

A Useful Strategy for Synthesis of the Disaccharide of OSW-1

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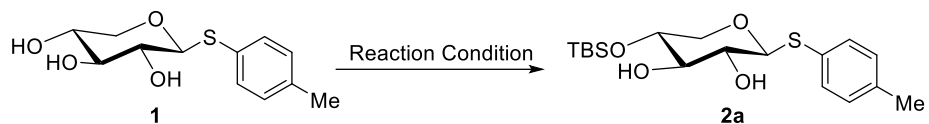
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1. General Methods

Thin layer chromatography (TLC) was performed on silica gel 60 F254 plates and components were visualized by ultraviolet light (254 nm) and/or phosphomolybdic acid, 20 wt% solution in ethanol. SiliFlash silica gel (230–400 mesh) was used for all column chromatography. Proton nuclear magnetic resonances (^1H NMR) were recorded at 600 MHz or 400 MHz on Bruker 600 or 400 NMR spectrometers. Carbon nuclear magnetic resonances (^{13}C NMR) were recorded at 150 MHz or 100 MHz on a Bruker 600 or 400 NMR spectrometers respectively. Chemical shifts are reported in parts per million (ppm) from an internal standard acetone (2.05 ppm), chloroform (7.26 ppm), or methanol- d_4 (3.35 and 4.78 ppm) for ^1H NMR; and from an internal standard of either residual acetone (206.26 ppm), chloroform (77.00 ppm), or methanol- d_4 (49.3 ppm) for ^{13}C NMR. NMR peak multiplicities are denoted as follows: s (singlet), d (doublet), t (triplet), q (quartet), dd (doublet of doublet), td (doublet of triplet), dt (triplet of doublet), and m (multiplet). Coupling constants (J) are given in hertz (Hz).

2. Experimental Procedures and Spectral Data of products

Table S1 Optimization of regioselective introducing the TBS at the C-4 hydroxy position

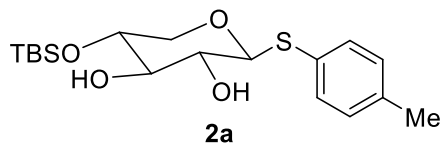


Entry	TBSCl	Base	Concentration (nM)	Temperature	Yield
1	1.0eq	imidazole	0.05	rt	78%
2	1.1eq	imidazole	0.05	rt	82%
3	1.3eq	imidazole	0.05	rt	70%
4	1.1eq	DIPEA	0.05	rt	73%
5	1.1eq	2,6-Lutidine	0.05	rt	69%
6	1.1eq	Et ₃ N	0.05	rt	79%
7	1.1eq	imidazole	0.1	rt	47%
8	1.1eq	imidazole	0.02	rt	85%
9	1.1eq	imidazole	0.01	rt	85%
10	1.1eq	imidazole	0.02	0°C	81% ^[b]
11	1.1eq	imidazole	0.02	40°C	63%

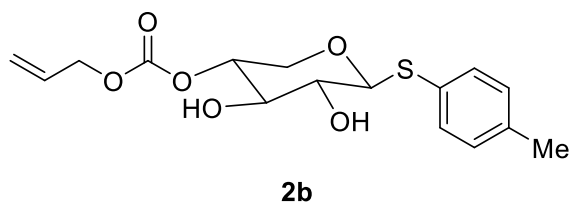
Reaction condition: [a] TBSCl (1.1 eq), imidazole (1.3 eq), DCM (c =0.02), room temperature, 1.5 hours.

[b] reaction time delay to 3 hours.

For optimization of the reaction conditions of regioselective introducing the TBS at the C-4 hydroxy position, we used compound **1** and TBSCl as standard substrates (Table S1). Initially, we tested a series of TBSCl concentrations, 1.1 eq of TBSCl provided compound **2a** in high yield (Entries 1-3). Next, a brief base-screening was undertaken and no improved result was obtained (Entries 4-6). Furthermore, the influence of the concentration of compound **1** was also explored (Entries 7-9) and the best result was achieved in low concentration (Entries 8 and 9). The optimal concentration of compound **1** is 0.02 nM because compound **1** at 0.1 nM does not completely dissolve the substrate in DCM and compound **1** at 0.01 nM requires too much solvent. Moreover, the temperature turned out to have an important effect on this reaction (Entries 10 and 11). The lowering the reaction temperature and extending the reaction time to 3 hours, the reaction also provided 81% yield (Entry 10). Unfortunately, the reaction temperature increased to 40°C, the yield of compound **2a** was decreased to 63% (Entry 11).

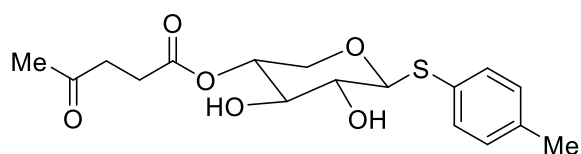


Butyldimethylsilyl chloride (4.11 g, 27.24 mmol) in dichloromethane was slowly dropped into a solution of **2** (6.0 g, 24.76 mmol) and imidazole (1.72 g, 27.24 mmol) in dichloromethane (500 mL). The reaction mixture was stirred at room temperature for 1.5 hours. The reaction mixture was quenched with saturated ammonium chloride (200 mL), and the aqueous layer was extracted with dichloromethane (200 mL) and washed with saturated brine (200 mL). The combined organic layer was dried over Na₂SO₄ and concentrated under reduced pressure. The residue was purified by column chromatography (ethyl acetate-hexanes, 1: 2) giving the desired compound **2a** (7.15 g, 81%) as a yellow oil. ¹H NMR (600 MHz, CDCl₃) δ 7.43 (d, *J* = 7.8 Hz, 2H, 2 × ArH), 7.13 (d, *J* = 7.8 Hz, 2H, 2 × ArH), 4.52 (d, *J* = 9.0 Hz, 1H, H-1), 3.98 (dd, *J*₁ = 11.4 Hz, *J*₂ = 4.8 Hz, 1H, H-6), 3.63-3.61 (m, 1H, H-4), 3.53 (t, *J* = 7.8 Hz, 1H, H-3), 3.38 (t, *J* = 8.4 Hz, 1H, H-2), 3.23 (t, *J* = 11.4 Hz, 1H, H-5), 2.96 (s, 2H, 2 × OH), 2.35 (s, 3H, CH₃), 0.88 (s, 9H, (CH₃)₃C-Si), 0.14 (s, 3H, CH₃-Si), 0.09 (s, 3H, CH₃-Si); ¹³C NMR (150 MHz, CDCl₃) δ 138.4, 133.2, 129.8, 1238.2, 88.9, 77.5, 71.7, 70.6, 25.7, 21.1, 17.9, -4.6, -4.7. HRMS(ESI) *m/z* calcd for C₁₈H₃₀O₄SSi ([M+Na⁺]): 393.1526, found 393.1519.



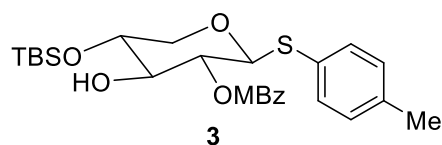
Allyl chloroformate (0.74 g, 6.14 mmol) in dichloromethane was slowly dropped into a solution of **2** (1.5 g, 5.85 mmol) and N,N-Diisopropylethylamine (0.83 g, 6.44 mmol) in dichloromethane (200 mL). The reaction mixture was stirred at room temperature overnight. The reaction mixture was quenched with saturated ammonium chloride (80 mL), and the aqueous layer was extracted with dichloromethane (100 mL) and washed with saturated brine (80 mL). The combined organic layer was dried over Na₂SO₄ and concentrated under reduced pressure. The residue was purified by column chromatography (ethyl acetate-hexanes, 1: 2) giving the desired compound **2b** (1.39 g,

70%) as a yellow oil. ^1H NMR (600 MHz, CDCl_3) δ 7.39 (d, $J = 7.8$ Hz, 2H, $2 \times \text{ArH}$), 7.14 (d, $J = 7.8$ Hz, 2H, $2 \times \text{ArH}$), 5.99-5.92 (m, 1H, $\text{CH}_2=\text{CH}-\text{CH}_2-$), 5.47 (d, $J = 4.8$ Hz, 1H, H-4), 5.40 (d, $J = 16.8$ Hz, 1H, $\text{CH}_2=\text{CH}-\text{CH}_2-$), 5.31 (d, $J = 10.2$ Hz, 1H, $\text{CH}_2=\text{CH}-\text{CH}_2-$), 4.71-4.67 (m, 3H, H-1, $\text{CH}_2=\text{CH}-\text{CH}_2-$), 4.12 (t, $J = 10.8$ Hz, 1H, H-6), 3.97 (dd, $J_1 = 11.4$ Hz, $J_2 = 12.0$ Hz, 1H, H-5), 3.90 (dd, $J_1 = 9.0$ Hz, $J_2 = 5.4$ Hz, 1H, H-2), 3.82 (t, $J = 9.0$ Hz, 1H, H-3), 2.34 (s, 3H, CH_3); ^{13}C NMR (150 MHz, CDCl_3) δ 177.5, 154.4, 138.1, 132.4, 131.0, 129.9, 119.5, 90.5, 74.7, 72.5, 72.1, 69.0, 60.3, 21.1. HRMS(ESI) m/z calcd for $\text{C}_{16}\text{H}_{20}\text{O}_6\text{S}$ ($[\text{M}+\text{Na}^+]$): 363.3792, found 363.3799.

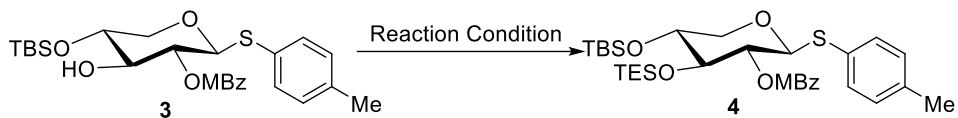


2c

Methyl levulinate (0.53 g, 4.10 mmol) in dichloromethane was dropped into a solution of **2** (1.0 g, 3.57 mmol), *N,N*-diisopropylcarbodiimide (0.54 g, 4.29 mmol) and triethylamine (0.43 g, 4.29 mmol), in dichloromethane (150 mL). The reaction mixture was stirred at room temperature overnight. The reaction mixture was quenched with saturated ammonium chloride (80 mL), and the aqueous layer was extracted with dichloromethane (100 mL) and washed with saturated brine (80 mL). The combined organic layer was dried over Na_2SO_4 and concentrated under reduced pressure. The residue was purified by column chromatography (ethyl acetate-hexanes, 1: 2) giving the desired compound **2c** (0.72 g, 57%) as a yellow oil. ^1H NMR (600 MHz, CDCl_3) δ 7.43 (d, $J = 7.8$ Hz, 2H, $2 \times \text{ArH}$), 7.12 (d, $J = 7.8$ Hz, 2H, $2 \times \text{ArH}$), 4.83-4.79 (m, 1H, H-4), 4.46 (d, $J = 9.6$ Hz, 1H, H-1), 4.10 (dd, $J_1 = 11.4$ Hz, $J_2 = 5.4$ Hz, 1H, H-6), 3.71 (t, $J = 9.0$ Hz, 1H, H-3), 3.38 (t, $J = 9.0$ Hz, 1H, H-2), 3.28 (t, $J = 9.0$ Hz, 1H, H-5), 3.10 (s, 2H, $2 \times \text{OH}$), 2.77 (t, $J = 6.6$ Hz, 2H), 2.62-2.53 (m, 2H), 2.34 (s, 3H, $\text{CH}_3-\text{C}=\text{O}$ -), 2.18 (s, 3H, CH_3); ^{13}C NMR (150 MHz, CDCl_3) δ 207.2, 172.3, 138.6, 133.6, 129.8, 127.5, 88.4, 75.3, 71.8, 71.2, 66.3, 38.0, 29.7, 27.9, 21.1. HRMS(ESI) m/z calcd for $\text{C}_{17}\text{H}_{22}\text{O}_6\text{S}$ ($[\text{M}+\text{H}^+]$): 355.4243, found 355.4238.



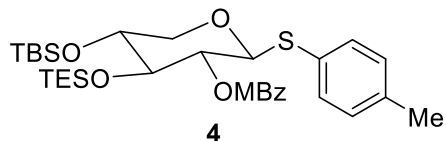
4-Methoxybenzoyl chloride (2.30 g, 13.46 mmol) in dichloromethane was slowly dropped into a solution of compound **2a** (4.0 g, 11.22 mmol), 4-(dimethylamino)pyridine (137 mg, 1.12 mmol) and dry triethylamine (1.70 g, 16.83 mmol) in dry dichloromethane (135 mL). The reaction mixture was stirred at room temperature for 2 hours. The reaction mixture was quenched with saturated ammonium chloride (60 mL), and the aqueous layer was extracted with dichloromethane (40 mL) and then washed with saturated brine (60 mL). The combined organic layer was dried over Na₂SO₄ and concentrated under reduced pressure. The residue was purified by column chromatography (ethyl acetate –hexanes, 1: 3) giving the desired compound **3** (4.7 g, 86%) as a yellow oil. ¹H NMR (400 MHz, CDCl₃) δ 8.05 (d, *J* = 8.8 Hz, 2H, 2 × ArH), 7.34 (d, *J* = 8.4 Hz, 2H, 2 × ArH), 7.09 (d, *J* = 8.0 Hz, 2H, 2 × ArH), 6.94 (d, *J* = 9.2 Hz, 2H, 2 × ArH), 4.96 (t, *J* = 9.6 Hz, 1H, H-2), 4.73 (d, *J* = 9.6 Hz, 1H, H-1), 4.00 (dd, *J*₁ = 11.6 Hz, *J*₂ = 4.8 Hz, 1H, H-6), 3.88 (s, 3H, CH₃-O), 3.77-3.67 (m, 2H, H-3, H-4), 3.28 (q, *J* = 9.6 Hz, 1H, H-5), 2.60 (t, *J* = 2.8 Hz, 1H, OH), 2.33 (s, 3H, CH₃), 0.90 (s, 9H, (CH₃)₃C-Si), 0.12 (s, 3H, CH₃-Si), 0.10 (s, 3H, CH₃-Si); ¹³C NMR (100 MHz, CDCl₃) δ 165.9, 163.7, 138.2, 133.3, 132.1, 129.7, 128.6, 121.9, 113.7, 87.0, 77.5, 72.7, 71.4, 70.0, 55.4, 25.7, 21.1, 18.0, -4.6, -4.7. HRMS(ESI) *m/z* calcd for C₂₆H₃₆O₆SSi ([M+H⁺]): 505.7203, found 505.7213.

Table S2 Optimization of regioselective introducing the TES at the C-3 hydroxy position.Reaction condition: TESOTf (1.5 eq), DMAP (0.1 eq), Et₃N (2.0 eq), DMF, room temperature, 2h.

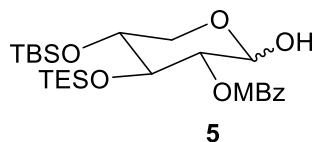
Entry	TESR	Base	Solvent	Temperature	Yield
1	1.5eq TESOTf	Et ₃ N	DCM	rt	45% ^[b]
2	1.5eq TESOTf	Et ₃ N	THF	rt	48% ^[b]
3	1.5eq TESOTf	Et₃N	DMF	rt	79%
4	2.0eq TESOTf	Et ₃ N	DMF	rt	78%
5	1.2eq TESOTf	Et ₃ N	DMF	rt	71%
6	2.0eq TESCOI	Et ₃ N	DMF	rt	52%
7	1.5eq TESOTf	DIPEA	DMF	rt	72%
8	1.5eq TESOTf	2,6-Lutidine	DMF	rt	63%
9	1.5eq TESOTf	imidazole	DMF	rt	61%
10	1.5eq TESOTf	Et ₃ N	DMF	40°C	76%
11	1.5eq TESOTf	Et ₃ N	DMF	80°C	65%

[b] reaction time delay to 8 hours. [c] reaction time delay to 24 hours

For optimization of the reaction conditions of regioselective introducing the TES at the C-3 hydroxy position, we used compound **3** as standard substrates (Table S2). Initially, we found that the solvent had a profound effect on the reaction, DCM and THF as normal solvents for hydroxy protection reaction were found to be unsuitable for this reaction (Entries 1 and 2). Utilizing DMF as a solvent, the reaction exhibits excellent result (Entry 3). Next, the different equivalent of TESOTf was screened and no improved result was obtained (Entries 4-5). Replacing the TESOTf with TESCOI resulted in an extremely less efficient reaction (entry 6). Furthermore, a brief base-screening was undertaken and no improved result was obtained (Entries 7-9). Moreover, increasing the temperature has no positive effects to improve the yield of compound **4** (Entries 10 and 11).

