Supporting Information

Total Synthesis of (-)-Deguelin via an Iterative Pyran-Ring Formation Strategy

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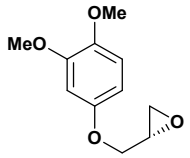
General Experimental

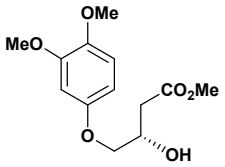
Unless otherwise described, all commercial reagents and solvents were purchased from commercial suppliers and used without further purification. Tetrahydrofuran (THF) and diethyl ether were distilled from sodium benzophenone ketyl. Dichloromethane, triethylamine, acetonitrile, and pyridine were freshly distilled from calcium hydride. Flash column chromatography was carried out using silica-gel 60 (230-400 mesh, Merck) and preparative thin layer chromatography was used with glass-backed silica gel plates (1mm, Merck). Thin layer chromatography was performed to monitor reactions. All reactions were performed under dry argon atmosphere in flame-dried glassware. Optical rotations were measured using a JASCO DIP-1000 digital polarimeter at ambient temperature using 100 nm cells of 2 mL capacity. Infrared spectra were recorded on a Perkin-Elmer 1710 FT-IR spectrometer. Mass spectra were obtained using a VG Trio-2 GC-MS instrument, and high resolution mass spectra were obtained using a JEOL JMS-AX 505WA unit. ^{1}H and ^{13}C NMR spectra were recorded on either a JEOL JNM-LA 300 (300MHz), JEOL JNM-GCX (400MHz), BRUKERAMX-500 (500MHz) or JEOL (600MHz) spectrometers. Chemical shifts are provided in parts per million (ppm, δ) downfield from tetramethylsilane (internal standard) with coupling constant in hertz (Hz). Multiplicity is indicated by the following abbreviations: singlet (s), doublet (d), doublet of doublet (dd), triplet (t), quartet (q), quintet (quin) multiplet (m) and broad (br). The purity of the compounds was determined by normal phase high performance liquid chromatography (HPLC), (Gilson or Waters, CHIRALPAK® AD-H (4.6 × 250 mm) or CHIRALPAK® OD-H (4.6 × 250 mm)).



8

(*S*)-2-((3,4-Dimethoxyphenoxy)methyl)oxirane (8)

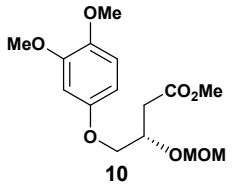
To a solution of (*S*)-(+)-glycidyl-3-nitrobenzenesulfonate (5.191 g, 19.6 mmol) and phenol **9** (2.016 g, 13.1 mmol) in dry DMF (39 mL) was added Cs_2CO_3 (21.528 g, 65.4 mmol) at ambient temperature. The reaction mixture was stirred for 4 h and quenched with water, and then extracted with EtOAc. The organic layer was washed with 1*N* NaOH aqueous solution and brine, dried over $MgSO_4$, and concentrated under reduced pressure. The residue was purified by flash column chromatography on silica gel (EtOAc : *n*-Hexane = 1 : 3) to afford 2.806 g (98%) of **8** as a white solid: $[\alpha]_D^{20}$ +4.4 (c 1.01, CH_2Cl_2); FT-IR (thin film, neat) ν_{max} 2955, 2923, 2853, 1598, 1514, 1464 cm^{-1}; ^{1}H-NMR ($CDCl_3$, 500 MHz) δ 6.74 (d, 1H, *J* = 8.7 Hz), 6.54 (d, 1H, *J* = 2.8 Hz), 6.38 (dd, 1H *J* = 8.7, 2.8 Hz), 4.16 (dd, 1H, *J* = 11.0, 3.1 Hz), 3.89 (dd, 1H, *J* = 11.0, 5.7 Hz), 3.82 (d, 6H, *J* = 10.9 Hz), 3.32 (m, 1H), 2.87 (t, 1H, *J* = 4.8 Hz), 2.72 (dd, 1H, *J* = 4.9, 2.6 Hz); ^{13}C-NMR ($CDCl_3$, 125 MHz) δ 153.1, 149.9, 143.9, 111.7, 103.9, 101.1, 69.3, 56.4, 55.8, 50.2, 44.6; HR-MS (FAB+) calcd for $C_{11}H_{14}O_4$ (M^+) 210.0892; found 210.0884.



(*S*)-Methyl 4-(3,4-dimethoxyphenoxy)-3-hydroxybutanoate

Cobalt carbonyl (2.346 g, 6.2 mmol) was added into a flame-dried 50mL round bottom flask. The flask was purged 5 times using CO balloon. Dry methanol (16 mL) was added and the mixture was stirred for 2 min. Epoxide **8** (6.490 g, 30.9 mmol) in dry methanol (16 mL) was added to the previous solution, and CO gas was bubbled into the mixture for 20 min. The resulting mixture was stirred until complete consumption of the starting material (monitored by TLC) at ambient temperature, diluted with ether, and filtered through a pad of celite. The filtrate was concentrated under reduced pressure and the residue was purified by flash column chromatography on silica gel (EtOAc : *n*-Hexane = 1 : 3) to afford 6.501 g (78%) of (*S*)-methyl 4-(3,4-dimethoxyphenoxy)-3-hydroxybutanoate as a yellow liquid: $[\alpha]_D^{20}$ -46.8 (c 0.57, CH_2Cl_2); FT-IR (thin film, neat) ν_{max} 3502, 2998, 2952, 2834, 1736, 1611, 1597, 1513, 1440 cm^{-1}; ^{1}H-NMR ($CDCl_3$, 500 MHz) δ 6.75 (d, 1H, *J* = 8.7 Hz), 6.52 (d, 1H,

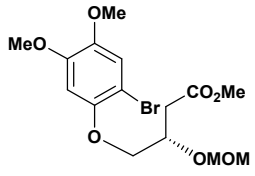
J = 2.8 Hz), 6.39 (dd, 1H, J = 12.8, 2.8 Hz), 4.38 (m, 1H), 3.94 (d, 2H, J = 5.2 Hz), 3.83 (d, 6H, J = 10.9 Hz), 3.71 (s, 3H), 3.03 (s, 1H), 2.66 (d, 1H, J = 4.4 Hz), 2.65 (d, 1H, J = 7.3 Hz); ^{13}C-NMR ($CDCl_3$, 125 MHz) δ 172.5, 153.0, 149.9, 143.9, 111.8, 103.9, 100.9, 71.3, 66.8, 56.4, 55.8, 51.9, 37.8; HR-MS (FAB+) calcd for $C_{13}H_{18}O_6$ (M^+) 270.1103; found 270.1104



10

Methyl (*S*)-4-(3,4-dimethoxyphenoxy)-3-(methoxymethoxy)butanoate (10)

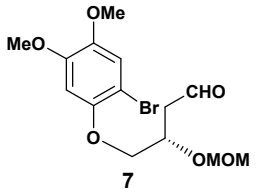
To a stirred solution of (*S*)-methyl 4-(3,4-dimethoxyphenoxy)-3-hydroxybutanoate (2.086 g, 7.7 mmol) in DMF was added diisopropylethylamine (6.8 mL, 38.6 mmol) at room temperature. The reaction mixture was stirred for 5 min and MOM chloride (2.7 mL, 33.2 mmol) was added at 0 °C. The reaction mixture was stirred at ambient temperature overnight, quenched with saturated NH_4Cl solution at 0 °C, and extracted with EtOAc. The organic layer was washed with saturated NH_4Cl solution and brine, dried over $MgSO_4$, and concentrated under reduced pressure. The residue was purified by flash column chromatography on silica gel (EtOAc : *n*-Hexane = 1 : 4) to afford 2.3195 g (96%) of **10** as a yellow liquid: $[\alpha]_D^{20}$ -4.8 (c 0.87, CH_2Cl_2); FT-IR (thin film, neat) ν_{max} 3057, 2994, 2953, 2834, 1737, 1612, 1597, 1512, 1465, 1452, 1439, 1373 cm^{-1}; ^{1}H-NMR ($CDCl_3$, 500 MHz) δ 6.75 (d, 1H, J = 8.7 Hz), 6.51 (d, 1H, J = 2.7 Hz), 6.38 (dd, 1H, J = 8.7, 2.7 Hz), 4.74 (m, 2H), 4.33 (m, 1H), 4.00 (dq, 2H, J = 12.8, 4.9 Hz), 3.82 (d, 6H, J = 11.1 Hz), 3.68 (s, 3H), 3.35 (s, 3H), 2.75-2.66 (m, 2H); ^{13}C-NMR ($CDCl_3$, 125 MHz) δ 171.5, 153.2, 149.9, 143.7, 111.8, 103.8, 100.9, 96.6, 72.8, 69.9, 56.4, 55.8, 55.6, 51.7, 37.4; HR-MS (FAB+) calcd for $C_{15}H_{22}O_7$ (M^+) 314.1366; found 314.1378



Methyl (*S*)-4-(2-bromo-4,5-dimethoxyphenoxy)-3-(methoxymethoxy)butanoate

To a cooled solution of butanoate **10** (1.501 g, 4.8 mmol) in THF (24 mL) was added NBS (858 mg, 4.8 mmol) at -78 °C. The reaction mixture was stirred at -78 °C for 50 min, warmed up to ambient temperature, and stirred

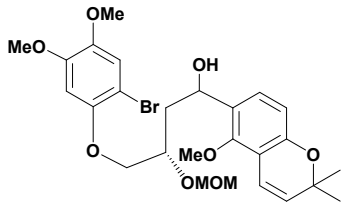
for 5 min. The resulting mixture was concentrated under reduced pressure. The residue was purified by flash column chromatography on silica gel (EtOAc : *n*-Hexane = 1 : 4) to afford 1.880 g (100%) of methyl (*S*)-4-(2-bromo-4,5-dimethoxyphenoxy)-3-(methoxymethoxy)butanoate as a brown liquid: $[\alpha]_D^{20}$ -6.9 (c 0.89, CH_2Cl_2); FT-IR (thin film, neat) ν_{max} 2955, 2951, 2842, 1738, 1584, 1509, 1463, 1439, 1381, 1312 cm^{-1}; ^{1}H-NMR ($CDCl_3$, 500 MHz) δ 6.99 (s, 1H), 6.58 (s, 1H), 4.79 (q, 2H, *J* = 6.8 Hz), 4.37 (m, 1H), 4.11 (dq, 2H, *J* = 13.3, 5.3 Hz), 3.84 (s, 3H), 3.80 (s, 3H), 3.69 (s, 3H), 3.38 (s, 3H), 2.84 (dd, 1H, *J* = 16.1, 5.2 Hz), 2.74 (dd, 1H, *J* = 16.1, 7.3 Hz); ^{13}C-NMR ($CDCl_3$, 125 MHz) δ 171.5, 149.3, 149.1, 144.3, 116.3, 101.9, 100.6, 96.8, 72.8, 71.9, 56.6, 56.2, 55.7, 51.7, 37.4; HR-MS (FAB+) calcd for $C_{15}H_{21}BrO_7$ (M^+) 394.0452; found 392.0474



7

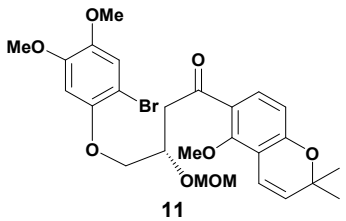
(*S*)-4-(2-Bromo-4,5-dimethoxyphenoxy)-3-(methoxymethoxy)butanal (7)

To a stirred solution of methyl (*S*)-4-(2-bromo-4,5-dimethoxyphenoxy)-3-(methoxymethoxy)butanoate (1.481 g, 5.5 mmol) in dry CH_2Cl_2 (28 mL) was dropwise added a solution of DIBAL-H (1.0 M solution in CH_2Cl_2, 5.5 mL) in toluene at -78 °C. The reaction mixture was stirred until complete consumption of starting material (monitored by TLC) and Rochelle solution was added dropwise at -78 °C. The reaction mixture was vigorously stirred at ambient temperature and extracted with EtOAc. The organic layer was washed with brine, dried over $MgSO_4$, and concentrated under reduced pressure. The residue was purified by flash column chromatography on silica gel (EtOAc : *n*-Hexane = 1 : 3) to afford 1.152 g (90%) of **7** as white solid: $[\alpha]_D^{20}$ -3.3 (c 0.20, CH_2Cl_2); FT-IR (thin film, neat) ν_{max} 3060, 2933, 2845, 2731,1725, 1584, 1505, 1442, 1382, 1333, 1313 cm^{-1}; ^{1}H-NMR (C_6D_6, 500 MHz) δ 9.50 (m, 1H), 7.02 (m, 1H), 6.42 (s, 1H), 4.68 (d, 1H, *J* = 6.9 Hz), 4.58 (d, 1H, *J* = 6.9 Hz), 4.30 (m, 1H), 3.85 (dd, 1H, *J* = 9.7, 5.3 Hz), 3.78 (dd, 1H, *J* = 9.7, 5.0 Hz), 3.43 (s, 3H), 3.27 (s, 3H), 3.15 (s, 3H), 2.55-2.43 (m, 2H); ^{13}C-NMR (C_6D_6, 125 MHz) δ 198.9, 150.2, 149.8, 145.6, 128.3, 128.2, 128.0, 127.9, 127.8, 117.5, 102.4, 101.6, 96.7, 72.1, 71.5, 56.1, 55.9, 55.3, 46.4; HR-MS (FAB+) calcd for $C_{14}H_{19}BrO_6$ (M^+) 362.0365; found 362.0376



(*S*)-4-(2-Bromo-4,5-dimethoxyphenoxy)-1-(5-methoxy-2,2-dimethyl-2H-chromen-6-yl)-3-(methoxymethoxy)butan-1-ol

To a solution of aryl bromide **6** (1.684 g, 6.3 mmol) in dry THF (40 mL) was added *n*-BuLi (1.6 M solution in hexane, 3.7 mL) at -78 °C. The reaction mixture was stirred for 30 min at the same temperature and a solution of aldehyde **7** (1.263 g, 3.5 mmol) in dry THF (17 mL) was added. The mixture was stirred for 30 min at -78 °C, and warmed to ambient temperature. The resulting mixture was stirred for 30 min, quenched with water, and extracted with EtOAc. The organic layer was washed with brine, dried over $MgSO_4$, and concentrated under reduced pressure. The residue was purified by flash column chromatography on silica gel (EtOAc : *n*-Hexane = 1 : 2) to afford 2.737 g (80%) of (*S*)-4-(2-bromo-4,5-dimethoxyphenoxy)-1-(5-methoxy-2,2-dimethyl-2H-chromen-6-yl)-3-(methoxymethoxy)butan-1-ol as a yellow liquid: Major diastereomer, $[\alpha]_D^{20}$ -27.4 (c 1.31, CH_2Cl_2); FT-IR (thin film, neat) ν_{max} 3511, 2966, 2936, 2837, 1637, 1601, 1508, 1464, 1383 cm^{-1}; ^{1}H-NMR ($CDCl_3$, 500 MHz) δ 7.22 (d, 1H, *J* = 8.2 Hz), 6.99 (s, 1H), 6.59 (d, 1H, *J* = 6.0 Hz), 6.53-6.51 (m, 2H), 5.63 (d, 1H, *J* = 8.3 Hz), 5.20 (m, 1H), 4.94 (d, 1H, *J* = 6.7 Hz), 4.79 (d, 1H, *J* = 5.7 Hz), 4.28 (m, 1H), 4.07-4.02 (m, 2H), 3.83 (s, 3H), 3.80 (s, 3H), 3.77 (s, 3H), 3.47 (s, 1H), 3.43 (s, 2H), 3.04 (m, 1H), 1.43(s, 6H); ^{13}C-NMR ($CDCl_3$, 125 MHz) δ 153.5, 153.4, 149.4, 149.0, 144.2, 130.5, 128.8, 126.8, 117.1, 116.3, 114.6, 112.7, 101.7, 100.2, 97.7, 96.8, 75.7, 75.5, 72.9, 67.1, 62.7, 56.6, 56.2, 55.9, 40.4, 27.9; HR-MS (FAB+) calcd for $C_{26}H_{33}BrO_8$ (M^+) 554.1343; found 552.1360

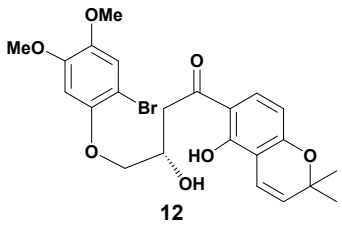


11

(*S*)-4-(2-Bromo-4,5-dimethoxyphenoxy)-1-(5-methoxy-2,2-dimethyl-2H-chromen-6-yl)-3-(methoxymethoxy)butan-1-one (11)

To a solution of (*S*)-4-(2-bromo-4,5-dimethoxyphenoxy)-1-(5-methoxy-2,2-dimethyl-2H-chromen-6-yl)-3-

(methoxymethoxy)butan-1-ol (1.50 g, 2.7 mmol) in dry CH_2Cl_2 (27 mL) was added sodium bicarbonate (690 mg, 8.1 mmol) and Dess-Martin periodinane (1.7 g, 4.1 mmol). The reaction mixture was stirred until complete consumption of alcohol (monitored by TLC), quenched with water, and extracted with dichloromethane. The organic layer was washed with 5% sodium thiosulfate pentahydrate aqueous solution, dried over $MgSO_4$, and concentrated under reduced pressure. The residue was purified by flash column chromatography on silica gel (EtOAc : *n*-Hexane = 1 : 3) to afford 1.275 g (85%) of **11** as a yellow liquid: $[\alpha]_D^{20}$ -36.6 (c 1.21, CH_2Cl_2); FT-IR (thin film, neat) ν_{max} 2966, 2936, 2841, 1670, 1590, 1508, 1463, 1372 cm^{-1}; ^{1}H-NMR ($CDCl_3$, 500 MHz) δ 7.56 (d, 1H, *J* = 8.7 Hz), 6.98 (s, 1H), 6.65 (s, 1H), 6.58 (d, 1H, *J* = 8.0 Hz), 6.55 (d, 1H, *J* = 9.3 Hz), 5.66 (d, 1H, *J* = 4.5 Hz), 4.79 (d, 1H, *J* = 13.6 Hz), 4.75 (d, 1H, *J* = 13.5 Hz), 4.55 (quint, 1H, *J* = 10.8 Hz), 4.13 (m, 1H), 3.86 (s, 3H), 3.79 (s, 3H), 3.78 (s, 3H), 3.49-3.31 (m, 2H), 3.34 (s, 3H), 1.42 (s, 6H); ^{13}C-NMR ($CDCl_3$, 125 MHz) δ 197.8, 158.0, 156.7, 149.4, 149.0, 144.0, 131.0, 130.4, 124.8, 116.5, 116.3, 114.8, 112.7, 101.7, 100.4, 96.9, 72.7, 72.3, 63.2, 56.6, 56.2, 55.6, 44.7, 27.9; HR-MS (FAB+) calcd for $C_{26}H_{32}BrO_8$ ($M + H^+$) 553.1265; found 551.1283

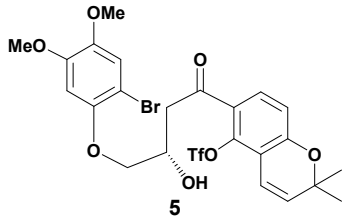


12

(*S*)-4-(2-Bromo-4,5-dimethoxyphenoxy)-3-hydroxy-1-(5-hydroxy-2,2-dimethyl-2H-chromen-6-yl)butan-1-one (12)

