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SHORT COMMUNICATION

THE XANTHONES OF *MACROCARPAEA GLABRA*[1,2]

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Abstract—Extracts of both roots and stem of *Macrocarpaea glabra* (L.f.) Gilg (Gentianaceae) have been shown to yield 1-hydroxy-3,7-dimethoxyxanthone (I) and 8-hydroxy-1,2,6-trimethoxyxanthone (IIb).

AS PART of a survey of the xanthonic constituents of less common genera of the Gentianaceae, we have examined *Macrocarpaea glabra* (L.f.) Gilg, a shrub native to Colombia. Extraction of the ground roots yielded two yellow crystalline products, X1, $C_{15}H_{12}O_5$, m.p. 168–170°, and X2, $C_{16}H_{14}O_6$, m.p. 159–160°, which showed the characteristic u.v. spectra of xanthones.

TABLE 1. NMR SPECTRA OF XANTHONES (τ) IN $CDCl_3$

	H-2,4	H-5,6	H-8	OH	OMe	OAc
I	3·62, 3·69 d, J=2·3 Hz	2·73 m	2·41 m	−2·85	6·12, 6·14	
IIb	3·65 s	2·70, 2·86 d, J=9·2	—	−3·30	5·99, 6·04, 6·12	—
IIc	3·59, 3·69 d, J=2·4	2·74, 2·89 d, J=9·1	—	—	5·97, 6·03, 6·10 (2)	
IId	3·34, 3·50 d, J=2·3	2·76, 2·95 d, J=9·1	—	—	6·04, 6·10 (2)	7·53

The NMR spectrum of X1 (Table 1) showed a chelated hydroxyl group, two methoxyls, and signals in the aromatic proton region indicative of 1,3-oxygenation in one ring and 7-oxygenation in the other.[3] Direct comparison with authentic 1-hydroxy-3,7-dimethoxyxanthone (I), previously isolated from *Frasera albicaulis* Dougl. *ex* Griesb. (Gentianaceae),[3] demonstrated the identity of the two materials.

The major product, X2, also showed a chelated hydroxyl, but three methoxyls instead of two. The aromatic signals appeared as a 2H singlet at τ 3·65, which could be ascribed to a

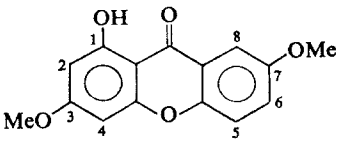
[1] Part IV in the series "Xanthones of the Gentianaceae"; for Part III see G. H. STOUT, T. S. LIN and K. SINGH, *Tetrahedron* **25**, 1975 (1969).

[2] Supported in part by a grant from the Public Health Service, Grant GM-12095.

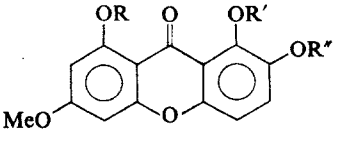
[3] G. H. STOUT, E. N. CHRISTENSEN, W. J. BALKENHOL and K. L. STEVENS, *Tetrahedron* **25**, 1961 (1969).

completely overlapped AB system in a phloroglucinol ring, and a quartet representing a second AB pair, $J=9{\cdot}2$ Hz, clearly arising from two *ortho* protons in the second ring. The absence of any signals below 2·5 τ ruled out C-1 (8) as a possible proton site[4] and restricted the possibilities to IIa,b or IIIa,b.

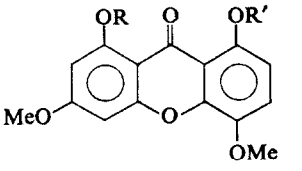
Upon methylation X2 yielded a monomethyl ether, m.p. 168–170°, in which the original τ 3·65 singlet was resolved into an AB quartet with $J=2{\cdot}4$ Hz as expected for *meta* coupling. The m.p. of this ether differs markedly from that of swerchirin dimethyl ether (IIIc), 210–211°,[5,6] but is very close to that reported for methyl decussatin (IIc), 166–167°.[6,7]



(I)



	R	R′	R″
(IIa)	Me	H	Me
(IIb)	H	Me	Me
(IIc)	Me	Me	Me
(IId)	Ac	Me	Me
(IIe)	Me	H	H



	R	R′
(IIIa)	H	Me
(IIIb)	Me	H
(IIIc)	Me	Me

Decussatin, isolated from *Swertia decussata* (Gentianaceae),[7] has been assigned the structure IIa on the basis of spectra,[8] the synthesis of its methyl ether,[6] and its preparation by partial methylation of swertinin[7] (IIe), in which the position of the two free hydroxyl groups is shown by easy oxidation with ammoniacal silver. Unfortunately no authentic sample was available for comparison, but the non-identity of decussatin and X2 and identification of the latter as IIb were assured as follows: the m.p.s of decussatin, 149–150°,[7] and its acetate, 167°,[7] differ by small but significant amounts from those of X2, 158–160°, and its acetate, 174·5–176·5°; formation of the acetate (IId) of X2 causes a downfield shift only in the NMR signals of the *meta*-coupled protons (H-2, H-4), showing that the acetylated hydroxyl must be attached to the same ring. The only structure consistent with these observations and possessing a chelated hydroxyl group is IIb.

