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SIX FLAVONOIDS FROM *BURSERA LEPTOPHLOEOS*

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Key Word Index—*Bursera leptophloeos*; Rubiaceae; branch wood; prenylflavonoids; chalcone.

Abstract—From branches of *Bursera leptophloeos* five flavonoids were isolated: 8-(3″-hydroxy-3″-methylbutyl)-5,7,4′-trihydroxydihydroflavonol, 6″,6″-dimethyldihydropyran (2″,3″:7,8)-5,4′-dihydroxydihydroflavonol, 8-(3″-hydroxy-3″-methylbutyl)-5,7,4′-trihydroxyflavonol, 6″,6″-dimethyldihydropyran (2″,3″:7,8)-5,4′-dihydroxyflavonol, 8-(γ,γ-dimethylallyl)-5,7,4′-trihydroxyflavonol, and two new related compounds 8-(γ,γ-dimethylallyl)-5,7,4′-trihydroxydihydroflavonol and 5″-isopropenyldihydrofuran-(2″,3″:7,8)-5,4′-dihydroxydihydroflavonol.

INTRODUCTION

Bursera leptophloeos Mart. (Burseraceae) is a resinous tree widely dispersed in the semiarid part of the northeast region of Brazil. Its heartwood is greatly used for wood carving. As far as we know there is no report of previous phytochemical investigation of this plant.

In this paper we are reporting the structure of two new prenyldihydroflavonols, **1** and **7**. Although the other prenylflavonoids **2–5** have been obtained earlier by hydrolysis of their glycosides [1–3], their occurrence as aglycones has not been described previously. The natural compound **6** was obtained earlier from *Sophora angustifolia* [4]; it constitutes the aglycone moiety of several glycosides [5].

RESULTS AND DISCUSSION

The ethanolic extract of branches of *B. leptophloeos* afforded two new compounds **1** and **7** as well as **2–6**. 8-(γ,γ-dimethylallyl)-5,7,4′-Trihydroxydihydroflavonol (**1**), EIMS analysis revealed a molecular ion at 356 (17%), suggesting a molecular formula $C_{20}H_{20}O_6$. Its dihydroflavonol character was indicated by the presence of peaks at *m/z* 221 (22%) and 165 (100%), corresponding to fragments **1b** and **1c**, respectively and this, was also in agreement with the UV data (λ_{max}^{MeOH} 294 nm). This conclusion was confirmed by characteristic signals at δ5.05 (1H, *d*, *J* = 11 Hz, H-2) and δ4.64 (1H, *d*, *J* = 11 Hz, H-3) in the ^{1}H NMR spectrum. The location of a hydroxyl group at C-4′ was readily apparent from the detection of an AA′BB′ system [7.42 (2H, *d*, *J* = 8 Hz, H-2′, 6′; 6.92 (2H, *d*, *J* = 8 Hz, H-3′, 5′)]. Absorptions at δ1.76 and 1.64 (3H, each, *br s*, H-5″ and H-4″), δ3.25 (2H, *br d*, *J* = 6 Hz, H-1″) and δ5.26 (1H, *br t*, H-2″) fits nicely with a prenyl moiety. The location of this side chain at the C-8 position was clear from the formic acid cyclization of **1** to **3**. The latter, still showing the chelated hydroxy at C-5 in the ^{1}H NMR spectrum (δ12.06), is similar to phellamuretin obtained previously by hydrolysis of phellodendroside [3] whose ^{1}H NMR data have not been reported yet. The ^{1}H NMR spectrum of the acetate **1a** showed four acetoxy groups [δ2.32 (3H, s), 2.30 (3H, s), 2.25 (3H, s) and 1.95 (3H, s)]. The H-2/H-3 *trans* relationship was clearly determined by the observed coupling constant value (*J* = 11 Hz), characteristic of axial–axial interaction. Based on ORD analysis we infer a 2*R* absolute configuration for **1** [6]. ^{13}C NMR assignments for **1a** (see Experimental) were based on the reported data for glepidotin A and other models [7, 8]. The chalcone, **8**, was obtained from **1** by treatment with methyl sulphate and sodium hydroxide (40%). The structure of this new product was elucidated by ^{1}H and ^{13}C NMR spectroscopy [9, 10].