To a solution of **11** (609 mg, 1.1 mmol) in dry CH_2Cl_2 (11 mL) was added boron trichloride solution (1.0 M in CH_2Cl_2, 3.3 mL) at -78 °C. The reaction mixture was stirred until complete consumption of the starting material, quenched with water (11 mL) at -78 °C, and extracted with dichloromethane. The organic layer was washed with brine, dried over $MgSO_4$, and concentrated under reduced pressure. The residue was purified by flash column chromatography on silica gel (EtOAc : *n*-Hexane = 1 : 2) to afford 365 mg (67%) of phenol **12** as a yellow liquid: $[\alpha]_D^{20}$ -244 (c 0.81, CH_2Cl_2); FT-IR (thin film, neat) ν_{max} 3440, 2969, 2933, 1641, 1618, 1508, 1440, 1376 cm^{-1}; ^{1}H-NMR ($CDCl_3$, 500 MHz) δ 12.75 (s, 1H), 7.57 (d, 1H, *J* = 8.9 Hz), 6.98 (s, 1H), 6.69 (d, 1H, *J* = 10.0 Hz), 6.59 (s, 1H), 6.33 (d, 1H, *J* = 8.9 Hz), 5.57 (d, 1H, *J* = 10.0 Hz), 4.57 (m, 1H), 4.07 (d, 1H, *J* = 5.3 Hz), 3.84 (s, 3H), 3.80 (s, 3H), 3.36 - 3.23 (m, 3H), 1.43 (s, 6H); ^{13}C-NMR ($CDCl_3$, 125 MHz) δ 203.3, 160.2, 159.8, 149.2, 149.1, 144.6, 131.2, 128.3, 116.0, 115.6, 113.6, 109.2, 108.7, 102.2, 100.9, 73.6, 66.8, 56.6, 56.2, 40.9, 28.3; HR-

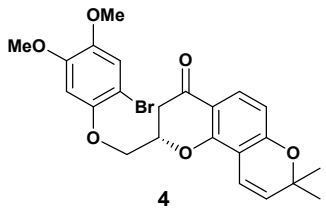
MS (FAB+) calcd for $C_{23}H_{26}BrO_7$ ($M + H^+$) 495.0845; found 493.0866



5

(*S*)-6-(4-(2-Bromo-4,5-dimethoxyphenoxy)-3-hydroxybutanoyl)-2,2-dimethyl-2H-chromen-5-yl trifluoromethanesulfonate (5)

To a solution of starting phenol **12** (560 mg, 1.1 mmol) in DMF (6 mL) were added K_2CO_3 (173 mg, 1.2 mmol) and $PhNTf_2$ (451 mg, 1.2 mmol) at ambient temperature. After complete consumption of substrate (monitored by TLC), the reaction mixture was quenched with water and extracted with ether. The organic layer was washed with brine, dried over $MgSO_4$, and concentrated under reduced pressure. The residue was purified by flash column chromatography on silica gel (EtOAc : *n*-Hexane = 1 : 2) to afford 435 mg (61%) of triflate **5** as a yellow liquid. $[\alpha]_D^{20}$ +6.9 (c 1.01, CH_2Cl_2); FT-IR (thin film, neat) ν_{max} 3448, 2952, 2925, 2854, 1736, 1686, 1603, 1508, 1463, 1427, 1373, 1312 cm^{-1}; ^{1}H-NMR ($CDCl_3$, 500 MHz) δ 7.64 (d, 1H, *J* = 8.6 Hz), 6.98 (s, 1H), 6.84 (d, 1H, *J* = 8.6 Hz), 6.61 (s, 1H), 6.55 (d, 1H, *J* = 10.1 Hz), 5.84 (d, 1H, *J* = 10.1 Hz), 4.59 (m, 1H), 4.09 (dq, 1H, *J* = 17.0, 4.9 Hz), 3.84 (s, 3H), 3.80 (s, 3H), 3.36-3.23 (m, 2H), 3.17 (d, 1H, *J* = 4.5 Hz), 1.45 (d, 6H, *J* = 2.2 Hz); ^{13}C-NMR ($CDCl_3$, 125 MHz) δ 198.2, 157.8, 149.2, 149.1, 144.5, 142.6, 133.5, 130.6, 124.6, 119.7, 116.0, 115.9, 115.8, 114.9, 102.0, 100.9, 73.4, 66.7, 56.6, 56.2, 43.7, 27.9, 27.9; HR-MS (FAB+) calcd for $C_{24}H_{24}BrF_3O_9S$ (M^+) 626.0259; found 624.0277

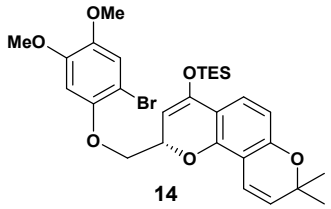


4

(*S*)-Bromoketone (4)

To a solution of triflate **5** (12 mg, 0.01 mmol) in dry toluene were added $Pd(OAc)_2$ (1 mg, 0.01 mmol), SPhos (2 mg, 0.01 mmol), and Cs_2CO_3 (9 mg, 0.03 mmol). The reaction mixture was stirred at 70 °C overnight, cooled down to ambient temperature, and filtered through a pad of celite. The solvent was removed under reduced

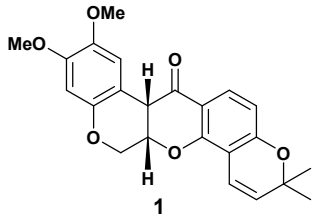
pressure. The residue was purified by flash column chromatography on silica gel (EtOAc : *n*-Hexane = 1 : 4) to afford 5 mg (60%) of **4** as a yellow solid: $[\alpha]_D^{20}$ -11.5 (c 0.77, CH_2Cl_2); FT-IR (thin film, neat) ν_{max} 3062, 2973, 2931, 2841, 1681, 1637, 1596, 1578, 1508, 1440, 1377, 1348 cm^{-1}; ^{1}H-NMR ($CDCl_3$, 500 MHz) δ 7.70 (d, 1H, *J* = 8.6 Hz), 7.00 (s, 1H), 6.61 (s, 1H), 6.60 (d, 1H, *J* = 9.6 Hz), 6.47 (d, 1H, *J* = 8.7 Hz), 5.56 (d, 1H, *J* = 10.0 Hz), 4.81 (m, 1H), 4.27 (d, 1H, *J* = 4.7 Hz), 3.85 (s, 3H), 3.82 (s, 3H), 2.99 (dd, 1H, *J* = 16.8, 12.7 Hz), 2.78 (dd, 1H, *J* = 16.8, 3.2 Hz), 1.44 (d, 6H, *J* = 16.6 Hz); ^{13}C-NMR ($CDCl_3$, 125 MHz) δ 189.9, 159.6, 157.1, 149.3, 149.1, 144.9, 128.9, 127.9, 116.1, 115.8, 114.7, 111.2, 109.3, 102.9, 101.8, 77.5, 76.5, 72.3, 56.5, 56.3, 39.1, 28.4, 28.1; HR-MS (FAB+) calcd for $C_{23}H_{24}BrO_6$ ($M + H^+$) 477.0739; found 475.0757



14

(*S*)-Bromosilylenolether (14)

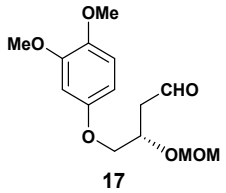
To a solution of ketone **4** (22 mg, 0.05 mmol) in dry dichloromethane (0.5 mL) were added TESOTf (0.02 mL, 0.09 mmol) and triethylamine (0.02 mL, 0.14 mmol) in one portion at ambient temperature. The reaction mixture was stirred for 30 min, quenched with saturated sodium bicarbonate aqueous solution, and extracted with ethyl aceatate. The organic layer was washed with brine, dried over $MgSO_4$, and concentrated under reduced pressure. The residue was purified by flash column chromatography on silica gel (EtOAc : *n*-Hexane/Et_3N = 1 : 10 : 0.02) to afford 26.3 mg (95%) of **14** as a yellow liquid: $[\alpha]_D^{20}$ +48.0 (c 0.38, CH_2Cl_2); FT-IR (thin film, neat) ν_{max} 2956, 2876, 1644, 1602, 1505, 1463, 1378, 1314 cm^{-1}; ^{1}H-NMR (C_6D_6, 300 MHz) δ 7.47 (d, 1H, *J* = 8.2 Hz), 6.98 (s, 1H), 6.92 (d, 1H, *J* = 15.0 Hz), 6.66 (d, 1H, *J* = 8.2 Hz), 6.32 (s, 1H), 5.34 (m, 1H), 5.24 (d, 1H, *J* = 10.0 Hz), 4.77 (d, 1H, *J* = 4.0 Hz), 4.12 (dd, 1H, *J* = 10.0, 7.2 Hz), 3.80 (dd, 1H, *J* = 10.2, 4.3 Hz), 3.24 (s, 3H), 3.22 (s, 3H), 3.22 (s, 3H), 1.24 (s, 6H), 0.99 (t, 9H, *J* = 8.2 Hz), 0.70 (q, 6H, *J* = 8.0 Hz);



1

(-)-Deguelin (1) from Bromosilylenolether 14

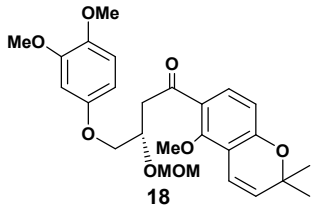
In a flame-dried flask were added $Pd(OAc)_2$ (1 mg, 0.01 mmol), CsF (4 mg, 0.02 mmol), and Bu_3SnF (7 mg, 0.02 mmol). To the reaction mixture was added P(*t*-Bu)$_3$ in dry toluene (1.0 mL). Silylenolether **14** in dry toluene (1 mL) was added. The reaction mixture was placed to pre-heated oil bath and then stirred for 3h. The reaction mixture was cooled down to ambient temperature and filtered through a pad of celite. The solvent was removed under reduced pressure and the residue was purified by flash column chromatography on silica gel (EtOAc : *n*-Hexane = 1 : 4) to afford 2 mg (27%) of **1** as foaming white to yellow solid: $[\alpha]_D^{20}$ -21.3 (c 0.31, CH_2Cl_2); ^{1}H-NMR ($CDCl_3$, 500 MHz) δ 7.73 (d, 1H, *J* = 8.5 Hz), 6.78 (s, 1H), 6.62 (d, 1H, *J* = 10.1 Hz), 6.43 (d, 1H, *J* = 8.5 Hz), 6.43 (s, 1H), 5.54 (d, 1H, *J* = 10.1 Hz), 4.89 (m, 1H,), 4.60 (dd, 1H, *J* = 3.1, 12.1 Hz), 4.19 (d, 1H, *J* = 12.1 Hz), 3.82 (d, 1H, *J* = 3.1 Hz), 3.78 (s, 3H), 3.75 (s, 3H), 1.43 (s, 3H), 1.36 (s, 3H)



17

(*S*)-4-(3,4-Dimethoxyphenoxy)-3-(methoxymethoxy)butanal (17)

To a stirred solution of butanoate **10** (1.2 g, 3.9 mmol) in dry CH_2Cl_2 (20 mL) was dropwise added a solution of DIBAL-H (1.0 M solution in CH_2Cl_2, 4 mL) in toluene at -78 °C. The reaction mixture was stirred until complete consumption of starting material (monitored by TLC) and Rochelle solution was added dropwise at -78 °C. The reaction mixture was vigorously stirred at ambient temperature and extracted with EtOAc. The organic layer was washed with brine, dried over $MgSO_4$, and concentrated under reduced pressure. The residue was purified by flash column chromatography on silica gel (EtOAc : *n*-Hexane = 1 : 3) to afford 1.05 g (96%) of **17** as white solid: $[\alpha]_D^{20}$ -187 (c 0.82, CH_2Cl_2); FT-IR (thin film, neat) ν_{max} 2998, 2938, 2833, 1725, 1597, 1513, 1452 cm^{-1}; ^{1}H-NMR ($CDCl_3$, 500 MHz) δ 9.83 (s, 1H), 6.74 (d, 1H, *J* = 8.8 Hz), 6.50 (d, 1H, *J* = 2.7 Hz), 6.36 (dd, 1H, *J* = 2.8, 8.8 Hz), 4.75 (q, 2H, *J* = 7.0 Hz), 4.45-4.40 (m, 1H), 4.04-3.97 (m, 2H), 3.83 (s, 3H), 3.81 (s, 3H), 3.36 (s, 3H), 2.83-2.78 (m, 2H); ^{13}C-NMR (C_6D_6, 100 MHz) δ 199.8, 152.7, 149.5, 143.4, 111.6, 103.5, 100.5, 96.0, 70.8, 69.7, 56.0, 55.4, 55.2, 46.0; HR-MS (FAB+) calcd for $C_{14}H_{20}O_6$ (M^+) 284.1260; found 284.1246

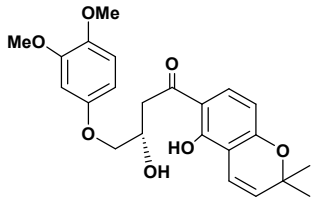


18

(*S*)-4-(3,4-Dimethoxyphenoxy)-1-(5-methoxy-2,2-dimethyl-2H-chromen-6-yl)-3-(methoxymethoxy)butan-1-one (18)

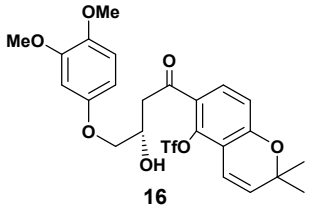
To a solution of aryl bromide **6** (1.7 g, 6.4 mmol) in dry THF (20 mL) was added *n*-BuLi (1.6 M solution in hexane, 3.6 mL) at -78 °C The reaction mixture was stirred for 15 min at the same temperature and a solution of **17** (1.0 g, 3.6 mmol) in dry THF (20 mL) was added at -78 °C. The mixture was stirred for 20 min at -78 °C and then warmed to ambient temperature. The resulting mixture was stirred for 5 min, quenched with water, and extracted with EtOAc. The organic layer was washed with brine, dried over $MgSO_4$, and concentrated under reduced pressure. The residue was filtered by short flash column chromatography on silica gel (EtOAc : *n*-Hexane = 1 : 2) to afford crude mixture of diastereomers as a colorless liquid: $[\alpha]_D^{20}$ -26.6 (c 1.34, CH_2Cl_2); FT-IR (thin film, neat) ν_{max} 3504, 2936, 2830, 1599, 1512, 1465, 1370 cm^{-1};

To a solution of above product in dry CH_2Cl_2 (36 mL) was added sodium bicarbonate (852mg, 10.1 mmol). Dess-Martin periodinane (2.1 g, 5.1 mmol) was added. After complete consumption of secondary alcohol (monitored by TLC) , the reaction mixture was quenched with water and extracted with dichloromethane. The organic layer was washed with 5% sodium thiosulfate pentahydrate aqueous solution, dried over $MgSO_4$, and concentrated under reduced pressure. The residue was purified by flash column chromatography on silica gel (EtOAc : *n*-Hexane = 1 : 4) to afford 1.5 g (88% for 2steps) of **18** as a colorless liquid: $[\alpha]_D^{20}$ -7.8 (c 1.22, CH_2Cl_2); FT-IR (thin film, neat) ν_{max} 3080, 2969, 2937, 2830, 1671, 1634, 1590, 1567, 1512, 1463, 1419, 1371, 1315 cm^{-1}; ^{1}H-NMR ($CDCl_3$, 500 MHz) δ 7.56 (d, 1H, *J* = 8.7 Hz), 6.98 (s, 1H), 6.65 (s, 1H), 6.58 (d, 1H, *J* = 8.0 Hz), 6.55 (d, 1H, *J* = 9.3 Hz), 5.66 (d, 1H, *J* = 4.5 Hz), 4.79 (d, 1H, *J* = 13.6 Hz), 4.75 (d, 1H, *J* = 13.5 Hz), 4.55 (quint, 1H, *J* = 10.8 Hz), 4.13 (m, 1H), 3.86 (s, 3H), 3.79 (s, 3H), 3.78 (s, 3H), 3.49-3.31 (m, 2H), 3.34 (s, 3H), 1.42 (s, 6H); ^{13}C-NMR ($CDCl_3$, 125 MHz) δ 197.8, 158.0, 156.7, 149.4, 149.0, 144.0, 131.0, 130.4, 124.8, 116.5, 116.3, 114.8, 112.7, 101.7, 100.4, 96.9, 72.7, 72.3, 63.2, 56.6, 56.2, 55.6, 44.7, 27.9; HR-MS (FAB+) calcd for $C_{26}H_{33}O_8$ ($M + H^+$) 473.2175; found 473.2176



(*S*)-4-(3,4-Dimethoxyphenoxy)-3-hydroxy-1-(5-hydroxy-2,2-dimethyl-2H-chromen-6-yl)butan-1-one

To a solution of **18** (705mg, 1.5 mmol) in dry CH_2Cl_2 (15 mL) was added boron trichloride solution (1.0 M in CH_2Cl_2, 4.5 mL) at -78 °C. After complete consumption of substrate (monitored by TLC), the reaction mixture was quenched with water (15 mL) at -78 °C and extracted with dichloromethane. The organic layer was washed with brine, dried over $MgSO_4$, and concentrated under reduced pressure. The residue was purified by flash column chromatography on silica gel (EtOAc : *n*-Hexane = 1 : 4) to afford 365 mg (64%) of (*S*)-4-(3,4-dimethoxyphenoxy)-3-hydroxy-1-(5-hydroxy-2,2-dimethyl-2H-chromen-6-yl)butan-1-one as a yellow liquid: $[\alpha]_D^{20}$ -15.2 (c 0.56, CH_2Cl_2); FT-IR (thin film, neat) ν_{max} 3491, 3087, 2969, 2931, 2837, 1734, 1641, 1614, 1512, 1486, 1463, 1426, 1376 cm^{-1}; ^{1}H-NMR ($CDCl_3$, 400 MHz) δ 12.74 (s, 1H), 7.53 (d, 1H, J = 6.6 Hz), 6.75 (d, 1H, J = 6.6 Hz), 6.68 (d, 1H, J = 7.5 Hz), 6.53 (d, 1H, J = 2.0 Hz), 6.39 (dd, 1H, J = 2.0, 6.5 Hz), 6.31 (d, 1H, J = 6.7 Hz), 5.56 (d, 1H, J = 7.6 Hz), 4.58-4.54 (m, 1H), 4.00 (d, 1H, J = 3.9 Hz), 3.83 (s, 3H), 3.81 (s, 3H), 3.24-3.19 (m, 3H), 1.43 (s, 6H); ^{13}C-NMR ($CDCl_3$, 100 MHz) δ 203.3, 160.1, 159.8, 153.0, 149.9, 143.8, 131.1, 128.3, 115.6, 113.6, 111.8, 109.3, 108.7, 103.9, 100.9, 77.9, 71.4, 66.7, 56.4, 55.8, 41.0, 28.3; HR-MS (FAB+) calcd for $C_{23}H_{26}O_7$ (M^+) 414.1679; found 414.1670

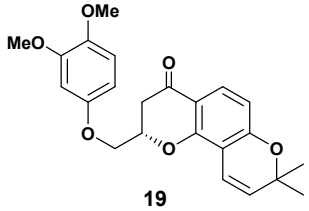


16

(*S*)-6-(4-(3,4-Dimethoxyphenoxy)-3-hydroxybutanoyl)-2,2-dimethyl-2H-chromen-5-yl trifluoromethanesulfonate (16)

To a solution of starting (*S*)-4-(3,4-dimethoxyphenoxy)-3-hydroxy-1-(5-hydroxy-2,2-dimethyl-2H-chromen-6-yl)butan-1-one (974 mg, 2.4 mmol) in dry DMF (12 mL) were added K_2CO_3 (358 mg, 2.6 mmol) and $PhNTf_2$ (933 mg, 2.6 mmol) at ambient temperature. After complete consumption of substrate (monitored by TLC), the reaction mixture was quenched with water and extracted with ether. The organic layer was washed with brine,

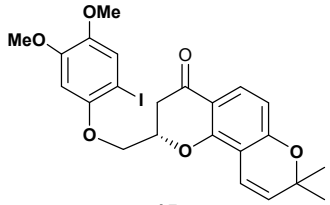
dried over $MgSO_4$, and concentrated under reduced pressure. The residue was purified by flash column chromatography on silica gel (EtOAc : *n*-Hexane = 1 : 4) to afford 1.141 g (72%) of triflate **16** as a yellow liquid: $[\alpha]_D^{20}$ -11.6 (c 0.97, CH_2Cl_2); FT-IR (thin film, neat) ν_{max} 3491, 3080, 2969, 2932, 2835, 1685, 1637, 1602, 1561, 1513, 1465, 1453, 1426, 1370, 1312 cm^{-1}; ^{1}H-NMR ($CDCl_3$, 500 MHz) δ 7.64 (d, 1H, *J* = 8.6 Hz), 6.98 (s, 1H), 6.84 (d, 1H, *J* = 8.6 Hz), 6.61 (s, 1H), 6.55 (d, 1H, *J* = 10.1 Hz), 5.84 (d, 1H, *J* = 10.1 Hz), 4.59 (m, 1H), 4.09 (dq, 1H, *J* = 17.0, 4.9 Hz), 3.84 (s, 3H), 3.80 (s, 3H), 3.36-3.23 (m, 2H), 3.17 (d, 1H, *J* = 4.5 Hz), 1.45 (d, 6H, *J* = 2.2 Hz); ^{13}C-NMR ($CDCl_3$, 125 MHz) δ 198.2, 157.8, 149.2, 149.1, 144.5, 142.6, 133.5, 130.6, 124.6, 119.7, 116.0, 115.9, 115.8, 114.9, 102.0, 100.9, 73.4, 66.7, 56.6, 56.2, 43.7, 27.9, 27.9; HR-MS (FAB+) calcd for $C_{24}H_{25}F_3O_9S$ (M^+) 546.1171; found 546.1162



