Phytochemistry, 1974, Vol. 13, pp. 1237 to 1239. Pergamon Press. Printed in England.

COUMARINS IN *EREMOCITRUS GLAUCA**

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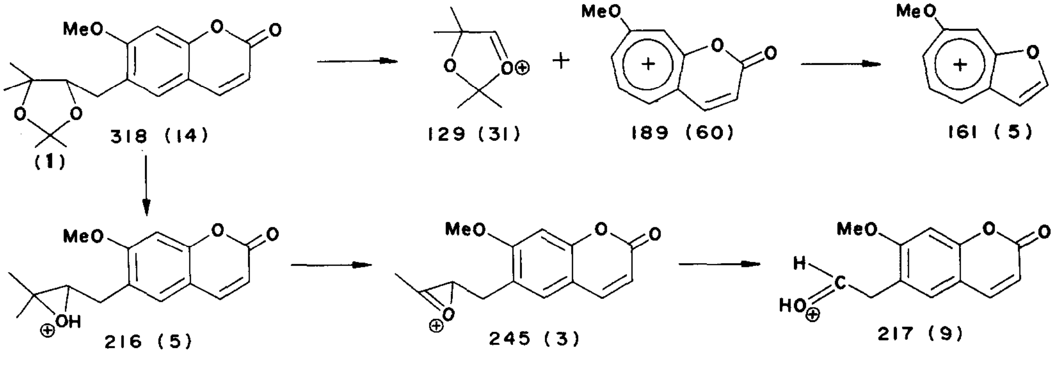
(*Revised Received* 13 *November* 1973)

Key Word Index—*Eremocitrus glauca*; Rutaceae; chemotaxonomy; coumarins; artifact; MS fragmentation.

Abstract—2′,3′-Dihydroxydihydrosuberosin its acetonide derivative and 7-hydroxycoumarin has been isolated from the extracts of *Eremocitrus glauca*. The structure of the acetonide was determined from its spectroscopic properties. The acetonide is regarded as an artifact of the isolation procedures and a similar acetonide has been prepared from marmin.

DURING an investigation of *Citrus* relatives for limonoid bitter principles, extracts of *Eremocitrus glauca* (Lindl.) hybrid (Rutaceae) were examined.[1] Chromatography of the acetone extracts of the whole, dried fruit and workup of those fractions containing blue fluorescing spots on TLC gave a colorless product which analyzed for $C_{18}H_{22}O_5$. The UV spectrum resembled that of a 7-alkoxycoumarin.[2,3] The IR spectrum showed no hydroxyl adsorption and the R_f value on TLC indicated a relatively non-polar compound.

The NMR spectrum showed bands which were assigned to: (a) a typical AB doublet for a coumarin lactone ring; (b) two aromatic singlets; (c) a benzylic quartet; (d) a quartet whose chemical shift corresponded to a proton on a carbon bonded to an ether oxygen; (e) one methoxy resonance; and (f) four *C*-methyl resonances.



SCHEME 1. MS FRAGMENTATION OF COMPOUND **1**.

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* Part X in the series "Chemotaxonomy of the Rutaceae". For part IX see DREYER, D. L. and HUEY, P. F. (1974) *Phytochemistry* **13**, in press.

[1] DREYER, D. L. (1966) *Phytochemistry* **5**, 367. The sample used is probably an *E. glauca* hybrid with lemon. For a discussion of the botany of *Eremocitrus* hybrids see SWINGLE, W. T. and REECE, P. C. (1967) *The Citrus Industry* (REUTHER, W., WEBBER, H. J. and BATCHELOR, L. D., eds.), Vol. I, p. 339, Revised Edn. University of California Press.

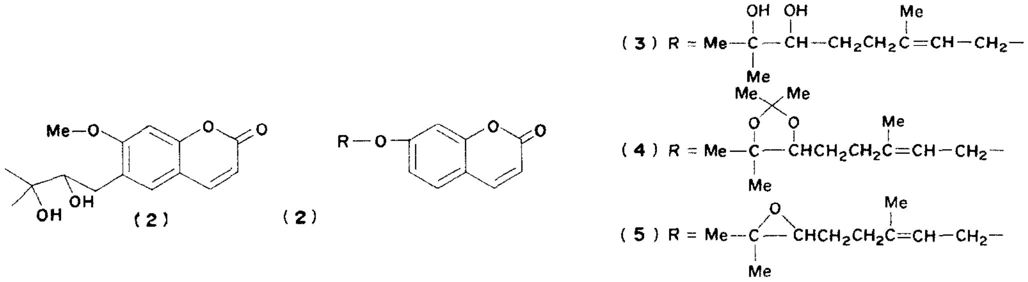
[2] SMITH, E., HOSANSKY, N., BYWATER, W. G. and VAN TAMELEN, E. E. (1957) *J. Am. Chem. Soc.* **79**, 3534.

[3] ABU-MUSTAFA, E. and FAYEZ, M. B. E. (1961) *J. Org. Chem.* **26**, 161; HALPERN, O., WASER, P. and SCHMID, H. (1957) *Helv. Chim. Acta* **40**, 758.

