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NEOLIGNANS FROM *LICARIA AUREA**

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Key Word Index—*Licaria aurea*; Lauraceae; diaryltetrahydrofuran neolignans; β-aryloxy-arylpropane neolignans.

Abstract—The fruit calyces of *Licaria aurea* were found to contain the diaryltetrahydrofuran type neolignans grandisin, de-*O*-methylgrandisin and dide-*O*-methylgrandisin, as well the β-aryloxy-arylpropane type neolignans virolongin A and virolongin B.

INTRODUCTION

Licaria aurea (Hub.) Kosterm. has been shown to contain the neolignans aurein (**1**) and eusiderin (**2**), in the wood [2]. The present analysis revealed the presence of fraxetin (7,8-dihydroxy-6-methoxycoumarin) [3] and mannitol in immature fruits and of the neolignans grandisin (**3a**) [4] de-*O*-methylgrandisin (**3b**), dide-*O*-methylgrandisin (**3c**), virolongin A (= virolongin [5]) (**4a**) and virolongin B (**4b**) [6] in the calyx. **3b** is a new natural compound. **3c** has previously been obtained by synthesis [7] and its isolation from *Virola pavonis* (A.DC.) A. C. Smith (family Myristicaceae) has recently been announced [8].

RESULTS AND DISCUSSION

Once it had been ascertained spectroscopically that the known **3a** is identical with **3b** and **3c** with respect to skeleton, stereochemistry and position of oxygen containing functions, it sufficed to determine their nature and relative locations. Compound **3b** has one hydroxyl and five methoxyls. The ^{13}C NMR spectrum indicates only one of the methoxyls (δ60.8) to be flanked by two substituents. All the other four have vacant *ortho* positions (δ56.35 ± 0.05). Hence only **3b** can represent the structure of this de-*O*-methylgrandisin. Compound **3c** has two hydroxyls and four methoxyls, all with vacant *ortho*-positions (δ56.35). Spectral comparison of virolongin (**4a**) with **4b** revealed that the compounds were isomers differing only with respect to the position of the double bond situated respectively at 7′,8′ and 8′,9′.

Grandisin (**3a**) is by far the most abundant compound extracted from the calyx (14%) and it was used as the starting material for the synthesis of a series of model neolignans. Thus, acid treatment of **3a** ($HClO_4$, HOAc, reflux for 7 min) gave the known **5** (33%) [7, 9] and the new **6** (8%). Oxidation of **3a** ($KMnO_4$, KOH, room temp for 30 min) gave the 7,7′-dioxoneolignans **7** (47%) and **8** (7%), both having been prepared previously by other routes [9]. Reduction of **3a** (Na, NH_3) gave the new 7-hydroxyneolignan **9a** (61%). This was transformed by acid treatment into the known dihydro derivative of **5** and by hydrogenolysis into the known **9b** [7, 9]. Compounds **9b** and **7** were converted by VOF_3 oxidation [9] into the (8*R*,8′*R*)-isomer of the known *meso*-deoxyschizandrin [9] and its new 7,7′-dioxo-derivative **10**, respectively.

EXPERIMENTAL

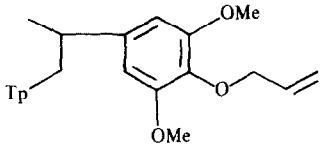
Isolation of constituents. Green fruits (250 g) were macerated in EtOH and the soln filtered and evapd. The residue (36 g) was partitioned between hexane and 60% aq EtOH. The EtOH soln was sepd and extracted with $CHCl_3$. The $CHCl_3$ layer was then sepd and evapd. The residue (3.8 g), submitted to silica gel CC, gave fraxetin (325 mg). The EtOH–H_2O layer was evapd and the residue (21.7 g), upon addition of Me_2CO, deposited crystalline mannitol (180 mg).