19

(*S*)-Ketone (19)

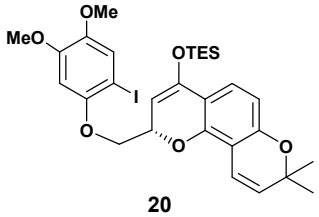
To triflate **16** (134mg, 0.2 mmol) in dry toluene (2 mL) were added $Pd(OAc)_2$ (8.9 mg, 0.04 mmol), SPhos (21 mg, 0.05 mmol), and Cs_2CO_3 (98 mg, 0.3 mmol). The reaction mixture was stirred at 70 °C for 3h. The reaction mixture was cooled down to ambient temperature and filtered through a pad of celite. The solvent was removed under reduced pressure and the residue was purified by flash column chromatography on silica gel (EtOAc : *n*-Hexane = 1 : 4) to afford 79mg (100%) of **19** as a white solid: $[\alpha]_D^{20}$ -15.5 (c 0.66, CH_2Cl_2); FT-IR (thin film, neat) ν_{max} 3070, 2963, 2927, 2856, 1733, 1683, 1637, 1596, 1578, 1512, 1441, 1393, 1377, 1348, 1321 cm^{-1}; ^{1}H-NMR ($CDCl_3$, 500 MHz) δ 7.70 (d, 1H, *J* = 8.6 Hz), 7.00 (s, 1H), 6.61 (s, 1H), 6.60 (d, 1H, *J* = 9.6 Hz), 6.47 (d, 1H, *J* = 8.7 Hz), 5.56 (d, 1H, *J* = 10.0 Hz), 4.81 (m, 1H), 4.27 (d, 1H, *J* = 4.7 Hz), 3.85 (s, 3H), 3.82 (s, 3H), 2.99 (dd, 1H, *J* = 16.8, 12.7 Hz), 2.78 (dd, 1H, *J* = 16.8, 3.2 Hz), 1.44 (d, 6H, *J* = 16.6 Hz); ^{13}C-NMR ($CDCl_3$, 150 MHz) δ 190.1, 159.6, 157.2, 153.0, 150.0 144.1, 128.9, 127.9, 115.8, 114.7, 111.8, 111.2, 109.3, 104.1, 101.2, 77.5, 76.5, 69.9, 56.4, 55.9, 39.2, 28.4, 28.1 ; HR-MS (FAB+) calcd for $C_{23}H_{25}O_6$ ($M + H^+$) 397.1651; found 397.1659



15

(*S*)-Iodoketone (15)

A solution of ketone **19** (46 mg, 0.1 mmol), NIS (29 mg, 0.12 mmol), and TFA (3 μL, 0.04 mmol) in acetonitrile (12 mL) was stirred for 4 h at ambient temperature. The solvent was evaporated reduced pressure and the residue was purified by flash column chromatography on silica gel (EtOAc : *n*-Hexane = 1 : 4) to afford 39 mg (64%) of **15** as a yellow solid: $[\alpha]_D^{20}$ -14.6 (c 1.19, CH_2Cl_2); FT-IR (thin film, neat) ν_{max} 3066, 2959, 2925, 2854, 1734, 1682, 1637, 1595, 1577, 1504, 1439, 1376, 1347 cm^{-1}; ^{1}H-NMR ($CDCl_3$, 400 MHz) δ 7.71 (d, 1H, *J* = 8.7 Hz), 7.18 (s, 1H), 6.64 (d, 1H, *J* = 10.2 Hz), 6.55 (s, 1H), 6.48 (d, 1H, *J* = 8.6 Hz), 5.56 (d, 1H, *J* = 10.0 Hz), 4.87-4.81 (m, 1H), 4.26 (d, 1H, *J* = 4.7 Hz), 3.86 (s, 3H), 3.82 (s, 3H), 3.01 (dd, 1H, *J* = 12.8, 16.9 Hz), 2.79 (dd, 1H, *J* = 3.1, 16.9 Hz), 1.45 (s, 3H), 1.41 (s, 3H); ^{13}C-NMR ($CDCl_3$, 100 MHz) δ 190.0, 159.6, 157.1, 151.9, 150.2, 145.1, 128.9, 127.9, 121.5, 115.8, 114.7, 111.2, 109.3, 100.1, 77.5, 76.4, 74.5, 72.0, 56.6, 56.2, 39.3, 28.4, 28.0; HR-MS (FAB+) calcd for $C_{23}H_{23}IO_6$ (M^+) 522.0539; found 522.0538

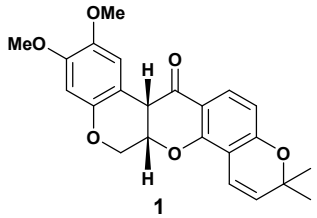


20

(*S*)-Iodosilylenolether ((-)-20)

To a solution of ketone **15** (22 mg, 0.05 mmol) in dry dichloromethane (0.5 mL) were added TESOTf (0.02 mL, 0.09 mmol) and triethylamine (0.02 mL, 0.14 mmol) in one portion at ambient temperature. The reaction mixture was stirred for 30 min, quenched with saturated sodium bicarbonate aqueous solution, and extracted with ethyl aceatate. The solvent was removed by reduced pressure and the residue was purified by short flash column chromatography on silica gel (EtOAc : *n*-Hexane/Et_3N = 1 : 10 : 0.2) to afford 26 mg (100%) of **20** as a colorless liquid: $[\alpha]_D^{20}$ +9.2 (c 0.37, CH_2Cl_2); FT-IR (thin film, neat) ν_{max} 2955, 2934, 2870, 1737, 1630, 1579, 1439, 1359, 1313 cm^{-1}; ^{1}H-NMR (C_6D_6, 300 MHz) δ 7.47 (d, 1H, *J* = 8.2 Hz), 6.98 (s, 1H), 6.92 (d, 1H, *J* = 15.0 Hz), 6.66 (d, 1H, *J* = 8.2 Hz), 6.32 (s, 1H), 5.34 (m, 1H), 5.24 (d, 1H, *J* = 10.0 Hz), 4.77 (d, 1H, *J* = 4.0 Hz), 4.12 (dd, 1H,

J = 10.0, 7.2 Hz), 3.80 (dd, 1H, J = 10.2, 4.3 Hz), 3.24 (s, 3H), 3.22 (s, 3H), 3.22 (s, 3H), 1.24 (s, 6H), 0.99 (t, 9H, J = 8.2 Hz), 0.70 (q, 6H, J = 8.0 Hz); ^{13}C-NMR ($CDCl_3$, 100 MHz) δ 155.5, 152.3, 151.3, 150.6, 147.9, 146.0, 129.3, 123.2, 122.8, 117.1, 114.7, 110.4, 109.4, 100.9, 95.1, 76.3, 75.4, 74.6, 72.5, 56.2, 55.6, 30.2, 28.1, 27.9, 6.9, 5.3, 1.4, 0.0; HR-MS (FAB+) calcd for $C_{29}H_{38}IO_6Si$ (M + H^+) 637.1482; found 637.1475

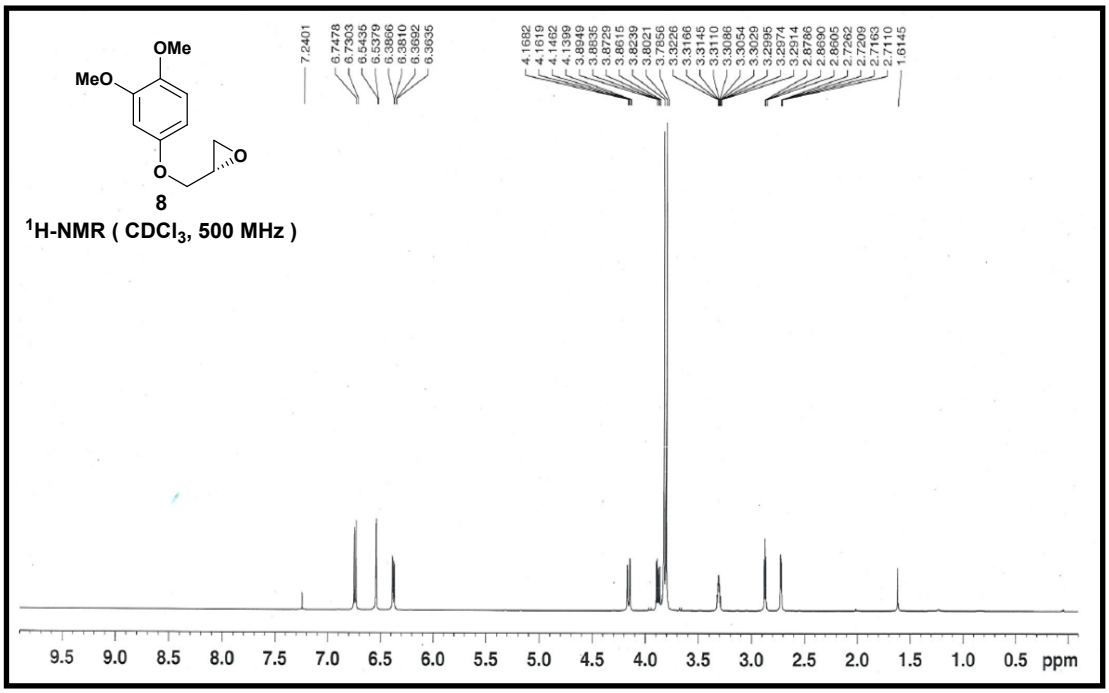


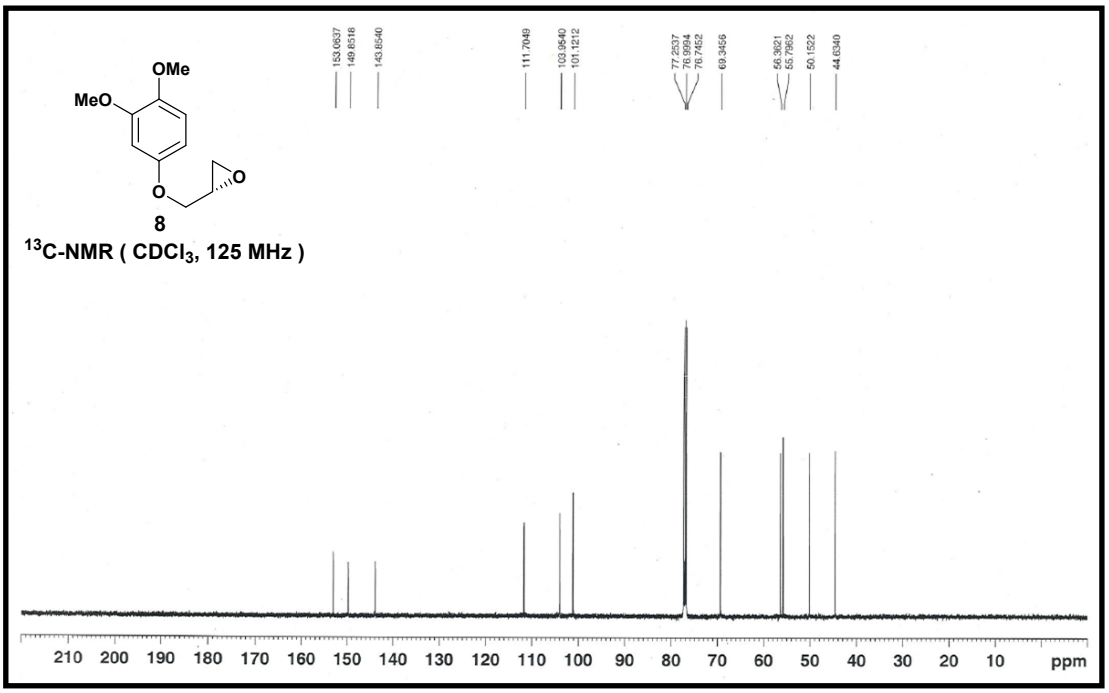
1

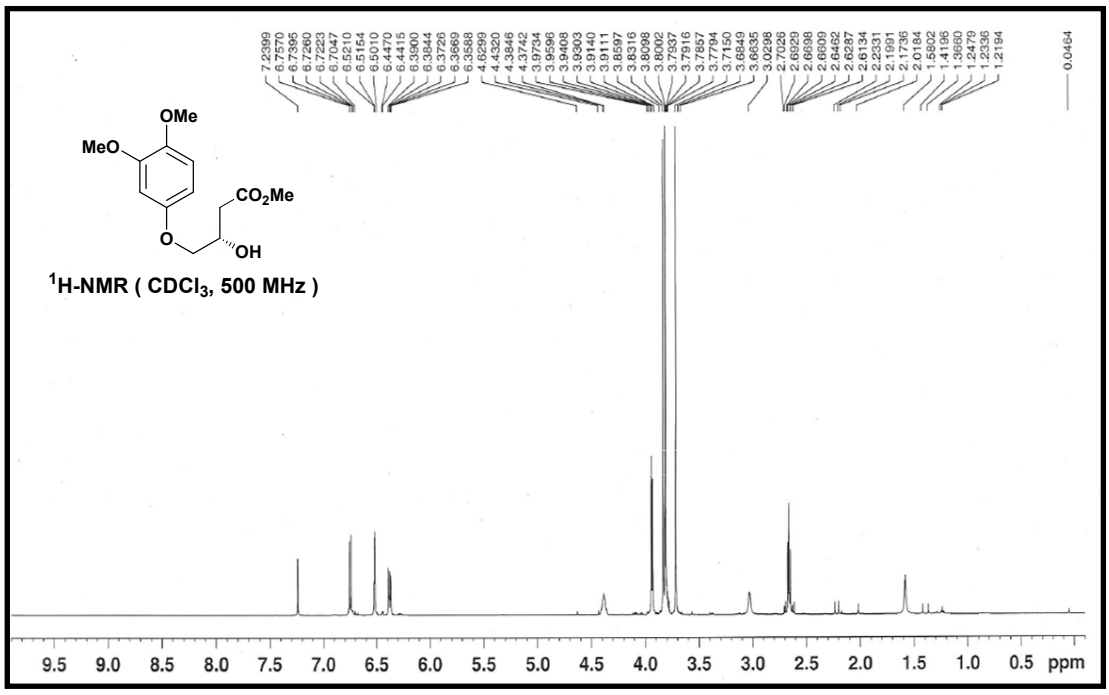
(-)-Deguelin (1) from Iodosilylenolether (-)-20

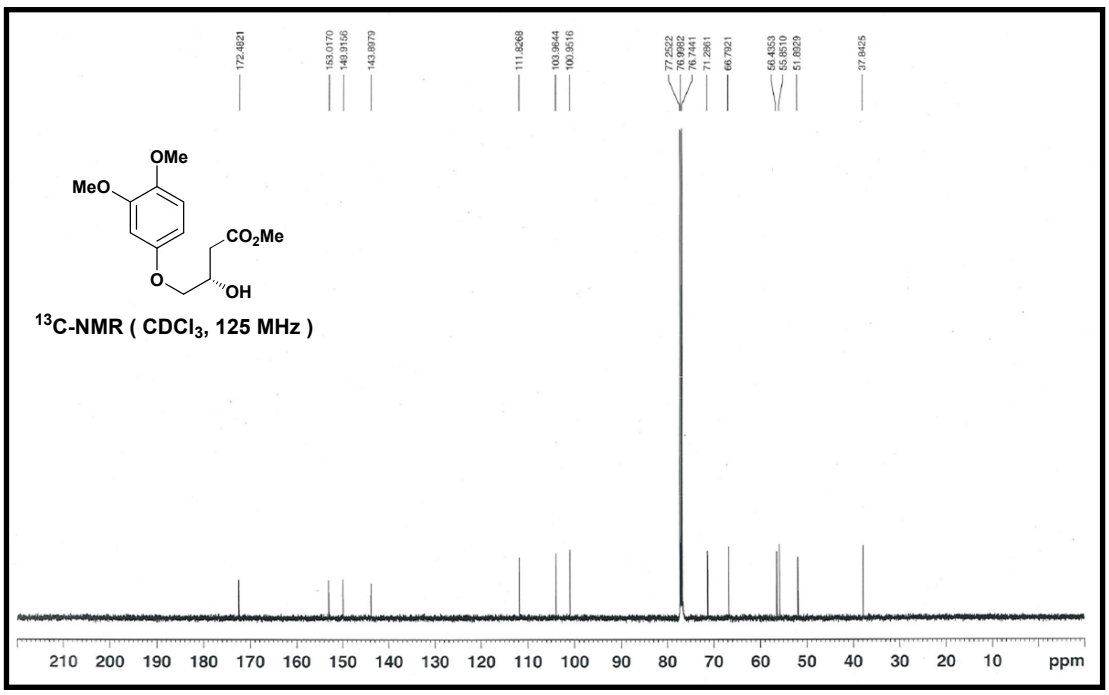
To a mixture of $Pd(OAc)_2$ (1.5 mg, 0.01 mmol), CsF (13.9 mg, 0.09 mmol), and Bu_3SnF (28 mg, 0.09 mmol), was added As(t-Bu)$_3$ (4.5 mg, 0.015 mmol) in dry toluene (0.15 mL). Silylenolether **20** (41.7 mg, 0.07 mmol) in dry benzene (0.50 mL) was added and the reaction mixture was stirred at 60°C for 3.5h. The reaction mixture was cooled down to ambient temperature and filtered through a pad of celite. The solvent was removed under reduced pressure and the residue was purified by flash column chromatography on silica gel (EtOAc : n-Hexane = 1 : 4) to afford 19 mg (72%) of **1** as a foaming white solid: $[\alpha]_D^{20}$ -25.1 (c 0.15, CH_2Cl_2); FT-IR (thin film, neat) ν_{max} 2952, 2925, 2853, 1674, 1635, 1598, 1578, 1513, 1443, 1393, 1378, 1346, 1274, 1235, 1215, 1199, 1148, 1113, 1095, 1079, 1061, 1011, 910, 893, 818, 771, 735, 704, 679, 635, 609 cm^{-1}; ^{1}H-NMR ($CDCl_3$, 500 MHz) δ 7.73 (d, 1H, J = 8.7 Hz), 6.77 (s, 1H), 6.63 (d, 1H, J = 10.1 Hz), 6.43 (d, 1H, J = 8.6 Hz), 6.43 (s, 1H), 5.54 (d, 1H, J = 10.1 Hz), 4.90 (m, 1H), 4.62 (dd, 1H, J = 3.1, 12.1 Hz), 4.17 (d, 1H, J = 12.1 Hz), 3.82 (d, 1H, J = 3.1 Hz), 3.79 (s, 3H), 3.75 (s, 3H), 1.43 (s, 3H), 1.35 (s, 3H); ^{13}C-NMR ($CDCl_3$, 125 MHz) δ 189.2, 160.1, 156.9, 149.5, 147.4, 143.9, 128.7, 128.6, 115.8, 112.8, 111.5, 110.4, 109.1, 104.7, 100.9, 77.7, 72.4, 66.3, 56.3, 55.8, 44.4, 28.5, 28.1; HR-MS (FAB+) calcd for $C_{23}H_{23}O_6$ (M + H^+) 395.1495; found 395.1485

