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A 1,3,7,8-TETRAOXYGENATED XANTHONE FROM *HAPLOCLATHRA PANICULATA*

TANUS J. NAGEM and JOSÉ C. DA SILVEIRA

Departamento de Química do Instituto de Ciências Exatas and Faculdade de Farmácia, Universidade Federal de Minas Gerais, Belo Horizonte, 30,000, Brazil

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Key Word Index—*Haploclathra paniculata*; Guttiferae; trunk wood; 3,7-dihydroxy-1,8-dimethoxyxanthone.

Abstract—A new xanthone was isolated from the trunk wood of *Haploclathra paniculata* and its structure determined by UV, IR, NMR and mass spectrometry as 3,7-dihydroxy-1,8-dimethoxyxanthone.

INTRODUCTION

Haploclathra paniculata (Mart) Benth (Guttiferae), known as Morapiranga or Amuirapiranga, is a native tree from the Amazonia region. The plant was collected in the region of the lower Rio Negro–Rio Jafari, from a specimen identified by the botanist Klaus Kubitzki (herbarium No. 58 556, Instituto Nacional de Pesquisas da Amazonia, INPA, Brazil). Only two species of this genus, *H. verticillata* [1] and *H. leiantha* [2] have been investigated before.

Investigation of the trunk wood of *H. paniculata* has now yielded besides the previously known 16 compounds (see Experimental) a new 1,3,7,8-tetraoxygenated xanthone. We report its structure as **1**. The isolation and identification of this xanthone constitute the subject of the present paper.

RESULTS AND DISCUSSION

The xanthone (**1**) obtained from the chloroform–methanol fractions by chromatography of an ethanol extract of the trunk wood was crystallized from ethanol as yellow crystals, mp 282–284°. On the basis of elementary analysis and mass spectrometry, the molecular formula was assigned as $C_{15}H_{12}O_6$.

The UV spectrum of **1**, showing λ_{max} at 243, 256, 309 and 356 (ε 26 600, 28 600, 13 500 and 6200, respectively), is characteristic of a 1,3,7,8-tetraoxygenated xanthone [3]. The presence of the 1,3,7,8-tetraoxygenated system was confirmed by methylation of **1** with an ether solution of diazomethane. The dimethyl ether (**2**) was found to be identical with 1,3,7,8-tetramethoxyxanthone in all aspects [4]. Hence, the xanthone **1** was a dihydroxydimethoxyxanthone in which none of the hydroxyl groups is chelated. The absence of an $AlCl_3$ shift also proved the absence of hydroxyl groups at the *peri*-position relative to the carbonyl [5], while a strong bathochromic shift of the K-band on addition of sodium acetate, typical of 3-hydroxyxanthones [6], confirmed the presence of one hydroxyl group at C-3.

The presence of a 1,3,7,8-tetraoxygenated system was confirmed by the presence of one pair of each of *ortho*-and *meta*-coupled protons in two different aromatic rings, as evidenced from the ^{1}H NMR spectrum of **1** which showed the aromatic protons exhibiting *meta* split doublets centred at δ6.37 (J = 2.5 Hz) and *ortho* split doublets at δ7.15, 7.33 (J = 9.0 Hz), besides the singlets at δ3.83, 3.89 (6H) due to the methoxyl groups.

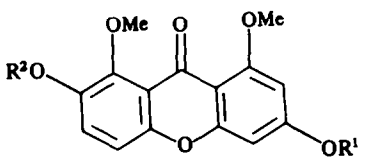
The mass spectrum showed an intense $[M]^+$ at m/z 288 (72%) as well as significant peaks at m/z 273 ($[M-15]^+$, 10%), 270 ($[M-18]^+$, 40%) and 259 ($[M-CHO]^+$, 33%) which agree with the proposed structure. The loss of water from the $[M]^+$ is due to the operation of an *ortho* effect caused by the methoxyl substituent at C-1 [7].

On the basis of these studies and biogenetic considerations [8] we are proposing the structure 3,7-dihydroxy-1,8-dimethoxyxanthone for compound **1**.

EXPERIMENTAL

Mps are uncorr. Separation by CC was carried out using Merck Kieselgel 0.063–0.200 mm and Sephadex LH-20 (25–100 μm, Pharmacia Fine Chemicals). TLC employed Merck Kieselgel 60 G and spots were visualized with I_2 vapour and UV fluorescence. IR spectra were determined in KBr pellets; only major bands are quoted. UV spectra were determined in 90% EtOH soln; additives (excess $NaOAc \cdot 3H_2O$, $AlCl_3 \cdot 6H_2O$ or drops of 20% NaOH) were introduced in equal amounts into the cell containing the soln and the cell containing the blank. MS were recorded using probe and GC/MS; only peaks with an intensity above 10% of the base peak are quoted. NMR spectra were recorded at 60 MHz.

