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EDGEWORTHIN, A NEW *BIS*-COUMARIN FROM *EDGEWORTHIA GARDNERI*

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Abstract—Besides daphnoretin and edgeworthin, a new *bis*-coumarin, was isolated from the stem-bark of *Edgeworthia gardneri*. Spectral and chemical evidence led to a structure in which two coumarin units are linked by an oxygen bridge between carbons 3 and 7′.

INTRODUCTION

THE FAMILY, *Thymelaeaceae*, which comprises of 40 genera and nearly 360 species[1] is reputed to produce coumarins[2–4] of various skeletal patterns. *Edgeworthia gardneri* Meissn[5] (syn. *E. tomentosa* Nakai), of this family is known locally as Aryili. Only the cellulose constituents of this plant have been examined.[6] The plant grows in the Middle-Hill and Birch-Hill areas of Darjeeling where the fruits of this plant are used as a fish-poison. In China roots and stems are used as a remedy for bubo. In the present communication, we report the isolation of a new *bis*-coumarin, named edgeworthin, together with daphnoretin (**1**).[3,7,8]

RESULTS AND DISCUSSION

Edgeworthin, $C_{18}H_{10}O_7$ (M^+ 338), m.p. 280–282° (dec.) was isolated as its diacetate from the chloroform extract of the defatted stem-bark of *E. gardneri* in poor yield. The parent coumarin was generated by mild acid-hydrolysis of the pure diacetate, $C_{22}H_{14}O_9$ (M^+ 422), m.p. 189°. Edgeworthin diacetate slowly dissolves in alcoholic alkali soln producing a deep-yellow colouration and is regenerated upon acidification indicating the presence of a coumarin nucleus in its molecule. It shows UV absorption, λ_{max}^{EtOH} 200, 292 sh and 323 nm, typical of 7-alkoxy coumarins.[9] Its IR spectrum reveals the presence of phenolic acetate (ν_{max} 1775, 1750 and 1245 cm^{-1}) and δ-lactone (ν_{max} 1720 cm^{-1}). The 60 MHz PMR spectrum in DMSO-d_6 of edgeworthin–diacetate is very similar to that of methyl daphnoretin except that the two aromatic methoxyl signals [δ, 3·90 (3H, *s*), 3·82 (3H, *s*)] of the latter are replaced by those due to two methyl groups of acetoxy residues

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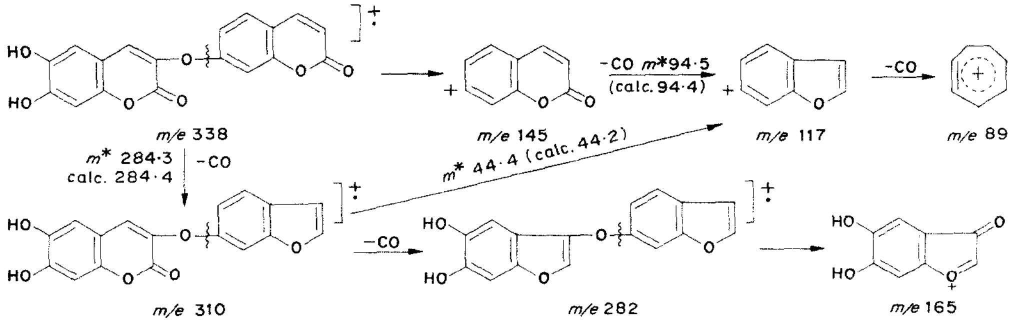
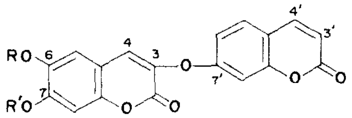
[1] HOOKER, J. D. (1879) *Flora of British India*, Vol. II,
[2] TSCHESCHE, R., SCOTT, U. and LEGLER, G. (1963) *Annalen* **662,** 115.
[3] MAJUMDER, P. L. and SENGUPTA, G. C. (1968) *J. Indian Chem. Soc.* **45,** 1058.
[4] BHATTACHARYA, A. K. and DAS, S. C. (1971) *Chem. Ind.* 885.
[5] CHOPRA, R. N., NAYER, S. L. and CHOPRA, I. C. (1956) *Glossary of Indian Medicinal Plants*, CSIR, New Delhi.
[6] SERA, A. and GOTO, R. (1957) *Mokuzai Kenkyu* 27.
[7] BICKOFF, E. M., LIVINGSTON, A. L. and GUGGOLZ, J. (1964) *J. Agr. Food Chem.* **12,** 535; (1965) *ibid* **13,** 151.
[8] KIRKIACHARIAN, B. and MENTZER, C. (1966) *Bull. Soc. Chim. France* 770.
[9] BOHME, H. and SEVERIN, T. (1957) *Arch. Pharm.* 209, 285, 405, 486, 488.