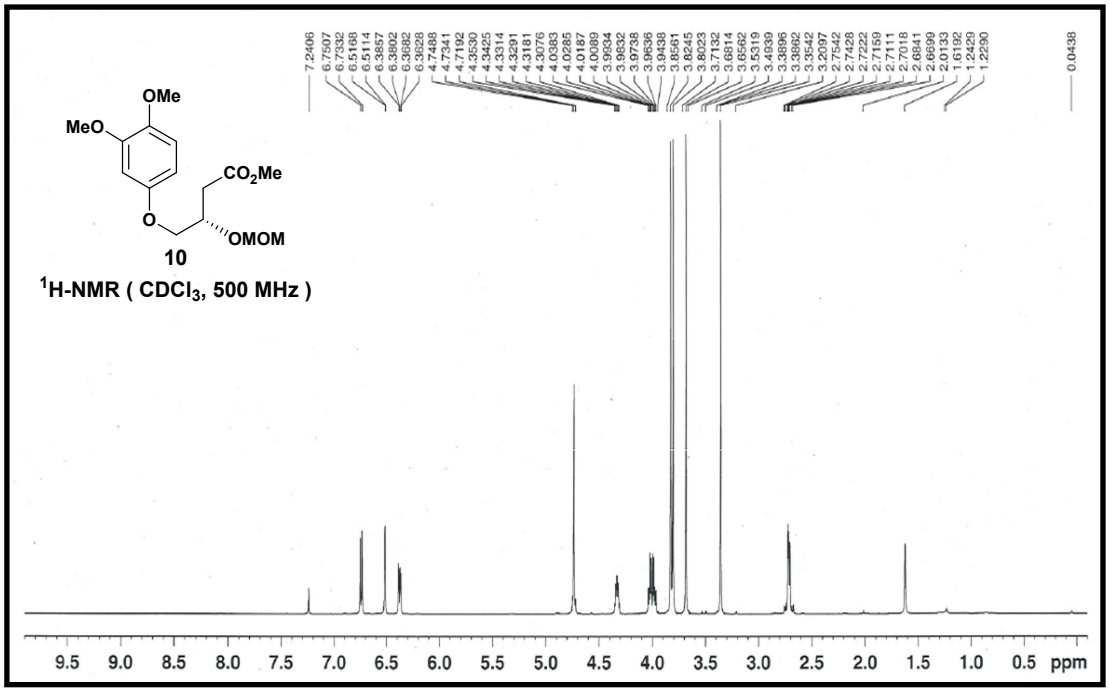
NMR Spectra

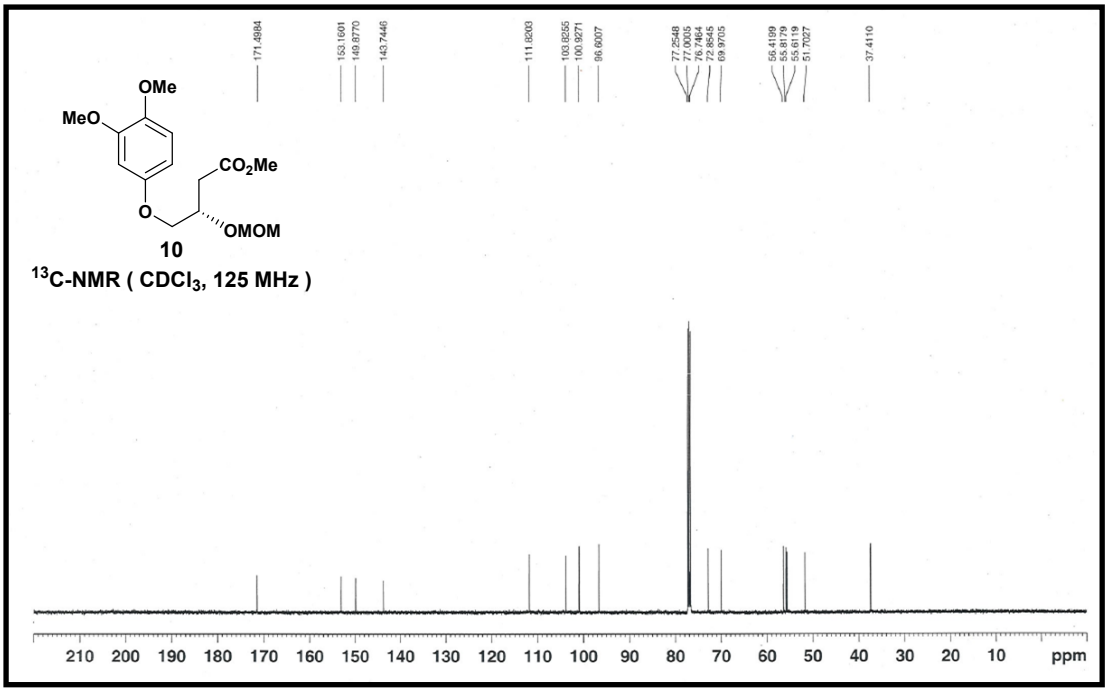

OMe
MeO
O
O
8
^{1}H-NMR (CDCl$_3$, 500 MHz)
7.2401
6.7478
6.7303
6.5435
6.5379
6.3866
6.3810
6.3692
6.3635
4.1682
4.1619
4.1462
4.1399
3.8949
3.8835
3.8729
3.8615
3.8239
3.8021
3.7856
3.3226
3.3166
3.3145
3.3110
3.3086
3.3054
3.3029
3.2995
3.2974
3.2914
2.8786
2.8690
2.8605
2.7262
2.7209
2.7163
2.7110
1.6145
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 ppm

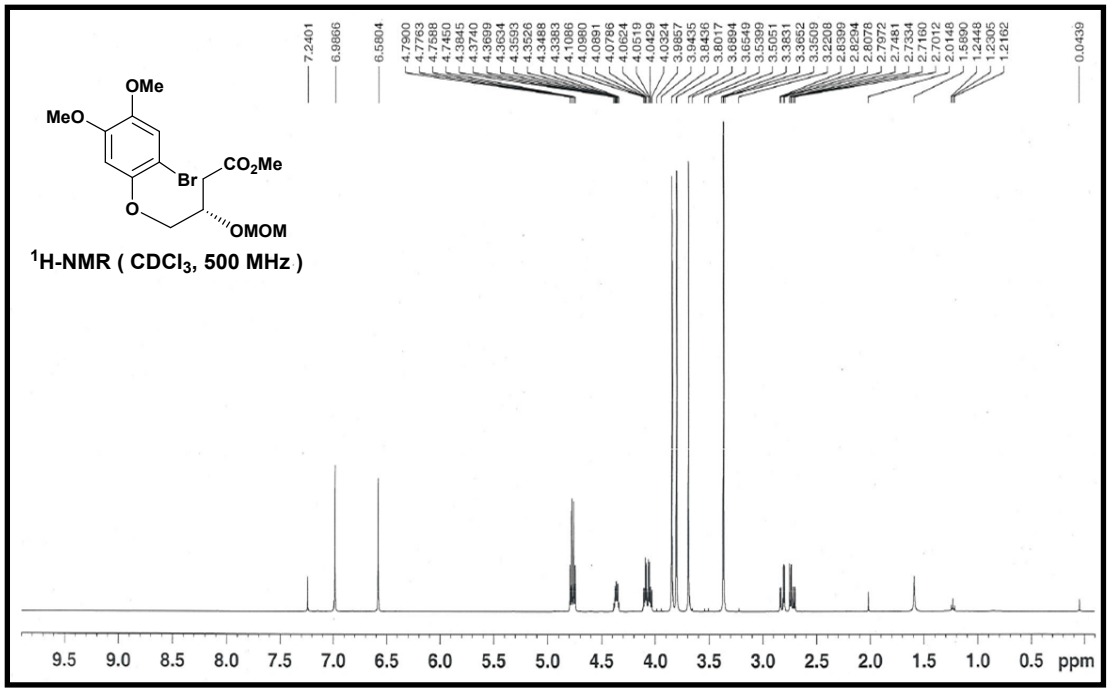

OMe
MeO
O
O
8
^{13}C-NMR (CDCl$_3$, 125 MHz)
153.0637
149.6516
143.8540
111.7049
103.9540
101.1212
77.2537
76.9994
76.7452
69.3456
56.3621
55.7962
50.1522
44.6340
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

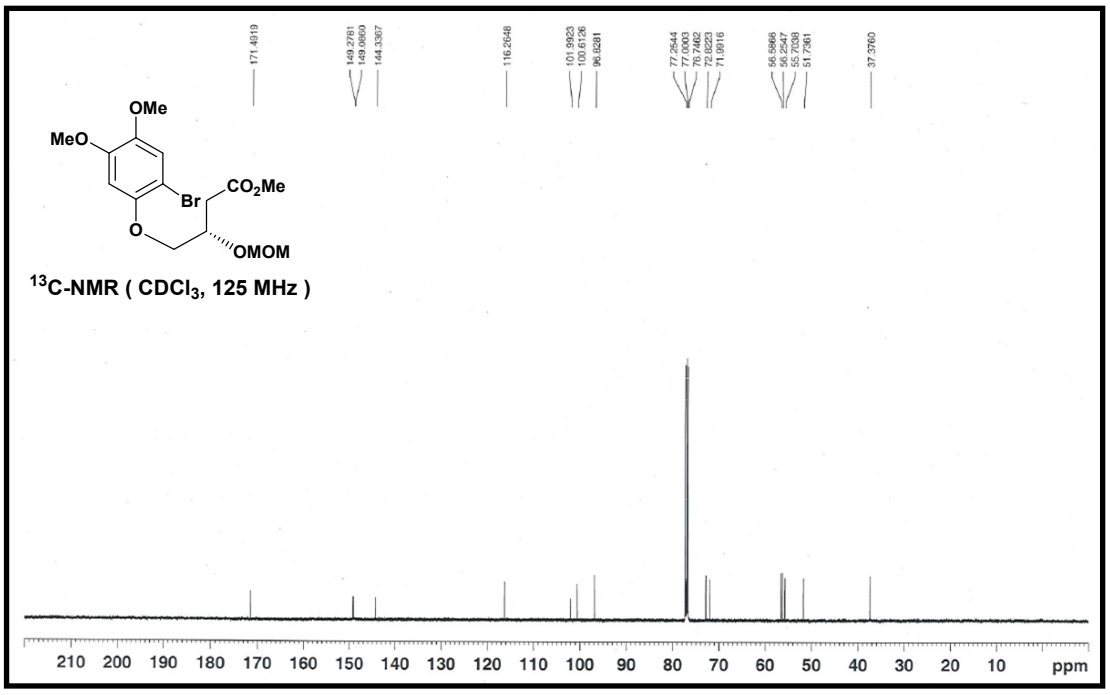

OMe
MeO
CO2Me
O
OH
1H-NMR (CDCl3, 500 MHz)
ppm

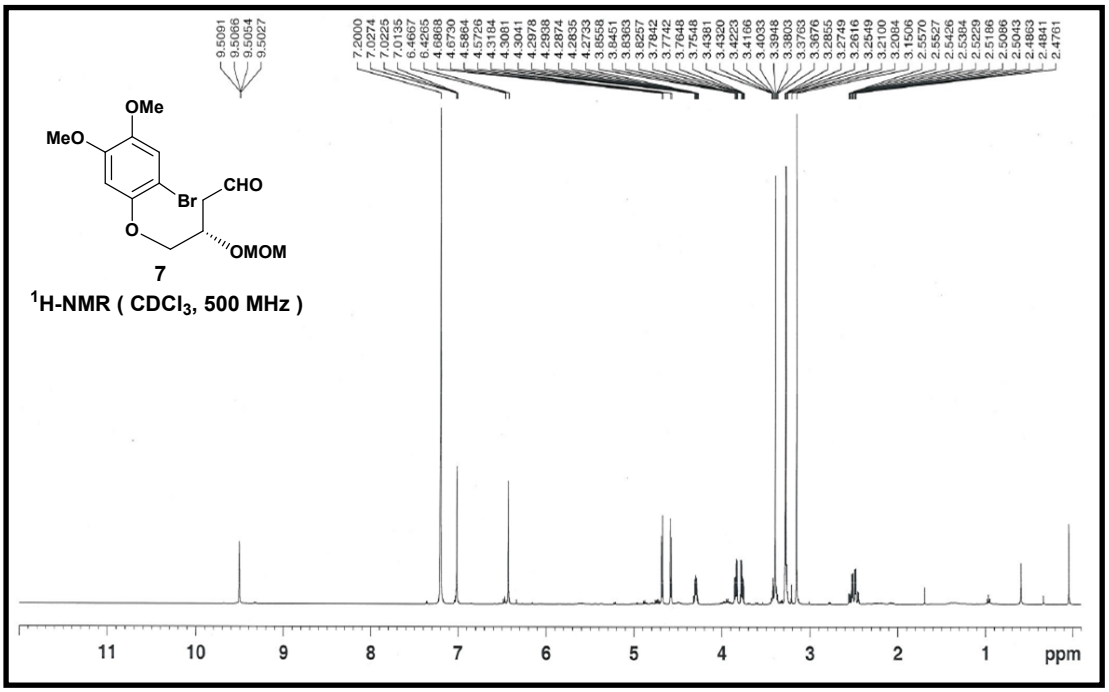

OMe
MeO
CO2Me
O
OH
13C-NMR (CDCl3, 125 MHz)
ppm

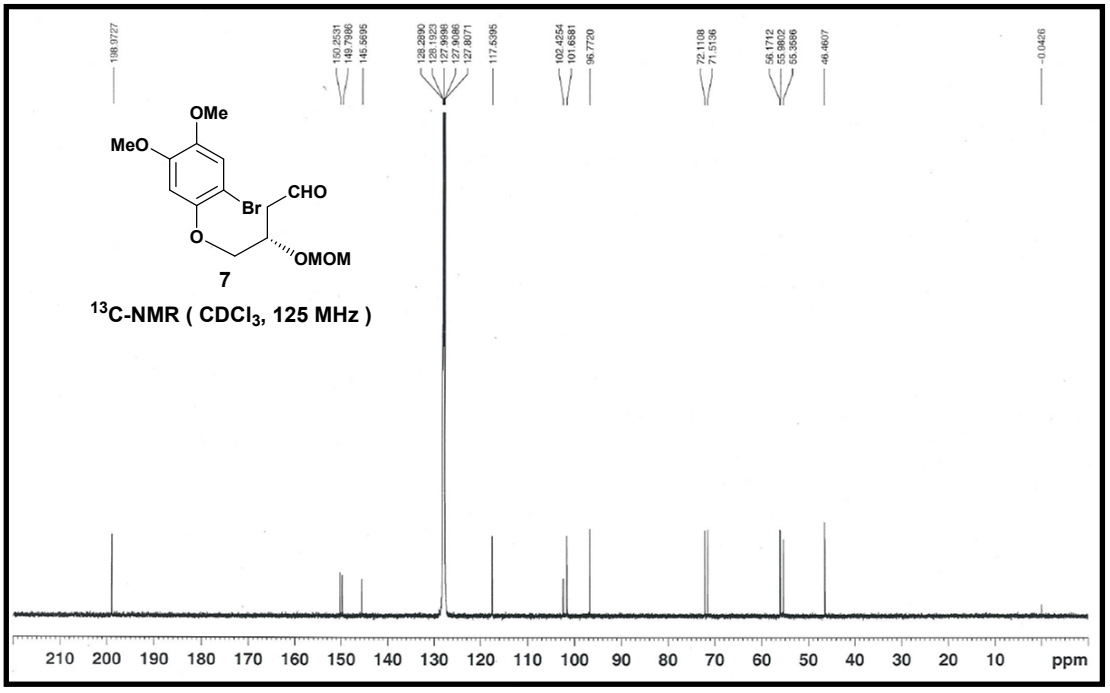

OMe
MeO
CO2Me
O
OMOM
10
1H-NMR (CDCl3, 500 MHz)
ppm

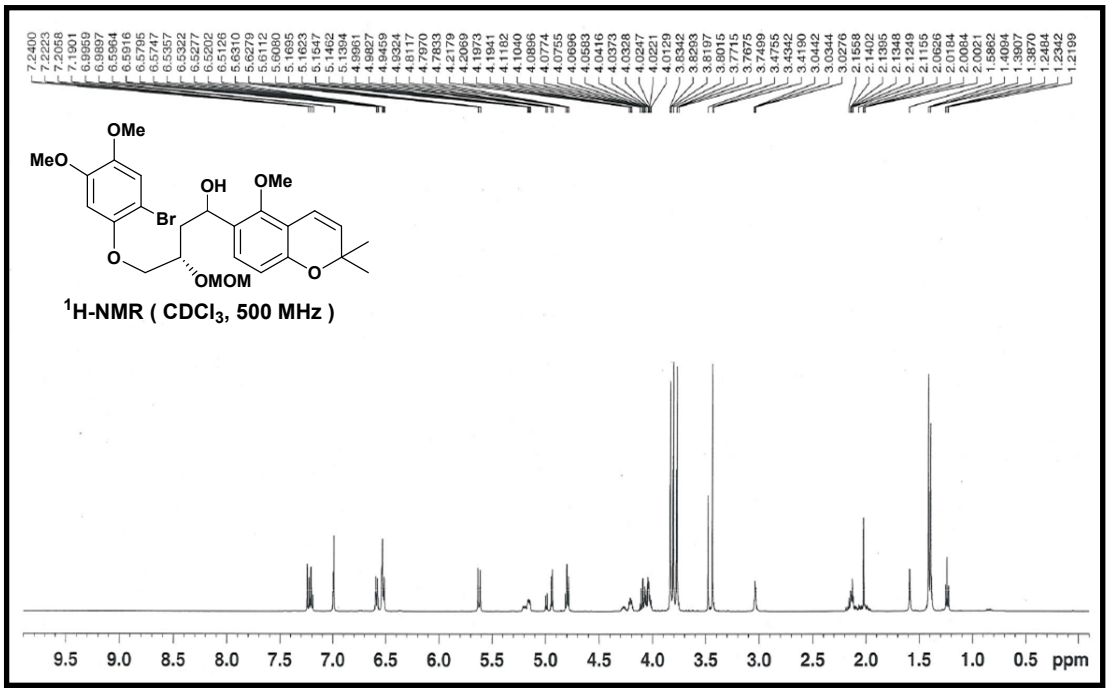

OMe
MeO
CO2Me
O
OMOM
10
13C-NMR (CDCl3, 125 MHz)
ppm

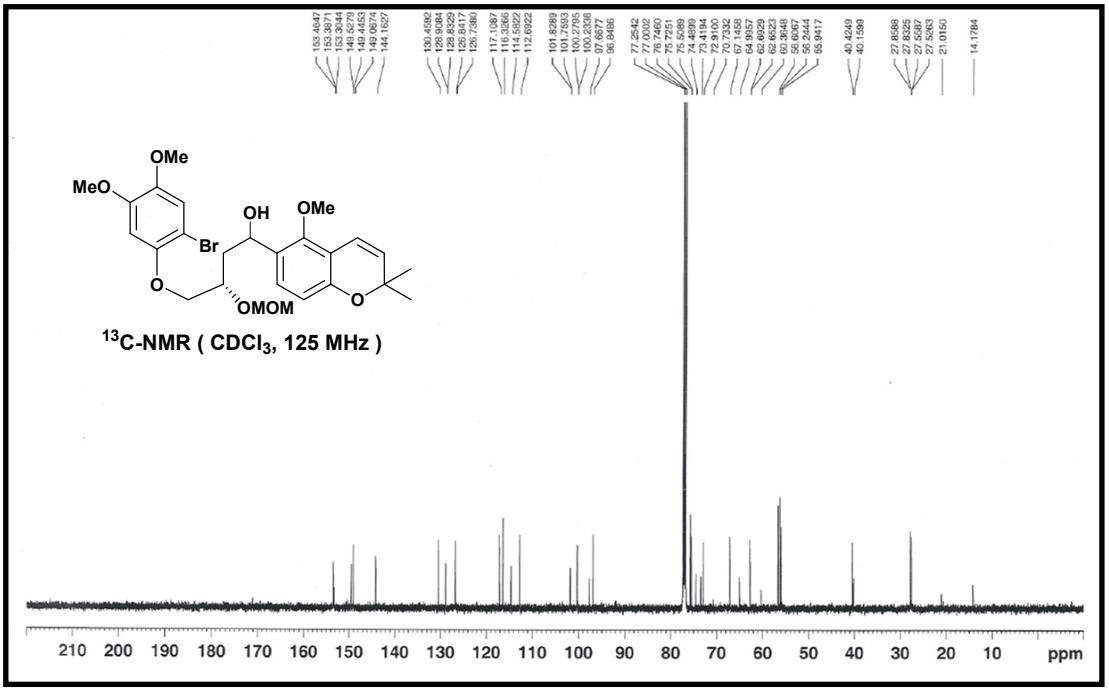

OMe
MeO
Br
CO2Me
O
OMOM
1H-NMR (CDCl3, 500 MHz)
7.2401
6.9866
6.5804
0.0439
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 ppm

