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ISOLATION OF ISOBAUERENOL FROM *HELIETTA LONGIFOLIATA**

D. F. THEUMANN and J. COMIN

Departmento de Química Orgánica, Facultad de Ciencias Exactas y Naturales, Perú 222,
Buenos Aires, Argentina

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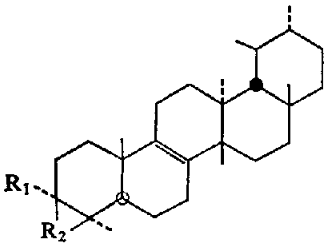
Abstract—From the bark of *Helietta longifoliata* Britt. (Rutaceae), the pentacyclic triterpenoid alcohol isobauerenol (D:C-friedo-ursa-8-en-3β-ol) (I) has been isolated for the first time from a natural source, and the following new derivatives described: isobauerenone (III) and isobauerene (IV).

FROM the bark of *Helietta longifoliata* Britt. (Rutaceae) growing in the north-east of Argentina, the furocoumarin heliettin[1] and the furoquinoline maculine[2] have been isolated. The present paper deals with the identification of the pentacyclic triterpenoid alcohol isobauerenol (I),[3,4] in what seems to be its first isolation from natural sources. It may also be worth mentioning that a pentacyclic triterpenoid with an 8,9 internal double bond has been isolated on only one other occasion: isofernene, from *Adiantum monochlamis* Eaton[5] (Adiantaceae).



Isobauerenol (I) $R_1=H$, $R_2=OH$
Acetate (II) $R_1=H$, $R_2=OCOCH_3$
Isobaurenone (III) R_1, $R_2=O$
Isobaurene (IV) $R_1=H$, $R_2=H$

Silica gel chromatography of the concentrated mother liquors of heliettin crystallization,[1] led to the isolation of a crystalline fraction (0·1 per cent of dry plant material) which, sublimed in high vacuum melts at 168–170°, $[\alpha]_D+45{\cdot}0°$, analyses for $C_{30}H_{50}O$, and gives the

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[2] D. F. THEUMANN and J. COMIN, *Anales Asoc. Quim. Argentina* **55**, 253 (1967).

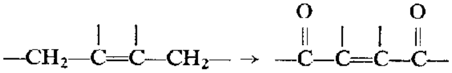
[3] P. SENGUPTA and H. N. KHASTGIR, *Tetrahedron* **19**, 123 (1963).

[4] F. N. LAHEY and M. W. LEEDING, *Proc. Chem. Soc.* 342 (1958).

[5] H. AGETA, K. IWATA and S. NATORI, *Tetrahedron Letters* 3413 (1964).

following derivatives: acetate (II), ketone (III) (by CrO_3 oxidation) and hydrocarbon (IV) (by Wolff-Kishner reduction of ketone).

The secondary alcoholic character of the compound is apparent from the derivatives it yields. The splitting of the NMR signal of the carbinolic proton (quartet at $\delta = 3{\cdot}25$, $J_{AX} + J_{BX} = 15$ cps) indicates an equatorial conformation for the OH group.[6] The molecular formula and a positive tetranitromethane reaction indicate the presence of a double bond, but no signal due to olefinic protons is apparent in the NMR spectrum. Oxidation of the acetate according to Ruzicka[7] gave a product $C_{32}H_{48}O_4$, whose u.v. spectrum has a maximum at 275 nm ($\epsilon = 7900$), pointing out the presence of a conjugated 1,4-diketone and, in the original product, of a quaternary double bond flanked by two methylene groups:



$$-CH_2-\overset{|}{C}=\overset{|}{C}-CH_2- \rightarrow -\overset{\overset{O}{\|}}{C}-\overset{|}{C}=\overset{|}{C}-\overset{\overset{O}{\|}}{C}-$$

The ORD curve of the ketone is of the same type as those of lanost-8-en-3-one and isomultiflorenone,[8] showing that the most probable position of the double bond is between C-8 and C-9, and that the carbonyl group (OH group) is, as usual, at C-3.