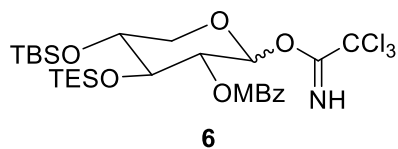


Triethylsilyl trifluoromethanesulfonate (3.23 g, 12.23 mmol) was added in one portion to a solution of compound **3** (4.0 g, 8.15 mmol), 4-(dimethylamino)pyridine (100 mg, 0.82 mmol) and triethylamine (1.65 g, 16.30 mmol) in dry dimethylformamide (80 mL). The reaction mixture was stirred at 30°C - 40°C for 4 hours. The reaction mixture was quenched with saturated ammonium chloride (200 mL). The aqueous layer was extracted with dichloromethane (200 mL), and then washed with saturated brine (100 mL). The combined organic layer was dried over Na₂SO₄ and concentrated under reduced pressure. The residue was purified by column chromatography (ethyl acetate –hexanes, 1: 6) giving the desired compound **4** (4.09 g, 83%) as a yellow oil. ¹H NMR (400 MHz, CDCl₃) δ 8.05 (d, *J* = 8.8 Hz, 2H, 2 × Ar*H*), 7.36 (d, *J* = 8.0 Hz, 2H, 2 × Ar*H*), 7.07 (t, *J* = 7.2 Hz, 1H, 2 × Ar*H*), 6.91 (d, *J* = 9.0 Hz, 2H, 2 × Ar*H*), 5.09-5.06 (m, 2H, H-2, H-1), 4.39 (dd, *J*₁ = 12.0 Hz, *J*₂ = 3.2 Hz, 1H, H-6), 3.87 (t, *J* = 5.4 Hz, 1H, H-4), 3.86 (s, 3H), 3.68-3.65 (m, 1H, H-3), 3.43 (dd, *J*₁ = 12.0 Hz, *J*₂ = 3.6 Hz, 1H, H-5), 0.93 (t, *J* = 8.4 Hz, 9H, CH₃CH₂-), 0.90 (s, 9H, (CH₃)₃C-Si), 0.63 (q, *J* = 7.8 Hz, 6H, CH₃CH₂-), 0.06 (s, 3H, CH₃-Si), 0.00 (s, 3H, CH₃-Si); ¹³C NMR (100 MHz, CDCl₃) δ 165.3, 163.4, 135.9, 132.0, 131.1, 128.8, 127.1, 122.4, 113.4, 86.8, 72.7, 72.0, 70.5, 65.3, 55.4, 25.8, 18.1, 6.84, 4.81, -4.4, -4.7. HRMS(ESI) *m/z* calcd for C₃₂H₅₀O₆SSi₂ ([M+H⁺]): 619.9833, found 619.9826.

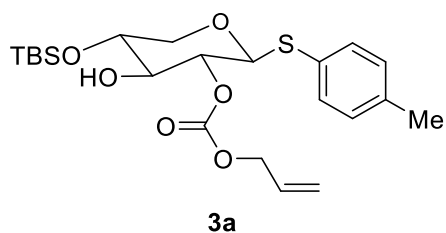


N-bromosuccinimide (2.05 g, 11.57 mmol) was added into a solution of **4** (3.5 g, 5.78 mmol) in acetone/H₂O (60 mL, 6:1). The reaction mixture was stirred at this temperature for 1 hour. The reaction mixture was quenched with saturated NaHCO₃ (20 mL), and the aqueous layer was extracted with dichloromethane (60 mL). The organic layer washed with saturated brine (30 mL). The combined organic layer was dried over Na₂SO₄ and concentrated under reduced pressure. The

residue was purified by column chromatography (ethyl acetate –hexanes, 1: 3) giving the desired compound **5** (2.07 g, 70%) as a yellow oil. ^1H NMR (600 MHz, CDCl_3) δ 8.05 (d, $J = 8.4$ Hz, 4H, $4 \times \text{ArH}$), 6.92 (d, $J = 8.8$ Hz, 4H, $4 \times \text{ArH}$), 5.28-5.26 (m, 1H), 4.86-4.83 (m, 1H), 4.14 (t, $J = 6.4$ Hz, 1H), 3.87 (t, $J = 5.4$ Hz, 1H), 3.88 (s, 3H), 3.84-3.68 (m, 2H), 3.64-3.56 (m, 1H), 3.43 (dd, $J_1 = 12.0$ Hz, $J_2 = 6.0$ Hz, 1H), 2.98 (d, $J = 6.8$ Hz, 1H), 0.94-0.89 (m, 1H), 0.85 (s, 15H), 0.65-0.58 (m, 1H), 0.14 (s, 3H), 0.85 (s, 3H), 0.03 (s, 3H), 0.01 (s, 3H); ^{13}C NMR (150 MHz, CDCl_3) δ 165.3, 163.4, 135.9, 132.0, 131.1, 128.8, 127.1, 122.4, 113.4, 86.8, 72.7, 72.0, 70.5, 65.3, 55.4, 25.8, 18.1, 6.84, 4.81, -4.4, -4.7. HRMS(ESI) m/z calcd for $\text{C}_{25}\text{H}_{44}\text{O}_7\text{Si}_2$ ($[\text{M}+\text{H}^+]$): 513.7973, found 513.7968.

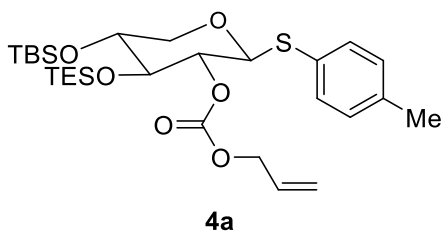


1,8-diazabicyclo[5.4.0]undec-7-ene (114 mg, 0.75 mmol) was added into a solution of **5** (2.0 g, 3.87 mmol) and trichloroacetonitrile (1 mL) in dry dichloromethane (30 mL). The reaction mixture was stirred at this temperature overnight. The reaction mixture was concentrated under reduced pressure. The residue was purified by column chromatography (EtOAc-hexanes-triethylamine, 1: 4:0.1) giving the desired compound **6** (1.98g, 78%) as a yellow oil.



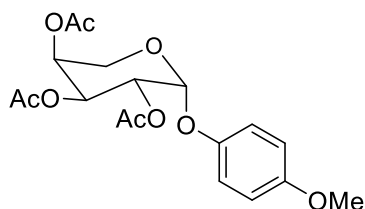
Allyl chloroformate (0.78 g, 6.47 mmol) in dichloromethane was slowly dropped into a solution of compound **2a** (2.0 g, 5.39 mmol), 4-(dimethylamino)pyridine (66 mg, 0.54 mmol) and dry triethylamine (0.6 g, 5.93 mmol) in dry dichloromethane (60 mL). The reaction mixture was stirred at room temperature for 2 hours. The reaction mixture was quenched with saturated ammonium chloride (60 mL), and the aqueous layer was extracted with dichloromethane (40 mL) and then washed with saturated brine (60 mL). The combined organic layer was dried over Na_2SO_4

and concentrated under reduced pressure. The residue was purified by column chromatography (ethyl acetate –hexanes, 1: 3) giving the desired compound **3a** (1.86 g, 76%) as a yellow oil. ^1H NMR (600 MHz, CDCl_3) δ 7.40 (d, $J = 7.8$ Hz, 2H, $2 \times \text{ArH}$), 7.12 (d, $J = 7.8$ Hz, 2H, $2 \times \text{ArH}$), 5.98 (ddt, $J_1 = 17.2$ Hz, $J_2 = 10.8$ Hz, $J_3 = 5.6$ Hz, 1H, $\text{CH}_2=\text{CH}-\text{CH}_2-$), 5.42 (d, $J = 17.2$ Hz, 1H, $\text{CH}_2=\text{CH}-\text{CH}_2-$), 5.31 (d, $J = 10.8$ Hz, 1H, $\text{CH}_2=\text{CH}-\text{CH}_2-$), 4.77-4.68 (m, 2H, $\text{CH}_2=\text{CH}-\text{CH}_2-$), 4.62 (t, $J = 9.6$ Hz, 1H, H-2), 4.57 (d, $J = 10.2$ Hz, 1H, H-1), 3.93 (dd, $J_1 = 11.4$ Hz, $J_2 = 5.4$ Hz, 1H, H-6), 3.69-3.65 (m, 1H, H-4), 3.61 (t, $J = 9.0$ Hz, 1H, H-3), 3.20 (t, $J = 10.2$ Hz, 1H, H-5), 2.35 (s, 3H, CH_3), 0.88 (s, 9H, $(\text{CH}_3)_3\text{C}-\text{Si}$), 0.11 (s, 3H, CH_3-Si), 0.08 (s, 3H, CH_3-Si); ^{13}C NMR (150 MHz, CDCl_3) δ 154.5, 138.3, 133.3, 131.3, 129.7, 128.5, 119.0, 86.9, 77.1, 75.8, 71.1, 69.9, 68.9, 25.6, 21.1, 17.9, -4.5, -4.6. HRMS(ESI) m/z calcd for $\text{C}_{22}\text{H}_{34}\text{O}_6\text{SSi}$ ($[\text{M}+\text{K}^+]$): 493.6162, found 493.6169.



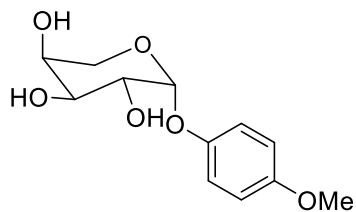
Triethylsilyl trifluoromethanesulfonate (1.74 g, 6.59 mmol) was added in one portion to a solution of compound **3a** (1.5 g, 3.29 mmol), 4-(dimethylamino)pyridine (40 mg, 0.33 mmol) and triethylamine (0.49 g, 4.94 mmol) in dry dimethylformamide (30 mL). The reaction mixture was stirred at 30°C - 40°C for 4 hours. The reaction mixture was quenched with saturated ammonium chloride (40 mL). The aqueous layer was extracted with dichloromethane (100 mL) and then washed with saturated brine (60 mL). The combined organic layer was dried over Na_2SO_4 and concentrated under reduced pressure. The residue was purified by column chromatography (silica, Ethyl acetate –hexanes, 1: 6) giving the desired compound **4a** (1.44 g, 77%) as a yellow oil. ^1H NMR (600 MHz, CDCl_3) δ 7.39 (d, $J = 7.8$ Hz, 2H, $2 \times \text{ArH}$), 7.10 (d, $J = 7.8$ Hz, 2H, $2 \times \text{ArH}$), 5.97 (ddt, $J_1 = 16.8$ Hz, $J_2 = 10.8$ Hz, $J_3 = 6.0$ Hz, 1H, $\text{CH}_2=\text{CH}-\text{CH}_2-$), 5.41 (d, $J = 16.8$ Hz, 1H, $\text{CH}_2=\text{CH}-\text{CH}_2-$), 5.30 (d, $J = 10.8$ Hz, 1H, $\text{CH}_2=\text{CH}-\text{CH}_2-$), 4.77 (d, $J = 7.8$ Hz, 1H, H-1), 4.69 (dq, $J_1 = 13.2$ Hz, $J_2 = 5.4$ Hz, 2H, $\text{CH}_2=\text{CH}-\text{CH}_2-$), 4.62 (t, $J = 7.8$ Hz, 1H, H-2), 4.12

(dd, $J_1 = 12.0$ Hz, $J_2 = 4.2$ Hz, 1H, H-6), 3.71 (t, $J = 7.2$ Hz, 1H, H-3), 3.65-3.62 (m, 1H, H-4), 3.24 (dd, $J_1 = 12.0$ Hz, $J_2 = 8.4$ Hz, 1H, H-5), 2.33 (s, 3H, CH₃), 0.97 (t, $J = 8.4$ Hz, 9H, CH₃CH₂-), 0.89 (s, 9H, (CH₃)₃C-Si), 0.60 (q, $J = 7.8$ Hz, 6H, CH₃CH₂-), 0.09 (s, 6H, CH₃-Si); ¹³C NMR (150 MHz, CDCl₃) 154.3, 137.7, 132.3, 131.4, 130.7, 129.6, 118.9, 87.4, 76.5, 74.7, 70.9, 68.7, 67.9, 25.9, 21.1, 18.0, 6.9, 4.9, -4.2, -4.6. HRMS(ESI) m/z calcd for C₂₈H₄₈O₆SSi₂ ([M+H⁺]): 569.9233, found 569.9239.



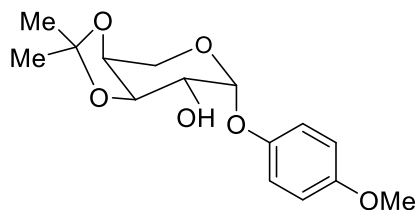
8

Boron trifluoride diethyl etherate (6.0 mL) in dichloromethane was slowly dropped into a solution of **7** (8.0 g, 25.56 mmol), 4-methoxyphenol (6.34 g, 51.12 mmol) in dry dichloromethane (200 mL) at 0°C. The reaction mixture was stirred at room temperature for 4 days hours. The reaction mixture was quenched with triethylamine (20 mL), and then diluted with dichloromethane (200 mL) then washed with saturated brine (200 mL). The combined organic layer was dried over Na₂SO₄ and concentrated under reduced pressure. The residue was purified by column chromatography (ethyl acetate –hexanes, 1: 4) giving the desired compound **8** (5.95 g, 57%) as a yellow oil. ¹H NMR (400 MHz, CDCl₃) δ 6.99 (d, $J = 8.8$ Hz, 2H, 2 × ArH), 6.83 (d, $J = 8.8$ Hz, 2H, 2 × ArH), 5.66 (d, $J = 7.6$ Hz, 1H, H-1), 5.57 (dd, $J_1 = 10.8$ Hz, $J_2 = 3.2$ Hz, 1H, H-3), 5.42-5.41 (m, 1H, H-4), 5.31 (dd, $J_1 = 10.8$ Hz, $J_2 = 3.2$ Hz, 1H, H-2), 4.10 (d, $J = 12.8$ Hz, 1H, H-6), 3.78-3.73 (m, 4H, H-5, CH₃O-), 2.21 (s, 3H, CH₃C=O-), 2.13 (s, 3H, CH₃C=O-), 2.06 (s, 3H, CH₃C=O-); ¹³C NMR (100 MHz, CDCl₃) δ 170.4, 170.3, 170.1, 155.3, 150.4, 117.8, 114.7, 95.9, 69.0, 68.1, 67.1, 61.1, 55.6, 20.9, 20.73, 20.7. HRMS(ESI) m/z calcd for C₁₈H₂₂O₉ ([M+H⁺]): 383.3725, found 383.3727.