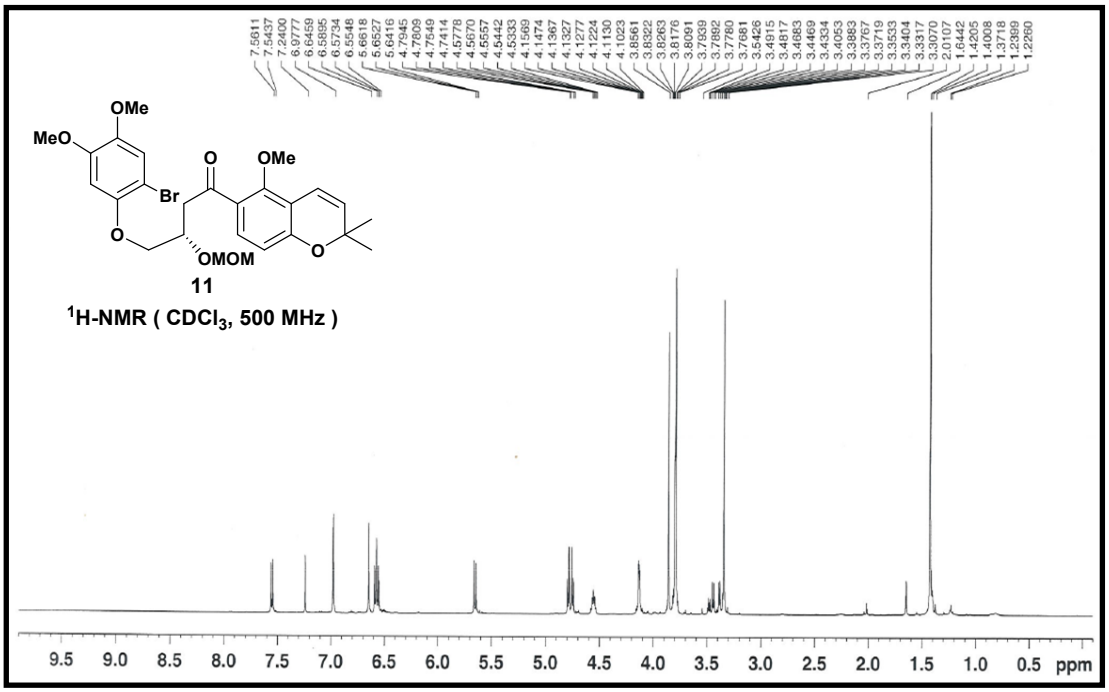

OMe
MeO
Br
CO2Me
O
OMOM
13C-NMR (CDCl3, 125 MHz)
171.4319
149.2781
149.0869
144.3367
116.2548
101.9923
100.6126
96.8281
77.2544
77.0003
76.7462
72.8223
71.9916
56.5966
56.2547
55.7038
51.7361
37.3760
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

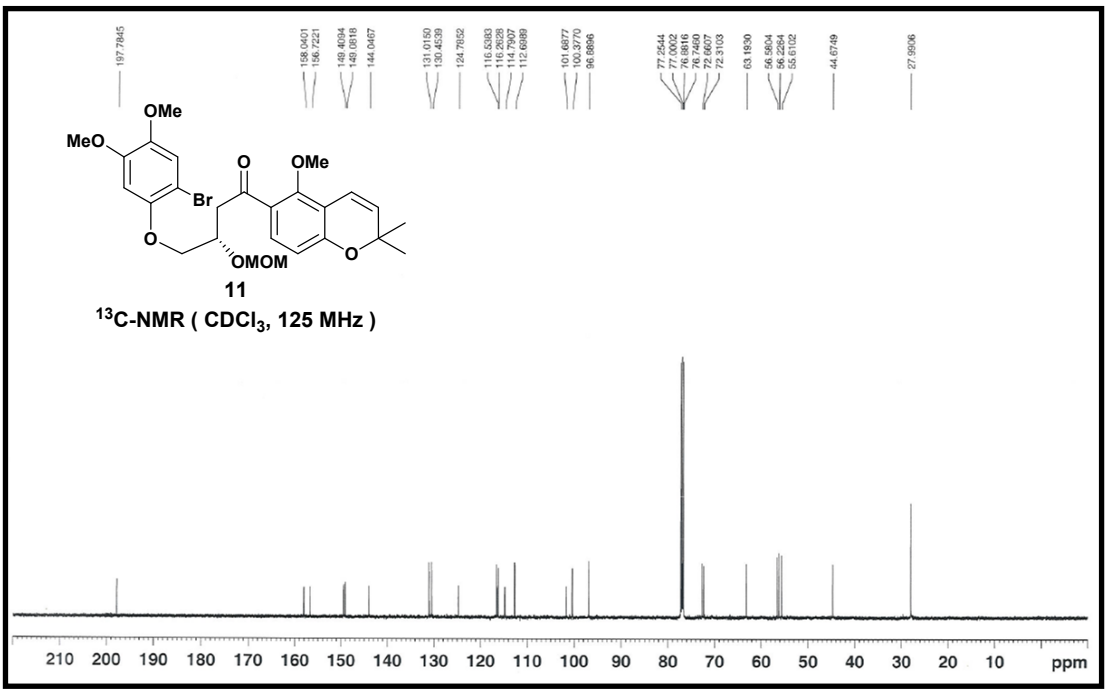

OMe
MeO
Br
CHO
O
OMOM
7
^{1}H-NMR (CDCl$_3$, 500 MHz)
ppm

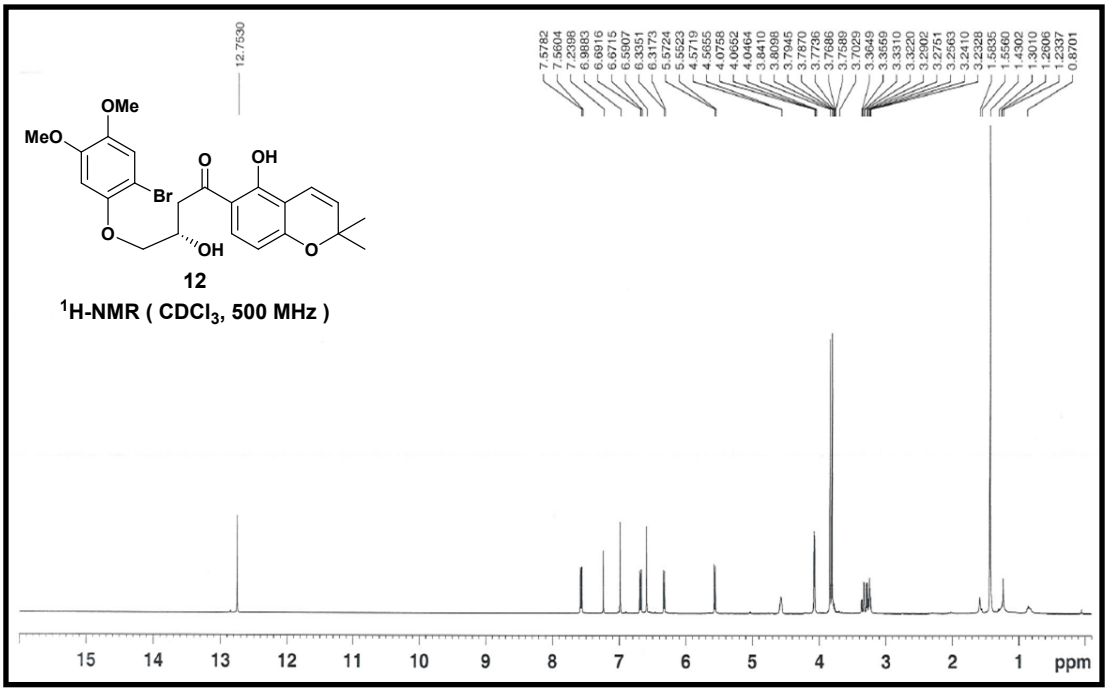

OMe
MeO
Br
CHO
O
OMOM
7
^{13}C-NMR (CDCl$_3$, 125 MHz)
ppm


OMe
MeO
OH
OMe
Br
O
OMOM
O
^{1}H-NMR (CDCl$_3$, 500 MHz)
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 ppm


OMe
MeO
OH
OMe
Br
O
OMOM
O
^{13}C-NMR (CDCl$_3$, 125 MHz)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

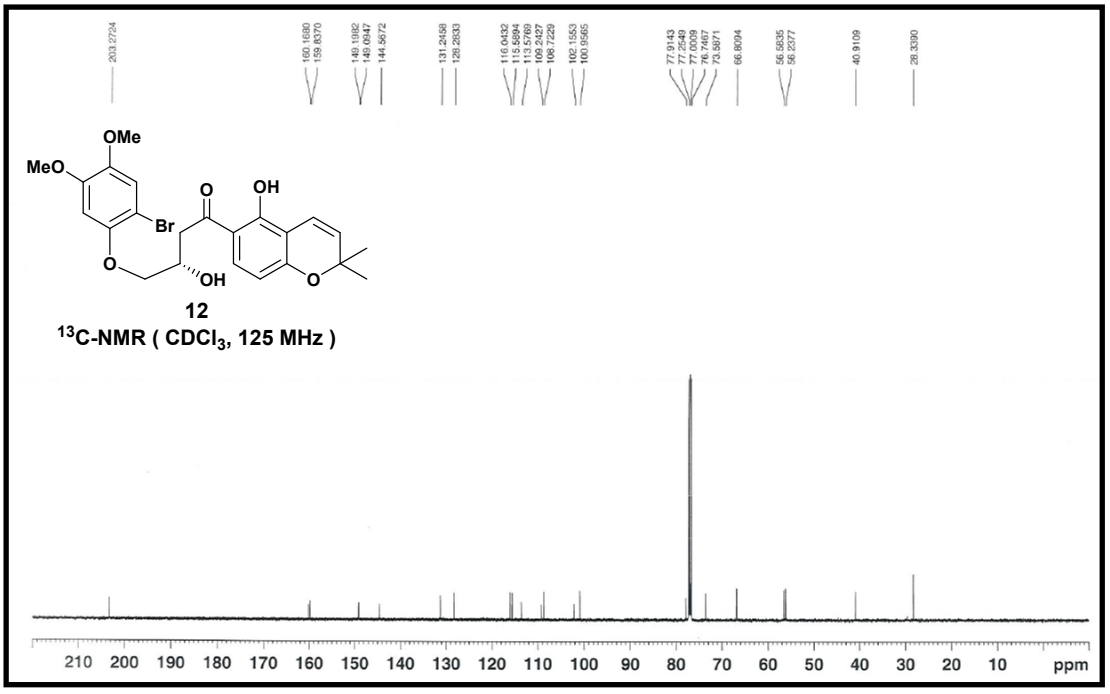

OMe
MeO
O
OMe
Br
O
OMOM
O
11
1H-NMR (CDCl3, 500 MHz)
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 ppm


OMe
MeO
O
OMe
Br
O
OMOM
O
11
13C-NMR (CDCl3, 125 MHz)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm



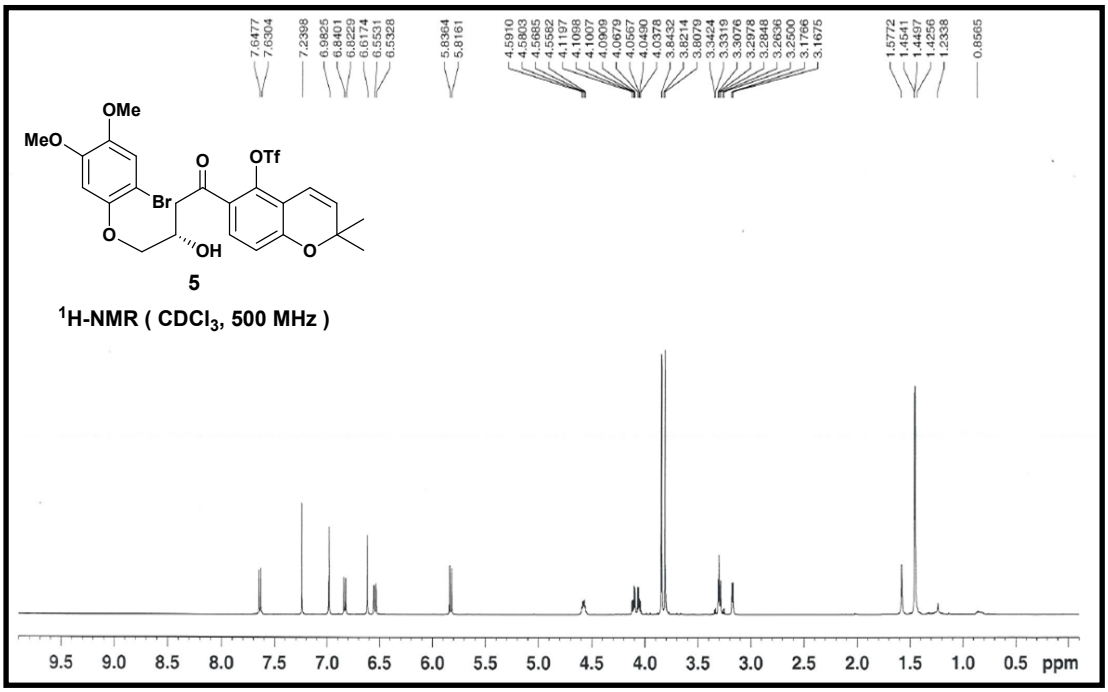
12

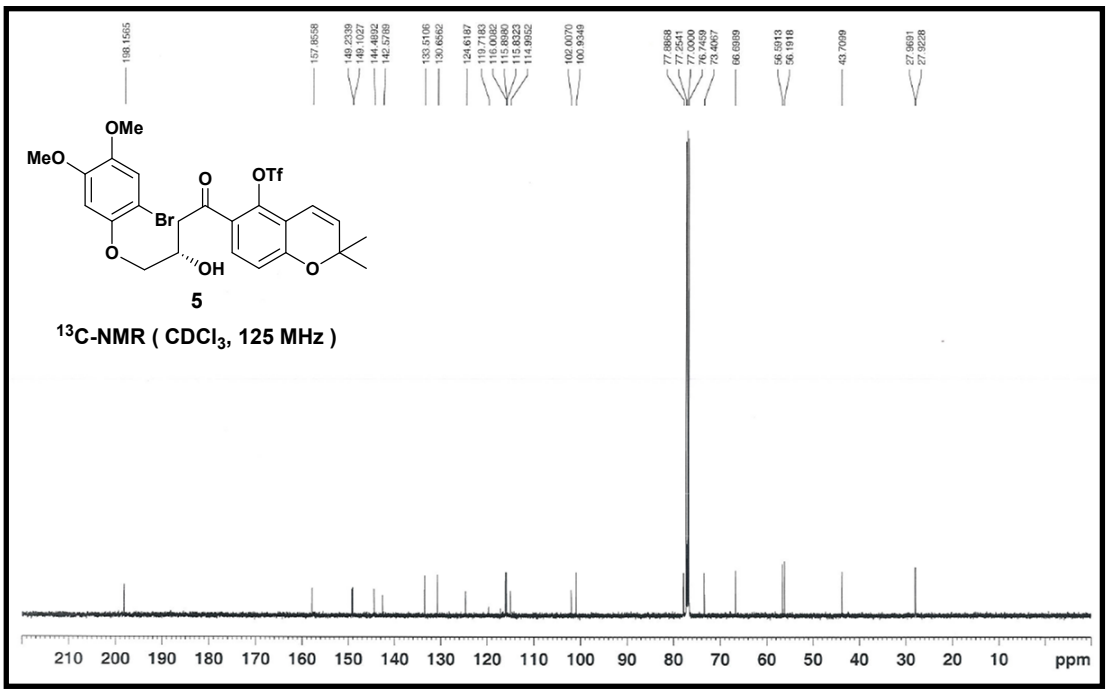
^{1}H-NMR ($CDCl_3$, 500 MHz)

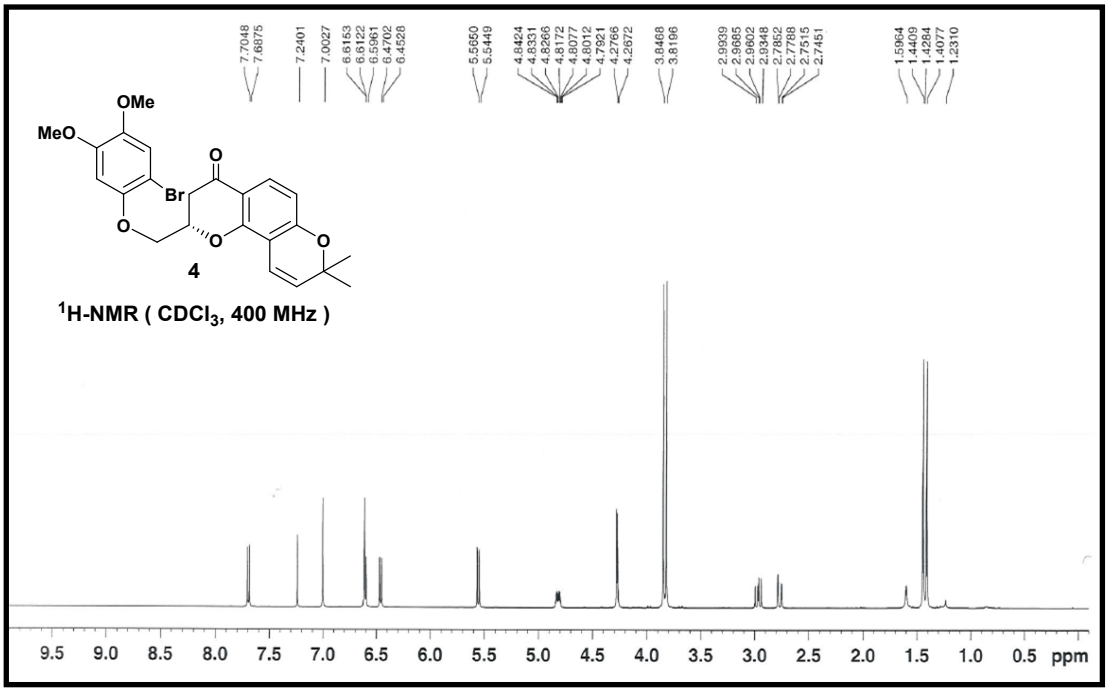


12

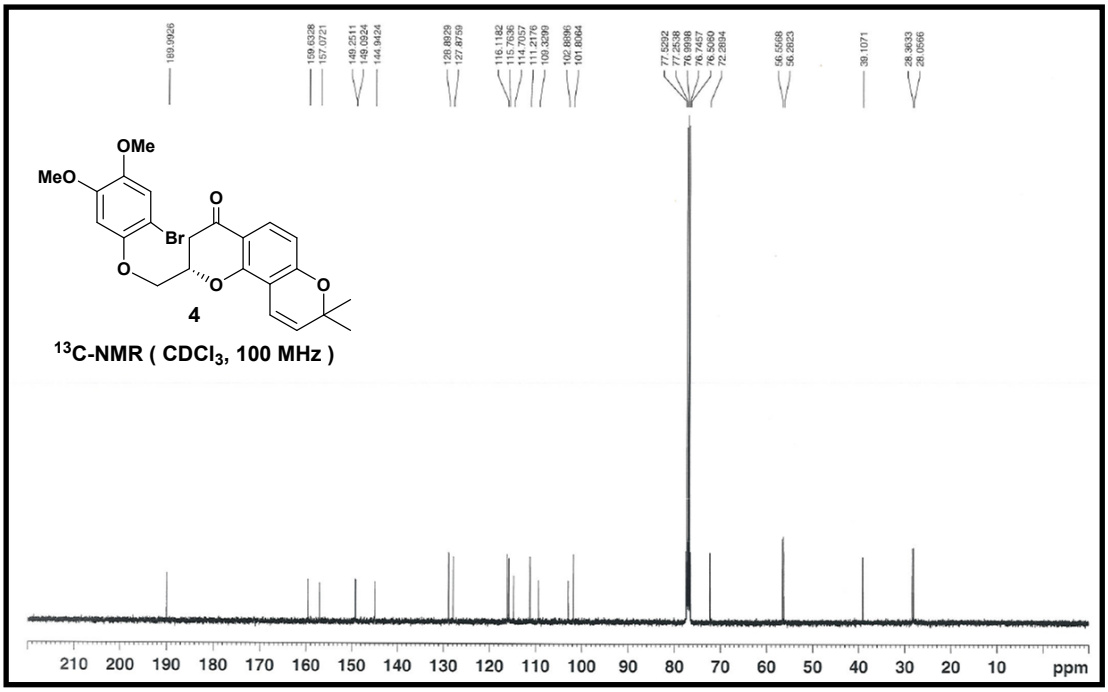
^{13}C-NMR ($CDCl_3$, 125 MHz)