5″-Isopropenyldihydrofuran (2″,3″:7,8)-5,4′-dihydroxydihydroflavonol (**7**), EI mass spectral analysis showed a molecular ion at *m/z* 354 (6%) and very similar spectral data to compound **1**. The major differences on the ^{1}H NMR spectrum were a terminal double bond at δ4.90 and 4.74 (1H each, *br s*), only one methyl group at δ1.82 (3H, *br s*, vinylmethyl), a saturated methylene at δ2.96 (1H, *dd*, *J* = 14 and 4 Hz) and 2.80 (1H, *dd*, *J* = 14 and 7 Hz), and a characteristic methyne at δ4.36 (1H, *dd*, *J* = 7 and 4 Hz), indicating the presence of the isopropenyl group supported by the ring dihydrofuran formed of the prenyl moiety in **1**. Based on this and the similarity in shape for both ORD curves we suggested a 2*R*,3*R*-dihydrofuran isopropenyl substituted flavonol structure for **7**.

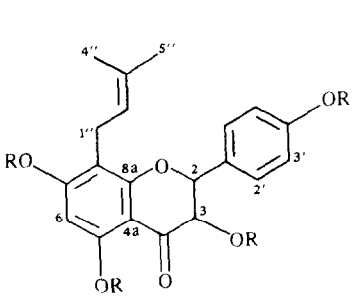
Compounds **2–6** were identified by the spectral data of the original compounds and their acetates **2a**, **4a**, **5a** and **6a**, respectively.

EXPERIMENTAL

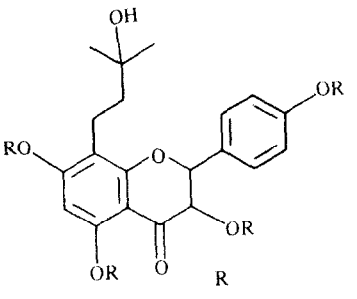
Mps: uncorr.

Plant material. Bursera leptophloeos Mart. was collected in Ceará, Brazil, in June, 1983 by Dr F. J. A. Matos (Laboratório de Produtos Naturais da Universidade Federal do Ceará) and identified by Dr A. G. Fernandes (taxonomist, Herbário Prisco Bezerra). A voucher specimen is deposited at this herbarium (No. 9619).

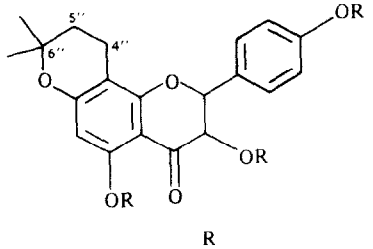
Isolation of flavonoids. Branches of *Bursera leptophloeos* Engl. (3.5 kg) were extracted with EtOH at room temp. and furnished a brown residue (488 g). After evapn of the solvent this material



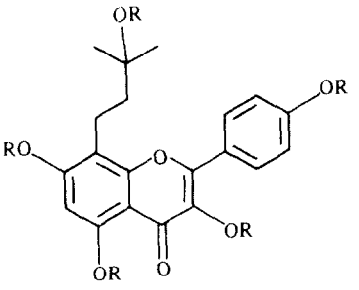
	R
1	H
1a	Ac



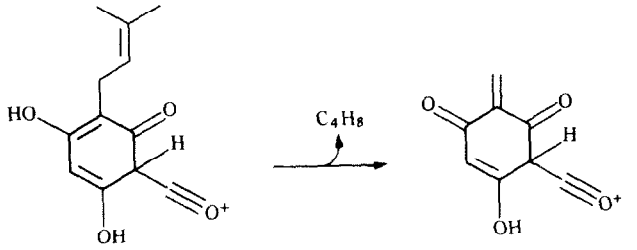
	R
2	H
2a	Ac



	R
3	H
3a	Ac



	R
4	H
4a	Ac



1b **1c**

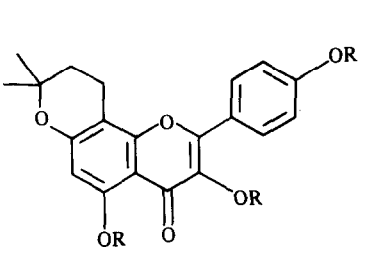
was mixed with silica gel (780 g) and eluted successively with C_6H_{12}, $CHCl_3$, Me_2CO, MeOH and mixtures of these solvents in a roughly graded way. The combined fractions 1–10 contained mainly fatty acids. Fractions 11–20 gave a pale red powder which by chromatographic purifications furnished **1** and **2** as the major constituents (*ca* 15 g each), and **3–5**, and **7**, as minor constituents (*ca* 0.2 g each). The compound **6** was isolated as acetate (**6a**).

