhingra, V. K., Mukerjee, S. K., Pardeshi, N. P. and Seshadri, T. R. (1972) *Phytochemistry* **11**, 1511.
2. Hui, W. H., Chan, C. K., Chow, L. C., Ng, H. Y. and Siu, Y. K. (1969) *Phytochemistry* **8**, 519.
3. Galbraith, M. N., Miller, C. J., Rawson, J. W. L., Ritche, E., Shannon, J. S. and Taylor, W. C. (1965) *Austral. J. Chem.* **18**, 226.
4. Budzikiewicz, H., Wilson, J. M. and Djerassi, C. (1963) *J. Am. Chem. Soc.* **85**, 3688.
5. Zimmermann, J. (1936) *Helv. Chim. Acta* **19**, 247.
6. Tschesche, R., Duphorn, I. and Snatzke, G. (1963) *Annalen* **667**, 131.