9

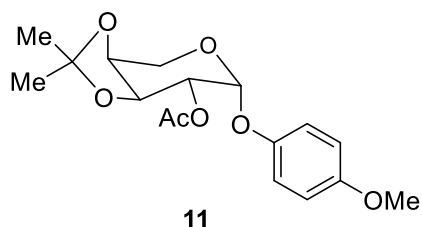
Sodium methoxide (113 mg, 2.09 mmol) was added into a solution of **8** (8.0 g, 20.92 mmol) in dry methanol (200 mL) at 0°C. The reaction mixture was stirred at room temperature overnight. The reaction mixture was concentrated under reduced pressure. The residue was purified by column chromatography (100% Ethyl acetate) and gave desired compound **9** (4.82 g, 90%) as white solid. ¹H NMR (600 MHz, Methanol-d₆) δ 7.06 (d, *J* = 8.4 Hz, 2H, 2 × ArH), 6.85 (d, *J* = 8.4 Hz, 2H, 2 × ArH), 5.39 (d, *J* = 3.0 Hz, 1H, H-1), 3.99-3.93 (m, 4H, H-2, H-3, H-4, H-6), 3.76 (s, 3H, CH₃O-), 3.66 (d, *J* = 12.0 Hz, 1H, H-5); ¹³C NMR (100 MHz, Methanol-d₆) δ 155.2, 151.3, 117.9, 114.1, 99.3, 69.4, 69.2, 68.8, 63.4, 54.7. HRMS(ESI) *m/z* calcd for C₁₂H₁₆O₆ ([M+H⁺]): 257.2615, found 257.2602.



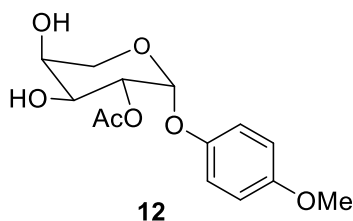
10

p-Toluenesulfonic acid monohydrate (297 mg, 1.56 mmol) added into a solution of **9** (4.0 g, 15.61 mmol), 2,2-dimethoxypropane (16.23 g, 156.09 mmol) in dry acetone (100 mL) at 0°C. The reaction mixture was stirred at room temperature overnight. The reaction mixture was quenched with triethylamine (20 mL), and then diluted with dichloromethane (200 mL) then washed with saturated brine (200 mL). The combined organic layer was dried over Na₂SO₄ and concentrated under reduced pressure. The residue was purified by column chromatography (ethyl acetate – hexanes, 1: 3) gave desired compound **10** (3.84 g, 83%) as a yellow oil. ¹H NMR (600 MHz, CDCl₃) δ 7.03 (d, *J* = 9.0 Hz, 2H, 2 × ArH), 6.84 (d, *J* = 9.0 Hz, 2H, 2 × ArH), 5.41 (d, *J* = 3.0 Hz, 1H, H-1), 4.36 (d, *J* = 6.6 Hz, 1H, H-3), 4.30 (d, *J* = 5.4 Hz, 1H, H-4), 4.10 (d, *J* = 13.2 Hz, 1H,

H-6), 4.00 (d, $J = 13.8$ Hz, 1H, H-5), 3.94-3.92 (m, 1H, H-2), 3.78 (s, 3H, CH_3O-), 1.57 (s, 3H, CH_3), 1.40 (s, 3H, CH_3); ^{13}C NMR (150 MHz, $CDCl_3$) δ 155.3, 150.4, 117.8, 114.7, 109.4, 97.4, 72.9, 70.2, 60.2, 55.6, 27.9, 25.9. HRMS(ESI) m/z calcd for $C_{15}H_{20}O_6$ ($[M+H^+]$): 297.3265, found 297.3259.

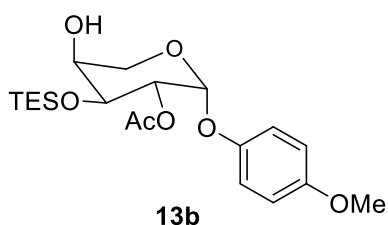
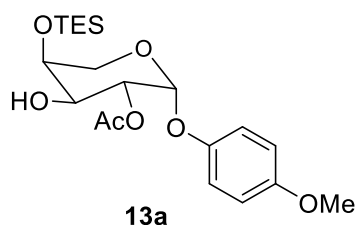


Acetic anhydride (2.07 g, 20.25 mmol) was added in one portion to a solution of compound **10** (3.0 g, 6.75 mmol) in dry pyridine (30 mL). The reaction mixture was stirred at room temperature overnight. The reaction mixture was evaporated, and then diluted with the dichloromethane (100 mL), then washed with saturated brine (80 mL). The combined organic layer was dried over Na_2SO_4 and concentrated under reduced pressure. The residue was purified by column chromatography (ethyl acetate –hexanes, 1: 4) giving the desired compound **11** (5.02 g, 88%) as a yellow oil. 1H NMR (600 MHz, $CDCl_3$) δ 6.99 (d, $J = 8.4$ Hz, 2H, $2 \times ArH$), 6.83 (d, $J = 8.4$ Hz, 2H, $2 \times ArH$), 5.52 (d, $J = 3.0$ Hz, 1H, H-1), 5.02 (dd, $J_1 = 7.8$ Hz, $J_2 = 3.6$ Hz, 1H, H-2), 4.53 (dd, $J_1 = 7.8$ Hz, $J_2 = 6.0$ Hz, 1H, H-3), 4.33 (d, $J = 5.4$ Hz, 1H, H-4), 4.07 (s, 2H, H-5, H-6), 3.78 (s, 3H, CH_3O-), 2.14 (s, 3H, CH_3), 1.58 (s, 3H, CH_3), 1.40 (s, 3H, CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.6, 155.2, 150.5, 117.6, 114.7, 109.6, 95.4, 73.4, 72.9, 72.0, 59.2, 55.7, 27.9, 26.3, 20.9. HRMS(ESI) m/z calcd for $C_{17}H_{22}O_7$ ($[M+Na^+]$): 361.3452, found 361.3459.



A solution of compound **11** (4.0 g, 11.82 mmol) in 70% $AcOH/H_2O$ (60 mL) was stirred at $70^\circ C - 80^\circ C$ for 3 hours. The reaction mixture was evaporated, and then diluted with the dichloromethane

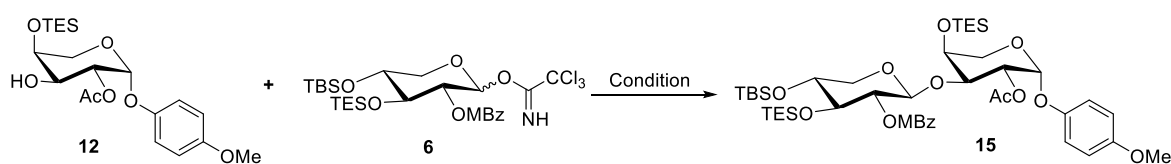
(60 mL) then washed with saturated brine (30 mL). The combined organic layer was dried over Na_2SO_4 and concentrated under reduced pressure. The residue was purified by column chromatography (ethyl acetate – hexanes, 1: 3) giving the desired compound **12** (3.03 g, 86%) as a yellow oil. ^1H NMR (400 MHz, CDCl_3) δ 6.99 (d, $J = 9.0$ Hz, 2H, $2 \times \text{ArH}$), 6.83 (d, $J = 9.0$ Hz, 2H, $2 \times \text{ArH}$), 5.58 (d, $J = 3.0$ Hz, 1H, H-1), 5.15 (dd, $J_1 = 10.2$ Hz, $J_2 = 3.0$ Hz, 1H, H-2), 4.25 (d, $J = 7.8$ Hz, 1H, H-3), 4.10 (s, 1H, H-4), 4.03 (d, $J = 12.6$ Hz, 1H, H-6), 3.82 (d, $J = 12.6$ Hz, 1H, H-5), 3.77 (s, 3H, CH_3O -), 2.97 (s, 2H, $2 \times \text{OH}$), 2.16 (s, 3H, CH_3); ^{13}C NMR (150 MHz, CDCl_3) δ 171.6, 155.2, 150.6, 117.9, 114.6, 96.2, 71.8, 69.3, 67.8, 62.8, 55.6, 20.9. HRMS(ESI) m/z calcd for $\text{C}_{14}\text{H}_{18}\text{O}_7$ ($[\text{M}+\text{Na}^+]$): 321.2802, found 321.2793.



Trimethylsilyl trifluoromethanesulfonate (2.46 g, 11.06 mmol) in dichloromethane was slowly dropped into a solution of **12** (3.0 g, 10.06 mmol), triethylamine (1.22 g, 12.07 mmol) in dichloromethane (60 mL) at -78 °C. The reaction mixture was stirred at this temperature for 2 hours. The reaction mixture was quenched with saturated ammonium chloride (30 mL), and the aqueous layer was extracted with dichloromethane (60 mL). The organic layer washed with saturated brine (40 mL). The combined organic layer was dried over Na_2SO_4 and concentrated under reduced pressure. The residue was purified by column chromatography (Ethyl acetate – hexanes, 1: 4) giving the desired compound **13a** (1.2 g, 19%) and **13b** (2.4 g, 72%) as a yellow oil. **13a**: ^1H NMR (600 MHz, CDCl_3) δ 6.99 (d, $J = 9.0$ Hz, 2H, $2 \times \text{ArH}$), 6.83 (d, $J = 9.0$ Hz, 2H, $2 \times \text{ArH}$), 5.54 (d, $J = 3.0$ Hz, 1H, H-1), 5.12 (dd, $J_1 = 9.6$ Hz, $J_2 = 3.0$ Hz, 1H, H-2), 4.12-4.07 (m, 2H, H-3, H-4), 3.95 (d, $J = 12.6$ Hz, 1H, H-6), 3.78 (s, 3H, CH_3O -), 3.69 (d, $J = 12.6$ Hz, 1H, H-5), 2.25 (s, 1H, OH), 2.15 (s, 3H, CH_3), 1.00 (t, $J = 7.8$ Hz, 9H, CH_3CH_2 -), 0.67 (q, $J = 7.8$ Hz, 6H, CH_3CH_2 -); ^{13}C NMR (100 MHz, CDCl_3) δ 171.2, 155.1, 150.8, 118.0, 114.6, 96.5, 71.3, 70.6, 67.9, 63.8, 55.6, 21.0, 6.7, 4.9. **13b**: ^1H NMR (600 MHz, CDCl_3) δ 6.99 (d, $J = 9.0$ Hz, 2H, $2 \times$

ArH), 6.83 (d, $J = 9.0$ Hz, 2H, $2 \times$ ArH), 5.54 (d, $J = 3.0$ Hz, 1H, H-1), 5.16 (dd, $J_1 = 9.6$ Hz, $J_2 = 3.0$ Hz, 1H, H-2), 4.32 (dd, $J_1 = 14.4$ Hz, $J_2 = 5.4$ Hz, 1H, H-4), 3.97-3.92 (m, 2H, H-3, H-6), 3.85 (dd, $J_1 = 18.6$ Hz, $J_2 = 2.4$ Hz, 1H, H-5), 3.77 (s, 3H, CH₃O-), 2.79 (d, $J = 2.4$ Hz, 1H, OH), 2.15 (s, 3H, CH₃-), 1.01 (t, $J = 7.8$ Hz, 9H, CH₃CH₂-), 0.68 (q, $J = 7.8$ Hz, 6H, CH₃CH₂-); ¹³C NMR (100 MHz, CDCl₃) δ 171.2, 155.1, 150.8, 117.9, 114.6, 96.5, 71.3, 70.6, 67.9, 63.8, 55.6, 21.0, 6.6, 4.8. HRMS(ESI) m/z calcd for C₂₀H₃₂O₇Si ([M+Na⁺]): 435.5432, found 435.5439.

Table S3 Optimization of the glycosylation reaction.

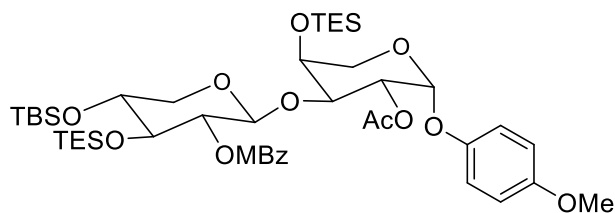


Entry	Acid	4Å MS	Solvent	Temperature	Yield
1	0.1eq TMSOTf	Powder	DCM	-78°C	46%
2	0.3eq TMSOTf	Powder	DCM	-78°C	36%
3	0.1eq BF ₃ ·Et ₂ O	Powder	DCM	-78°C	72%
4	0.05eq BF ₃ ·Et ₂ O	Powder	DCM	-78°C	54%
5	0.3eq BF ₃ ·Et ₂ O	Powder	DCM	-78°C	56%
6	0.1eq BF ₃ ·Et ₂ O	Beads	DCM	-78°C	41%
7	0.1eq BF₃·Et₂O	Powder	DCM	-60°C	78%
8	0.1eq BF ₃ ·Et ₂ O	Powder	DCM	-25°C	37%

Reaction condition: BF₃·Et₂O (0.1 eq), 4Å MS, DCM, -60°C, 1.5h

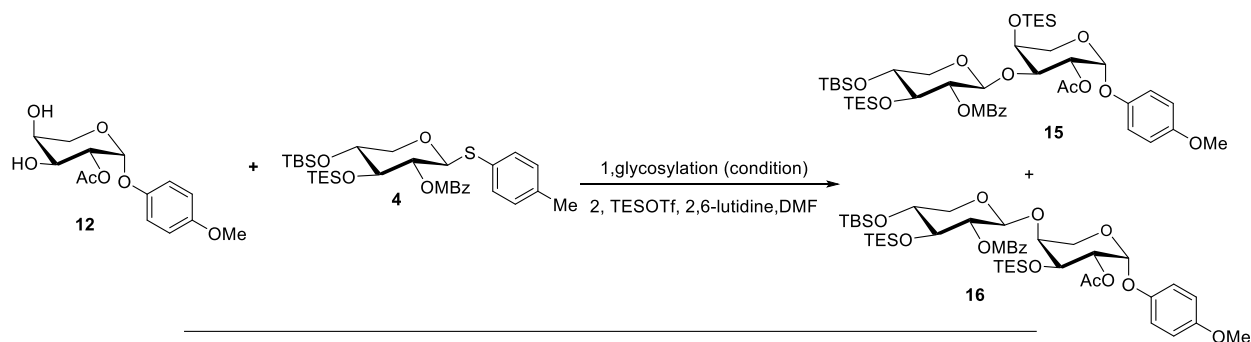
Generally, the catalytic amount of TMSOTf and BF₃·Et₂O are typical for glycosylation. For optimization of the glycosylation reaction, we used compound **12** (donor) and compound **6** (acceptor) as standard substrates (Table S3). Initially, we tested different equivalents of TMSOTf, and only obtained a low yield of compound **15** (Entries 1 and 2). Fortunately, 0.1 equivalent of BF₃·Et₂O at -78°C produced the required compound **15** in a yield of 72% (Entry 3). Next, the different equivalent of BF₃·Et₂O was screened, and no matter increases or decreases the equivalent, the yield of compound **15** remained poor (Entries 4-5). Replacing the 4Å MS powder with 4Å MS beads resulted in an extremely less efficient reaction (Entry 6). Moreover, raising the temperature from -78°C to -60°C increased the yield of compound **15** to 78% (Entry 7). Unfortunately, the

temperature cannot be raised to -25°C , which can decrease the yield of compound **15** to 37% (Entry 8).