OMe
MeO
O
OTf
Br
O
OH
O
5
1H-NMR (CDCl3, 500 MHz)
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 ppm

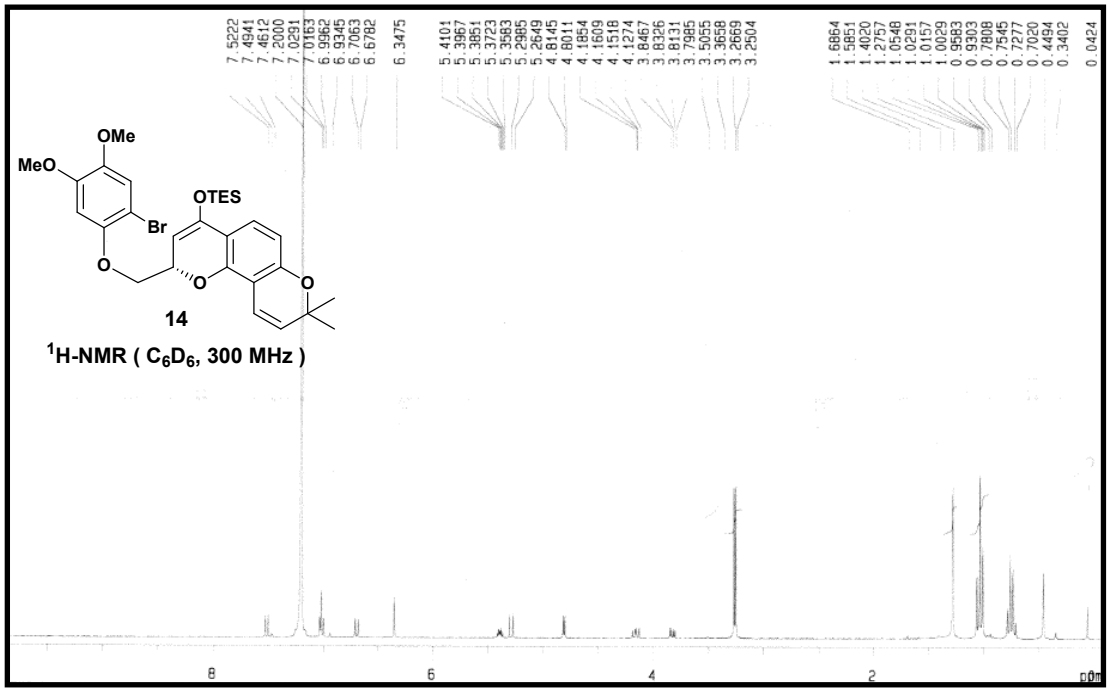

OMe
MeO
O
OTf
Br
O
OH
O
5
13C-NMR (CDCl3, 125 MHz)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

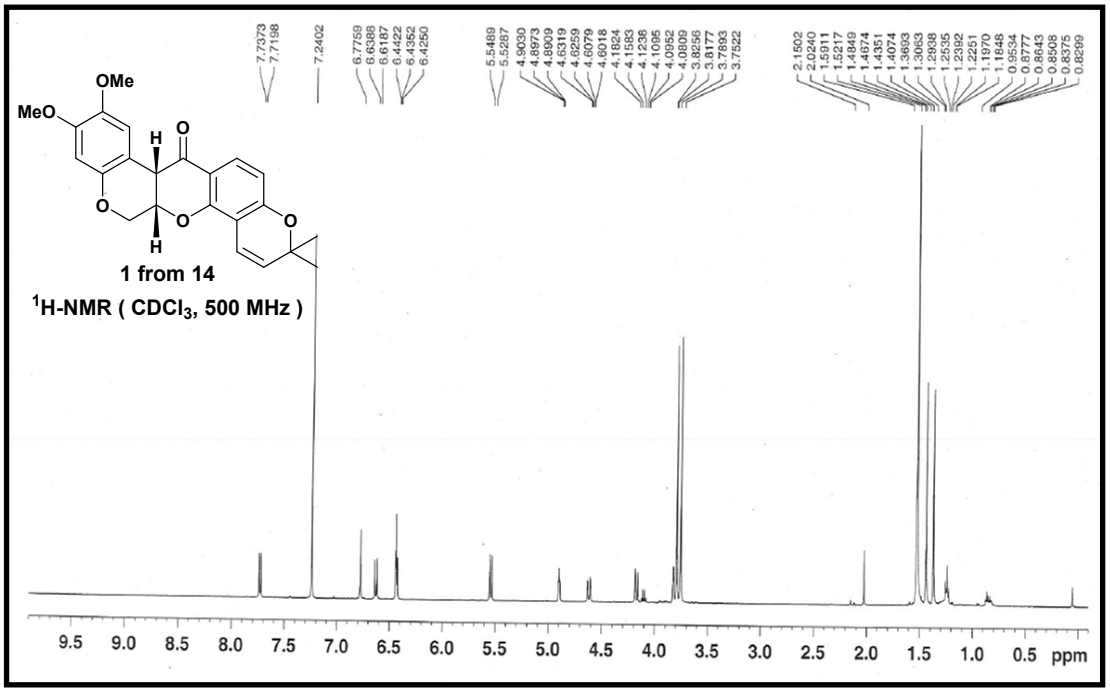


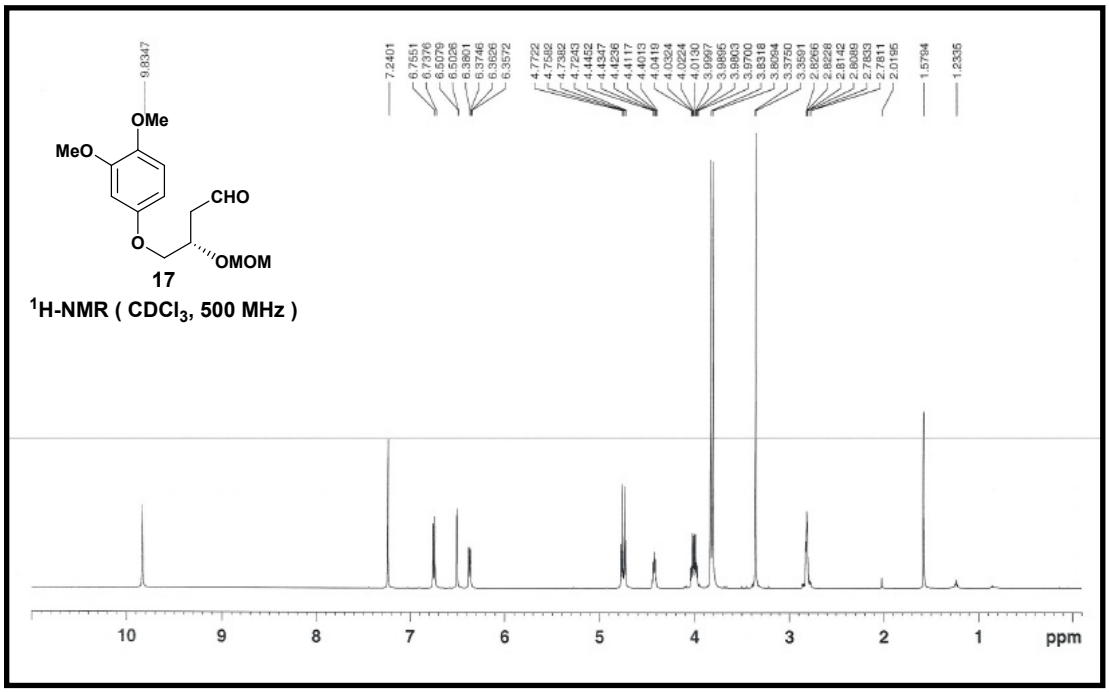
^{1}H-NMR ($CDCl_3$, 400 MHz)



^{13}C-NMR ($CDCl_3$, 100 MHz)

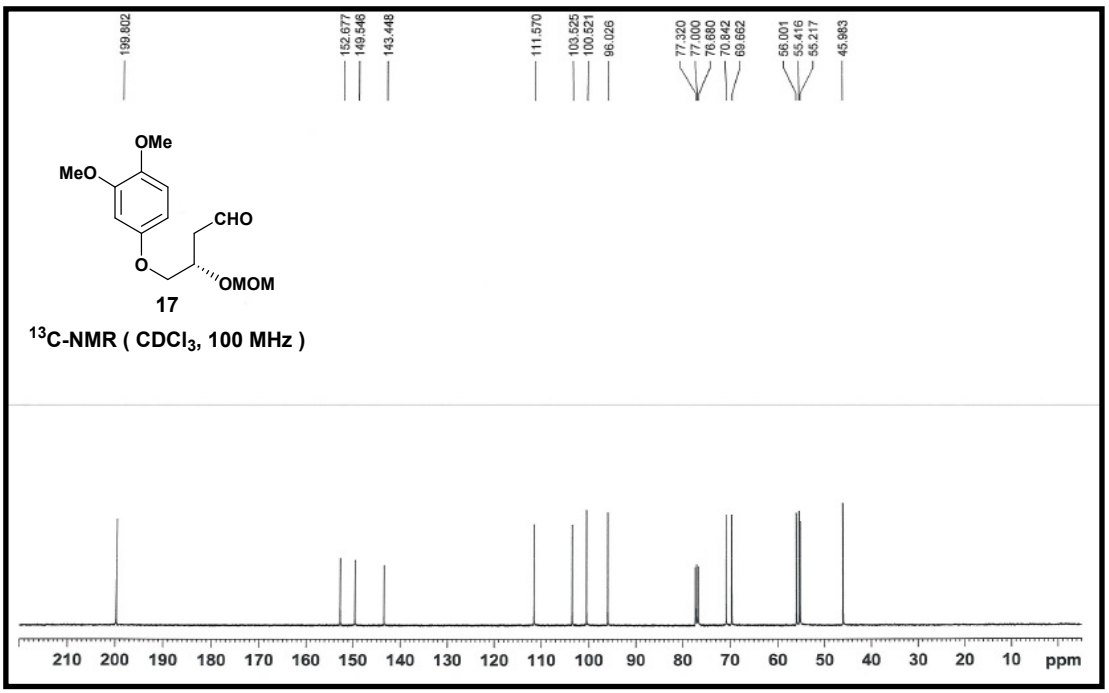

OMe
MeO
OTES
Br
O
O
O
14
1H-NMR (C6D6, 300 MHz)


OMe
MeO
H
O
O
O
O
H
1 from 14
1H-NMR (CDCl3, 500 MHz)
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 ppm



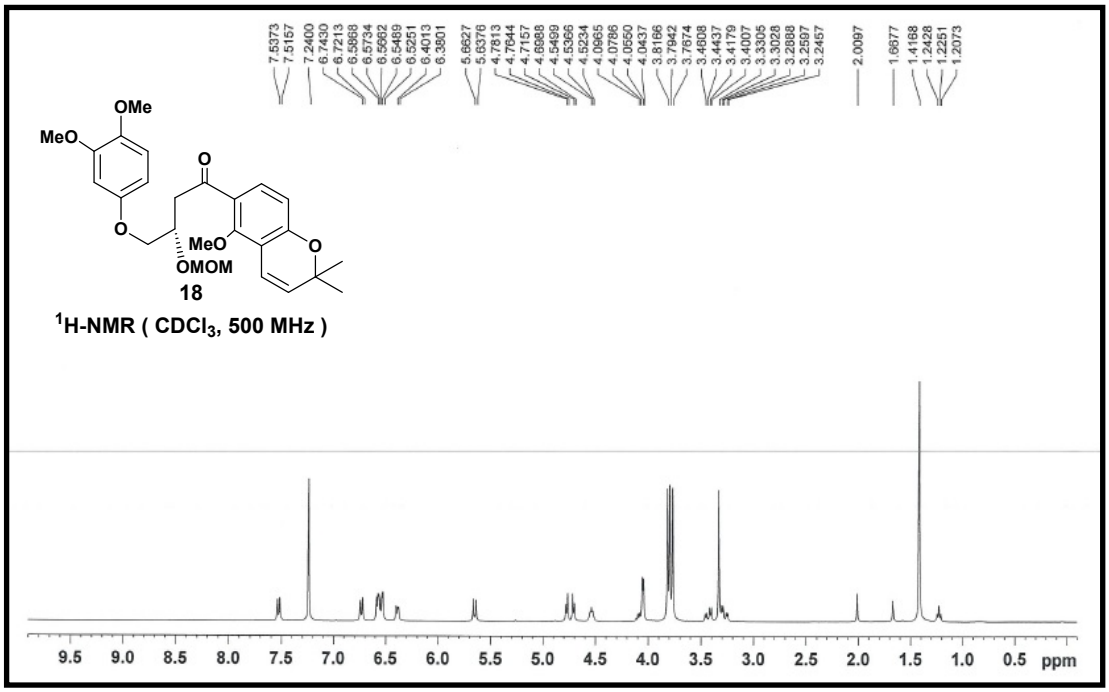
17

^{1}H-NMR ($CDCl_3$, 500 MHz)

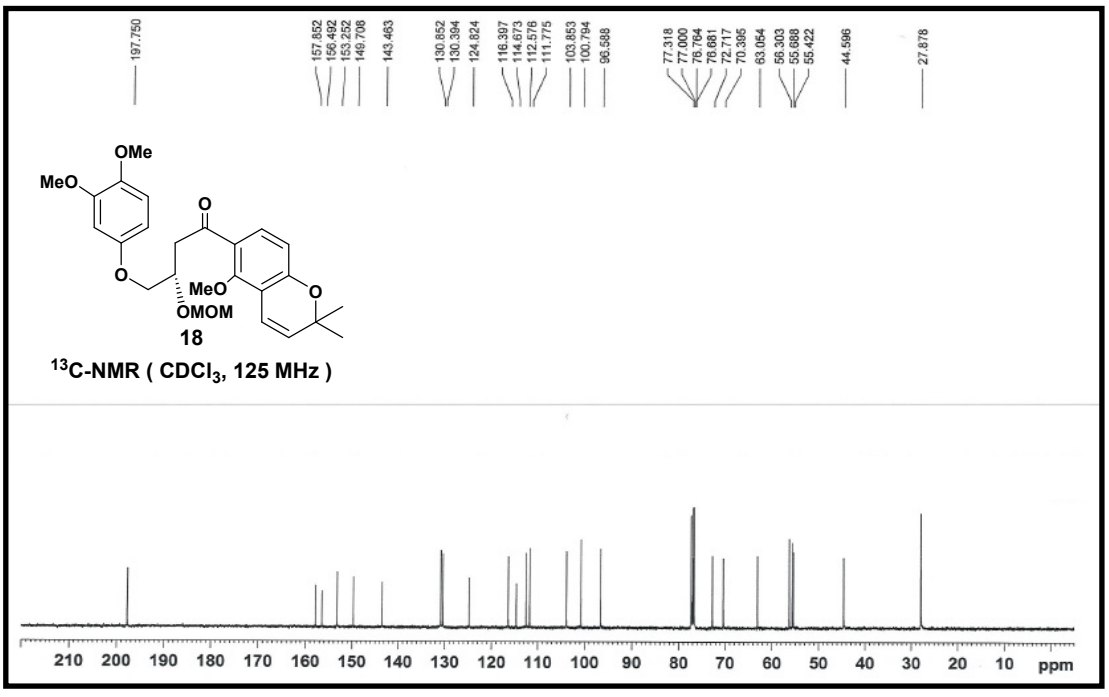


17

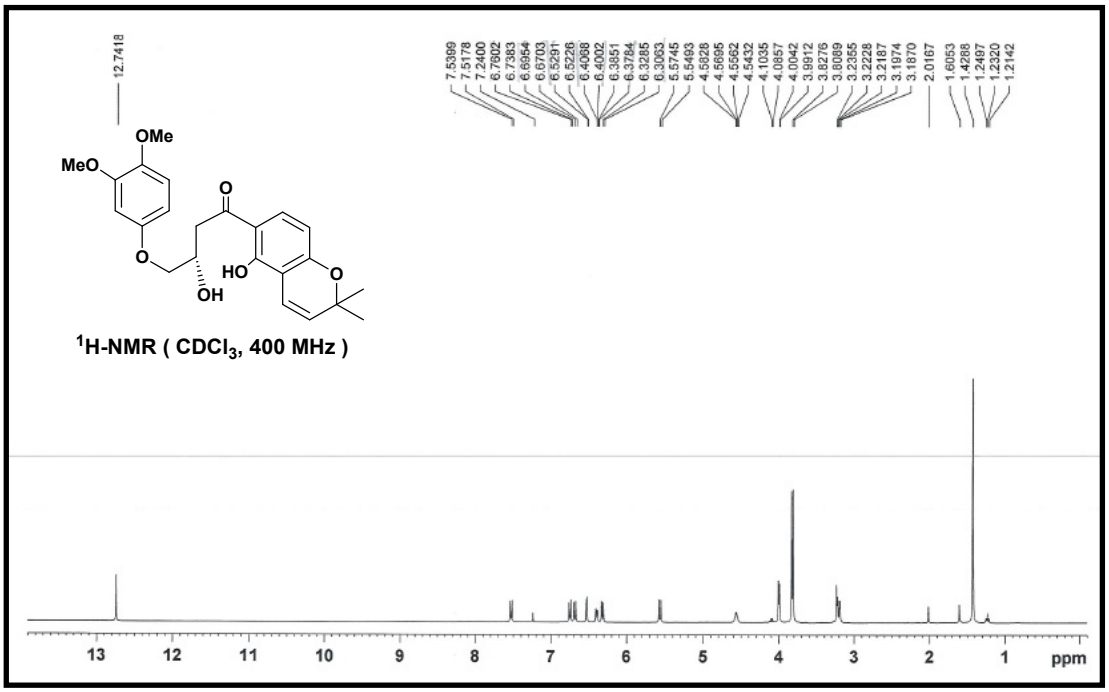
^{13}C-NMR ($CDCl_3$, 100 MHz)



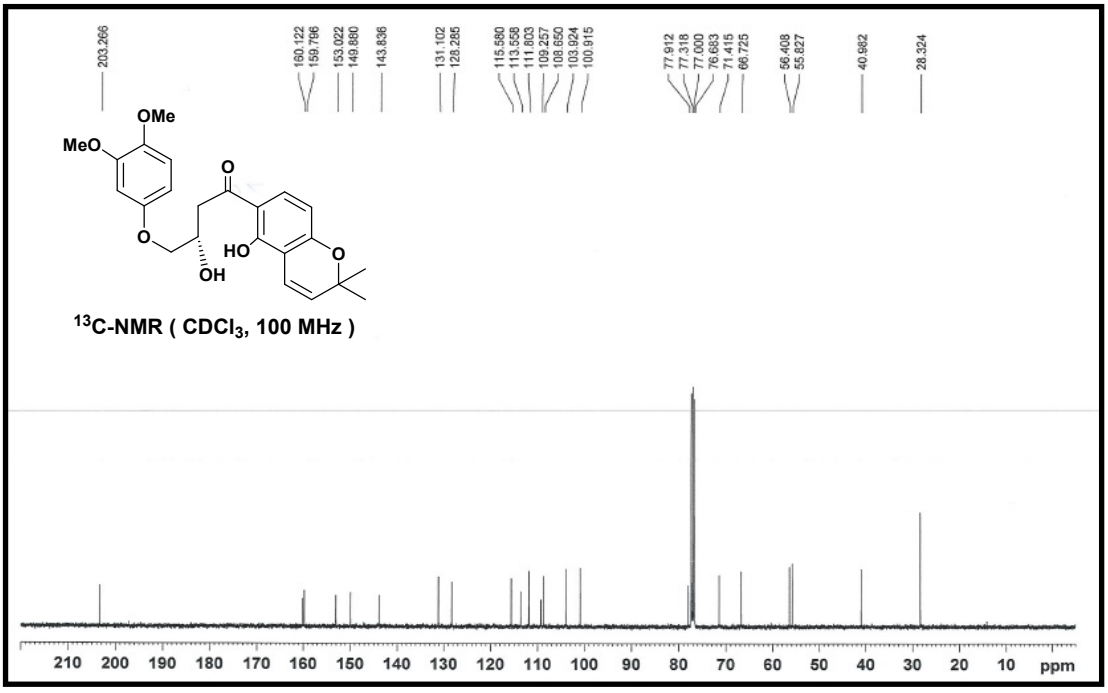
^{1}H-NMR ($CDCl_3$, 500 MHz)



