Phytochemistry, 1978, Vol. 17, pp 583–584 Pergamon Press Printed in England.

A NEW COUMARIN FROM *PEREZIA MULTIFLORA*

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(*Revised received* 20 *September* 1977)

Key Word Index—*Perezia multiflora*; Compositae; coumarins; 3,4,8-trimethoxy-6-hydroxy-5-formyl-2H-1-benzopyran-2-one; structural determination.

Abstract—A new highly oxidized coumarin was isolated from the roots of *Perezia multiflora*. Its structure was elucidated as 3,4,8-trimethoxy-6-hydroxy-5-formyl-2H-1-benzopyran-2-one.

INTRODUCTION

The genus *Perezia* is divided into section *Acourtia* [1] which is abundant in North America and contains mainly benzoquinones [2] and cedranolides [3] and section *Perezia* [4] which grows in South America and has not yet been adequately studied. We therefore undertook examination of the roots of *P. multiflora* collected in Ecuador, from which we were able to isolate coumarins **3**, **4** and **5**. During the course of our work, there appeared a publication [5] describing the isolation of compounds **1**–**4** from the same plant. Our studies of **3** and **4** are complementary to this work and in addition we report the structure of **5**.

RESULTS AND DISCUSSION

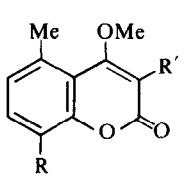
Chromatography of the hexane extracts of the roots gave 3 crystalline compounds whose UV spectra suggested aromatic skeletons. Their MS gave M^+ at 220, 250 and 280 respectively corresponding to $C_{12}H_{12}O_4$ (**3**), $C_{13}H_{14}O_5$ (**4**) and $C_{13}H_{12}O_7$ (**5**).

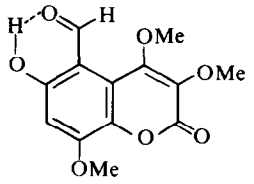
The PMR spectrum of **3** showed two aromatic protons as a singlet at 6.95, a vinyllic proton at 5.67, two OMe groups at 3.95 and 3.90 and an aromatic Me group at 2.57. The chemical shift of the vinyllic proton in conjunction with the elemental composition and the substituents seen in the NMR, suggested a 4-methoxy-coumarin with a Me and a OMe group on the aromatic ring.

Compound **4** differs from **3** in the presence of a third OMe group at C-3, since its PMR spectrum showed the two aromatic proton singlet at 6.91, 3 OMe groups at 4.21 (3H) and 3.92 (6H) and the Me group at 2.55.

In the last coumarin (**5**) the Me group of **4** has been oxidized to an aldehyde which appeared at 10.67 and is *ortho* to an OH group found at 13.55 which disappeared upon equilibration with D_2O. The remaining signals are one aromatic proton at 6.55 and 3 OMe groups at 4.28 (3H) and 4 (6H). Its IR spectrum showed the OH at 3400 and the aldehyde at 1720 cm^{-1} superimposed on the coumarin ester.

Treatment of **3** and **4** with $Pr(fod)_3$ shift reagent resolved the singlet corresponding to the two aromatic protons into two doublets (J = 8 Hz) showing that they are in an *ortho* relationship. Furthermore one of the doublets of each molecule is broader than the other due to a benzilic coupling with the Me group which is also *ortho* to one proton. This relation was also tested by CMR as shown later. The shift reagent experiments of **3** and **4** were compared with the behaviour of 3-methoxy- and of 4-methoxy-coumarin, providing further structural support as can be seen in the plots of Fig. 1, since the vinyllic proton of **3** behaves as H-3 of 4-methoxy-coumarin and the 3-OMe group of **4** behaves as the OMe group of 3-methoxy coumarin.





1: R = R' = H
2: R = H; R' = OMe
3: R = OMe; R' = H
4: R = R' = OMe

Since the Me group and the two aromatic protons are vicinal on the aromatic ring, there are only 4 possibilities left for the structure of the natural products i.e. OMe at C-5 with the Me (or aldehyde) at C-6 or C-8 and OMe at C-8 with the Me (or aldehyde) at C-5 or C-7. The OMe was located at C-8 from CMR measurements as follows: the spectrum of 4-methoxy coumarin was fully assigned using coumarin and several methoxy-coumarins [6] as suitable model compounds. It showed C-2 at 162.5; C-3, 90.0; C-4, 166.2; C-4a, 115.5; C-5, 122.8; C-6, 123.7; C-7, 132.2; C-8, 116.5; C-8a, 153.1 and OMe at 56.3 δ. The effect of Me and OMe groups on the *ipso*, *ortho*, *meta* and *para* positions of aromatic compounds is well known [7] and allowed prediction of the CMR spectra of the benzene ring of the 4 possibilities.

The estimated data for those molecules having the OMe group at C-8 were in reasonable agreement with the experimental spectrum of **3**, while those having the OMe at C-5 were quite different. The sp2 region of **3** showed C-2 at 161.8; C-3, 90.2; C-4, 169.2; C-3a 114.9; C-5, 127.5; C-6, 121.4; C-7, 113.5; C-8, 145.7 and C-8a at 144.5 δ.

Furthermore a gated decoupling experiment revealed

* On leave from Escuela Politécnica Nacional, Quito Ecuador with an OAS scholarship.