15

Method 1: The acceptor **7** (900 mg, 1.38 mmol), donor **13a** (200 mg, 0.46 mmol) and 4Å MS powder (300 mg) were dissolved in dry dichloromethane (10 mL). The reaction mixture was stirred at room temperature for 2 hours, and then cold down to -60°C . Boron trifluoride diethyl etherate (17 μL , 0.05 mmol) in dichloromethane was slowly dropped into this mixture and stirred at -60°C for 3 hours. The reaction mixture was quenched with triethylamine and filtered 4Å MS. The organic solvent was concentrated under reduced pressure. The residue was purified by column chromatography (ethyl acetate-hexanes, 1: 4) giving the desired compound **15** (326 mg, 78%) as a yellow oil. ^1H NMR (400 MHz, CDCl_3) δ 7.96 (d, $J = 8.8$ Hz, 2H, $2 \times \text{ArH}$), 6.88 (d, $J = 8.0$ Hz, 4H, $4 \times \text{ArH}$), 6.77 (d, $J = 9.2$ Hz, 2H, $2 \times \text{ArH}$), 5.53 (d, $J = 3.2$ Hz, 1H, H-1'), 5.09 (dd, $J_1 = 10.0$ Hz, $J_2 = 3.6$ Hz, 1H), 5.03 (t, $J = 8.0$ Hz, 1H), 4.79 (d, $J = 7.2$ Hz, 1H), 4.17 (s, 1H), 4.11 (dd, $J_1 = 9.6$ Hz, $J_2 = 2.8$ Hz, 1H), 3.96 (dd, $J_1 = 11.6$ Hz, $J_2 = 4.8$ Hz, 1H), 3.89-3.69 (m, 10H), 3.54 (dd, $J_1 = 11.6$ Hz, $J_2 = 2.4$ Hz, 1H), 3.29 (dd, $J_1 = 11.6$ Hz, $J_2 = 9.6$ Hz, 1H), 1.78 (s, 3H), 0.98 (t, $J = 8.0$ Hz, 9H), 0.91 (s, 9H), 0.86 (t, $J = 8.0$ Hz, 9H), 0.68-0.61 (m, 6H), 0.56-0.49 (m, 6H), 0.14 (s, 3H), 0.12 (s, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ 170.0, 164.5, 163.3, 154.9, 150.7, 131.6, 122.8, 117.9, 114.5, 113.4, 102.5, 96.1, 75.7, 74.6, 71.9, 70.5, 65.9, 64.7, 55.8, 55.3, 25.9, 20.5, 18.1, 6.8, 6.7, 5.1, 4.8, -4.0, -4.6. HRMS(ESI) m/z calcd for $\text{C}_{45}\text{H}_{74}\text{O}_{13}\text{Si}_3$ ($[\text{M}+\text{H}^+]$): 908.3365, found 908.3371.

Table S4 Optimization of the glycosylation reaction.

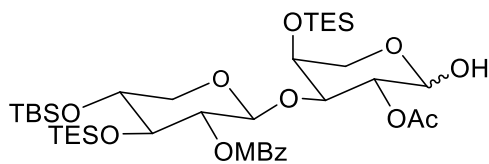
Entry	Acid	NIS/NBS	Compound 4	Temperature	Yield
1	0.1eq BF ₃ ·Et ₂ O	NIS	2.0eq	-60°C	50% 15 + 15% 16
2	0.1eq BF ₃ ·Et ₂ O	NBS	2.0eq	-60°C	31% 15 + 12% 16
3	0.1eq BF ₃ ·Et ₂ O	NIS	2.0eq	-78°C	46% 15 + 11% 16
4	0.1eq BF ₃ ·Et ₂ O	NIS	2.0eq	-40°C	56% 15 + 20% 16
5	0.3eq BF ₃ ·Et ₂ O	NIS	2.0eq	-40°C	41% 15 + 14% 16
6	0.05eq BF ₃ ·Et ₂ O	NIS	2.0eq	-40°C	59% 15 + 18% 16
7	0.05eq BF₃·Et₂O	NIS	3.0eq	-40°C	68% 15 + 16% 16
8	0.05eq BF ₃ ·Et ₂ O	NIS	4.0eq	-40°C	61% 15 + 14% 16
9	0.05eq BF ₃ ·Et ₂ O	NIS	3.0eq	-25°C	56% 15 +23% 16

Reaction condition: a, NIS(3.0eq), BF₃·Et₂O (0.05eq), 4Å MS, DCM, -40°C, 4h; b, TESOTf (1.5 eq), 2,6-lutidine (2.0 eq), room temperature, DMF, 2h

For optimization of the one pot of glycosylation reaction, we used compound **12** (Acceptor) and compound **4** (Donor) as standard substrates (Table S4). First, we used the optimal reaction condition in Table S3, entry 7. Unfortunately, 0.1 equivalent of BF₃·Et₂O and 3.0 equivalent of NBS generated just a 16% yield of compound **15** (Entry 1). Replacing the NBS with NIS resulted in an extremely improved yield of the product (Entry 2). The yield of the product decreased when the temperature was lowered to -78°C, while the ratio of compound **15** to compound **16** increased to 3:1 (Entry 3). Fortunately, raising the temperature to -40°C, the yield of compound **15** was increased to 55% (Entry 4). Next, a brief equivalent of BF₃·Et₂O screening was undertaken, and the high equivalent of BF₃·Et₂O resulted in a low yield of the product (Entry 5). Additionally, we found various byproducts on TLC plate staining. We guess the TBS and TES group on xylose part were likely to be deprotected by the high equivalent of BF₃·Et₂O, and these byproducts will be glycosylated with compound **4**. The yield of product increased when the equivalent of BF₃·Et₂O was reduced to 0.05 equivalent (Entry 6). Moreover, increasing the equivalent of compound **4**

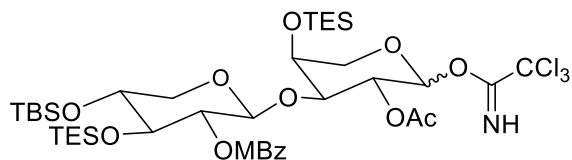
exhibited that both yield and the ratio of the product are increased (Entries 7 and 8). Unfortunately, the reaction temperature raised to -25°C , the yield and the ratio of product both decreased (Entry 9).

Method 2: The acceptor **4** (1.55 g, 2.5 mmol), donor **12** (400 mg, 1.25 mmol) and 4Å MS powder (500 mg) were dissolved in dry dichloromethane (20 mL). The reaction mixture was stirred at room temperature for 2 hours, and then cold down to -60°C . Boron trifluoride diethyl etherate (17 μL , 0.05 mmol) and N-iodosuccinimide (675 mg, 3.0 mmol) in dichloromethane was slowly dropped into this mixture and stirred at -60°C for 3 hours. The reaction mixture was quenched with triethylamine (500 mg, 5.0 mmol) and then triethylsilyl trifluoromethanesulfo-nate (600 mg, 2.5 mmol) in dichloromethane was slowly dropped into this reaction. The mixture was stirred at this temperature for 2 hours. The reaction mixture was quenched with saturated ammonium chloride (20 mL), and the aqueous layer was extracted with dichloromethane (20 mL). The organic layer washed with saturated brine (10 mL). The combined organic layer was dried over Na_2SO_4 and concentrated under reduced pressure. The residue was purified by column chromatography (ethyl acetate –hexanes, 1: 4) giving the desired compound **15** (738 mg, 65%) as a yellow oil. ^1H NMR (400 MHz, CDCl_3) δ 7.96 (d, $J = 8.8$ Hz, 2H, $2 \times \text{ArH}$), 6.88 (d, $J = 8.0$ Hz, 4H, $4 \times \text{ArH}$), 6.77 (d, $J = 9.2$ Hz, 2H, $2 \times \text{ArH}$), 5.53 (d, $J = 3.2$ Hz, 1H, H-1'), 5.09 (dd, $J_1 = 10.0$ Hz, $J_2 = 3.6$ Hz, 1H), 5.03 (t, $J = 8.0$ Hz, 1H), 4.79 (d, $J = 7.2$ Hz, 1H), 4.17 (s, 1H), 4.11 (dd, $J_1 = 9.6$ Hz, $J_2 = 2.8$ Hz, 1H), 3.96 (dd, $J_1 = 11.6$ Hz, $J_2 = 4.8$ Hz, 1H), 3.89-3.69 (m, 10H), 3.54 (dd, $J_1 = 11.6$ Hz, $J_2 = 2.4$ Hz, 1H), 3.29 (dd, $J_1 = 11.6$ Hz, $J_2 = 9.6$ Hz, 1H), 1.78 (s, 3H), 0.98 (t, $J = 8.0$ Hz, 9H), 0.91 (s, 9H), 0.86 (t, $J = 8.0$ Hz, 9H), 0.68-0.61 (m, 6H), 0.56-0.49 (m, 6H), 0.14 (s, 3H), 0.12 (s, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ 170.0, 164.5, 163.3, 154.9, 150.7, 131.6, 122.8, 117.9, 114.5, 113.4, 102.5, 96.1, 75.7, 74.6, 71.9, 70.5, 65.9, 64.7, 55.8, 55.3, 25.9, 20.5, 18.1, 6.8, 6.7, 5.1, 4.8, -4.0, -4.6. HRMS(ESI) m/z calcd for $\text{C}_{45}\text{H}_{74}\text{O}_{13}\text{Si}_3$ ($[\text{M}+\text{H}^+]$): 908.3365, found 908.3371.



17

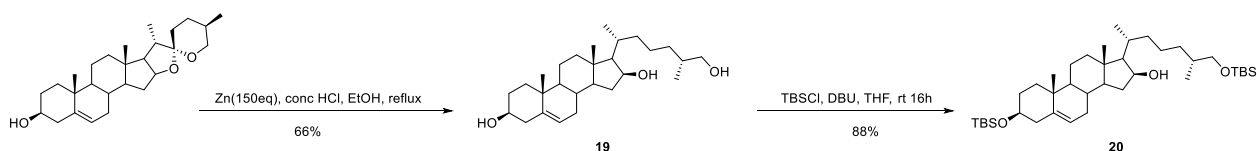
Ammonium cerium (IV) nitrate (1.09 g, 1.98 mmol) was added into a solution of **15** (1.2 g, 1.32 mmol) in acetonitrile /H₂O (40 mL, 4:1). The reaction mixture was stirred at this temperature for 10 mins. The reaction mixture was quenched with saturated NaHCO₃ (20 mL), and the aqueous layer was extracted with dichloromethane (60 mL). The organic layer washed with saturated brine (30 mL). The combined organic layer was dried over Na₂SO₄ and concentrated under reduced pressure. The residue was purified by column chromatography (ethyl acetate - hexanes, 1: 4) and gave desired compound **17** (677 mg, 64%) as yellow oil. ¹H NMR (400 MHz, CDCl₃) δ 7.97 (d, *J* = 8.8 Hz, 2H, 2 × Ar*H*), 6.90 (d, *J* = 8.8 Hz, 2H, 2 × Ar*H*), 5.21 (s, 1H), 4.99 (t, *J* = 3.6 Hz, 1H), 4.95-4.88 (m, 1H), 4.71 (d, *J* = 6.8 Hz, 1H), 4.06 (s, 1H), 3.98-3.95 (m, 2H), 3.92-3.85 (m, 6H), 3.79-3.75 (m, 2H), 3.71-3.66 (m, 2H), 3.54 (dd, *J*₁ = 11.6 Hz, *J*₂ = 3.6 Hz, 1H), 3.22 (dd, *J*₁ = 11.6 Hz, *J*₂ = 8.8 Hz, 1H), 2.81 (d, *J* = 4.8 Hz, 1H), 1.87 (s, 3H), 0.96-0.84 (m, 27H), 0.68-0.62 (m, 6H), 0.61-0.53 (m, 6H), 0.14 (s, 3H), 0.12 (s, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 170.0, 164.6, 163.4, 163.3, 131.9, 131.7, 122.7, 122.3, 113.5, 113.4, 101.9, 90.9, 77.2, 75.2, 74.5, 73.9, 71.6, 70.9, 65.5, 64.2, 55.4, 25.9, 25.8, 20.6, 18.1, 6.8, 6.7, 5.1, 4.7, -4.1, -4.6. HRMS(ESI) *m/z* calcd for C₃₈H₆₈O₁₂Si₃ ([M+H⁺]): 802.2125, found 802.2129.



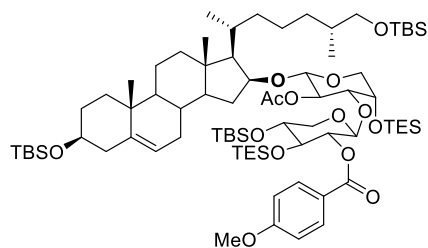
18

1,8-diazabicyclo[5.4.0]undec-7-ene (43 mg, 0.28 mmol) was added into a solution of **17** (0.9 g, 1.12 mmol), trichloroacetonitrile (0.8 g, 5.6 mmol) in dry dichloromethane (20 mL). The reaction mixture was stirred at this temperature overnight. The reaction mixture was concentrated under reduced pressure. The residue was purified by column chromatography (ethyl acetate-hexanes-

triethylamine, 1: 4:0.1) giving the desired compound **18** (942 mg, 89%) as yellow oil. ¹H NMR (400 MHz, CDCl₃) δ 8.50 (s, 1H), 7.96 (d, *J* = 8.4 Hz, 2H, 2 × *ArH*), 6.90 (d, *J* = 8.8 Hz, 2H, 2 × *ArH*), 6.42 (d, *J* = 3.2 Hz, 1H), 5.18 (dd, *J*₁ = 10.4 Hz, *J*₂ = 3.6 Hz, 1H), 4.99 (t, *J* = 7.6 Hz, 1H), 4.72 (d, *J* = 7.2 Hz, 1H), 4.21 (s, 1H), 4.01-3.93 (m, 3H), 3.87 (s, 3H), 3.84-3.76 (m, 2H), 3.73-3.65 (m, 2H), 3.25 (dd, *J*₁ = 11.6 Hz, *J*₂ = 9.2 Hz, 1H), 1.66 (s, 3H), 0.97 (t, *J* = 8.0 Hz, 9H), 0.92 (s, 9H), 0.88-0.84 (m, 9H), 0.68-0.63 (m, 6H), 0.55-0.49 (m, 6H), 0.13 (s, 3H), 0.12 (s, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 169.7, 164.4, 163.3, 160.9, 131.7, 122.8, 113.5, 102.7, 94.9, 91.2, 77.2, 75.5, 74.8, 74.1, 71.8, 70.2, 69.4, 66.6, 65.8, 55.4, 25.9, 20.2, 18.1, 6.9, 6.8, 5.1, 4.8, -4.0, -4.6.

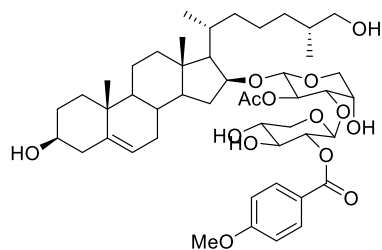


tert-Butyldimethylsilyl chloride (0.9 g, 5.98 mmol) in dichloromethane was slowly dropped into a solution of **19**^[1] (1.0 g, 2.39 mmol), 1,8-diazabicyclo [5.4.0]undec-7-ene (1.46 g, 9.55 mmol), 4-(dimethylamino)-pyridine (60 mg, 4.78 mmol) in dichloromethane (25 mL). The reaction mixture was stirred at this temperature for 2 hours. The reaction mixture was quenched with saturated ammonium chloride (40 mL), and the aqueous layer was extracted with dichloromethane (60 mL). The organic layer was washed with saturated brine (40 mL). The combined organic layer was dried over Na₂SO₄ and concentrated under reduced pressure. The residue was purified by column chromatography (ethyl acetate –hexanes, 1: 4) gave desired compound **20** (1.36 g, 88%) as a yellow oil. ¹H NMR (400 MHz, CDCl₃) δ 5.32 (d, *J* = 5.2 Hz, 1H, -CH=C), 4.37-4.34 (m, 1H, CH-OSi), 3.52-3.47 (m, 1H, CH-O), 3.44 (dd, *J*₁ = 9.6 Hz, *J*₂ = 6.0 Hz, 1H, CH₂-OSi), 3.36 (dd, *J*₁ = 9.6 Hz, *J*₂ = 6.4 Hz, 1H, CH₂-OSi), 2.31-2.15 (m, 3H), 2.03-1.97 (m, 2H), 1.87-1.78 (m, 2H), 1.74-1.71 (m, 1H), 1.62-1.47 (m, 6H), 1.44-1.27 (m, 4H), 1.22-0.98 (m, 12H), 0.92-0.85 (m, 24H), 0.06 (s, 6H, CH₃Si-), 0.04 (s, 6H, CH₃Si-); ¹³C NMR (100 MHz, CDCl₃) δ 141.7, 120.9, 72.6, 72.5, 68.5, 61.4, 54.6, 50.2, 42.8, 42.8, 42.2, 39.9, 37.3, 36.6, 36.3, 35.8, 33.6, 32.1, 31.8, 31.5, 29.8, 26.0, 25.9, 25.6, 23.8, 20.7, 19.4, 18.4, 18.3, 18.2, 16.7, 13.0, -4.5, -4.6, -5.3, -5.4. HRMS(ESI) *m/z* calcd for C₃₉H₇₄O₃Si₂ ([M+Na⁺]): 670.1772, found 670.1766.



