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# 4-HYDROXYGRENOBLONE, ANOTHER UNCOMMON *C*-PRENYLATED FLAVONOID FROM *PLATANUS ACERIFOLIA* BUDS

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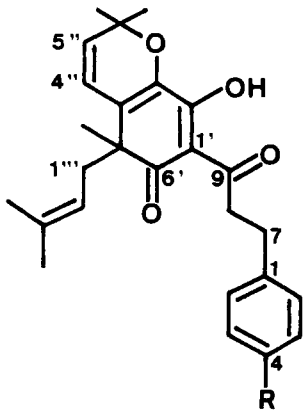
The *n*-hexane extract of the unripe buds of *Platanus acerifolia* Willd. (Platanaceae) has previously yielded three alkylated pinocembrin derivatives (7-*O*- or 6-*C*-prenylated, two compounds being also 8-*C*-methylated) (1), along with a 6-oxodihydrochalcone named grenoblone (**1**) exhibiting an uncommon *C*-prenylation in 4′ (2). In continuation of our work on polyphenols of this species, we have now examined the $C_6H_6$ extract of the buds, and during fractionation, a minor constituent has been detected with a yellow fluorescence similar to grenoblone but with a chromatographic behavior more polar. We now report the isolation and structure elucidation of this new natural product identified as 4-hydroxygrenoblone (**2**).




**1** R=H
**2** R=OH

The same yellow fluorescence and uv absorptions (**1**: λ 354, 270 nm; **2**: λ 352, 272 nm) strongly suggested that both compounds **1** and **2** possessed an identical conjugated system. The molecular ion at *m/z* 422 for **2** indicated a supplementary O atom in this molecule in comparison with **1** ($M^{+\cdot}$ *m/z* 406, $C_{26}H_{30}O_4$); this oxygen belonged to an hydroxyl observed as a singlet at δ 5.04 ppm in the $^1$H-nmr spectrum (Table 1) similar to that of **1**, except for the aromatic region where the overlapped signals δ 7.19-7.25 ppm (5H) are substituted by two distinct doublets integrating for 2H each at δ 7.12 and 6.74 ppm ($J$=8 Hz) determining the hydroxyl group in the 4-position. Those results are supported by a comparative analysis of the $^{13}$C-nmr data of **1** and **2** (Table 2), showing the disappearance of an aromatic CH in **1** (δ 125.9 ppm) in favor of a quaternary *O*-bound ethylenic C-atom in **2** (δ 153.9 ppm), the 4-hydroxylation shielding the *ortho*- and *para*-carbons as expected (C-3 and 5: Δδ=−13.1 ppm; C-4: Δδ=−7.9 ppm), the *meta*-carbons shifting slightly at lower field (C-2 and 6: Δδ=+1.1 ppm). As the A-ring of this chalcone derivative is not subjected to any change, as predicted by the uv spectrum run in MeOH and in the presence of shift reagents ($AlCl_3$; NaOMe) and the mass spectrum with the base peak at *m/z* 339 $(M\text{-}68\text{-}15)^+$, resonances of all the carbons belonging to this part of the molecule are not significantly affected.

On the basis of the reported data, compound **2** is considered 4-hydroxygrenoblone, a new natural product with which acetylation results in a 25 nm hypsochromic shift in band I; this is due to suppression in the uv spectrum of the effect of the enolic group in the β-posi-

TABLE 1. $^1$H-nmr Data of Grenoblone (**1**) at 400 MHz and 4-Hydroxygrenoblone (**2**) at 300 MHz ($CDCl_3$; δ ppm/TMS)

| Atom | Compound | |
|---|---|---|
| | **1** | **2** |
| H-2 | | 7.12, br d, $J$=8 Hz |
| H-3 | | 6.74, d, $J$=8 Hz |
| H-4 | ca. 7.19-7.25, m | |
| H-5 | | 6.74, d, $J$=8 Hz |
| H-6 | | 7.12, br d, $J$=8 Hz |
| H-7 | 2.93, t, $J$=8 Hz | 2.87, t, $J$=8 Hz |
| H-8 | 3.34, dt, $J$=15.5, 8 Hz<br>3.30, dt, $J$=15.5, 8 Hz | 3.34, dt, $J$=15.5, 7.5 Hz<br>3.30, dt, $J$=15.5, 7.5 Hz |
| H-4″ | 6.45, d, $J$=10 Hz | 6.46, d, $J$=10 Hz |
| H-5″ | 5.36, d, $J$=10 Hz | 5.36, d, $J$=10 Hz |
| H-1‴ | 2.67, br dd, $J$=14, 7 Hz<br>2.47, br dd, $J$=14, 7.5 Hz | 2.68, br dd, $J$=14, 7 Hz<br>2.48, br dd, $J$=14, 8 Hz |
| H-2‴ | 4.77, ddqq, $J$=7.5, 7, 1.5, 1.5 Hz | 4.78, br dd, $J$=8, 7 Hz |
| HO-4 | | 5.04, s |
| HO-2′ | 18.90, s | 18.90, s |
| Me-5′ | 1.37, s | 1.38, s |
| Me-6″ | 1.49 (6H), s | 1.46, s and 1.45, s |
| Me-3‴ | 1.56 (6H), br s | 1.55 (6H), br s |

tion with respect to the endocyclic carbonyl. This is the first report of the occurrence of a flavonoid with an hydroxylated B-ring in *P. acerifolia* buds.

Grenoblone and 4-hydroxygrenoblone are distinguished from other flavonoid compounds by two structural variations in the A-ring: 5′-di-*C*-alkylation preventing formation of the aromatic ring and 4′-*C*-prenylation occurring in a position which is usually oxygenated. If the former particular feature has been previously reported (3-6), the latter character is specific to *P. acerifolia*.