This leaves as possible structures for this alcohol those of isomultiflorenol,[3] isofernerol,[9] the unknown arbora-8-en-3β-ol, and isobauerenol.[3,4] Comparison of the physical data of our compound and its derivatives with those published in the literature for the above terpenoids showed the possibility of it being isobauerenol. This was confirmed by direct comparison (m.p., R_f, i.r., MS) with an authentic sample kindly provided by Professor P. Sengupta. The possibility of isobauerenol being an artifact is excluded by the fact that only mild isolation procedures were employed.

EXPERIMENTAL

M.ps are uncorrected. Microanalyses were performed by Dr. B. B. de Deferrari. I.r. spectra: Perkin-Elmer 137B instrument, in nujol mulls. NMR spectra: Varian A-60 spectrometer, in $CDCl_3$ soln., with TMS as internal standard. Optical rotations; Rudolph 70 polarimeter, in $CHCl_3$. ORD curve: Jasco 5 instrument, in MeOH soln. Mass spectra: Varian M-66, Atlas CH-4 and AEI MS-9 instruments. TLC on alumina "G" (Merck) and benzene (S1) or petrol. ether (S2) as solvents.

Isobauerenol (*D:C-Friedo-ursa*-8-*en*-3β-*ol*) (*I*)

The petrol. ether mother liquors from heliettin crystallization[1] were concentrated to dryness and the residue (25 g, corresponding to 2·5 kg of *Helietta longifoliata* dry bark) was dissolved in benzene and extracted with 2 N HCl). The organic layer was dried, concentrated, and chromatographed on a 250 g silica gel column, eluting with benzene and benzene–AcOEt (9:1). After the initial oily eluates a crystalline fraction was obtained that, after recrystallization from MeOH and sublimation (150°/0·001 mm), weighed 2·6 g, m.p. 168–170°, undepressed by admixture with an authentic sample; $[\alpha]_D^{22} + 45{\cdot}0°$ (c, 0·8); i.r. spectrum: band at 3400 cm^{-1} (OH), identical to that of an authentic sample; NMR spectrum: $\delta = 3{\cdot}25$ (q, 1H, $J_{AX} + J_{BX} = 15$ cps, 3-H); Mass spectrum: $(M+1)^+$ 427 (52 per cent), M^+ 426 (100 per cent), 411 (57 per cent), 259 (46 per cent), 247 (68 per cent), 229 (31 per cent), identical to that of an authentic sample; R_f 0·31 (S1). (Found: C, 84·32; H, 11·64. Calc. for $C_{30}H_{50}O$: C, 84·44; H, 11·81 per cent.)

Isobauerenyl acetate (3β-*Acetoxy-D:C-friedo-ursa*-8-*ene*) (*II*)

A solution of isobauerenol (150 mg) in pyridine (8 ml) and Ac_2O (8·0 ml) was left at room temp. for 36 hr. It was then poured on ice water and the ppt (142 mg) filtered, recrystallized from MeOH and sublimed at

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[6] A. LABLANCHE-COLOMBIER, J. LEVISALLES, J. P. PETE and H. RUNDLER, *Bull. Soc. Chim. Fr.* 1689 (1963).

[7] L. RUZICKA, E. REY and A. C. MUHR, *Helv. Chim. Acta* **27**, 472 (1944).

[8] C. DJERASSI, *Optical Rotatory Dispersion*, p. 97, McGraw-Hill, New York (1960).

[9] K. NISHIMOTO, M. ITO, S. NATORI and T. OHMOTO, *Tetrahedron* **24**, 735 (1968).

150°/0·001 mm: m.p. 212–213°, $[\alpha]_D^{25} + 44{\cdot}0°$ (*c*, 0·56) (lit.[3,4] m.p. 223–225°, $[\alpha]_D + 42°$); i.r. spectrum: bands at 1240 and 1730 cm^{-1} (—COOR); NMR spectrum: $\delta = 4{\cdot}57$ (q, 1H, $J_{AX} + J_{BX} = 15$ cps, 3-H); R_f 0·42 (S2). (Found: C, 82·07; H, 10·94. Calc. for $C_{32}H_{52}O_2$: C, 81·99; H, 11·18 per cent.)