8-(*γ,γ-dimethylallyl*)-5,7,4′-*Trihydroxydihydroflavonol* (**1**). Mp 186–187°; UV λ_{max}^{MeOH} nm: 294, 337 (sh); $\lambda_{max}^{MeOH+NaOAc}$ nm: 331; CD θ_{max}^{MeOH} 330 nm (+11570), 290 (−30705); EIMS *m/z* (rel. int.): 356 ($M^{\cdot+}$, 17), 338 (4), 300 (7), 283 (3), 221 (22), 165 (100), 134 (42), 107 (53); ^{1}H NMR (CD_3COCD_3) 100 MHz: δ12.06 (1H, *s*), 9.70 (*br s*, D_2O exchangeable), 8.5 (*br s*, D_2O exchangeable), 7.42 (2H, *d*, *J* = 8 Hz), 6.92 (2H, *d*, *J* = 8 Hz), 6.06 (1H, *s*), 5.26 (1H, *br t*), 5.05 (1H, *d*, *J* = 11 Hz), 4.64 (1H, *d*, *J* = 11 Hz), 3.25 (2H, *br d*, *J* = 6 Hz), 1.76 (3H, *s*), 1.64 (3H, *s*).

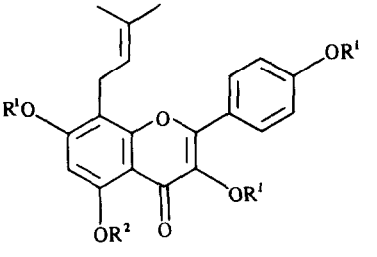
Acetate (**1a**). Mp 159–161°; UV λ_{max}^{MeOH} nm: 263, 322; EIMS *m/z* (rel. int.): 524 ($M^{\cdot+}$, 3), 481 (78), 464 (4), 439 (32), 422 (30), 220 (35), 203 (28), 177 (18), 165 (100), 136 (50), 107 (45), ^{1}H NMR (CD_3COCD_3) 100 MHz: δ7.66 (2H, *d*, *J* = 8 Hz), 7.23 (2H, *d*, *J* = 8 Hz),6.86 (1H, *s*), 5.86 (1H, *d*, *J* = 12 Hz), 5.62 (1H, *d*, *J* = 12 Hz), 5.02 (1H, *br t*), 3.20 (2H, *br s*, *J* = 6 Hz), 2.32 (3H, *s*), 2.30 (3H, *s*), 2.25 (3H, *s*), 1.95 (3H, *s*), 1.76 (3H, *s*), 1.65 (3H, *s*); ^{13}C NMR ($CDCl_3$) 25.2 MHz: δ185.07 (C-4), 168.73 (3 × OCOMe), 167.71 (OCOMe), 159.83 (C-7), 154.94 (C-8a), 151.25 (C-4′), 149.19 (C-5), 132.40, 132.30 (C-1′, C-3′), 122.21 (C-8), 110.60 (C-4a), 128.41 (C-2′,6′), 121.71 (C-3′, 5′), 120.61 (C-2″), 109.80 (C-6), 80.57 (C-2), 73.22 (C-3), 25.51 (C-5″), 23.13 (C-1″), 20.29, 20.80, 20.80, 20.23 (OCOMe), 17.80 (C-4″).