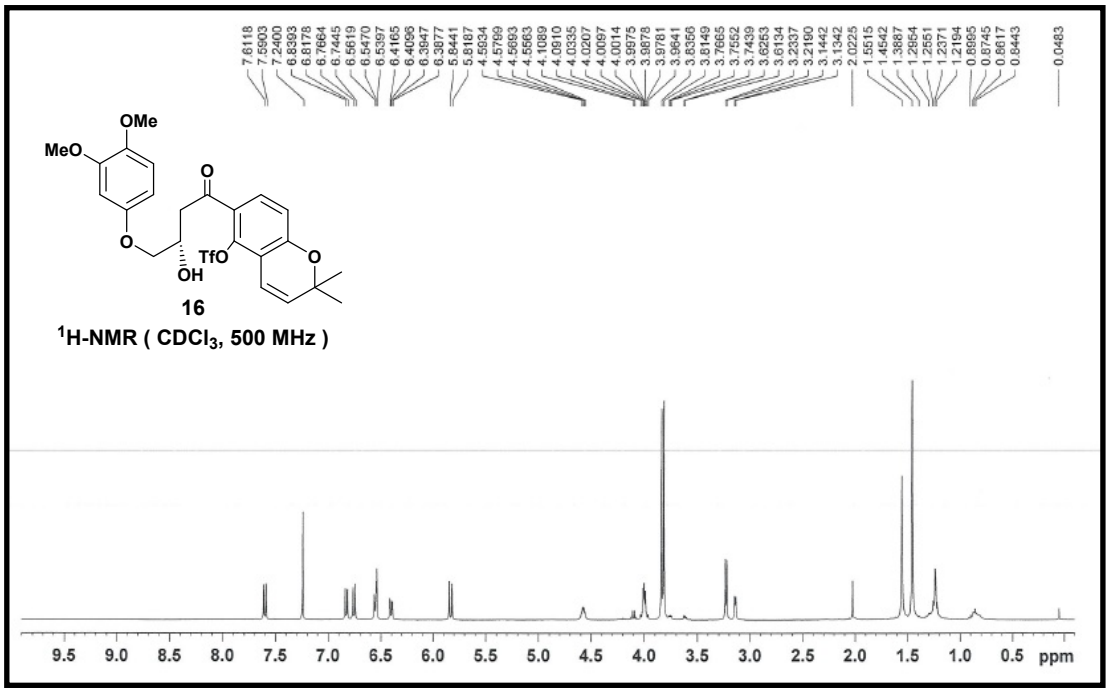
^{13}C-NMR ($CDCl_3$, 125 MHz)

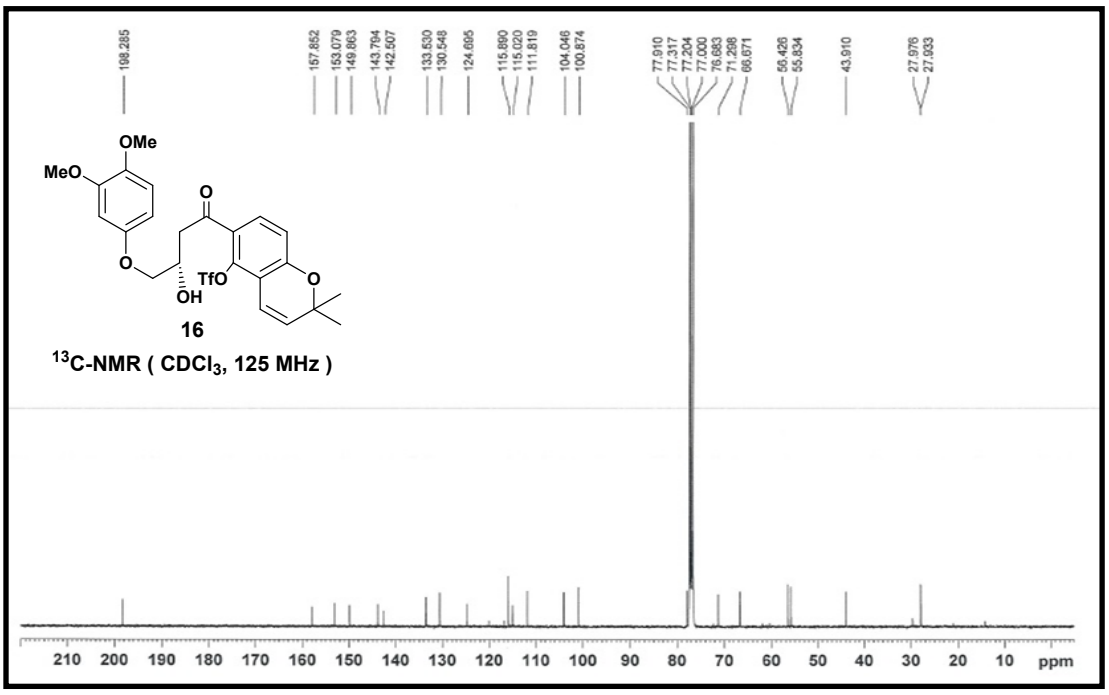


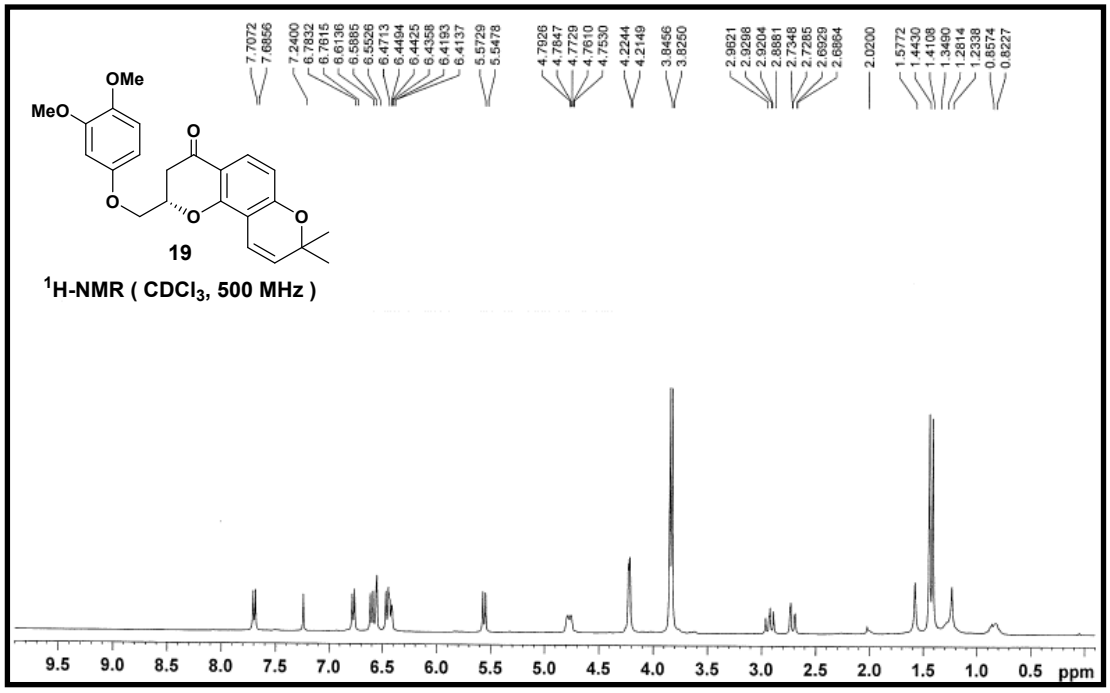
^{1}H-NMR ($CDCl_3$, 400 MHz)



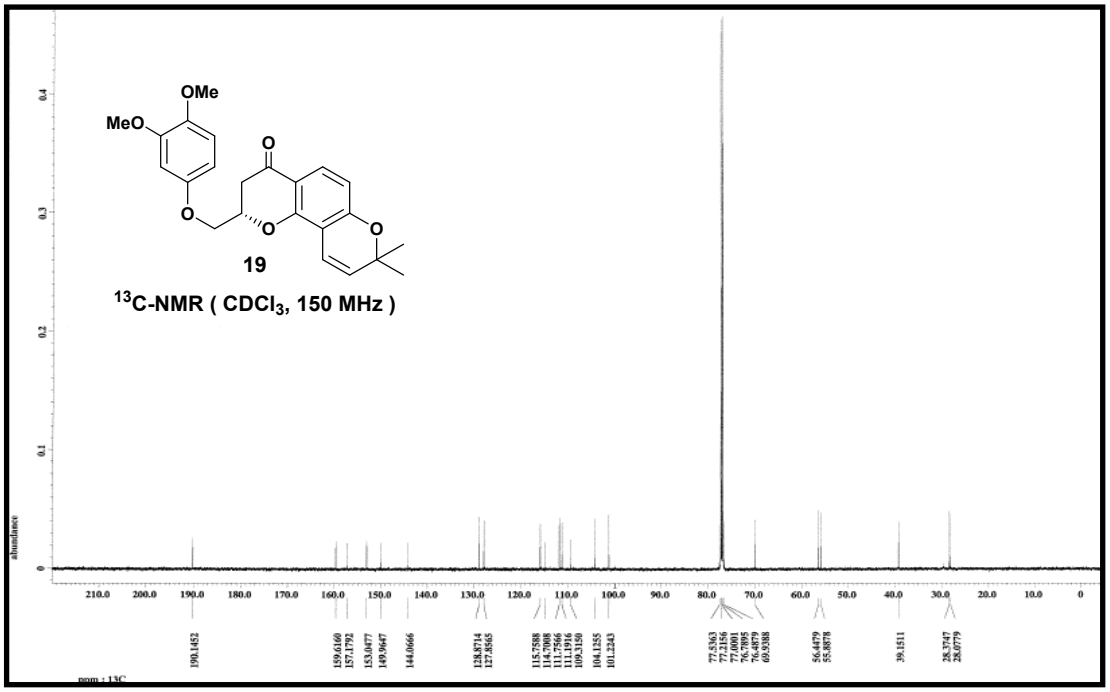
^{13}C-NMR ($CDCl_3$, 100 MHz)


7.8118
7.5903
7.2400
6.8393
6.8178
6.7664
6.7445
6.5619
6.5470
6.5397
6.4165
6.4096
6.3947
6.3077
5.8441
5.8187
4.5934
4.5799
4.5693
4.5563
4.1089
4.0910
4.0335
4.0207
4.0097
4.0014
3.9975
3.9878
3.9781
3.9641
3.8356
3.8149
3.7665
3.7552
3.7439
3.6253
3.6134
3.2337
3.2190
3.1442
3.1342
2.0225
1.5515
1.4542
1.3887
1.2954
1.2551
1.2371
1.2194
0.8985
0.8745
0.8617
0.8443
0.0483
OMe
MeO
O
O
TfO
O
OH
16
1H-NMR (CDCl3, 500 MHz)
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 ppm

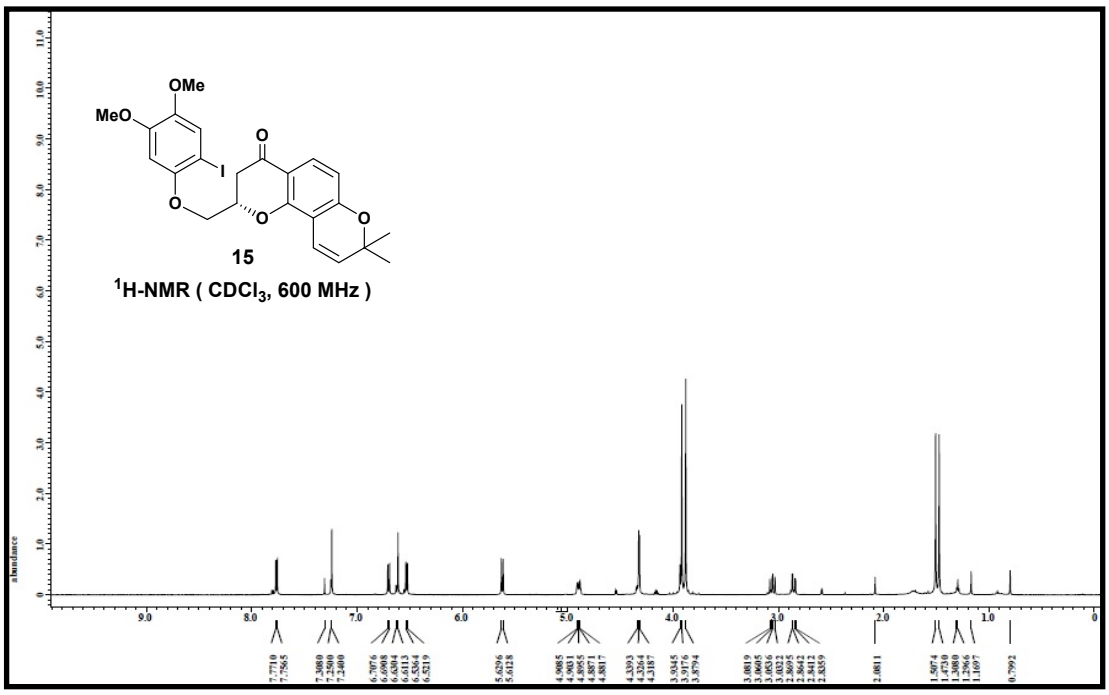

198.285
157.852
153.079
149.863
143.764
142.507
133.530
130.548
124.695
115.890
115.020
111.819
104.046
100.874
77.910
77.317
77.204
77.000
76.683
71.298
66.671
55.426
55.834
43.910
27.976
27.933
OMe
MeO
O
O
TfO
O
OH
16
13C-NMR (CDCl3, 125 MHz)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

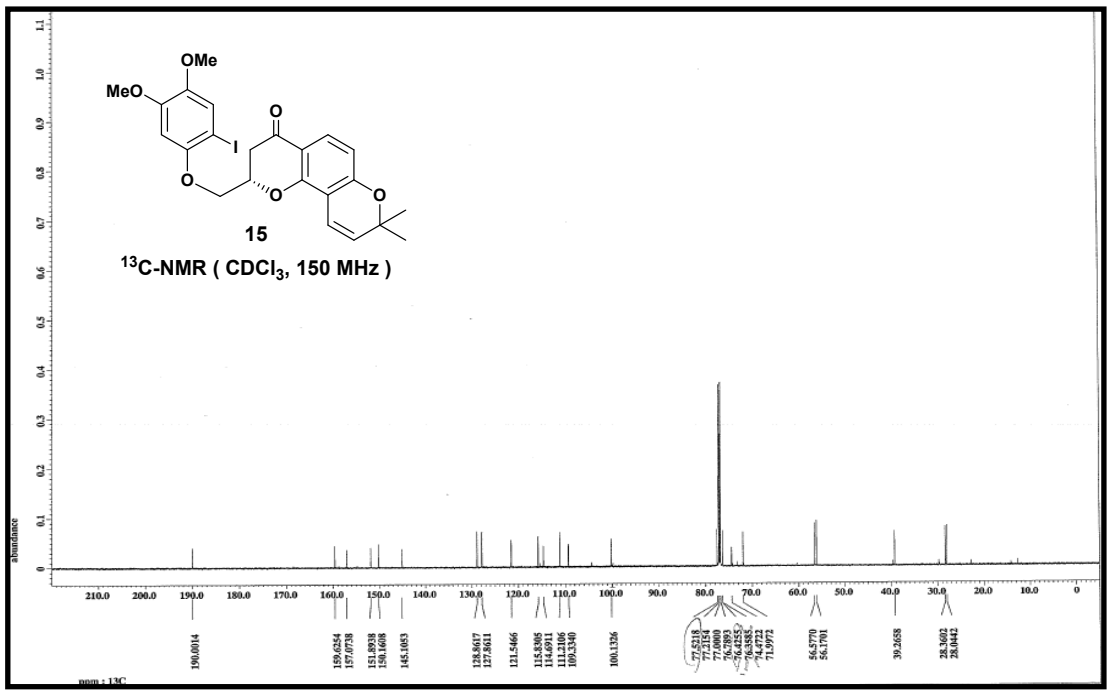


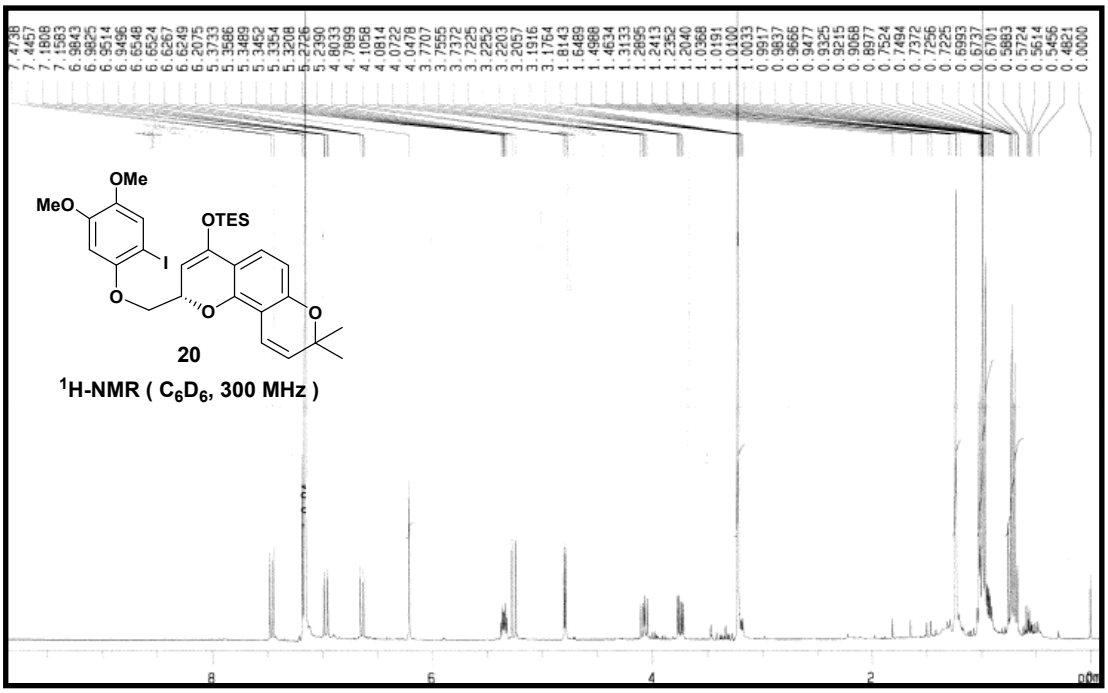
^{1}H-NMR ($CDCl_3$, 500 MHz)

