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PUETUBEROSANOL, AN EPOXYCHALCANOL FROM *PUERARIA TUBEROSA**

RIAZ A. KHAN, PAWAN K. AGRAWAL† and RANDHIR S. KAPIL‡

Central Institute of Medicinal and Aromatic Plants, Lucknow-226015, India; ‡Regional Research Laboratory, Jammu-Tawi 180 001, India

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Key Word Index—*Pueraria tuberosa*; Leguminosae; tuber; epoxychalcanol; puetuberosanol.

Abstract—A novel chalcane derivative, puetuberosanol has been isolated from *Pueraria tuberosa* and its structure was deduced as 3′-hydroxy-4′-phenoxy-α,β-epoxychalcan-α′-ol, on the basis of 2D NMR spectroscopic evidence.

INTRODUCTION

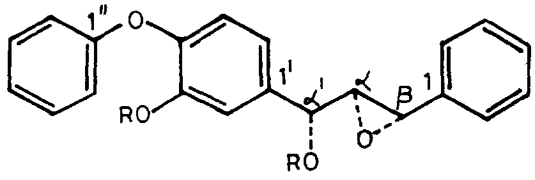
In our continuing studies on Indian medicinal plants [2], we have now investigated *Pueraria tuberosa*, the ethanolic extract of which exhibited anti-implantation activity, [3]. Previous reports describe the characterization of isoflavonoids, including ptercarpanoids [4–8], but there have been no reports with respect to chalcanoids. We report herein the isolation and structural elucidation of a novel epoxychalcanol derivative, puetuberosanol, from the fresh tubers of this species.

RESULTS AND DISCUSSION

Chromatographic purification of the chloroform fraction of an alcoholic extract of the fresh tubers led to the isolation of puetuberosanol (**1**) as a creamy white solid, which showed IR absorption bands for hydroxyl groups at 3260–3480 cm^{-1}, an ether linkage at 1260 and 1108 cm^{-1} and aromatic ring systems at 1595 cm^{-1}. The EI-mass spectrum showed a $[M]^+$ at *m/z* 334 revealing its molecular formula as $C_{21}H_{18}O_4$, which was consistent with the ^{1}H and ^{13}C NMR data. The DEPT spectrum of **1** revealed 16 methine resonances, distinguishable into 3-oxy-substituted aliphatic and 13 aryl types, and five nonprotonated aryl carbon resonances, three of which were oxy-substituted. These features in conjunction with ^{13}C NMR chemical shifts (δ 61.61; 135.76, 128.72 × 2, 128.76 × 2; 157.28, 121.75, 121.91, 130.5 × 2, 119.09; 131.99, 110.47, 110.95, 149.07, 149.12, 117.35) and resolution-enhanced ^{1}H NMR (δ 5.49 (1H), 6.95–7.55 (13 × aryl-H)), led us to infer the presence of CHOH, phenyl, phenoxy and 3,4-disubstituted phenyl groups.

The dihydroxylated nature of **1** was indicated mainly by the presence of two D_2O-exchangeable resonances at δ 4.45 (1H, *d*, $J = 0.83$ Hz) and at δ 8.79 (1H, *s*), confirmed by acetylation of **1**, which afforded a diacetate (**2**). The ^{1}H NMR of 2 displayed a phenolic acetoxyl group (δ 2.34), along with the characteristic downfield shift (1.24 ppm) of the benzyloxymethine signal, confirming the existence of two hydroxyl groups, a phenolic and a *sec*-hydroxyl group.

The substructure –OHCH–CH(O)CH– incorporating a 1,2-disubstituted oxirano ring system was deduced from the ^{13}C NMR signals [9, 10] at δ 51.70 (CH) and 54.52 (CH), as in **1**, and by mutually-coupled ^{1}H NMR resonances at δ 5.49 (*dd*, $J = 0.83$ and 2.38 Hz) and δ 3.54 (*dd*, $J = 2.38$ and 4.03 Hz) and the coupling of the latter with the resonance at δ 3.47 (*d*, $J = 4.03$ Hz). The value of the vicinal coupling constant ($^3J_{H\alpha,H\beta} =$ 4.03 Hz) reflected *cis* orientation of the oxirane ring [11]. ^{1}H-decoupling experiments and ^{1}H–^{1}H COSY cross-peak connectivities were consistent with the above mentioned key-structural fragment, which was substituted by phenyl and 3,4-dioxyphenyl substituents on either side. HETCOR and LR-HETCOR correlations allowed assignments of the carbon resonances and the connectivity between the above-mentioned partial substructures. A correlation between the phenyl C1 (δ 135.76) and Hβ and Hα confirmed that an unsubstituted phenyl group was attached to Cβ, while a correlation between C1′ (δ 133.99) and Hα, Hα′ and H6′ confirmed the 3′,4′-dioxysubstituted nature of the aromatic ring B. The correlation observed between C4′ (δ 149.12) and H5′, H6′, H2″ and H6″ reflected the attachment of the phenoxy group at C4′, whereas C3′ (δ 149.07), in agreement with the existence of a free hydroxyl group at this position, showed correlation