## EXPERIMENTAL

GENERAL EXPERIMENTAL PROCEDURES.—The source of plant material and general extrac-

TABLE 2. $^{13}$C-nmr Chemical Shifts of Grenoblone (**1**) and 4-Hydroxy-grenoblone (**2**) at 75.5 MHz ($CDCl_3$; δ ppm/TMS)

| Atom | Compound | | Atom | Compound | |
|---|---|---|---|---|---|
| | **1** | **2** | | **1** | **2** |
| C-1 | 141.3 | 133.4 | C-5′ | 52.4 | 52.5 |
| C-2 | 128.5 | 129.6 | C-6′ | 195.7 | 195.8 |
| C-3 | 128.3 | 115.2 | C-4″ | 123.5 | 123.5 |
| C-4 | 125.9 | 153.9 | C-5″ | 118.4 | 118.4 |
| C-5 | 128.3 | 115.2 | C-6″ | 81.1 | 81.1 |
| C-6 | 128.5 | 129.6 | C-1‴ | 31.0 | 30.5 |
| C-7 | 37.8 | 37.8 | C-2‴ | 114.7 | 114.7 |
| C-8 | 41.5 | 41.9 | C-3‴ | 134.8 | 134.9 |
| C-9 | 202.2 | 202.4 | Me-5′ | 23.6 | 23.6 |
| C-1′ | 104.4[a] | 104.4[c] | Me-6″ | 28.3 | 28.3 |
| C-2′ | 185.7[b] | 185.8[d] | | 28.7 | 28.7 |
| C-3′ | 173.2[b] | 173.2[d] | Me-3‴ | 18.0 | 18.0 |
| C-4′ | 106.7[a] | 106.7[c] | | 25.8 | 25.8 |

[a-d]Assignments with the same letter designation may warrant changing.

tion are given in Kaouadji *et al.* (1). Analytical tlc was carried out on silica gel 60 F-254 plates (E. Merck). Silica gel 60 PF-254 containing gypsum (E. Merck) for preparative layer chromatography was used for circular centrifugal tlc. Sephadex LH20 (Pharmacia Fine Chemicals) was used for column chromatography. Hplc was carried out on a Waters Model 6000A equipped with a variable wavelength detector and μBondapack $C_{18}$ column (30 cm). Uv spectra were measured in MeOH on a Beckman 25 spectrometer. $^1$H- and $^{13}$C-nmr spectra ($CDCl_3$; δ ppm/TMS) were recorded on an AM300 Brucker nmr spectrometer. Extensive decoupling was used to verify assignments. Ei mass spectra were taken on an AEI MS902 mass spectrometer (70 eV).

ISOLATION OF 4-HYDROXYGRENOBLONE.—*P. acerifolia* unripe buds, first defatted with *n*-hexane (1, 2), were extracted at room temperature by $C_6H_6$ to afford, after removal of the solvent, a brown viscous mass (2.65 g). A portion (0.98 g) of this residue was subjected to fractionation by circular centrifugal tlc on silica gel, developed with a gradient from *n*-hexane to $CHCl_3$-MeOH (80:20). Combination of similar eluates provided 15 fractions on the basis of tlc analysis on silica gel in *n*-hexane-iPrOH (95:5), $C_6H_6$-butanone-MeOH (85:10:5), $CHCl_3$, and $CHCl_3$-MeOH (95:5). Fractions 6-10 (0.37 g) containing compound **2** were treated by repeated cctlc with different solvent mixtures used in tlc analysis to concentrate the related product. This procedure yielded 25 mg of impure 4-hydroxygrenoblone with final purification carried out on a portion (14 mg) by semi-preparative hplc on reverse phase $C_{18}$ [MeOH-$H_2O$ (90:10); flow rate 2 ml/min] and then by filtration through a Sephadex LH20 column (MeOH) providing 4 mg of a yellow oil.

4-HYDROXYGRENOBLONE (**2**).—Yellow colored and fluorescent oil; uv λ MeOH 352, 289 sh, 272, 265 sh, 221; /$AlCl_3$=/$AlCl_3$+HCl 366, 305 sh, 275, 265 sh, 242, 222; /NaOMe 340 sh, 275, 230 sh, 215 nm; ms *m/z* (%) 422 ($M^{+\cdot}$; 4), 407 (3), 354 (50), 339 (100), 331 (25), 321 (4), 275 (3), 251 (4), 233 (2), 191 (4), 123 (5), 121 (3), 109 (5), 107 (11), 105 (4), 103 (3), 91 (32), 69 (66); $^1$H nmr (Table 1); $^{13}$C nmr (Table 2).

ACETYLATED DERIVATIVE.—(**2**, $C_5H_5N$, $Ac_2O$, room temperature, 7 days), viscous compound extracted by $C_6H_6$; uv λ MeOH 327, 262, 232 sh nm.

## LITERATURE CITED

1. M. Kaouadji, P. Ravanel and A.M. Mariotte, *J. Nat. Prod.*, **49**, 153 (1986).
2. M. Kaouadji, *J. Nat. Prod.*, **49**, 500 (1986).
3. M. Nilsson, *Acta Chem. Scand.*, **13**, 750 (1959).
4. T. Anthonsen, I. Falkenberg, M. Laake, A. Midelfart, and T. Mortensen, *Acta Chem. Scand.*, **25**, 1929 (1971).
5. T. Uyar, K.E. Malterud, and T. Anthonsen, *Phytochemistry*, **17**, 2011 (1978).
6. F. Bohlmann, J. Ziesche, and P.K. Mahanta, *Phytochemistry*, **18**, 1033 (1979).

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