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PINDROLACTONE, A LANOSTANE DERIVATIVE FROM THE LEAVES OF *ABIES PINDROW*

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Abstract—Pindrolactone, a new tetracyclic triterpenoid, has been isolated from the leaves of *Abies pindrow* and its structure advanced as 3α-hydroxylanosta-7,9(11),22*E*,24-tetraen-26,23-olide. Copyright © 1996 Elsevier Science Ltd

INTRODUCTION

Abies pindrow is distributed throughout the western Himalayas at an altitude of 2800–4000 m [1]. A review of the literature revealed the occurrence of triterpenes and triterpene lactones in different *Abies* species [2, 3], but no triterpenoid lactone has yet been reported from *A. pindrow*. Chromatographic resolution of a methanolic extract of the leaves of this plant led to the isolation of a new triterpenoid lactone, and the structural elucidation of this compound, pindrolactone, is the subject matter of the present communication.

RESULTS AND DISCUSSION

Pindrolactone (**1**) $C_{30}H_{42}O_3$ (HR mass spectrum: $[M]^+$ 450.3130), mp 210°, was recognized to be a triterpenoid from a positive colour test with the Liebermann–Burchard reagent. The presence of a hydroxyl group (ν_{max} 3460 cm^{-1}) and a conjugated γ-lactone carbonyl function (ν_{max} 1750 cm^{-1}) in the molecule was revealed from its IR spectrum. The UV characteristics (λ_{max} 277, 234 and 230) of **1** suggested the presence of two discrete chromophores, presumably a heteroannular diene [4] and a conjugated butenolide [5]. That **1** is built on a lanostane skeleton and bears a conjugated γ-lactone in the side chain became apparent from various spectral data.

The ^{1}H and ^{13}C NMR spectral data (Table 1) indicated the presence of a vinylic methyl, a secondary methyl and five tertiary methyl groups. In the EI mass spectrum, **1** showed a significant peak at *m/z* 313 by

Table 1. NMR spectral data for pindrolactone (**1**) in $CDCl_3$

Position	^{1}H, δ (*m*,* *J* in Hz) (400 MHz)	^{13}C (ppm)† (100 MHz)
1	—	28.7
2	—	25.1
3	3.44 (diffuse *t*, *W*/2 6.5)	76.6
4	—	37.1
5	—	37.9
6	—	23.1
7	5.58 (*br d*, 6)	121.0
8	—	146.8
9	—	153.0
10	—	34.7
11	5.18 (*t*, 2)	114.5
12	—	44.6
13	—	50.5
14	—	51.8
15	—	32.0
16	—	25.0
17	—	53.0
18	0.97 (*s*)	17.1
19	0.94 (*s*)	22.3
20	3.22 (*dq*, 7, 10)	36.4
21	0.98 (*d*, 7)	17.3
22	5.20 (*d*, 10)	118.4
23	—	136.4
24	6.97 (*q*, 1.5)	138.1
25	—	128.8
26	—	171.3
27	1.99 (*d*, 1.5)	10.5
28	0.79 (*s*)	19.2
29	0.91 (*s*)	23.0
30	1.00 (*s*)	28.2

*Multiplicity of signals.

†Assignments were made on the basis of 2D ^{1}H–^{1}H COSY, 2D ^{1}H–^{13}C COSY and 2D long-range ^{1}H–^{13}C COSY experiments.

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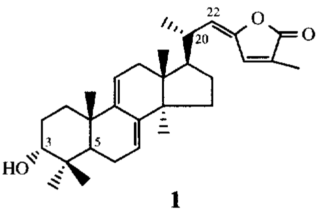
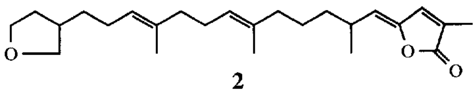
loss of a C_8-side chain ($C_8H_9O_2$), which is rather characteristic of a lanostane-type triterpene [6]. The ^{13}C NMR spectrum reveals that, in addition to the lactone carbonyl (δ_C 171.3) **1** possesses eight sp^2 carbon atoms, half of which are present as =C< and the remaining half as =CH–. As the ^1H–^1H COSY spectrum does not show any coupling between two olefinic hydrogens, all the four olefinic double bonds must be trisubstituted, and **1** is devoid of any homoannular diene system. This observation taken in conjunction with the UV spectrum led to the speculation that **1** bears in its molecule a $\Delta^{7,9(11)}$ heteroannular diene and an $\alpha,\beta,\gamma,\delta$-unsaturated γ-lactone ring.