Since the two aromatic singlets were not coupled the 6- and 7-positions of the coumarin system must be substituted.[4] The similarity of the UV spectrum to that of umbelliferone rather than that of scopoletin suggests that the 6-position is occupied by an alkyl group rather than an oxygen function.[3]

The MS of the coumarin was particularly helpful in the structural assignment. The MS showed a series of fragment ions at *m/e* 189, 161 and 159 associated with a 7-methoxy-6-alkylcoumarin[5] this allowed rejection of cyclic structures of the marmesin type. The molecular ion at *m/e* 318 indicated that the side chain in the 6-position was more than a simple isopentyl group. The NMR spectrum had resonances suggesting the presence of an isopentyl side chain with additional structural features giving rise to two *C*-methyl singlets. Structure 1 accounts for the observed spectral properties. The MS contained peaks consistent with the presence of an acetonide ring system, *m/e* 261, 245, 217, 129 (Scheme 1). A metastable peak at *m/e* 52·4 supports the initial fragmentation of the molecular ion to the species *m/e* 129. The assignment of those peaks due to the acetonide portion of the coumarin parallels MS assignments on sugar acetonides.[6]

Upon workup of the polar fractions from the column small amounts of a further coumarin were isolated which was identical with 2′,3′-dihydroxydihydrosuberosin (**2**), peucedanol methyl ether,[7] previously isolated from the extracts of *Coleonema album* (Rutaceae).[8]



SCHEME 2.

It appears that acetonide **1** is an artifact formed during the extraction procedures arising from 2′,3′-dihydroxydihydrosuberosin **2** and the extracting solvent, acetone. A similar acetonide of marmin was reported from workup of the extracts of *Geijera parviflora*.[9,10]

In order to test the possibility of acetonide formation under the extraction conditions, marmin (**3**) was refluxed with a trace of citric acid in dry acetone. By this means the known acetonide of marmin (**4**) was obtained.[9] On the other hand when the 6′,7′-epoxide of 7-geranyloxycoumarin (**5**) was refluxed with acetone in the presence of citric acid under the same conditions only starting material (**5**) was recovered.

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[4] For example, compare NMR data given by SHANBHAG, S. N., MESTA, C. K., MAHESHWAS, M. L., PAKNIKAR, S. K. and BHATTACHARYYA, S. C. (1964) *Tetrahedron* **20**, 2605.

[5] KUTNEY, J. P., EIGENDORF, G., INABA, T. and DREYER, D. L. (1971) *Organic MS* **5**, 249.

[6] DE JONGH, D. C. and BIEMAN, K. (1964) *J. Am. Chem. Soc.* **86**, 67.

[7] HATA, K., KOZAWA, M., IKESHIRO, Y. and YEN, K. (1968) *Yakugaku Zasshi* **88**, 513; (1968) *Chem. Abstr.* **69**, 96521.

[8] DREYER, D. L., PICKERING, M. V. and COHAN, P. (1972) *Phytochemistry* **11**, 705; See also RONDEST, J., DAS, B. C., RICROCH, M., KAN-FAN, C., POTIER, P. and POLONSKY, J. (1968) *Phytochemistry* **7**, 1019.

[9] DREYER, D. L. and LEE, A. (1972) *Phytochemistry* **11**, 763.

[10] The isolation of an acetonide recently reported by Ubaidullaev *et al.* may also be such an artifact; UBAIDULLAEV, K., BESSONOVA, I. A. and YUNUSOV, S. YU. (1972) *Khim. Prir. Soed.* 343; (1973) *Chem. Abstr.* **78**, 2010.

These results indicate that compound **1** could arise as an artifact from 2′,3′-dihydroxydihydrosuberosin (**2**) or less likely from the corresponding epoxide. The co-occurrence of the diol (**2**) with the acetonide (**1**) suggests that in this case **2** gives rise to **1** but participation of the suberosin epoxide cannot be completely excluded.

EXPERIMENTAL

NMR data are given in δ. The area of the peaks were consistent with their assignments.

Isolation. The whole dried fruit obtained from the Citrus Research Center, University of California, Riverside was ground, defatted and extracted with acetone. Solvent was removed from the extracts and the residue chromatographed on a column of silicic acid in one run and on acid washed alumina in another. The fractions from the column were monitored by TLC. The solvent was removed from those benzene fractions which show a blue fluorescing spot and the residue crystallized from EtOAc–hexane. An analytical sample from C_6H_6–hexane to give m.p. 169·5–172°; ν 1734, 1630, 1567 cm^{-1} (Nujol); λ_{max}^{EtOH} 222 (16000), *ca* 242, *ca* 251, *ca* 298, 329 (11 500) nm; NMR δ 7·71 (*d*, *J* 10) H-4, 7·46, 6·88 (*s*) H-5 and H-8, 6·29 (*d*, *J* 10) H-3, 3·95 (*s*) methoxy, 2·34 (*q*, *J* 10, *J* 2), 2·14 (*q*, *J* 12, *J* 2) benzylic, 1·48, 1·33 *C*-methyls ($CDCl_3$). H-7 was obscured by the methoxy resonance. ORD at 27° in ethanol (*c* 0·12); $[\alpha]_{600}$ + 29°, $[\alpha]_{232}$ + 1660°, $[\alpha]_{210}$ − 6600° (last reading). MS *m/e* (rel. intensity) 318 (14), 303 (5), 261 (5), 245 (3), 217 (9), 190 (30), 189 (60), 161 (5), 159 (9), 131 (10), 130 (5), 129 (31), 71 (25), 59 (100), 43 (18) (Found: C, 67·93; H, 7·25. $C_{18}H_{22}O_5$ requires: C, 67·91; H, 6·97%). Further elution of the column with benzene–$CHCl_3$ mixtures gave fractions which yielded 7-hydroxycoumarin while $CHCl_3$ eluted fractions which upon workup gave compound **2**, m.p. 136–138·5°, which was identical in all respects with a synthetic sample.[8]

Acetonide of marmin (**4**). A soln of **3** in dry acetone and several mg of citric acid was refluxed for 30 hr. Workup of the reaction gave **4**, m.p. 80–83°, identical in all respects with a sample previously isolated.[8]

Acknowledgement—The authors are indebted to R. G. Beimer for the MS measurements.