From a chemotaxonomic point of view, these results suggest a close relationship between *Macrocarpaea* (tribe Gentianeae, sub-tribe Tachiinae) and the more widely studied genera of the sub-tribe Gentianinae, especially since very preliminary results suggest that xanthone production is not ubiquitous even within the tribe Gentianeae.[9]

EXPERIMENTAL

A sample of *Macrocarpaea glabra* (L.F.) Gilg. was collected between San Miguel and Aguadita, Colombia, elev. *ca.* 2100 m. Voucher material has been deposited in the Instituto de Ciencias Naturales, Bogota, Colombia, and in the Oaks Ames Herbarium of Useful Plants, Harvard, as *Garcia-Barriga* 18875. This collection

[4] For examples of NMR spectra of 1-hydroxy-3,5,6-dimethoxyxanthones, see B. JACKSON, H. D. LOCKSLEY and F. SCHEINMANN, *J. Chem. Soc.* 178 (1966).
[5] S. R. DALAL and R. C. SHAH, *Chem. & Ind.* 664 (1956).
[6] S. R. DALAL and R. C. SHAH, *Chem. & Ind.* 140 (1957).
[7] S. R. DALAL, S. SETHNA and R. C. SHAH, *J. Ind. Chem. Soc.* **30**, 456 (1953).
[8] R. C. SHAH, A. B. KULKARNI and S. R. DALAL, *J. Sci. Ind. Res. (India)* **13B**, 175 (1954).
[9] G. H. STOUT and J. FRIES, unpublished results on *Sabbatia*.

corresponds to the specimen *Garcia-Barriga* 12061 discussed by Ewan[10] in his revision of *Macrocarpaea* and assigned to this species, although with some reservation as to its relationship to the type of *M. polyantha* Gilg.

Isolation

Finely ground root of *M. glabra* was extracted (hexane) in a soxhlet, the extract evaporated, and the residue extracted with pentane and with CH_2Cl_2. The CH_2Cl_2 fraction (417 mg) was chromatographed on silica gel with various concentrations of pet. ether/ethyl acetate as eluents. Fractions were cut on the basis of TLC and yielded as the major pure products: XI (more mobile), 32 mg of yellow needles, m.p. 168–170°; m.m.p. with 1-hydroxy-3,7-dimethoxyxanthone[3] 168–170°. NMR, see Table 1; u.v. (EtOH) 237 (25,000), 258 (35,700), 303 (12,500), 367 (6000) nm. (Found: Mol. wt. 272·069. Calc. for $C_{15}H_{12}O_5$: Mol. wt. 272·068.) X2 (less mobile), 371 mg of yellow needles, m.p. 159–160°; NMR, Table 1; u.v. (EtOH) 240 (24,400), 260 (28,300), 312 (8350), 374 (3340) nm. (Found: Mol. wt. 302·081. $C_{16}H_{14}O_6$ required: Mol. wt. 302·079.)

Similar isolations from the pentane-soluble fraction (562 mg) as well as from extracts of branches yielded further quantities of X1 and X2.

Methylation of X2 with dimethyl sulfate in THF with NaH gave the white methyl ether, m.p. 168–170°. NMR, Table 1; u.v. (EtOH) 242 (35,500), 252 (36,200), 303 (16,100), 351 (4850). (Found: Mol. wt. 316·096. $C_{17}H_{16}O_6$ required: Mol. wt. 316·095.) Acetylation with acetic anhydride/pyridine afforded the acetate, m.p. 174·5–176·5°. NMR, Table 1; u.v. (EtOH) 244 (25,000), 279 (9150), 303 (9500), 354 (3520). (Found: Mol. wt. 344·087. $C_{18}H_{16}O_7$ required: Mol. wt. 344·089.)

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[10] J. EWAN, *Contrib. U.S. Natl. Herb.* **29**, 226 (1948).

Note added in proof

A recent paper [P. RIVAILLE, J. MASSICOT, M. GUYOT and V. PLOUVIER, *Phytochem.* **8**, 1533 (1969)] reports the reisolation of authentic decussatin and shows it to have the structure IIb rather than IIa. The NMR spectral properties reported are in excellent agreement with those of our material and leave no doubt as to the identity of the two samples, although the m.p. differences described above remain and are currently unexplained.