Fresh calyces (1 kg) were treated in the same way. The residue (88.2 g) was again partitioned as described above. The $CHCl_3$ extract (28 g) was submitted to silica gel CC. Elution with C_6H_6 and crystallization from Et_2O–MeOH gave **3a** (12 g). Elution with C_6H_6–EtOAc (7:3) and finally with $CHCl_3$ gave two mixts. A and B. A was sepd by TLC (silica gel, C_6H_6–EtOAc 4:1) into **3b** (8 mg) and **3c** (15 mg). B was purified by repeated TLC using the same system to give **4a** (200 mg) and **4b** (30 mg).

De-O-methylgrandisin (**3b**). Mp 135–137°. IR ν_{max}^{KBr} cm^{-1}: 3500, 1595, 1505, 1465, 1330, 1235, 1125, 1010, 825. UV λ_{max}^{MeOH} nm: 235, 272, (ε 6900, 3150). ^1H NMR (60 MHz, $CDCl_3$) δ1.10 (*d*, *J* = 6 Hz, 3H-9, 3H-9′), 1.70 (*m*, H-8, H-8′), 3.87 (*s*, OMe), 3.89 (*s*, 2 OMe), 3.90 (*s*, 2 OMe), 4.67 (*d*, *J* = 8 Hz, H-7, H-7′), 5.52 (*s*, OH), 6.6–6.75 (*m*, 4ArH). ^{13}C NMR (20 MHz, $CDCl_3$) δ13.9, 14.0 (C-9, C-9′), 51.0, 51.1 (C-8, C-8′), 56.3, 56.4 (4OMe-3,4,3′4′,), 60.8 (OMe-4′), 88.5, 88.7 (C-7, C-7′), 103.1 (C-2′, C-6′), 103.4 (C-2, C-6), 133.4 (C-1), 134.4 (C-4), 138.1 (C-1′, C-4′), 147.1 (C-3, C-5), 153.4 (C-3′, C-5′). MS *m/z* (rel. int.): 418 (13, $[M]^+$), 236 (34), 222 (33), 208 (36), 194 (25), 181 (37).

Virolongin B (**4b**). Oil. IR ν_{max}^{KBr} cm^{-1}: 1635, 1590, 1490, 1415, 1375, 1330, 1275, 1240, 1130, 1055, 980, 915, 825. UV λ_{max}^{EtOH} nm: 225, 280 (ε 13 400, 5800). ^1H NMR (60 MHz, $CDCl_3$) δ1.20 (*d*, *J*

*Part 90 in the series 'The Chemistry of Brazilian Lauraceae'. For Part 89 see ref. [1]. Based in part on the Doctorate theses presented by J.M.B.-F. and M.S. da S. to Universidade de São Paulo (1986). Present addresses: †Laboratório de Tecnologia Farmacêutica, Universidade Federal da Paraíba, 58000 João Pessoa, PB; ‡Departamento de Ciências Farmacêuticas, Universidade Federal da Paraíba, 58000 João Pessoa, PB; Brazil.



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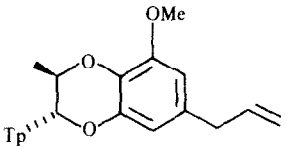

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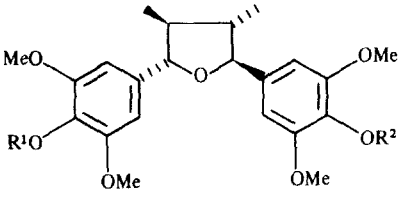
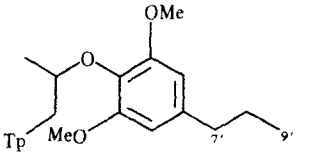
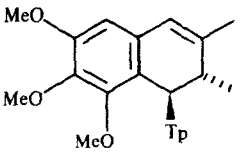


3a $R^1 = R^2 = Me$
3b $R^1 = H$, $R^2 = Me$
3c $R^1 = R^2 = H$



4a $\Delta^{7'}$
4b $\Delta^{8'}$



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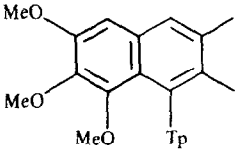

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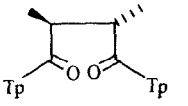

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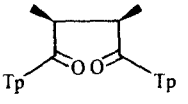