1 R = H
2 R = Ac

related naturally occurring compounds having epoxy alcohol as a structural fragment [11–13]. Hence, based on the accumulated evidence, the chemical structure of puetuberosanol was elucidated as **1**, which to the best of our knowledge represents the first naturally occurring epoxychalcanol with phenoxy substitution [14–16].

EXPERIMENTAL

General. Mp. uncorr. ^{1}H (400 MHz) and ^{13}C (100 MHz), experimental conditions as reported elsewhere [17]. EIMS, 70 eV.

Plant material. Tubers of *P. tuberosa* were collected from Shahdol Forest, Madhya Pradesh (India) and authenticated by the Botany Division, C.D.R.I., Lucknow, where a specimen is deposited.

Extraction and isolation. Fresh tubers (100 kg) were finely chopped and extracted with 95% EtOH. The alcoholic mother liquor was concd *in vacuo* to give a brown mass to which H_2O was added. It was then extracted with hexane, $CHCl_3$ and *n*-BuOH. A part of the $CHCl_3$ extract (20 g) was subjected to fractionation on a column of silica gel in hexane. The column was eluted with mixts of hexane and EtOAc of gradually increasing polarity. The hexane–EtOAc (11 : 9) fr. (166 mg) was purified by CC to yield **1** (68 mg) as a creamy white material, R_f 0.4 (hexane–EtoAc, 3 : 2). Mp 178–81°. $[\alpha]_D^{25°}$ + 12 (*c* 1.0, Me_2CO). UV (MeOH): λ_{max}: 326, 286, 224, 202 nm. IR ν(KBr): 3260–3480, 1595, 1402, 1260, 1108, 994, 955, 870 cm^{-1}. ^{1}H NMR (CD_3OD): δ 3.47 (1H, *d*, J = 4.03 Hz, Hα), 3.54 (1H, *dd*, J = 2.38, 4.03 Hz, Hβ), 5.49 (*dd*, J = 0.83, 2.38 Hz, Hα'), 6.95 (1H, *d*, J = 7.8 Hz, H5'), 6.96 (1H, *dd*, J = 2.0, 7.8 Hz, H6'), 7.06 (1H, *dd*, J = 2.0 Hz, H2'), 7.26 (2H, *dd*, J = 2.0, 7.8 Hz, H3'', H5''), 7.26 (1H, H4', H4''), 7.45–7.55 (4H, *m*, H2, H3, H5, H6), 7.55 (2H, *dd*, J = 2.0, 7.8 Hz, H2'', H6''). ^{13}C NMR (CD_3OD): δ 51.70 (Cβ), 54.52 (Cα), 61.61 (cα), 110.47 (C2'), 110.95 (C5'), 110.35 (C6'), 119.09 (C4''), 121.75, 121.91 (C2'', C6''), 128.72/128.76 (C2, C3, C5, C6), 130.5 (C3'', C5''), 130.55 (C4'), 133.99 (C1'), 135.76 (C1), 149.07 (C3'), 149.12 (C4'), 157.28 (C1''). MS *m/z* (rel. int.): 334

Acetylation of compound **1**. Compound **1** (25 mg) was kept overnight in Ac_2O–pyridine, which on usual work-up, afforded a diacetate (**2**). Mp 151°. ^{1}H NMR ($CDCl_3$): δ 2.16, 2.32 (3H each, *s*, 2 × OAc), 3.52 (1H, *dd*, J = 2.0, 4.0 Hz, Hα), 3.75 (1H, *d*, J = 4.0 Hz, Hβ), 6.96 (1H, *d*, J = 7.0 Hz, Ar-H), 7.12 (1H, *d*, J = 7.0 Hz, Ar-H), 7.25–7.30 (4H, *m*, Ar-H), 7.42–7.60 (6H, *m*, Ar-H), 7.85 (1H, *d*, J = 7.0 Hz, Ar-H). MS *m/z* (rel. int.): 418 ([M]$^+$, 81), 316 (51), 287 (40), 260 (19), 231 (13), 182 (19), 174 (10), 160 (20), 159 (26), 146 (26), 114 (42).

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