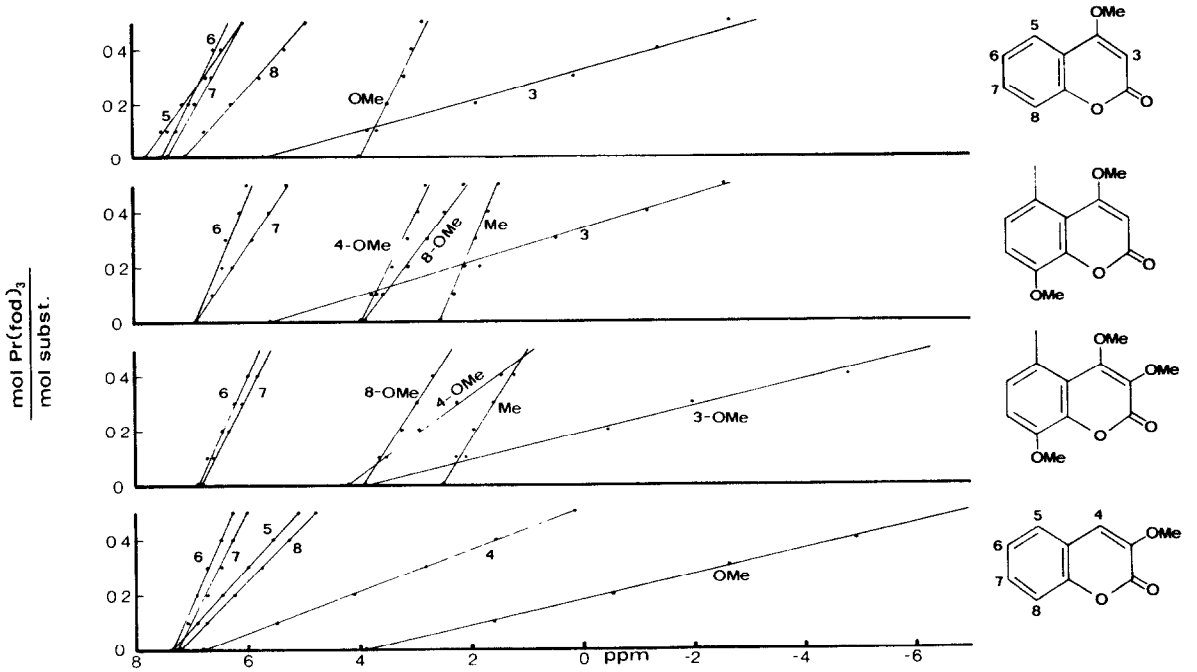


Fig. 1. The behaviour of coumarins in the presence of $Pr(fod)_3$ shift reagent.

that the signals at 90.2 and 113.5 are doublets (J = 174 and 165 Hz respectively while C-6 appeared as a doublet of quartets (^1J = 163 and ^3J = 7 Hz) thus verifying the *ortho* relationship of one aromatic proton with the Me group.

At this point only the position of the Me (or aldehyde) for **3**, **4** and **5** at C-5 or C-7 remianed unknown. When we were starting some synthetic work to clarify this point, a work appeared describing the isolation of compounds **1**–**4** from the same plant [5]. The PMR spectra of **1** and **2** early allowed assignment of the Me group at C-5 since in this molecule H-8 is *ortho* to the ester group and appears at higher fields and the coupling constants of the aromatic protons revealed that they are *vicinal*. This fact simplified the structural assignment of the coumarins of *P. multiflora* and the new pereflorin B is therefore represented as **5**.

EXPERIMENTAL

Perezia multiflora (H et B) Less was collected at Páramo de Salcedo, Ecuador, 3800 m above sea level in January 1976. Voucher samples are deposited at Escuela Politécnica Nacional Quito, Ecuador and Escuela Nacional de Ciencias Biológicas, Instituto Politécnico Nacional, México City where Prof. J. Rzedowski classified the material. Hexane extracts of the ground roots (4 kg) gave 28 g residue. Chromatography over Si gel (350 g) gave 52 mg **4** (C_6H_6–$CHCl_3$, 9:1), 22 mg **5** (C_6H_6–$CHCl_3$, 7:3) and 7 mg **3** (C_6H_6–$CHCl_3$, 1:1). The IR, UV, PMR, MS and mp of **3** and **4** are in agreement with reported data [5].

8-Methoxypereflorin (**3**). CMR: Varian XL-100-12 FT 16 K, $CDCl_3$ int TMS; δ 161.8 (C-2), 90.2 (*d*, J = 174 Hz, C-3), 169.2 (C-4), 114.9 (C-4a), 127.5 (C-5), 126.4 (d_q, ^1J = 163, ^3J = 7 Hz, C-6), 113.5 (*d*, J = 165, C-7), 145.7 (C-8), 144.5 (C-8a), 56.3 and 55.9 (2 × OMe *q*, J = 147 and 150 Hz) and 22.7 *q*, Me (J = 145 Hz).

3,8-Dimethoxypereflorin (**4**). CMR: δ 159.4 (C-2), 130.5 (C-3), 157.6 (C-4), 116.9 (C-4a), 127.3 (C-5), 126.9 (C-6), 112.0 (C-7), 145.5 (C-8), 141.0 (C-8a), 60.6, 60.4 and 56.2 (3 × OMe) and 22.6 Me.

Pereflorin B (**5**). Pale yellow needles (Me_2CO–C_6H_{14}) mp 199–200°. IR: $CHCl_3$; 3400 (OH), 1720 (coumarin and aldehyde), 1605, 1570 cm^{-1} (aromatics). UV: EtOH 95%: λ_{max} 215, 240, 307 nm (ε = 22400, 12900, 18500). MS: 70 eV, M^+ *m/e* 280 (100%). PMR: 60 MHz $CDCl_3$ int. TMS; 13.55 (*s*, OH), 10.67 (aldehyde), 6.55 (aromatic), 4.28 (OMe) and 4 ppm (2 × OMe).

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