Valency calculation reveals 10 double bond equivalents in the molecule. Four double bonds and a lactone ring account for six of them and thus the carbocyclic portion of **1** must have four rings. Compound **1** was thus considered to have a lanostane skeleton with a 7,9(11)-heteroannular diene system and this was confirmed from a comparison of spectral data for the carbocyclic moiety of the compound with those for 3α-methoxylanosta-7,9(11),24-trien-26,23*R*-olide [6]. The appearance of the carbinyl hydrogen at C-3 as a diffused triplet ($W/2 = 6.5$ Hz) [3] and the relatively high chemical shift of C-5 (δ_C 37.9) indicated the orientation of the hydroxyl group at C-3 to be α, because such an orientation can cause γ-*gauche* interaction [7].

The vinylic methyl group (δ 1.99), *alpha* to the lactone carbonyl, showed allylic coupling with the olefinic hydrogen at C-24 (δ 6.97) and thus the methyl group appeared as a fine doublet ($J = 1.5$ Hz) and the olefinic hydrogen as a narrow quartet ($J = 1.5$ Hz). The appearance of the olefinic hydrogen as a clean quartet indicates that it does not couple with any other vicinal hydrogen. Based on these observations and the fact that the ^{13}C NMR spectrum of the compound does not show any sp^3 oxycarbon signal other than that for C-3 suggested an extension of conjugation of the lactone carbonyl and the structure of pindrolactone was deduced as **1**. The ^1H NMR data for the protons of the $\alpha,\beta,\gamma,\delta$-unsaturated γ-lactone of **1** are in fair agreement with the corresponding hydrogens of 22-deoxyvariabilin (**2**), a sesterterpene lactone [8]. However, in the ^{13}C NMR spectrum, a difference in the chemical shift of C-23 (δ_C 136.4) from the corresponding carbon of **2** (δ_C 128.9) was observed and this difference might possibly be attributed to the difference in configuration of the olefin attached to the butenolide ring. In **2** this olefin has been shown to have a *Z* configuration while it is probably *E* in **1**.



1



2

The electron impact mass spectrum of pindrolactone confirmed the structure **1** advanced for the compound. The molecule underwent a straightforward cleavage into two halves giving rise to a peak at m/z 313 for the carbocyclic part of the lanostane skeleton and a peak at m/z 137 for the α-methylbutenolide side chain. All these data indicate **1** to be 3α - hydroxylanosta - 7, 9(11),22*E*,24-tetraen-26,23-olide.

EXPERIMENTAL

General. Mps: uncorr.; IR: KBr discs; UV: MeOH; NMR: 400 MHz (^1H) and 100 MHz (^{13}C), $CDCl_3$ with TMS as int. standard; EIMS: 70 eV; CC: silica gel columns (BDH, 60–120 mesh).

Plant material. The plant was purchased from M/S United Chemicals and Allied Products, Calcutta, and identified by the Department of Botany, Banaras Hindu University. A voucher specimen is deposited in the department.

Extraction and isolation. Dried and powdered leaves (1 kg) of *A. pindrow* were extracted with MeOH in a Soxhlet apparatus. Removal of solvent furnished 150 g of extract, which was subjected to CC on silica gel, eluting with solvents of increasing polarity. Elution with petrol–C_6H_6 (3:1) furnished **1** (40 mg).

Pindrolactone (**1**). Granules, mp 210° (MeOH), $[\alpha]_D^{20}$ +17° (*c* 0.45, $CHCl_3$); HRMS m/z: $[M]^+$ 450.3130 (calc. for $C_{30}H_{42}O_3$: 450.3134); IR ν_{max} (cm^{-1}): 3460, 1750, 1660, 1610, 1450, 1370; UV λ_{max}^{MeOH} (nm): 277, 234, 230 ($\log \varepsilon = 4.65, 3.15, 3.12$); ^1H NMR and ^{13}C NMR: Table 1; EIMS m/z (rel. int.): $[M]^+$ 450 (20), 435 (8), 432 (10), 417 (20), 354 (15), 340 (18), 325 (8), 314 (30), 313 (20), 312 (8), 311 (8), 289 (10), 205 (10), 187 (30), 185 (18), 173 (10), 161 (10), 160 (15), 159 (25), 96 (15), 95 (20), 94 (20).

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