[δ, 2·36 (6H, *s*)]. Moreover, the striking similarity of the chemical shifts and the splitting patterns of three downfield protons [δ, 6·38 (*d*, *J* 9·5 Hz); 8·05 (*d*, *J* 9·5 Hz) and 7·9 (*s*)] in the PMR spectrum of edgeworthin diacetate with those of the C-3′, C-4′ and C-4 protons of methyl daphnoretin indicates not only the *bis*-coumarin structure of the diacetate, but also suggests the mode of linkage of the two coumarin moieties to be exactly similar to that in methyl daphnoretin.[2,10]

The above contention was further corroborated by the mass spectral fragmentations of edgeworthin diacetate which can be best rationalized (see Scheme) in terms of a daphnoretin-like structure (**2**) for edgeworthin.





(**1**) R = Me; R′ = H
(**2**) R = R′ = H
(**3**) R = R′ = Ac
(**4**) R = R′ = Me

The foregoing observations strongly suggest that edgeworthin should be represented by structure (**2**), and this was finally verified by the following chemical evidence.

Methylation of (**2**) with dimethyl sulphate in dry acetone in presence of anhydrous potassium carbonate furnished dimethyl–edgeworthin, $C_{20}H_{17}O_7$, m.p. 231°, identical in all respects with methyl–daphnoretin (**4**) obtained by methylation of daphnoretin (**1**), $C_{19}H_{12}O_7$ (M^+ 352) under similar reaction conditions. Conversely, (**1**) upon demethylation with boron tribromide in methylene chloride afforded (**2**) in almost quantitative yield.

EXPERIMENTAL

Melting points determined on a Köfler block, are uncorrected. Silica gel was used for column chromatography and silica gel G for TLC. UV spectra were measured in 95% aldehyde-free EtOH and IR spectra were run in nujol mulls. Anhydrous Na_2SO_4 was used for drying solvents and petrol used had b.p. 60–80°. All analytical samples were tested for purity by TLC.

Isolation of daphnoretin (**1**) *and edgeworthin diacetate* (**3**). Air-dried powdered stem-bark (1 kg) of *E. gardneri* was extracted with petrol for 48 hr and the defatted material was extracted with $CHCl_3$ for 48 hr. This extract was concentrated and kept overnight in a refrigerator. The brown solid was filtered from the mother liquor and on repeated crystallization from THF or glacial HOAc gave a crystalline compound (yield, 0·05%), m.p. 244°, which was characterized as daphnoretin (UV, IR, m.p. and TLC with authentic sample). δ (60 MHz, DMSO-d_6, TMS as internal standard): 8·01 (1H, *d*, *J* 9·5 Hz; C-4′ H), 7·83 (1H, *s*; C-4 H), 7·77–6·95 (5H, *m*; Ar–H), 6·86 (1H, *s*; C-7 OH), 6·35 (1H, *d*, *J* 9·5 Hz; C-3′ H), 3·83 (3H, *s*; C-6 OCH_3). *m/e* (abundance %): 352 (M^+ 100), 337 (1·5), 324 (2), 323 (1·3), 322 (2·2), 310 (1·5), 309 (6·6), 295 (2·2), 281 (1·1), 191 (2·2), 180 (4·4), 179 (34), 176 (3·6), 173 (1·7), 164 (6·6), 162 (2·2), 151 (3·8), 148 (3·2), 146 (5·5), 145 (7), 136 (3·6), 135 (3·8), 134 (3·4), 120 (2·5), 119 (2·2), 117 (3·6), 108 (3·8), 92 (4·3), 90 (2·6), 89 (30). *m** 317·5, 298·2, 94·5. The mother liquor on evaporation gave a gummy residue which was treated with Ac_2O/C_5H_5N in the cold and the acetylated product after usual work up was

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[10] KIRKIACHARIAN, B. and MENTZER, C. (1965) *Compt. Rend.* **260**, 197.