8-(*3″-hydroxy-3″-methylbutyl*)-5,7,4′-*Trihydroxydihydroxyflavonol* (**2**). Mp 221–222°; UV λ_{max}^{MeOH} nm: 297, 338 (sh); $\lambda_{max}^{MeOH+AlCl_3}$ nm: 321; $\lambda_{max}^{MeOH+AlCl_3+HCl}$ nm: 320; EIMS *m/z* (rel. int.): 374 ($M^{\cdot+}$, 28), 356 (44), 338 (33), 301 (48), 221 (85), 165 (99), 136 (34), 134 (86), 107 (100); ^{1}H NMR (CD_3COCD_3) 60 MHz: δ11.5 (1H, *s*, HO-5), 7.45 (2H, *d*, *J* = 8 Hz, H-2′,6′), 6.95 (2H, *d*, *J* = 8 Hz, H-3′,5′), 6.02 (1H, *s*, H-6), 5.08 (1H, *d*, *J* = 10 Hz, H-2), 4.60 (1H, *d*, *J* = 10 Hz, H-3), 3.05 (*br s*, HO, D_2O exchangeable), 2.70 (2H, *t*, *J* = 6 Hz, H-1″, 1″), 1.65 (2H, *t*, *J* = 6 Hz, H-2″, 2″), 1.28 (6H, *s*, Me-3″, 3″): $[\alpha]_{25°}^{\lambda} \frac{589\ 546}{+16\ +18.3}$ (MeOH; *c* 1).

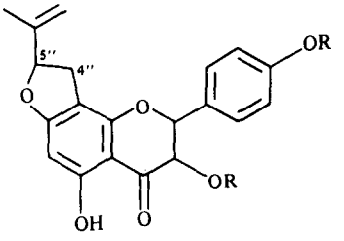
Acetate (**2a**). Mp 189–191°; EIMS *m/z* (rel. int.): 542 ($M^{\cdot+}$, 2), 483 (28), 482 (10), 427 (28), 422 (14), 385 (23), 380 (14), 365 (10), 343 (15), 325 (17), 165 (52), 107 (16), 43 (100); ^{1}H NMR (CD_3COCD_3)



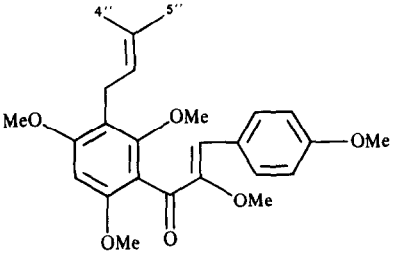
	R
5	H
5a	Ac



	R^1	R^2
6	H	H
6a	Ac	H



	R
7	H
7a	Ac



8

60 MHz: δ7.70 (2H, *d*, J = 8 Hz, H-2′, 6′), 7.22 (2H, *d*, J = 8 Hz, H-3′,5′), 6.88 (1H, *s*, H-6), 5.88 (1H, *d*, J = 12 Hz,H-2), 5.60 (1H, *d*, J = 12 Hz, H-3), 2.60 (2H, *m*, H-1″, 1″), 2.37 (6H, *s*, AcO), 2.30 (3H, *s*, AcO), 1.98 (3H, *s*, AcO), 1.60 (2H, *m*, H-2″, 2″), 1.30 (6H, *s*, Me-3″, 3″).

6″,6″-Dimethyldihydropyran (2″,3″:7,8)-5,4′-dihydroxydihydroflavonol (**3**). This compound was obtained as a natural product and by cyclization of **1** (200 mg) in 90% HCO_2H (6 ml) at 100°, for 3 hr. Dilution with H_2O, extraction with $CHCl_3$, evapn of the soluble portion and purification by CC gave **3** (90 mg). Mp 210–211°; UV λ_{max}^{MeOH} nm: 217, 293, 337 (sh); $\lambda_{max}^{MeOH+NaOAc}$ nm: 217, 293, 337 (sh); EIMS *m/z* (rel. int.): 356 ($M^{\cdot+}$, 36), 339 (7), 327 (24), 221 (58), 194 (39), 165 (100), 139 (28), 134 (48), 107 (28); ^{1}H NMR (CD_3COCD_3) 60 MHz: δ12.13 (1H, *s*, HO-5), 7.40 (2H, *d*, J = 8 Hz, H-2′, 6′), 6.90 (2H, *d*, J = 8 Hz, H-3′, 5′), 5.83 (1H, *s*, H-6), 5.05 (1H, *d*, J = 11 Hz, H-2), 4.60 (1H, *d*, J = 11 Hz, H-3), 3.00 (*br s*, D_2O exchangeable), 2.60 (2H, *t*, J = 6.5 Hz, H-4″, 4″), 1.85 (2H, *t*, J = 6.5 Hz, H-5″, 5″), 1.35 (6H, *s*, Me-6″, 6″).