Isolation and purification. Powdered trunk wood (10 kg) was continuously extracted with hot EtOH in a Soxhlet apparatus. Removal of solvent gave a residue (378 g), part of which (247 g) was chromatographed on silica gel (1500 g) using C_6H_6, $CHCl_3$



1 $R^1 = R^2 = H$
2 $R^1 = R^2 = Me$

and MeOH as eluants. Several fractions were collected and separated into 20 groups (A_1–A_{20}) by TLC. A_1 (0.415 g) was washed with EtOH giving lupenone (0.038 g). A_2 (4.117 g), A_3 (0.105 g), A_4 (0.186 g) and A_5 (0.273 g) were recrystallized from EtOH giving, respectively, lupeol (3.088 g), 1-hydroxy-7-methoxyxanthone (0.018 g), 1-hydroxy-3,5-dimethoxyxanthone (0.056 g) and sitosterol (0.125 g). A_6 (1.615 g) and A_7 (1.437 g) were repeatedly chromatographed on silica gel giving hexanoic acid (0.023 g), 4-hydroxy-3,5-dimethoxybiphenyl (aucuparin) (0.047 g), besides an additional amount of 1-hydroxy-3,5-dimethoxyxanthone (0.073 g). A_8 (0.052 g), A_9 (0.048 g), A_{10} (14.270 g) and A_{11} (0.437 g) were repeatedly recrystallized from EtOH giving, respectively, 1,7-dihydroxy-8-methoxyxanthone (0.020 g), 1-hydroxy-7,8-dimethoxyxanthone (0.023 g), 1,7-dihydroxy-3,8-dimethoxyxanthone (5.680 g) and 1,5-dihydroxy-3-methoxyxanthone (0.237 g). A_{12} (6.140 g) was chromatographed on silica gel giving friedelin (0.052 g) and 1,3,5-trimethoxyxanthone (0.005 g). A_{13} (1.083 g) was recrystallized from EtOH giving 3,8-dihydroxy-1,7-dimethoxyxanthone (0.833 g). A_{14} (0.866 g) was rechromatographed on silica gel giving 5-hydroxy-1,3-dimethoxyxanthone (0.010 g). A_{15} (15.02 g) was rechromatographed on Sephadex LH-20. Several fractions were collected and separated into two groups (B_1 and B_2) by TLC. B_1 (0.152 g) was rechromatographed on silica gel giving 1,3,7-trihydroxyxanthone (0.038 g). B_2 (0.581 g) was recrystallized in EtOH giving compound **1** (0.167 mg).

The remaining group of fractions will be studied in the future. All of the known compounds had their structures confirmed by mp, TLC, IR, MS and NMR, agreeing with lit. values. The xanthones were also converted into derivatives (partial methylation with CH_2N_2 and total methylation with Me_2SO_4–K_2CO_3) and some of them were compared with authentic samples isolated from *H. leiantha* [3] available in our laboratory.

3,7-Dihydroxy-1,8-dimethoxyxanthone (**1**). Yellow crystals, mp 282–284°. UV λ_{max}^{EtOH} nm: 243, 256, 309, 356 (ε respectively 26 600, 28 600, 13 500, 6200); $\lambda_{max}^{EtOH+NaOH}$ nm: 250, 270, 299 sh, 343 (ε respectively 26 400, 28 600, 8500, 17 500)—acidification restored the spectrum in EtOH; $\lambda_{max}^{EtOH+NaOAc}$ nm: 236, 254, 267 sh, 289, 344 (ε respectively 26 100, 21 600, 16 700, 7300, 14 500); $\lambda_{max}^{EtOH+NaOAC+H_3BO_3}$ and $\lambda_{max}^{EtOH+AlCl_3}$ nm (ε): identical to the spectrum in EtOH. IR ν_{max}^{KBr} cm^{-1}: 3410–3200, 1640, 1600, 1500, 1200, 1170, 1115, 965, 830, 730, 655. ^1H NMR (DMSO-d_6): δ3.83, 3.89 (6H, *s*, OMe-1 and 8) 6.37 (2H, *d*, *J* = 2.5 Hz, C-2 and C-4), 7.15 (1H, *d*, *J* = 9.0 Hz, H-5), 7.33 (1H, *d*, *J* = 9.0 Hz, H-6). MS *m/z* (rel. int.): 288 $[M]^+$ (72), 273 $[M-Me]^+$ (10), 270 $[M-18]^+$ (40), 259 $[M-CHO]^+$ (12), 245 $[M-CO-Me]^+$ (33), 213 $[M-CH_2O-CO-OH]^+$ (100). (Found: C, 62.23; H, 4.10. $C_{15}H_{12}O_6$ requires: C, 62.58; H, 4.20%.)

1,3,7,8-Tetramethoxyxanthone (**2**). A soln of **1** (50 mg) was methylated with CH_2N_2 in Et_2O soln giving **2** as colourless needles, mp 165–167° (MeOH) (lit. [4], mp 165°). UV λ_{max}^{EtOH} nm: 242, 252, 303, 351 (ε respectively 33 500, 36 200, 16 100, 4900). IR ν_{max}^{KBr} cm^{-1}: 2940, 1655, 1600, 1570, 1210, 1155, 1095, 965. ^1H NMR ($CDCl_3$): δ3.90, 3.97, 4.03 (all *s*, 12H, 4 × OMe), 6.32 (1H, *d*, *J* = 2.5 Hz, C-2), 6.41 (1H, *J* = 2.5 Hz, C-4), 7.11 (1H, *J* = 9.0 Hz, C-5), 7.27 (1H, *J* = 9.0 Hz, C-6). (Found: C, 64.19; H, 5.15. $C_{17}H_{16}O_6$ requires: C, 64.55; H, 5.10%.)

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