Isobauren-7,11-*dione*-3β-*acetate*

To a soln. of isobauerenyl acetate (170 mg) in AcOH (10 ml) at 70°, CrO_3 (300 mg) in AcOH (10 ml) and water (0·5 ml) were added in 30 min. The mixture was cooled, the excess CrO_3 eliminated with MeOH and water (25 ml) and ether (25 ml) added. The aqueous layer was extracted once with ether and the combined ether extracts were dried and the solvent evaporated. The residue was dissolved in petrol. ether and chromatographed on a column of deactivated alumina (15 g, Woelm I, deact. with 1 ml 10% AcOH), eluting with light petroleum–benzene, 9:1. The solvent was removed and the residue (85 mg) was chromatographed through neutral alumina (15 g, Woelm I), eluting with benzene. The solvent was evaporated and the residue (25 mg) crystallized from MeOH and sublimed at 180°/0·001 mm; m.p. 250–253°, $[\alpha]_D^{17} - 20{\cdot}0°$ (*c*, 0·35) (lit.[3, 4]m.p. 256–258°, $[\alpha]_D - 27°$); u.v. spectrum: λ_{max} 269 nm ($\epsilon = 7900$); i.r. spectrum: bands at 1240 cm^{-1}, 1730 cm^{-1} (—COOR), 1660 cm^{-1} (conjugated CO); R_f 0·75 (S1). (Found: C, 77·01; H, 9·88. Calc. for $C_{32}H_{48}O_4$: C, 77·37; H, 9·74 per cent.)

Isobauerenone (*D: C-Friedo-ursa*-8-*en*-3-*one*) (*III*)

To a stirred soln. of isobauerenol (200 mg) in acetone (20 ml), 5 ml of Kiliani's reagent (2·7 g of CrO_3 in 20 ml of 25% H_2SO_4) was slowly added at 0°. The excess reagent was destroyed with MeOH and the solution poured on ice water. The ppt (187 mg) was filtered and recrystallized from acetone, m.p. 184–185°, $[\alpha]_D^{26} + 76{\cdot}5°$ (*c*, 0·6); i.r. spectrum: band at 1700 cm^{-1} (CO); ORD (*c*, 0·11): $[\Phi]_{302} + 2934°$ (peak), $[\Phi]_{270} + 771°$ (valley); Mass spectrum: $(M+1)^+$ 425 (28 per cent), M^+ 424 (80 per cent), 257 (32 per cent), 246 (24 per cent), 245 (100 per cent), 205 (60 per cent), R_f 0·86 (S1), 0·17 (S2). (Found: C, 84·92; H, 11·38. $C_{30}H_{48}O$ required: C, 84·91; H, 11·40 per cent.)

Isobauerene (*D: C-Friedo-ursa*-8-*ene*) (*IV*)

Isobauerenone (76 mg) was dissolved in $(CH_2OH)_2$ (11 ml), *n*-butanol (5 ml) and hydrazine hydrate 98 per cent (3 ml) added, and the mixture refluxed 18 hr in a stream of N_2. It was then cooled, KOH (300 mg) added and the excess hydrazine and water removed by distillation up to 300°. After refluxing another hour it was cooled, water (30 ml) added and extracted with ether. The ether extracts were washed with 2 N H_2SO_4, dried and concentrated to dryness. The residue was taken up in light petroleum and chromatographed on a column of basic alumina (12 g, Woelm I). The eluate gave by evaporation of the solvent a crystalline residue (25 mg), which was sublimed at 130°/0·001 mm: m.p. 173–174°, $[\alpha]_D^{27} + 37{\cdot}0°$ (*c*, 0·47); Mass spectrum: $(M+1)^+$ 411 (34 per cent), M^+ 410 (100 per cent), 395 (50 per cent), 243 (44 per cent), 232 (22 per cent), 232 (22 per cent), 231 (100 per cent), 206 (25 per cent), 205 (23 per cent); R_f 1·0 (S1, S2). (Found: C, 87·80; H, 11·90. $C_{30}H_{50}$ required: C, 87·73; H, 12·27 per cent.)

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