21

Trimethylsilyl trifluoromethanesulfonate (5 μ L, 0.03 mmol) in dichloromethane was slowly dropped into a solution of **20** (850 mg, 0.9 mmol), donor **18** (200 mg, 0.3 mmol) in dry dichloromethane (10 mL) with 4Å MS at -60°C . The reaction mixture was stirred at -40°C for 3 hours. The reaction mixture was quenched with triethylamine (0.5 mL), and then diluted with dichloromethane (20 mL) then washed with saturated brine (10 mL). The combined organic layer was dried over Na_2SO_4 and concentrated under reduced pressure. The residue was purified by column chromatography (ethyl acetate –hexanes, 1: 4) gave desired compound **21** (262 mg, 61%) as a white powder. ^1H NMR (400 MHz, CDCl_3) δ 8.00 (d, $J = 8.8$ Hz, 2H, $2 \times \text{ArH}$), 6.89 (d, $J = 8.8$ Hz, 2H, $2 \times \text{ArH}$), 5.30 (d, $J = 3.6$ Hz, 1H, $-\text{CH}=\text{C}$), 5.03 (dd, $J_1 = 3.2$ Hz, $J_2 = 2.4$ Hz, 1H), 4.87-4.85 (m, 2H), 4.24 (d, $J = 3.6$ Hz, 1H), 4.19-4.13 (m, 1H), 4.04-4.03 (m, 1H), 3.89-3.86 (m, 5H), 3.83 (t, $J = 5.6$ Hz, 1H), 3.75-3.74 (m, 1H), 3.64-3.61 (m, 1H), 3.51-3.40 (m, 2H), 3.36-3.32 (m, 2H), 3.27 (dd, $J_1 = 11.6$ Hz, $J_2 = 6.4$ Hz, 1H), 2.28 (t, $J = 12.0$ Hz, 1H), 2.19-2.10 (m, 2H), 2.00-1.96 (m, 2H), 1.91 (s, 3H), 1.85-1.68 (m, 4H), 1.56-1.38 (m, 8H), 1.32-1.14 (m, 8H), 1.01-0.81 (m, 70H), 0.67-0.56 (m, 12H), 0.09 (s, 3H), 0.06 (s, 9H), 0.04 (s, 6H), 0.03 (s, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ 168.6, 164.6, 163.2, 141.6, 131.9, 122.8, 121.1, 113.3, 81.9, 77.2, 72.7, 68.6, 60.8, 55.3, 54.9, 50.3, 42.8, 42.1, 39.6, 37.4, 36.6, 36.3, 36.1, 35.9, 34.04, 32.1, 31.9, 31.6, 31.5, 29.7, 39.6, 36.0, 25.9, 25.8, 20.9, 20.8, 19.3, 18.4, 18.3, 18.2, 18.1, 16.7, 13.0, 6.9, 6.8, 4.9, 4.8, -4.2, -4.5, -4.6, -4.7, -5.2, -5.3. HRMS(ESI) m/z calcd for $\text{C}_{77}\text{H}_{140}\text{O}_{14}\text{Si}_5$ ($[\text{M}+\text{H}^+]$): 1431.3855, found 1431.3851.



WB-06

Pd(CH₃CN)Cl₂ (90 mg, 0.35 mmol) was added into a solution of **21** (200 mg, 0.14 mmol) in acetone/H₂O (5 mL) at room temperature. The reaction mixture was stirred at room temperature overnight. The reaction mixture was quenched with triethylamine (0.5 mL), and then diluted with dichloromethane (20 mL) then washed with saturated brine (10 mL). The combined organic layer was dried over Na₂SO₄ and concentrated under reduced pressure. The residue was purified by column chromatography (ethyl acetate –hexanes, 1: 4) and gave desired compound **WB-06** (102 mg, 85%) as a white powder. ¹H NMR (600 MHz, CDCl₃) δ 7.91 (d, *J* = 9.0 Hz, 2H, 2 × *ArH*), 6.91 (d, *J* = 9.0 Hz, 2H, 2 × *ArH*), 5.22 (d, *J* = 4.2 Hz, 1H, -CH=C-), 4.93 (t, *J* = 7.8 Hz, 1H), 4.82 (t, *J* = 7.8 Hz, 1H), 4.73 (d, *J* = 7.8 Hz, 1H), 4.58 (d, *J* = 7.2 Hz, 1H), 4.12 (d, *J* = 7.2 Hz, 1H), 3.92 (s, 1H), 3.87-3.84 (m, 2H), 3.88-3.85 (m, 4H), 3.66 (dd, *J*₁ = 9.6 Hz, *J*₂ = 3.0 Hz, 1H), 3.55-3.49 (m, 2H), 3.42 (d, *J* = 12.6 Hz, 1H), 3.31-3.21 (m, 3H), 2.13-2.00 (m, 3H), 1.87-1.82 (m, 2H), 1.75-1.67 (m, 1H), 1.68-1.66 (m, 2H), 1.43 (s, 3H), 1.39-1.29 (m, 6H), 1.25-1.13 (m, 6H), 1.12-1.01 (m, 8H), 0.91-0.78 (m, 11H); ¹³C NMR (100 MHz, CDCl₃) δ 171.0, 167.1, 165.3, 142.3, 133.1, 123.6, 122.3, 114.8, 104.3, 103.9, 82.5, 81.2, 75.8, 75.3, 72.4, 72.1, 71.0, 69.8, 68.5, 66.7, 66.4, 62.1, 60.0, 56.3, 56.1, 51.7, 43.3, 43.0, 41.0, 38.5, 37.7, 37.6, 37.5, 36.9, 36.3, 35.3, 32.9, 32.3, 30.6, 23.6, 21.9, 21.0, 19.8, 18.7, 17.3, 13.2. HRMS(ESI) *m/z* calcd for C₄₇H₇₀O₁₄ ([M+H⁺]): 860.0705, found 860.0711.

Cytotoxicity: The human ileocecal adenocarcinoma (HCT-8) cell line was purchased from American Type Culture Collection (American Type Culture Collection, Manassas, VA, USA). HCT-8 cells were cultured in Dulbecco's modified Eagle's medium (DMEM, ATCC) supplemented with 10% and 100 units/mL (U/mL) penicillin/streptomycin and incubated in a humidified atmosphere (5% CO₂) at 37 °C.

The human cervical cancer (Hela) cell line was purchased from American Type Culture Collection (American Type Culture Collection, Manassas, VA, USA). Hela cells were cultured in Dulbecco's modified Eagle's medium (DMEM, ATCC) supplemented with 10% and 100 units/mL (U/mL) penicillin/streptomycin and incubated in a humidified atmosphere (5% CO₂) at 37 °C.

The human breast cancer (MDA-MB-231) cell line was purchased from American Type Culture Collection (American Type Culture Collection, Manassas, VA, USA). MDA-MB-231 cells were cultured in Dulbecco's modified Eagle's medium (DMEM, ATCC) supplemented with 10% and 100 units/mL (U/mL) penicillin/streptomycin and incubated in a humidified atmosphere (5% CO₂) at 37 °C.

The human breast cancer (MCF-7) cell line was purchased from American Type Culture Collection (American Type Culture Collection, Manassas, VA, USA). MCF-7 cells were cultured in Dulbecco's modified Eagle's medium (DMEM, ATCC) supplemented with 10% and 100 units/mL (U/mL) penicillin/streptomycin and incubated in a humidified atmosphere (5% CO₂) at 37 °C.

The human ovarian cancer (SKOV-3) cell line was purchased from American Type Culture Collection (American Type Culture Collection, Manassas, VA, USA). MCF-10A cells were cultured in Dulbecco's modified Eagle's medium (DMEM, ATCC) supplemented with 10% and 100 units/mL (U/mL) penicillin/streptomycin and incubated in a humidified atmosphere (5% CO₂) at 37 °C.

The human epithelial (MCF-10A) cell line was purchased from American Type Culture Collection (American Type Culture Collection, Manassas, VA, USA). MCF-10A cells were cultured in Dulbecco's modified Eagle's medium (DMEM, ATCC) supplemented with 10% and 100 units/mL (U/mL) penicillin/streptomycin and incubated in a humidified atmosphere (5% CO₂) at 37 °C.

The human microglia clone 3 cell line (HMC-3) was purchased from American Type Culture Collection (American Type Culture Collection, Manassas, VA, USA). HMC₃ cells were cultured

in Eagle's Minimum Essential Media (EMEM, ATCC) supplemented with 10% and 100 units/mL (U/mL) penicillin/streptomycin and incubated in a humidified atmosphere (5% CO₂) at 37 °C.

AlamarBlue Cytotoxicity Assay: Cytotoxicity was evaluated using an alamarBlue (Sigma-Aldrich) assay. Cells were plated into a 96 well plate at a concentration of 5000 cells/well in medium with 10% fetal bovine serum (FBS) at 37 °C and 5% CO₂, and 24 h later, the cells were incubated with **WB-06** at different concentrations for 72 h. Taking out old medium after 72 h. Then medium/alamarBlue (10:1) fresh solution was added and incubated for 2-3 h. The absorbance (A) at a wavelength of 570 nm was measured with a Bio-Rad microplate reader. The relative cell viability (%) was calculated by $(A_{\text{sample}}/A_{\text{control}}) \times 100 \%$. All samples were done in triplicate and the experiment was replicated three times.

Reference

1. [a] Williams, J. R.; Chai, D.; Wright, D. *Steroids* 2002, **67**, 1041-1044. [b] D Zheng.; Y Guan.; X Chen.; Y Xu.; X Chen.; P Lei. *Bioorg.Med. Chem. Lett.* 2011, **21**, 3257–3260. [c] C Liu.; A Wang.; L Jin.; Y Guo.; Y Li.; Z Zhao.; P Lei. *Tetrahedron* 2016,**72**, 4091-4102.

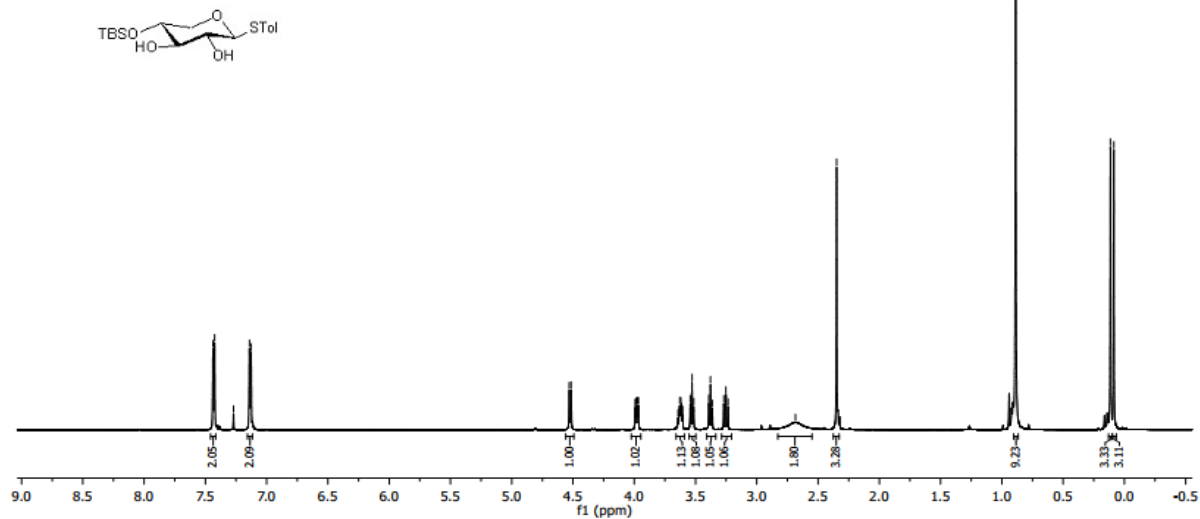
WB-04-37

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7.425
7.270
7.190
7.127

4.530
4.515
3.993
3.985
3.974
3.956
3.628
3.620
3.542
3.529
3.515
3.391
3.377
3.269
3.255
2.349