Acetate (**3a**). Mp 72–73°; ^{1}H NMR ($CDCl_3$) 60 MHz: δ7.62 (2H, *d*, J = 8.5 Hz, H-2′, 6′), 7.22 (2H, *d*, J = 8.5 Hz, H-3′, 5′), 6.30 (1H, *s*, H-6), 5.73 (1H, *d*, J = 12 Hz, H-2), 5.42 (1H, *d*, J = 12 Hz, H-3), 2.60 (2H, *t*, J = 6.5 Hz, H-4″, 4″), 1.90 (3H, *s*, AcO), 2.30 (6H, *s*, AcO), 1.80 (2H, *t*, J = 6.5 Hz, H-5″, 5″), 1.32 (6H, *s*, Me-6″, 6″).

8-(3″-hydroxy-3″-methylbutyl)-5,7,4′-Trihydroxyflavonol (**4**). Yellow needles, mp 223–224°; UV λ_{max}^{MeOH} nm: 275, 338 (sh), 362.5; λ_{max}^{MeOH} nm: 282, 330, 412.5; $\lambda_{max}^{MeOH+AlCl_3}$ nm: 275, 368 (sh), 436; $\lambda_{max}^{MeOH+AlCl_3+HCl}$ nm: 275, 368, 437; MS *m/z* (rel. int.): 372 ($M^{\cdot+}$, 58), 354 (58), 339 (34), 311 (77), 299 (100), 165 (16), 121 (40); ^{1}H NMR (CD_3COCD_3) 60 MHz: δ12.40 (1H, *s*, HO-5), 8.10 (2H, *d*, J = 8 Hz, H-2′, 6′), 6.98 (2H, *d*, J = 8 Hz, H-3′, 5′), 6.55 (1H, *s*, H-6), 2.80 (2H, *m*, H-1″, 1″), 1.70 (2H, *m*, H-2″, 2″), 1.30 (6H, *s*, Me-3″, 3″).

Acetate (**4a**). EIMS *m/z* (rel. int.): 540 ($M^{\cdot+}$, 3), 498 (66), 483 (16), 465 (22), 456 (67), 438 (81), 396 (69), 341 (70), 299 (80), 165 (46), 121 (100), 93 (42); ^{1}H NMR (CD_3COCD_3) 60 MHz: δ7.90 (2H, *d*, J = 8 Hz, H-2′, 6′), 7.40 (1H, *s*, H-6), 7.28 (2H, *d*, J = 8 Hz, H-3′, 5′), 2.60 (2H, *m*, H-1″, 1″), 2.35 (6H, *s*, AcO), 2.28 (6H, *s*, AcO), 1.70 (2H, *m*, H-2″, 2″), 1.25 (6H, *s*, Me-3″, 3″).

6″,6″-Dimethyldihydropyran (2″,3″:7,8)-5,4′-dihydroxyflavonol (**5**). Mp 210–211°: EIMS (rel. int.): 354 ($M^{\cdot+}$, 4), 337 (11), 311 (7), 299 (6), 203 (13), 177 (6), 121 (100), 105 (14), 93 (40); ^{1}H NMR (CD_3COCD_3) 60 MHz: δ12.46 (1H, *s*, HO-5), 9.80 (*br s*, HO, D_2O exchangeable), 8.10 (2H, *d*, J = 10 Hz, H-2′, 6′), 7.00 (2H, *d*, J = 10 Hz, H-3′, 5′), 6.38 (1H, *s*, H-6), 3.05 (*br s*, HO, D_2O exchangeable), 2.68 (2H, *t*, J = 6 Hz, H-4″, 4″), 1.88 (2H, *t*, J = 6 Hz, H-5″, 5″), 1.40 (6H, *s*, Me-6″, 6″).

Acetate (**5a**). Mp 200–201°; ^{1}H NMR (CD_3COCD_3) 60 MHz: δ7.95 (2H, *d*, J = 8 Hz, H-2′, 6′), 7.30 (2H, *d*, J = 8 Hz, H-3′, 5′), 6.88 (1H, *s*, H-6), 2.70 (2H, *t*, J = 6 Hz, H-4″, 4″), 2.30 (3H, *s*, AcO), 2.29 (3H, *s*, AcO), 2.27 (3H, *s*, AcO), 1.88 (2H, *t*, J = 6 Hz, H-5″, 5″), 1.40 (6H, *s*, Me-6″, 6″).