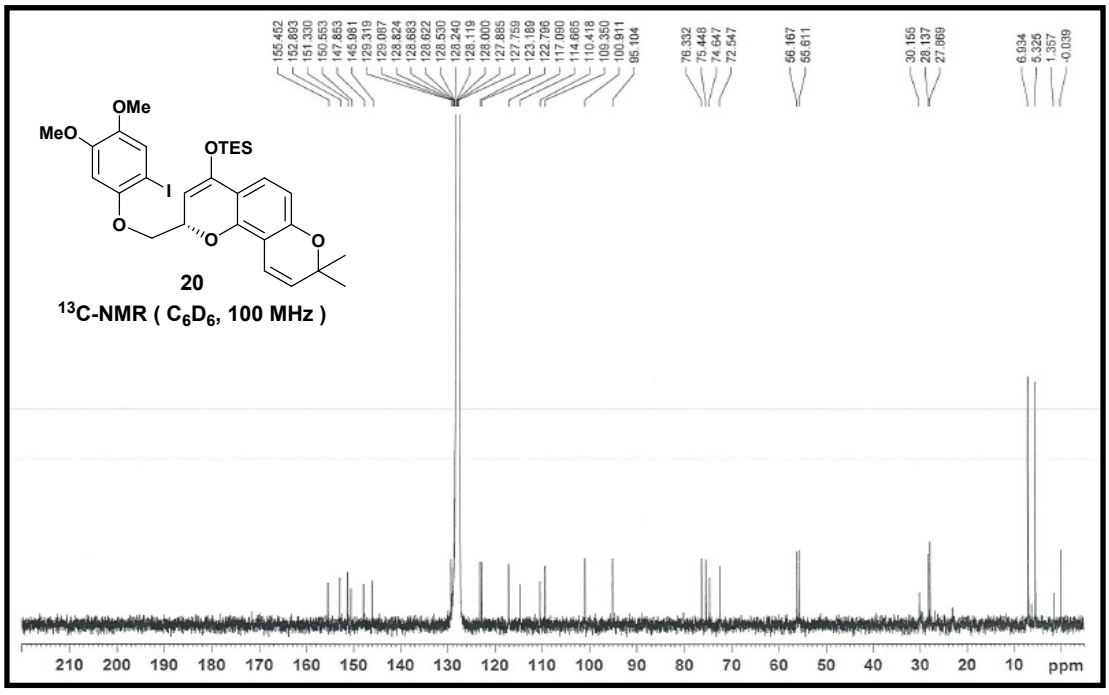


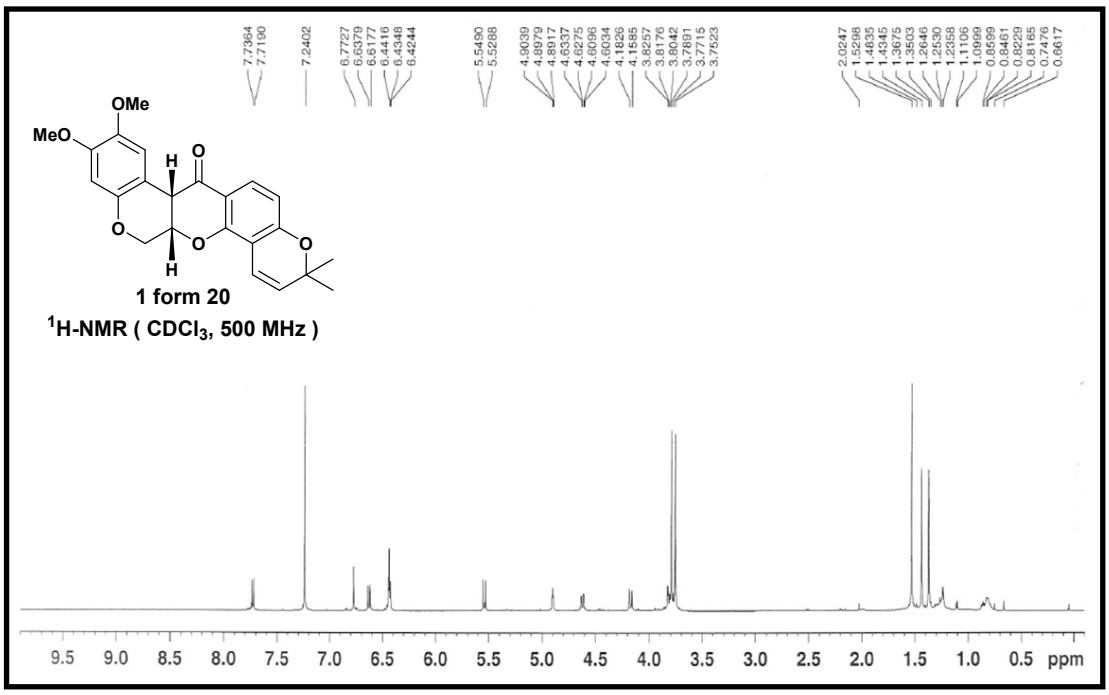
^{13}C-NMR ($CDCl_3$, 150 MHz)

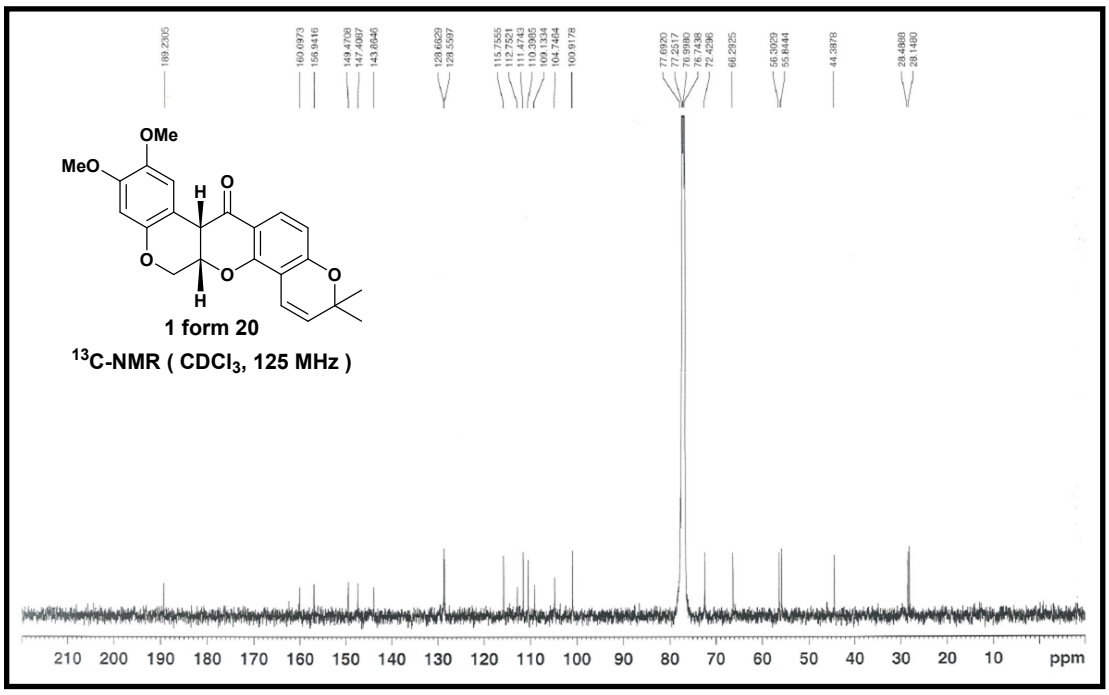

OMe
MeO
I
O
O
O
O
15
1H-NMR (CDCl3, 600 MHz)


OMe
MeO
I
O
O
O
O
15
13C-NMR (CDCl3, 150 MHz)


OMe
MeO
OTES
I
O
O
O
20
1H-NMR (C6D6, 300 MHz)


OMe
MeO
OTES
I
O
O
O
20
13C-NMR (C6D6, 100 MHz)
ppm

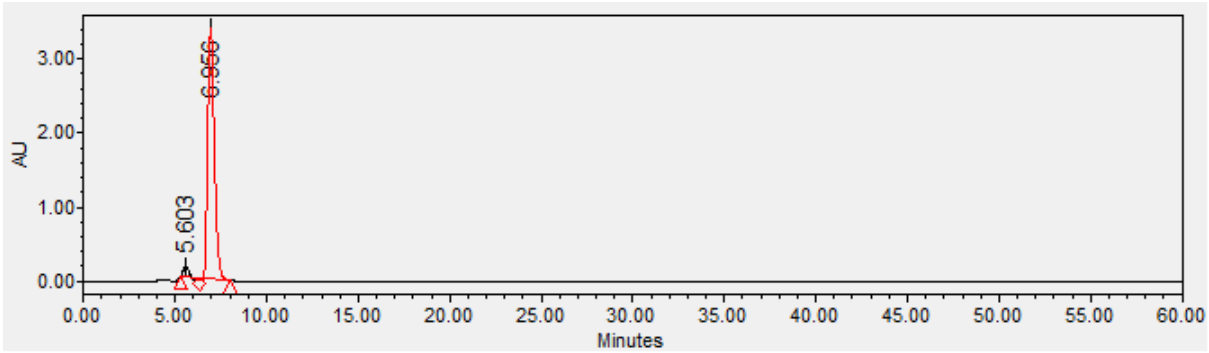

7.7364
7.7190
7.2402
6.7727
6.6379
6.6177
6.4446
6.4348
6.4244
5.5490
5.5288
4.9039
4.8979
4.8917
4.6337
4.6275
4.6096
4.6034
4.1826
4.1585
3.8257
3.8176
3.8042
3.7891
3.7715
3.7523
2.0247
1.5298
1.4835
1.4345
1.3675
1.3503
1.2646
1.2530
1.2358
1.1106
1.0999
0.8599
0.8461
0.8229
0.8165
0.7476
0.6617
OMe
MeO
H
O
O
O
O
H
O
1 form 20
1H-NMR (CDCl3, 500 MHz)
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 ppm


189.2305
160.6973
156.9416
149.4708
147.4087
143.8645
129.6629
125.5097
115.7555
112.7321
111.4763
110.3985
109.1334
104.7464
100.9178
77.6920
77.2797
76.9980
76.7438
72.4296
66.2925
56.3929
55.8444
44.3878
28.4888
28.1460
OMe
MeO
H
O
O
O
O
H
O
1 form 20
13C-NMR (CDCl3, 125 MHz)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

HPLC Analysis for Iodosilylenolether (20)

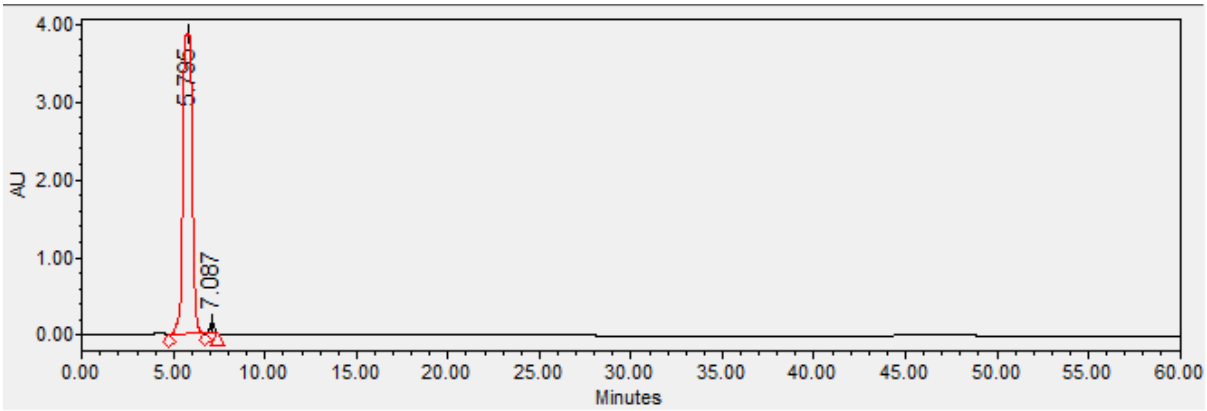
Column conditions: CHIRALPAK® AD-H, 0.8ml/min, 1:7 IPA:hexanes

(+)-20



Retention Time (min)	Area (μV*sec)	% Area	Height (μV)
5.603	3424699	3.86	135104
6.956	85308291	96.14	3379976

(-)-20

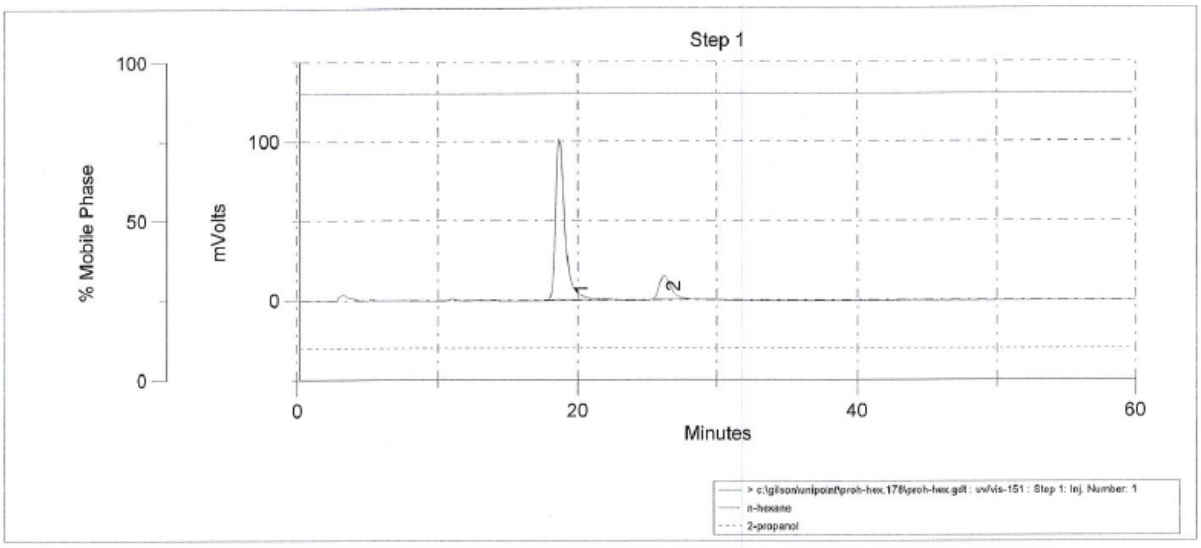


Retention Time (min)	Area (μV*sec)	% Area	Height (μV)
5.795	137326442	98.38	3848922
7.087	2266287	1.62	133025

HPLC Analysis for (-)-Deguelin (1)

(-)-Deguelin from 14

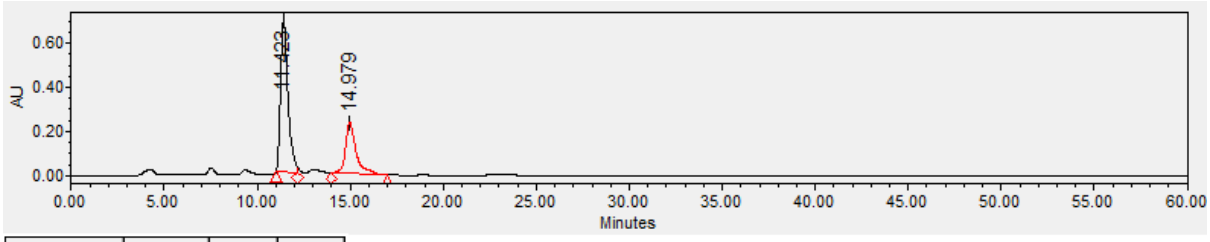
Column conditions: CHIRALPAK® AD-H, 1ml/min, 1:9 IPA:hexanes



	R. Time	Area	Area %	Height
1	18.68	7997242.00	83.50	101.40
2	26.22	1580279.88	16.50	15.59

(-)-Deguelin from (-)-20 (Table 2, entry 3)

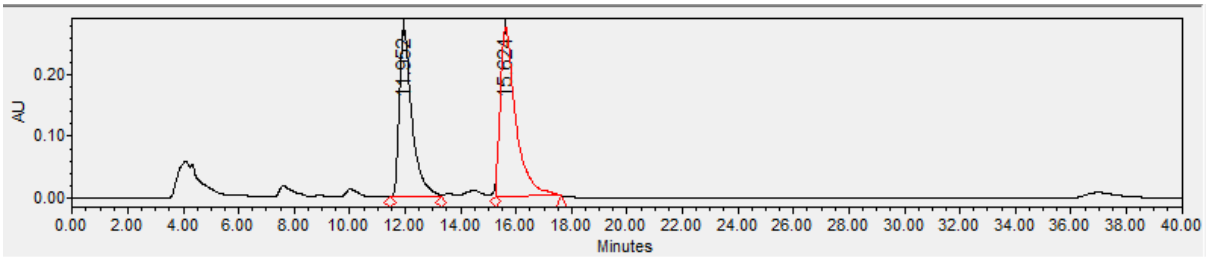
Column conditions: CHIRALPAK® AD-H, 0.8ml/min, 1:4 IPA:hexanes



Retention Time (min)	Area (μV*sec)	% Area	Height (μV)
11.423	19264877	67.61	688737
14.979	9227953	32.39	233320

(-)-Deguelin from (-)-20 (Table 2, entry 7)

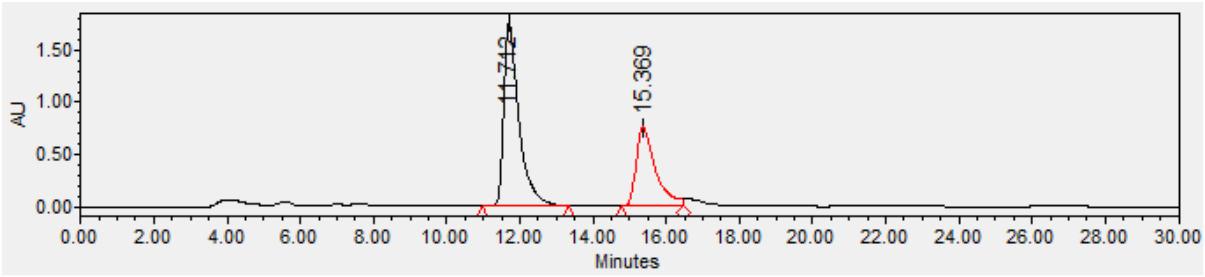
Column conditions: CHIRALPAK® AD-H, 0.8ml/min, 1:4 IPA:hexanes



Retention Time (min)	Area (μV*sec)	% Area	Height (μV)
11.952	8644112	44.85	274322
15.624	10627136	55.15	274520

(-)-Deguelin from (-)-20 (Table 2, entry 8)

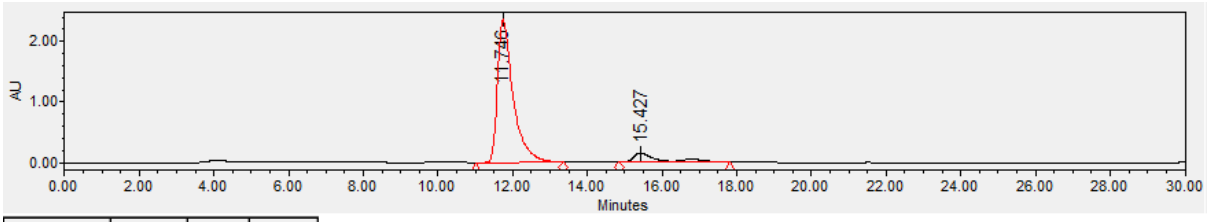
Column conditions: CHIRALPAK® AD-H, 0.8ml/min, 1:4 IPA:hexanes



Retention Time (min)	Area (μV*sec)	% Area	Height (μV)
11.712	50734933	64.70	1757603
15.369	27683833	35.30	757745

(-)-Deguelin from (-)-20 (Table 2, entry 9)

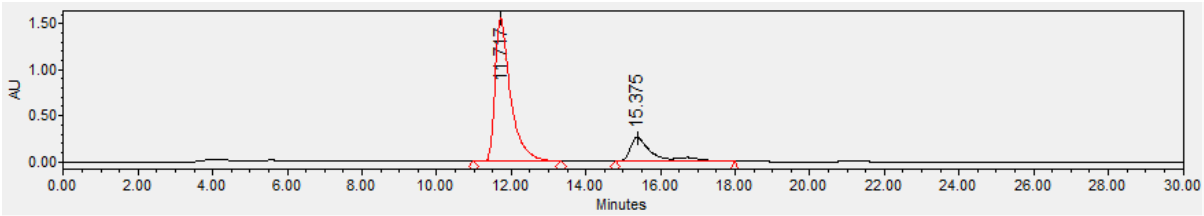
Column conditions: CHIRALPAK® AD-H, 0.8ml/min, 1:4 IPA:hexanes



Retention Time (min)	Area (μV*sec)	% Area	Height (μV)
11.746	68627778	90.28	2361514
15.427	7390004	9.72	152073

(-)-Deguelin from (-)-20 (Table 2, entry 10)

Column conditions: CHIRALPAK® AD-H, 0.8ml/min, 1:4 IPA:hexanes



Retention Time (min)	Area (μV*sec)	% Area	Height (μV)
11.717	44962701	80.07	1558874
15.375	11189597	19.93	259686