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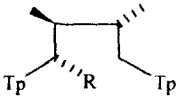
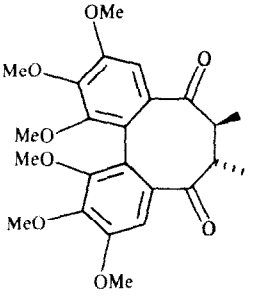


9a R = OH
9b R = H



10

Tp = 3,4,5-trimethoxyphenyl

= 6 Hz, 3H-9), 2.70 (*dd*, $J = 16$, 8 Hz, H-7), 3.10 (*dd*, $J = 14$, 6 Hz, H-7), 3.30 (*d*, $J = 7$ Hz, 2H-7'), 3.80 (*s*, 2 OMe), 3.85 (*s*, 3 OMe), 4.2–4.6 (*m*, H-8), 4.95–5.3 (*m*, 2H-9'), 5.8–6.3 (*m*, H-8'), 6.40 (*s*, H-2, H-6), 6.50 (*s*, H-2', H-6'). ^{13}C NMR (20 MHz, $CDCl_3$) δ19.6 (C-9), 40.5 (C-7'), 43.6 (C-7), 56.0 (3 OMe), 56.6 (OMe), 60.6 (OMe), 79.5 (C-8), 105.7 (C-2', C-6'), 106.6 (C-2, C-6), 115.8 (C-9'), 134.5 (C-1'), 134.8 (C-1), 135.3 (C-4'), 136.5 (C-4), 137.2 (C-8'), 152.8 (C-3', C-5'), 153.6 (C-3, C-5), MS *m/z* (rel. int.): 402 (11, $[M]^+$, 221 (6), 209 (100), 208 (30), 194 (23), 193 (14), 181 (10), 178 (11), 165 (5), 151 (9), 135 (7), 107 (9), 91 (19), 77 (13), 65 (7), CD (*c* 1.0 mg/25 ml MeOH): $[\theta]_{220}0$, $[\theta]_{239} -3400$, $[\theta]_{250} -2800$, $[\theta]_{285} -400$, $[\theta]_{370}$ 0.

(7*S*,8*S*,8'*R*)-7-*Hydroxy*-3,4,5,3',4',5'-*hexamethoxy*-8.8'-*neolignan* (**9a**). Mp 124–126° (MeOH). IR ν_{max}^{KBr} cm^{-1}: 3530, 1590, 1510, 1460, 1330, 1235, 1130, 1005, 965. UV λ_{max}^{MeOH} 230, 280 (ε 6100, 1500). ^{1}H NMR (60 MHz, $CDCl_3$) δ0.65 (*d*, $J = 7$ Hz, 3H-9'), 0.90 (*br s*, 3H-9), 2.0 (*m*, H-8, H-8'), 2.55 (*br s*, 2H-7'), 3.84 (*s*, 6OMe), 4.40 (*d*, $J = 12$ Hz, H-7), 6.45 (*s*, H-2', H-6'), 6.57 (*s*, H-2, H-6). ^{13}C NMR (20 MHz, $CDCl_3$) δ9.6 (C-9), 12.5 (C-9'), 33.0 (C-8'), 41.9 (C-7'), 42.5 (C-8), 76.8 (C-7), 55.4 (4 OMe), 60.1 (2 OMe), 103.2 (C-2', C-6'), 105.6 (C-2, C-6), 135.7, 136.5, 136.8, 139.9 (C-1, C-1', C-4, C-4'), 152.3 (C-3, C-5, C-3', C-5'). MS *m/z* (rel. int.): 434 (10, $[M]^+$, 416 (12), 249 (1), 238 (20), 210 (2), 208 (28), 198 (13), 197 (100), 181 (58), 169 (80).