Acetate (**6a**). Mp 166–168°; EIMS *m/z* (rel. int.): 480 ($M^{\cdot+}$, 54), 438 (80), 425 (17), 395 (77), 383 (63), 341 (76), 299 (69), 165 (38), 133 (26), 121 (100), 105 (36), 93 (48): ^{1}H NMR ($CDCl_3$) 60 MHz: δ12.40, (1H, *s*, HO-5), 7.90 (2H, *d*, J = 8.5 Hz, H-2′, 6′), 7.22 (2H, *d*, J = 8.5 Hz, H-3′, 5′), 6.80 (1H, *s*, H-6), 5.15 (1H, *t*, J = 7 Hz, H-2″), 3.30 (2H, *d*, J = 7 Hz, H-1″, 1″), 2.30 (9H, *s*, AcO), 1.80 (3H, *s*, Me-3″), 1.75 (3H, *s*, Me-3″).

5″-Isopropenyldihydrofuran-(2″,3″:7,8)-5,4′-dihydroxydihydroflavonol (**7**). Mp 196–197°; EIMS *m/z* (rel. int.): 354 ($M^{\cdot+}$, 6), 301 (71), 219 (8), 165 (100), 136 (7), 107 (20); ^{1}H NMR (CD_3COCD_3) 100 MHz; δ12.00 (1H, *s*, HO-5), 7.36 (2H, *d*, J = 8 Hz, H-2′, 6′), 6.85 (2H, *d*, J = 8 Hz, H-3′, 5′), 5.94 (1H, *s*, H-6), 5.00 (1H, *d*, J = 11 Hz, H-2), 4.90 and 4.74 (= CH_2, *br s*), 4.62 (1H, *d*, J = 11 Hz, H-3), 4.36 (1H, *dd*, J = 7 and 4 Hz, H-5″), 2.96 (1H, *dd*, J = 14 and 4 Hz, H-4″), 2.80 (1H, *dd*, J = 14 and 7 Hz, H-4″), 1.82 (3H, *s*, vinylmethyl).

Acetate (**7a**). Mp 90–98°; CD θ_{max}^{MeOH} 335 nm (+5340), 293

(−21 360); EIMS *m/z* (rel. int.): 480 ($M^{\cdot+}$, 2), 452 (20), 399 (20), 336 (21), 261 (4), 219 (100), 165 (58), 136 (50), 134 (54), 107 (42), 43 (91).

3'(γ,γ-dimethylallyl)-2',4',6',4,α-Pentamethoxychalcone (**8**). The soln of **1** (400 mg) in EtOH (2.5 ml), was treated with aq. soln 44% NaOH (0.5 ml) and Me_2SO_4 (0.5 ml), under reflux during 6 hr. The EtOH was evapd, the mixture treated with satd NaCl and extracted with Et_2O. After evapn, the residue was chromatographed on silica gel column to give a deep yellow product (50 mg). UV λ_{max}^{MeOH} nm: 316. ^{1}H NMR (CD_3COCD_3) 60 MHz: δ7.65 (2H, *d*, $J = 8$ Hz, H-2, 6), 6.80 (2H, *d*, $J = 8$ Hz, H-3, 5), 6.50 (1H, *s*, H-β or H-5'), 6.45 (1H, *s*, H-5' or H-β), 5.15 (1H, *m*, H-2''), 3.85 (3H, *s*, OMe), 3.80 (3H, *s*, OMe), 3.79 (3H, *s*, OMe), 3.78 (3H, *s*, OMe), 3.65 (3H, *s*, OMe), 3.25 (2H, *d*, H-2'', 2''), 1.65, 1.55 (3H, each, *s*, Me, Me). ^{13}C NMR ($CDCl_3$) 25.2 MHz: δ192.20 (C=O), 160.14, 159.75 (C-4, C-4'), 156.59, 156.19 (C-2', C-6'), 153.47 (C-α), 131.88 (C-2, C-6), 130.89 (C-3''), 127.43 (C-β), 126.37 (C-1), 123.13 (C-2''), 115.86, 115.73 (C-1', C-3'), 113.79 (C-3, C-5), 91.64 (C-5'), 62.72 (MeO-2'), 58.48 (OMe), 55.95 (OMe), 55.64 (OMe), 55.12 (OMe), 25.68 (C-5''), 22.47 (C-1''), 17.75 (C-4'').

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