0.867
0.114
0.086

Figure S1. ^1H NMR of compound **2a**



WB-04-37

138.366
133.197
129.794
128.199

88.974
77.499
77.312
77.100
76.788
71.685
70.594

25.671
21.120
17.994

4.684
4.722

Figure S1. ^{13}C NMR of compound **2a**

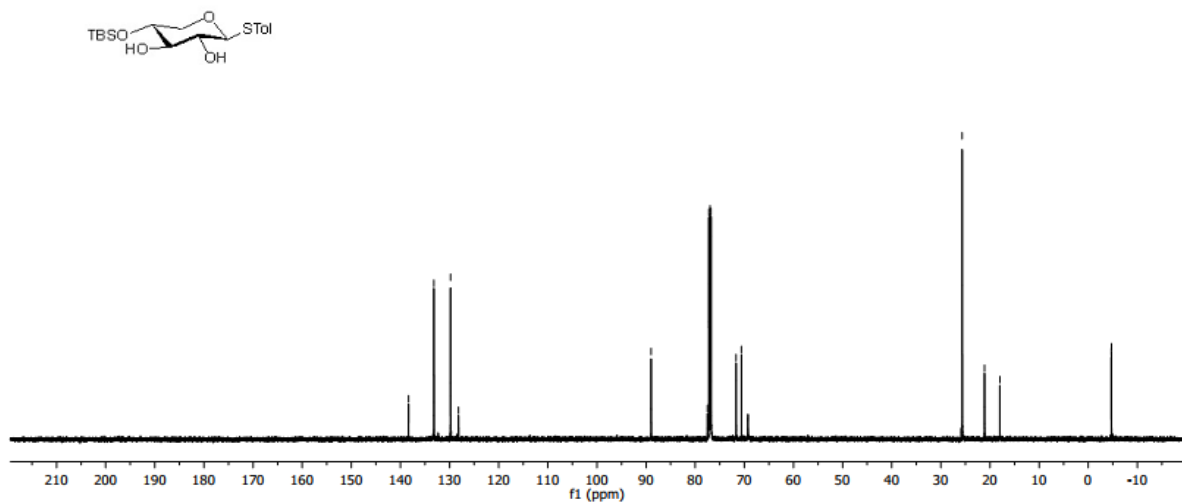
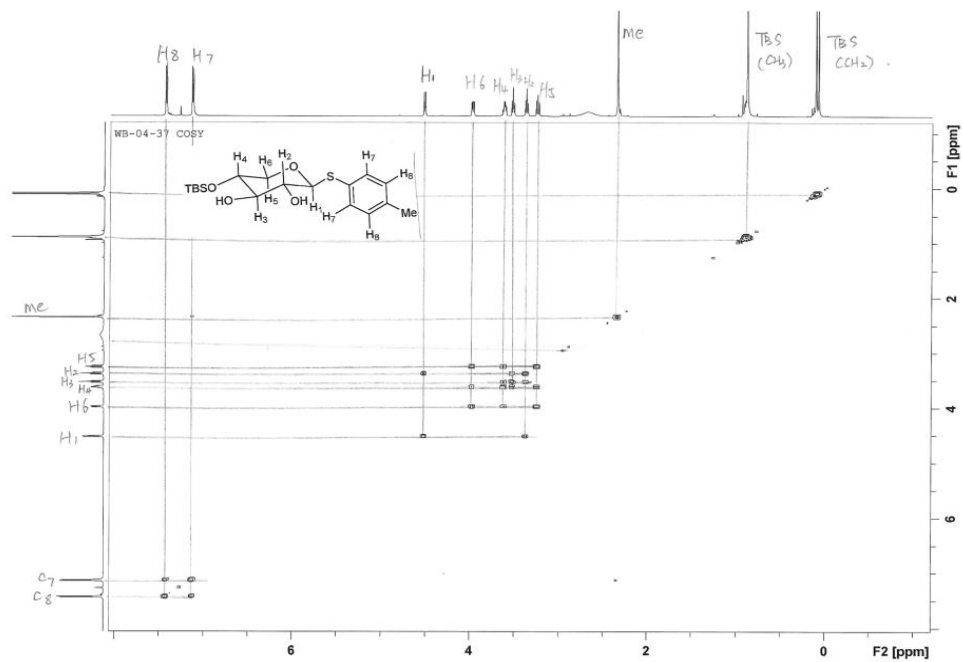
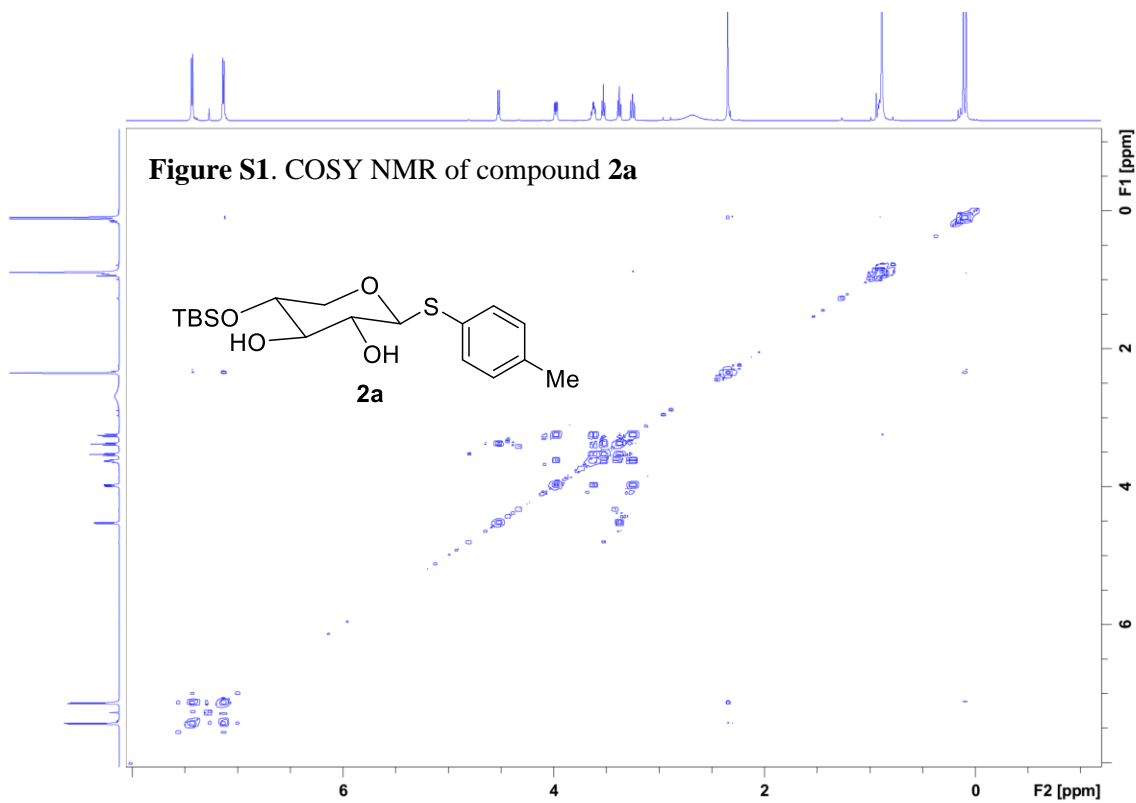
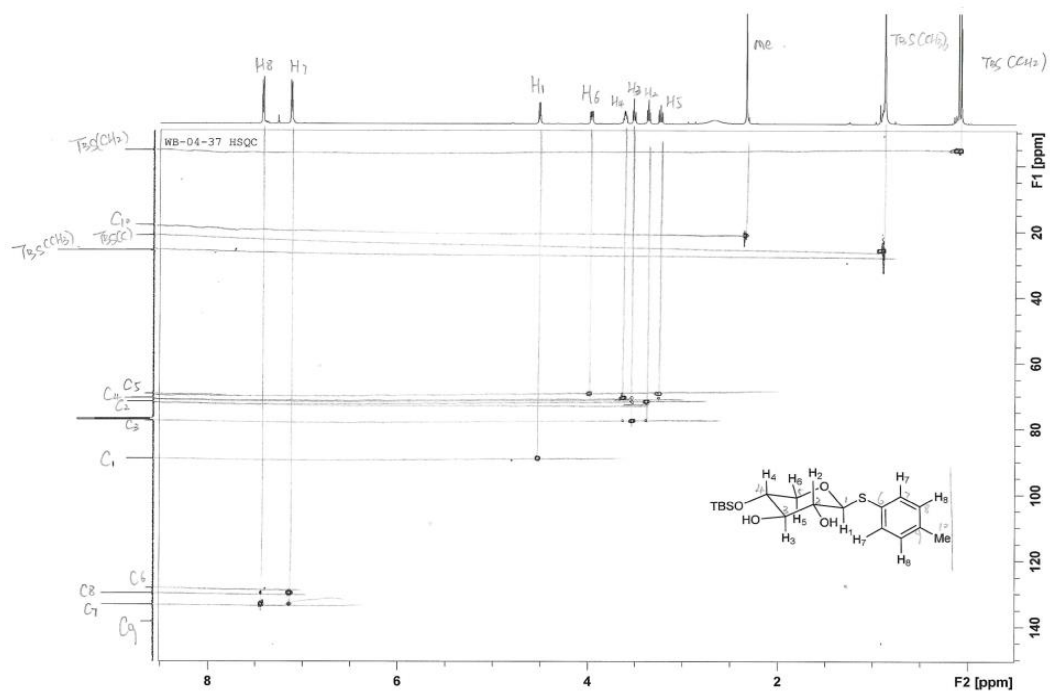
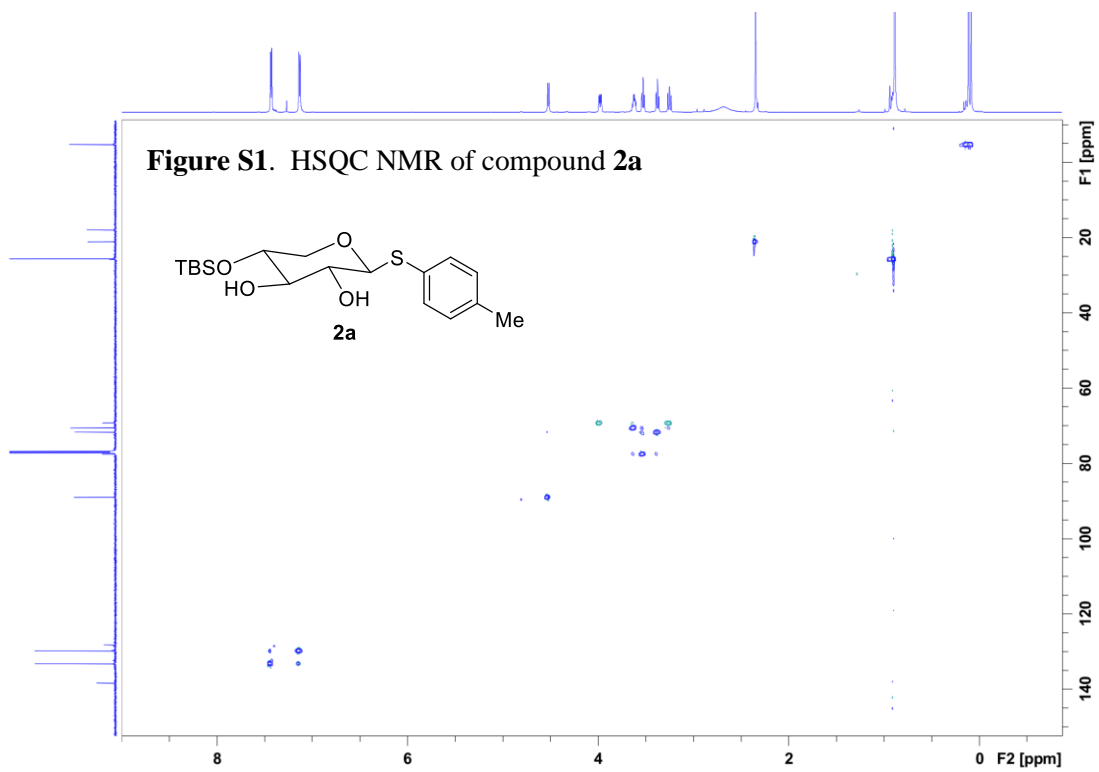
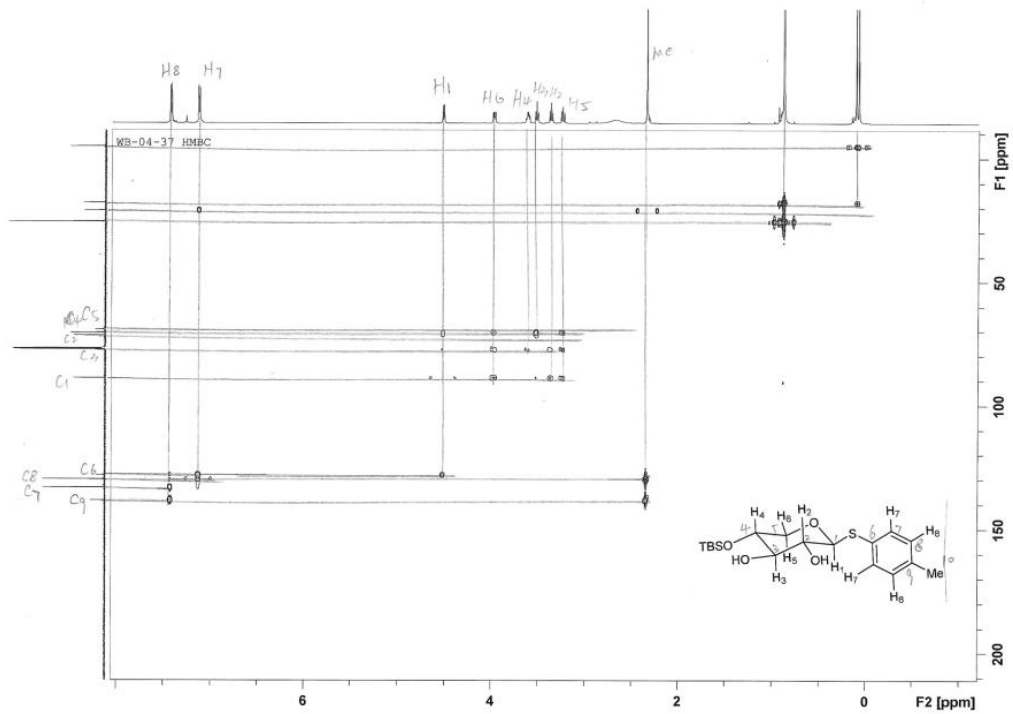
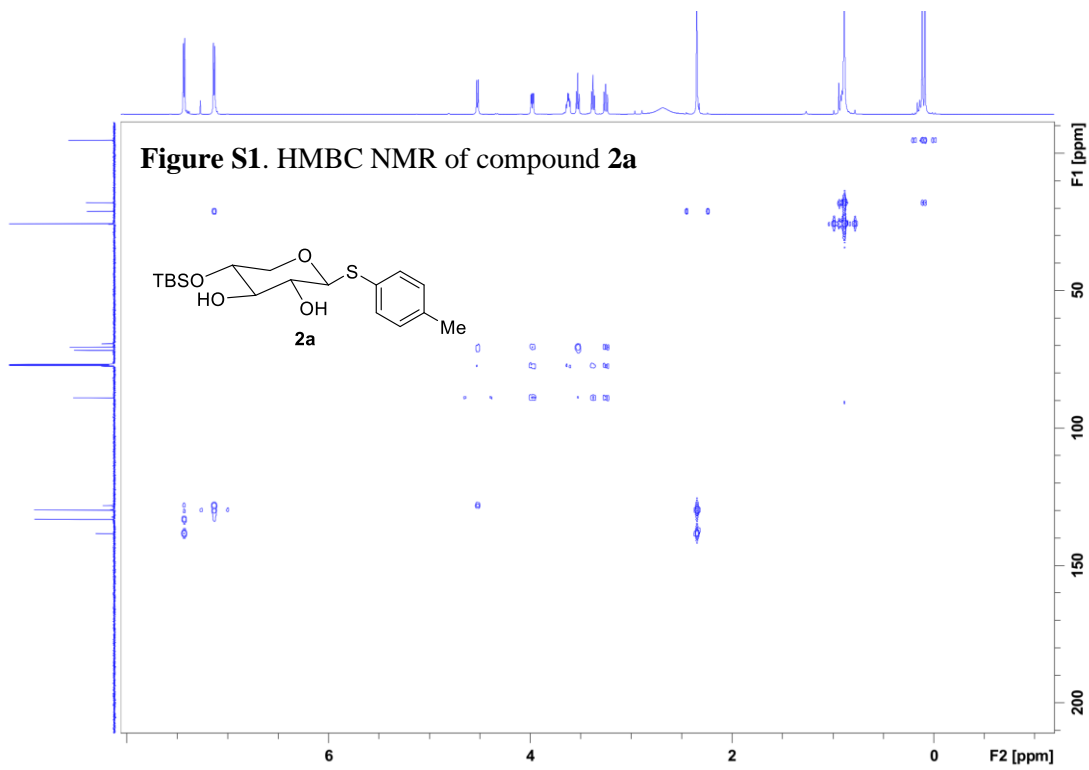


Figure S1. COSY NMR of compound 2a



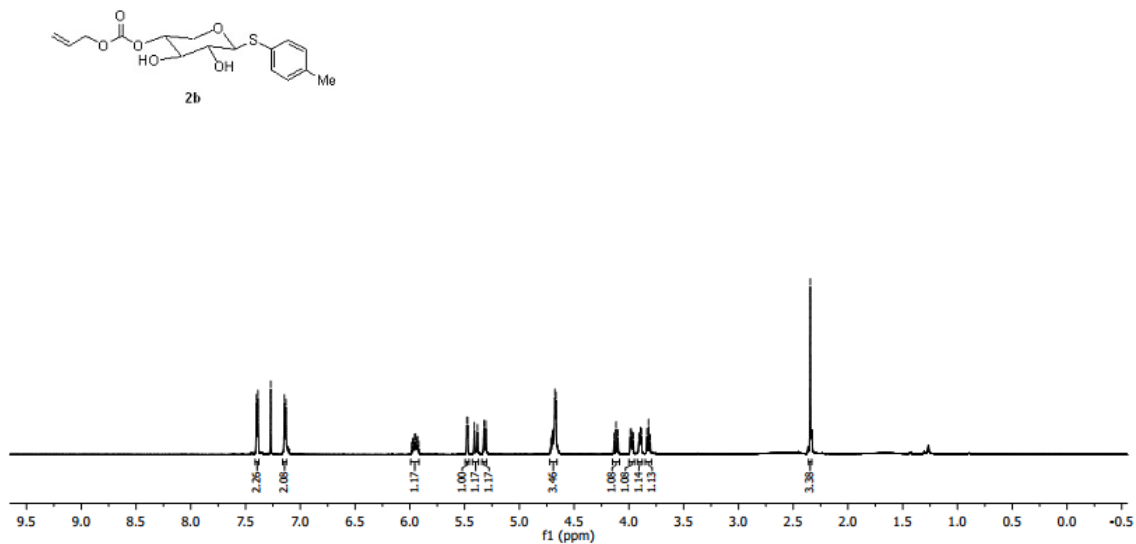




WB-05-31

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7.270
7.145
7.132
5.684
5.676
5.666
5.957
5.947
5.938
5.929
5.919
5.479
5.471
5.411
5.323
5.306
4.688
4.688
4.675
4.656
4.117
4.099
3.987
3.980
3.968
3.959
3.909
3.900
3.894
3.885
3.875
3.860
3.805
2.394