(8*S*,8'*S*)-3,4,5,3',4',5'-*Hexamethoxy*-7.7'-*dioxo*-2.2',8.8'-*neolignan* (**10**). Mp 116–118°. IR ν_{max}^{KBr} cm^{-1}: 1695, 1558, 1480, 1380, 1340, 1200, 1010, 935. UV λ_{max}^{MeOH} nm: 228, 265, 305 (ε 13750, 3350, 1550). ^{1}H NMR (60 MHz, $CDCl_3$) δ1.30 (*d*, $J = 7$ Hz, 3H-9, 3H-9'), 3.7–3.9 (*m*, H-8, H-8'), 3.88, 3.90, 3.93 (3*s*, 6 OMe), 7.20, 7.30 (2*s*, H-6, H-6'). MS *m/z* (rel. int.): 321 (100), 278 (6), 250 (3), 195 (11), 179 (4), 151 (4).

3,4,5,3',4',5'-*Hexamethoxy*-8'.8',2.7'-*neolignan* (6). Mp 73–75° (Et_2O–hexane). IR ν_{max}^{KBr} cm^{-1}: 1605, 1575, 1500, 1463, 1395, 1255, 1095, 888. UV λ_{max}^{MeOH} nm: 236, 283 (ε 19550, 2450).

^{1}H NMR (60 MHz, $CDCl_3$) δ2.40 (*s*, 3H-9, 3H-9'), 3.90, 3.92, 4.02 (3*s*, 6 OMe), 6.85 (*s*, H-2', H-6'), 7.45 (*s*, H-6), 7.80 (*s*, H-7). ^{13}C NMR (20 MHz, $CDCl_3$) δ19.8, 19.9 (C-9, C-9'), 55.6 (3 OMe), 60.9, 61.1 (3 OMe), 101.5 (C-2', C-6'), 121.0 (C-2, C-7), 126.1 (C-1, C-7'), 129.5 (C-8'), 133.0 (C-8, C-1'), 135.1 (C-4'), 140.1 (C-4, C-6), 147.2 (C-3, C-5), 152.2 (C-3', C-5').

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HAPLOXANTHONE FROM *HAPLOCLATHRA* SPECIES

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Key Word Index—*Haploclathra leiantha*; *H. paniculata*; Guttiferae; 1,3,7-trihydroxy-8-methoxyxanthone; haploxanthone.

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

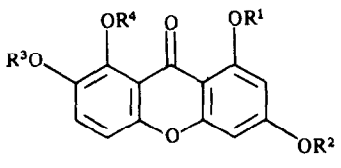
INTRODUCTION

Previously, we reported the isolation of 'Leiaxanthone' [1] and anthaxanthone [2] from *Haploclathra leiantha*., and 3,7-dihydroxy-1,8-dimethoxyxanthone from *H. paniculata* besides several known xanthones (see Experimental of refs [1, 3]). Now we describe the isolation and characterization of a new 1,3,7,8-tetraoxygenated xanthone from both species for which we give the trivial name 'haploxanthone'. In this communication we report its structure as **1** which to our knowledge is the first report of the occurrence of a tetraoxygenated xanthone from this source.

RESULTS AND DISCUSSION

Haploxanthone (**1**), obtained from chloroform–methanol fractions by chromatography of extracts of the trunk wood of *H. leiantha* and H. *paniculata*, was crystallized from ethanol as yellow crystals, mp 250–252°. On the basis of elementary analysis and mass spectrometry the molecular formula was assigned as $C_{14}H_{10}O_6$. The xanthone (**1**) formed a dimethyl ether (**2**) with diazomethane, a trimethyl ether (**3**) with dimethyl sulphate–potassium carbonate and a triacetyl derivative (**4**) with acetic anhydride. Hence, the compound was a trihydroxymethoxyxanthone in which one of the hydroxyl groups is chelated.

The UV spectrum of **1** showing λ_{max}^{EtOH} (nm) 242, 264, 322 and 383 (ε resp. 31 400, 35 800, 21 000 and 13 700) is characteristic of a 1,3,7,8-tetraoxygenated xanthone [4]. The presence of a 1,3,7,8-tetraoxygenated system was



1 $R^1 = R^2 = R^3 = H$, $R^4 = Me$
2 $R^1 = H$, $R^2 = R^3 = R^4 = Me$
3 $R^1 = R^2 = R^3 = R^4 = Me$
4 $R^1 = R^2 = R^3 = Ac$, $R^4 = Me$