chromatographed. EtOAc–EtOH (3:1) elution gave a solid which on re-crystallization from petrol–EtOAc mixture gave pure (**3**) (yield, 0·003%). (Found: C, 62·42; H, 3·25; MeCO–, 20·02. $C_{22}H_{14}O_9$ requires: C, 62·56; H, 3·31; 2MeCO–, 20·38%). δ (60 MHz, DMSO-d_6): 8·05 (1H, *d*, *J* 9·5 Hz; C-4′ $\underline{H}$), 7·9 (1H, *s*; C-4 $\underline{H}$), 7·8–7·08 (5H, *m*; Ar–$\underline{H}$), 6·38 (1H, *d*, *J* 9·5 Hz; C-3′ $\underline{H}$), 2·36 (6H, *s*; 2-OCOC$\underline{H}_3$). *m/e* (abundance %): 422 ($\overline{M}^+$ 6·4), 394 (5·3), 380 (17·7), 353 (15), 352 (58), 339 (21·5), 338 (100), 324 (1·7), 310 (3·7), 309 (5), 282 (1), 281 (2), 179 (13·9), 146 (12·6), 145 (7·5), 117 (4·9), 89 (32·9).

Isolation of edgeworthin (**2**). Edgeworthin diacetate (**3**) (150 mg) was refluxed with 2N aq. MeOH–H_2SO_4 (25 ml) for 2 hr and MeOH was removed under reduced pressure. The solid was filtered, washed with H_2O, dried and crystallized from THF to give (**2**) (100 mg). (Found: C, 63·80; H, 2·90. $C_{18}H_{10}O_7$ requires: C, 63·92; H, 2·95%). λ_{max} nm (log ϵ): 200 (4·84), 290 (4·10), 321 (4·22); in 1 N KOH λ_{max} nm (log ϵ): 220 (5·00), 260 (4·17), 295 (4·10), 320 (4·06), 337 sh (3·99); ν_{max} cm^{-1}: 3350 (OH), 1690 (>C=O), 1610 (>C=C<).

Edgeworthin dimethyl ether (**4**). To the soln of (**2**) (50 mg) in dry Me_2CO (15 ml), freshly dist. Me_2SO_4 (3 ml) and anhyd. K_2CO_3 (200 mg) were added and the solution was refluxed for 4 hr. The solution was filtered hot, washed with Me_2CO, evaporated to dryness, diluted with H_2O, acidified with dil. HCl, extracted with $CHCl_3$, dried, concn and chromatographed. $CHCl_3$ elution gave a solid (40 mg) which was crystallized from C_6H_6–$CHCl_3$, m.p. 231°. (Found: C, 65·42; H, 3·77; MeO, 16·52. Calculated for $C_{20}H_{14}O_7$: C, 65·57; H, 3·83; 2MeO, 16·93%). λ_{max} nm (log ϵ): 205 (4·72), 219 inf (4·48), 227 (4·30), 262 (3·94), 324 (4·32), 342 (4·34); ν_{max} cm^{-1}: 1725 (>C=O), 1605 and 818 (>C=C<). δ (60 MHz, DMSO-d_6): 8·05 (1H, *d*, *J* 9·5 Hz; C-4′ $\underline{H}$), 7·9 (1H, *s*; C-4 $\underline{H}$), 7·83–7·03 (5H, *m*; Ar–$\underline{H}$), 6·38 (1H, *d*, *J* 9·5 Hz; C-3′ $\underline{H}$), 3·90 (3H, *s*; C-7 OC$\underline{H}_3$), 3·82 (3H, *s*; C-6 OC$\underline{H}_3$).

Demethylation of daphnoretin (**1**). To the solution of (**1**) (750 mg) in CH_2Cl_2 (100 ml), BBr_3 (3 ml) was added dropwise with stirring; the solution was stirred for 12 hr and then kept for 48 hr. The excess of the reagent was destroyed with H_2O and the solvent evaporated. The solid was filtered and dried to give crude (**2**). After acetylating a part of it with Ac_2O/C_5H_5N the product was chromatographed. The EtOAc–EtOH (3:1) eluate gave a solid which on crystallizations from petrol–EtOAc mixture gave a product, m.p. 189°, identical (m.m.p., co-TLC and superimposable IR spectra) with (**3**). Another part of crude (**2**) was methylated with Me_2SO_4 following the previous method and the methylated product was worked up in the usual way to furnish a crystalline product, m.p. 231° (C_6H_6–$CHCl_3$), identical (m.m.p., co-TLC and superimposable IR spectra) with (**4**).

Methylation of daphnoretin (**1**). Daphnoretin (**1**). was methylated with Me_2SO_4 in the usual manner and the methylated product was crystallized from C_6H_6–$CHCl_3$ mixture to give (**4**), m.p. 231°.

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