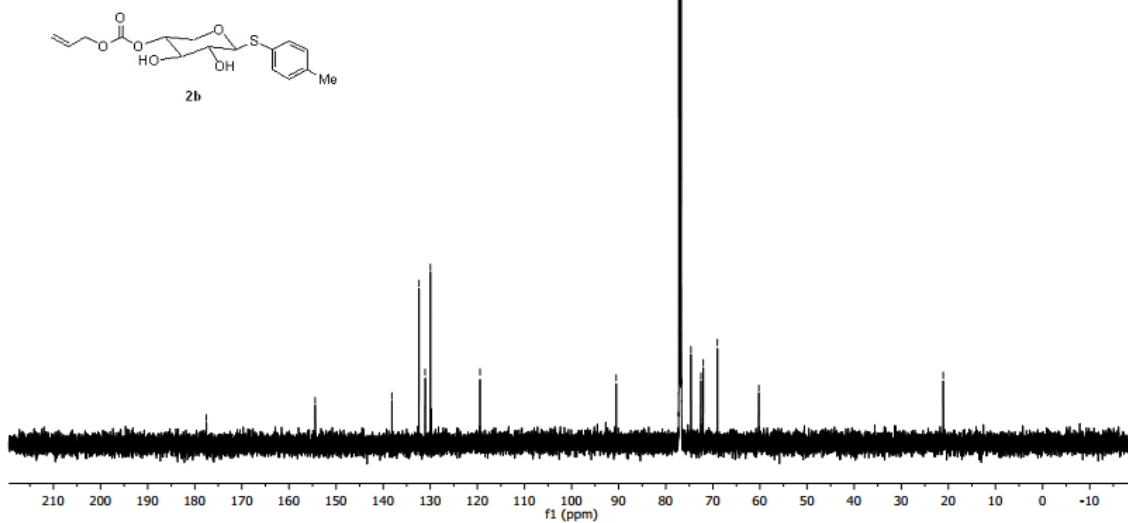
Figure S1. ^1H NMR of compound **2b**

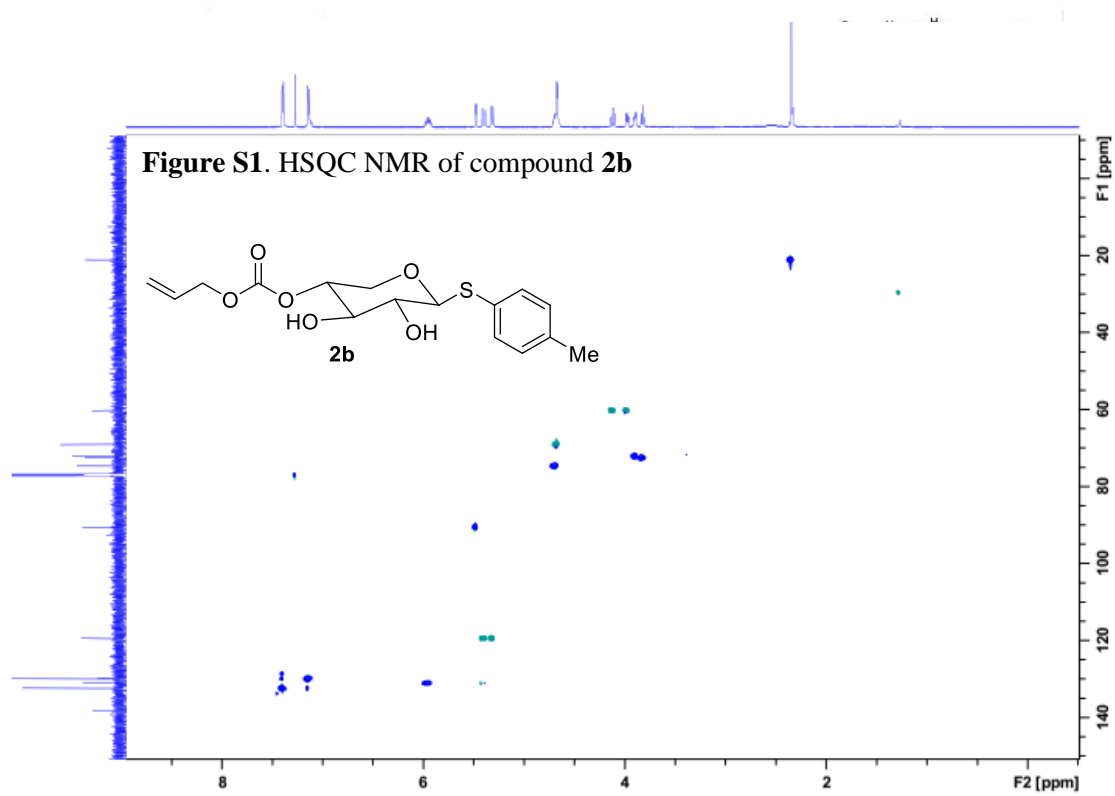
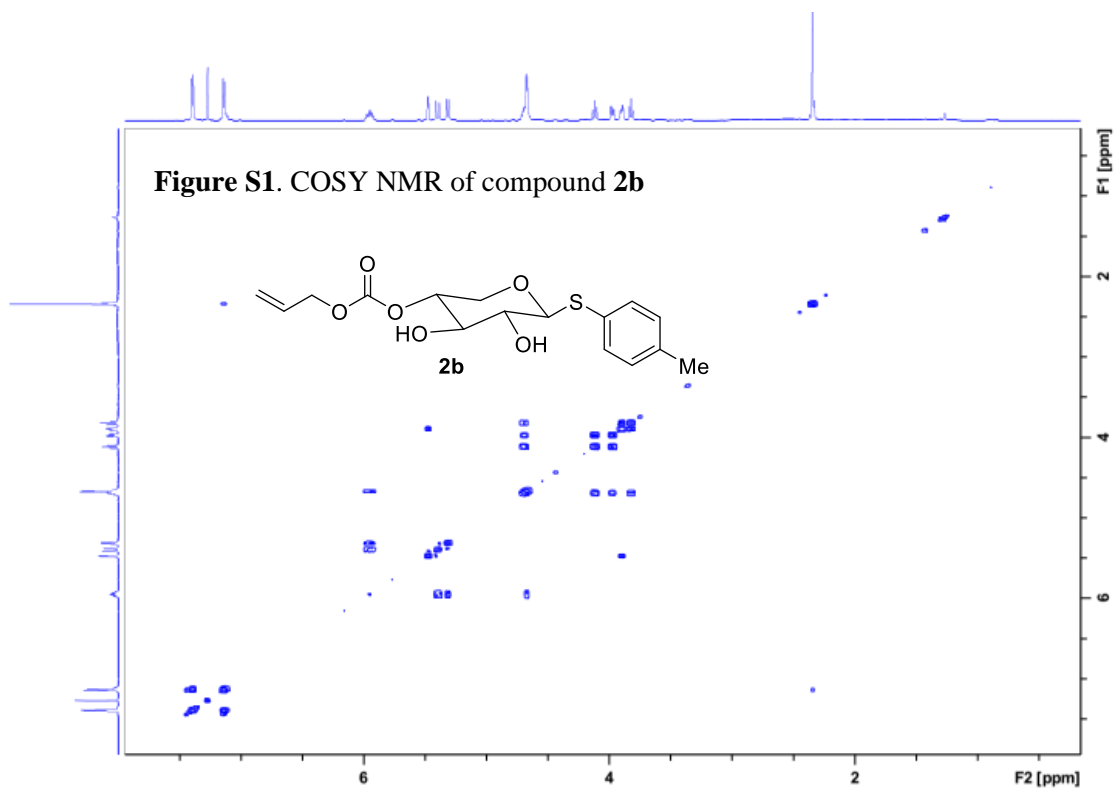


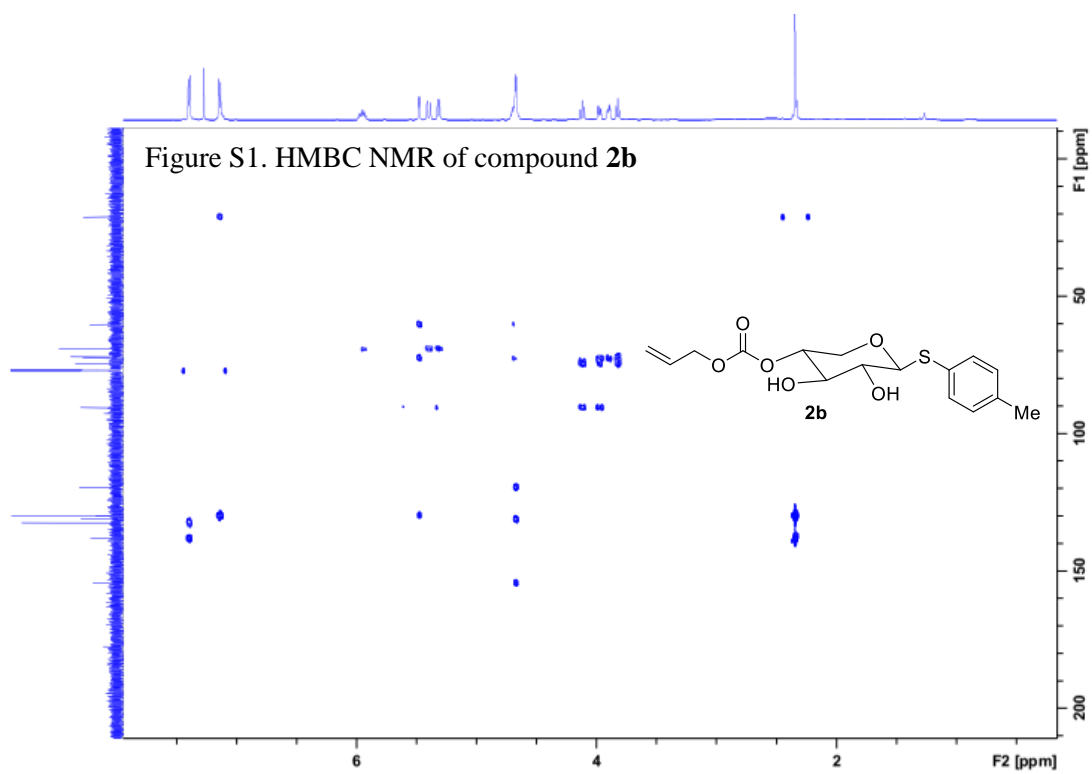
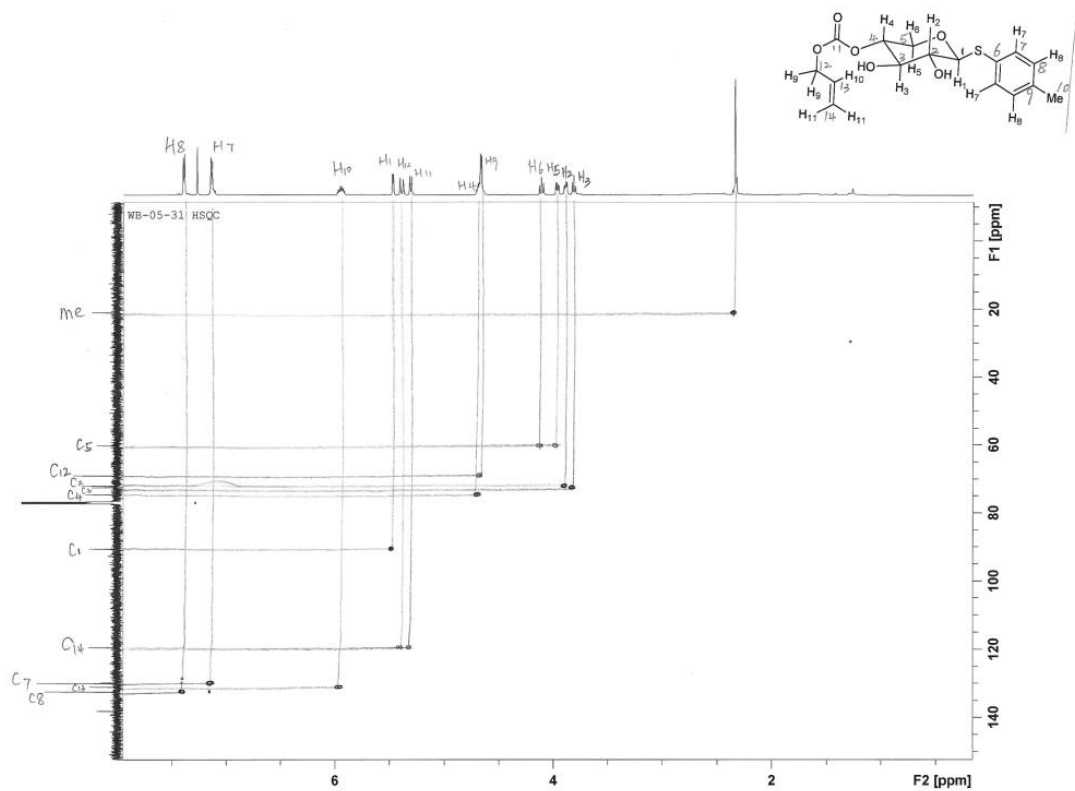
WB-05-31

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154424
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133432
131028
128970
119454
80.567
77.212
77.000
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74.444
72.544
72.058
69.047
60.259
21.100

Figure S1. ^{13}C NMR of compound **2b**





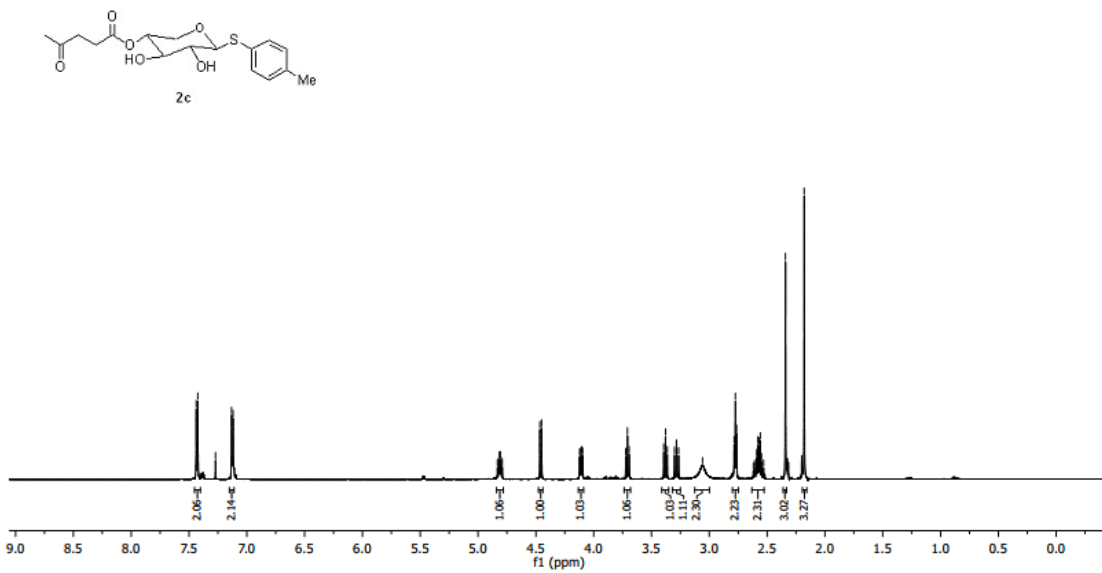


WB-04-77

7.637
7.628
7.130
7.119

4.832
4.815
4.815
4.807
4.800
4.791
4.680
4.660
4.122
4.113
4.103
4.094
3.708
3.693
3.394
3.379
3.364
3.284
3.283
3.283
2.774
2.764
2.619
2.609
2.596
2.580
2.570
2.560
2.549
2.342
2.179

Figure S1. ^1H NMR of compound **2c**



WB-04-77

207.223

172.323

138.578

133.586

129.776

127.457

88.444

77.212

76.280

76.280

75.303

71.840

71.168

66.344

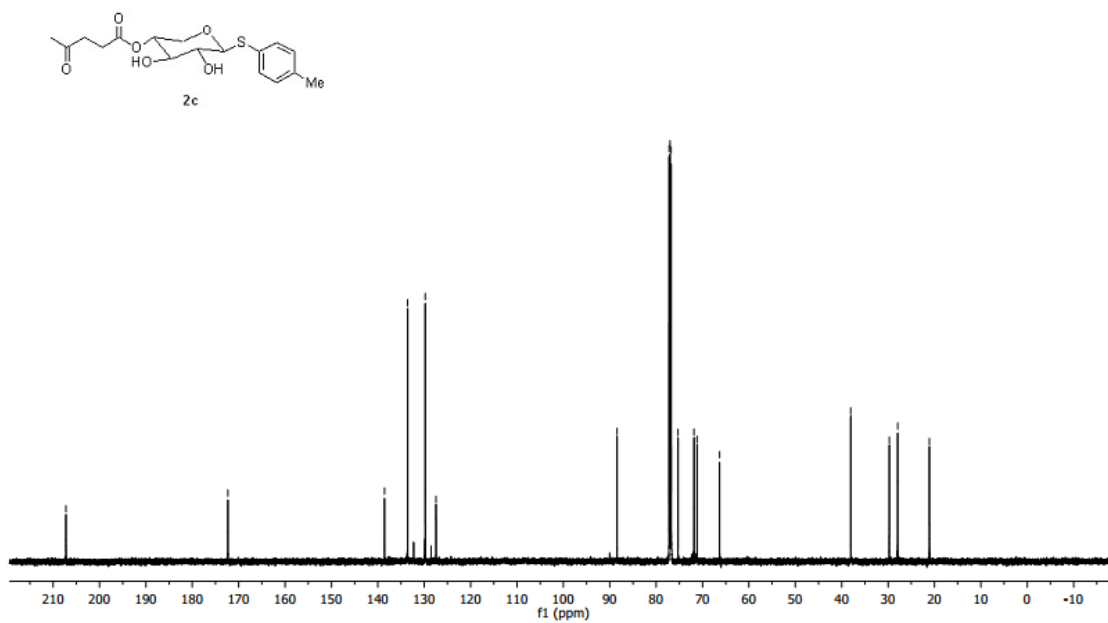
38.035

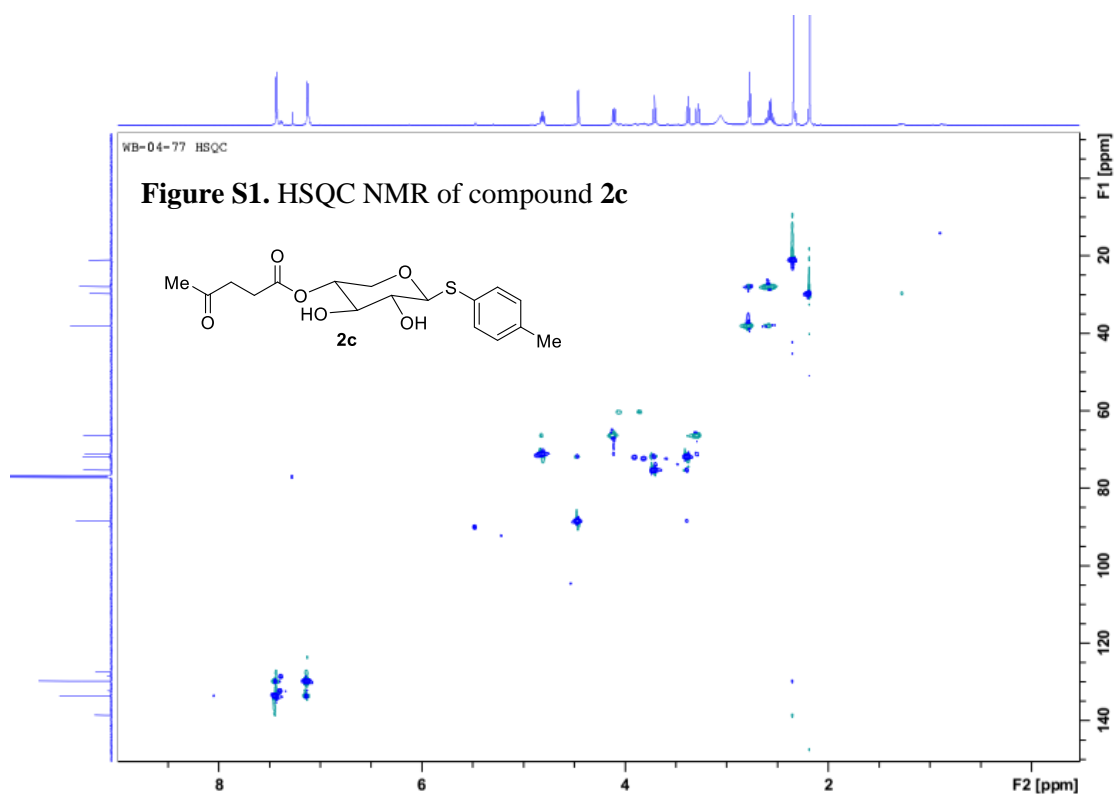
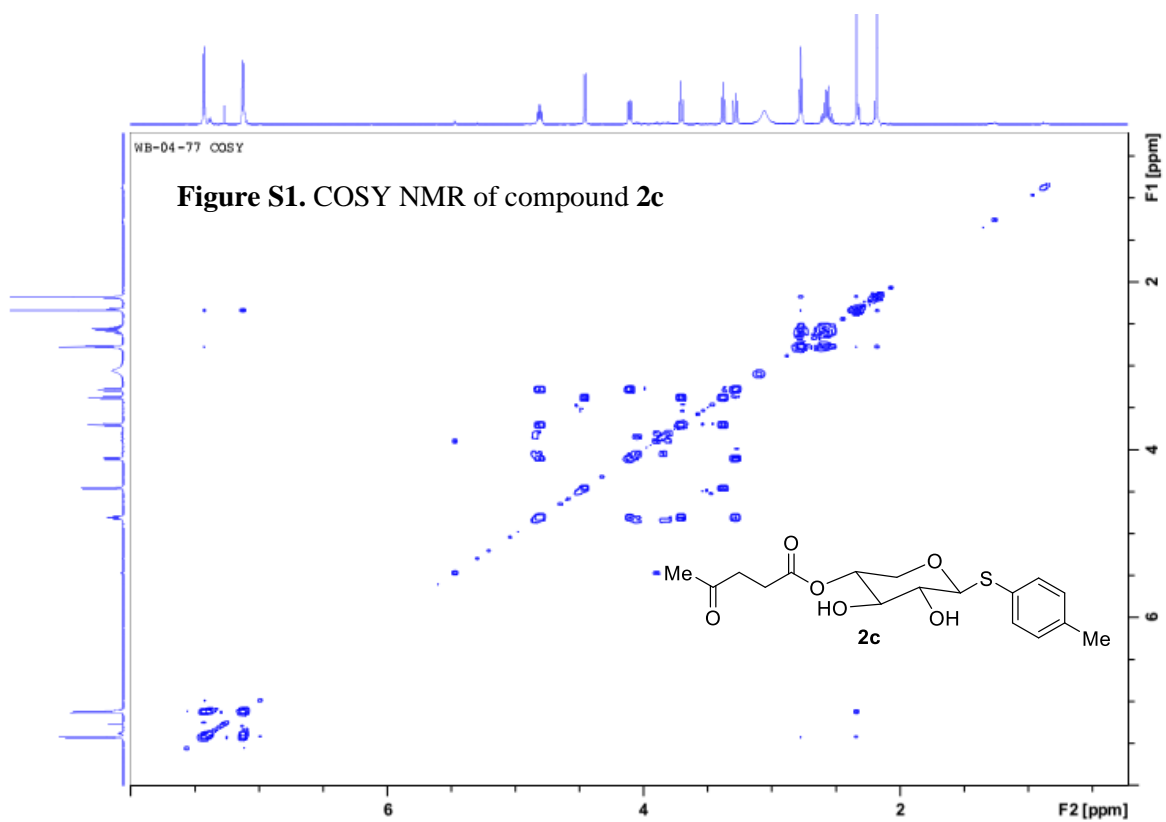
29.742

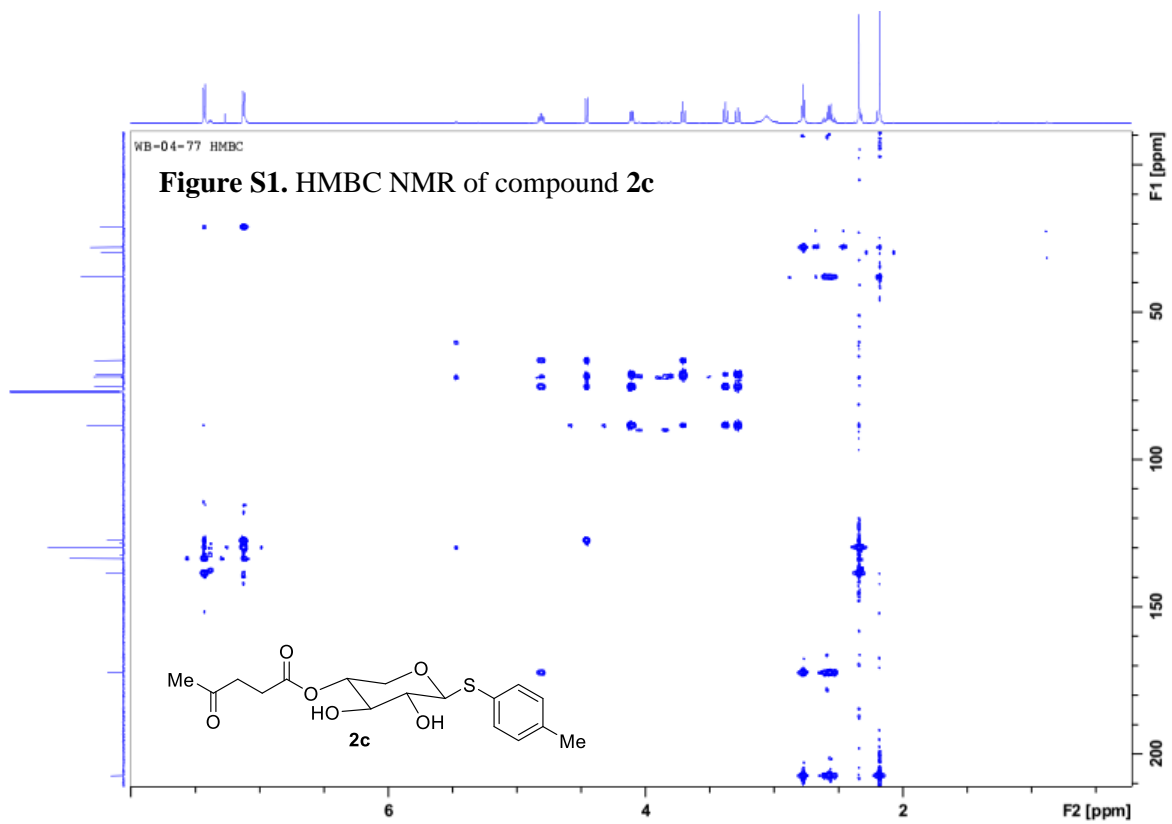
27.942

21.095

Figure S1. ^{13}C NMR of compound **2c**



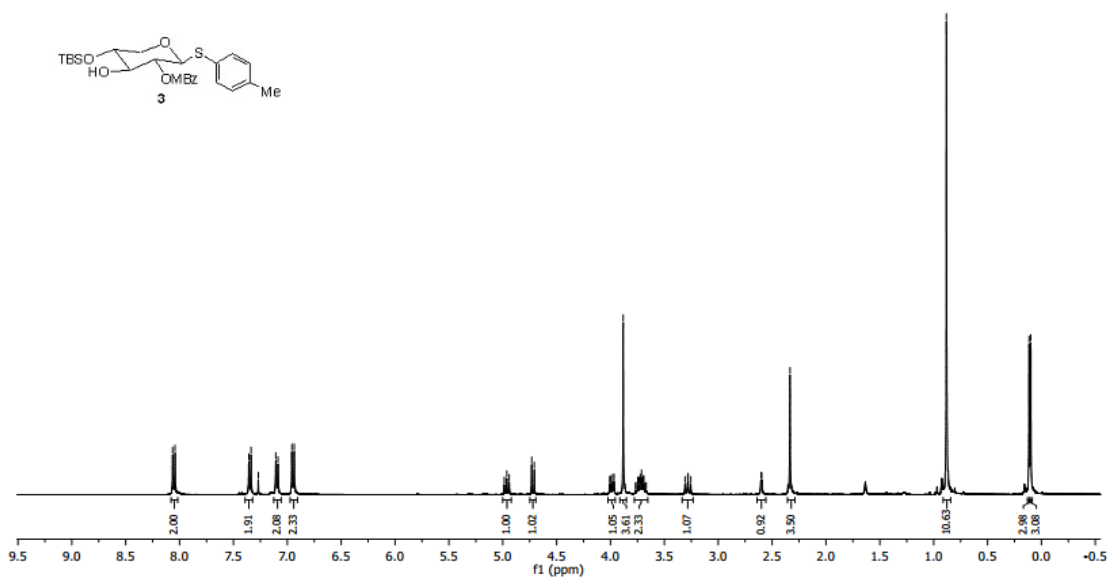




WB-04-41



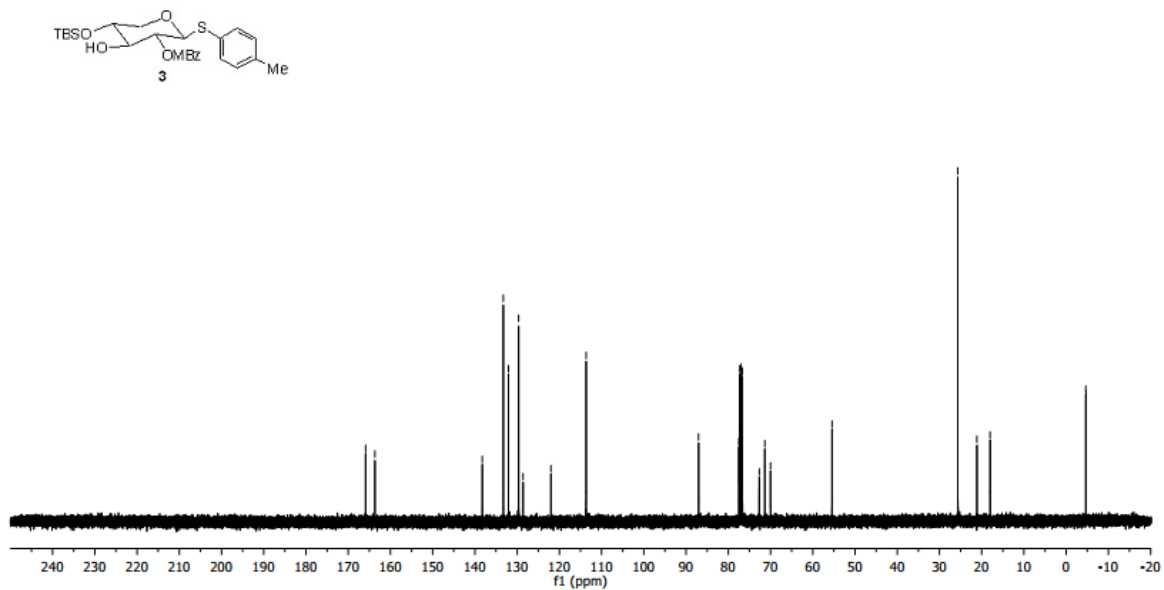
Figure S1. ¹H NMR of compound 3



WB-04-41

165.886
163.683
136.243
133.286
132.062
129.660
128.608
121.993
113.666
87.037
77.511
77.317
77.000
76.683
72.678
71.369
70.001
55.447
25.665
21.131
18.008
-4.651
-4.718

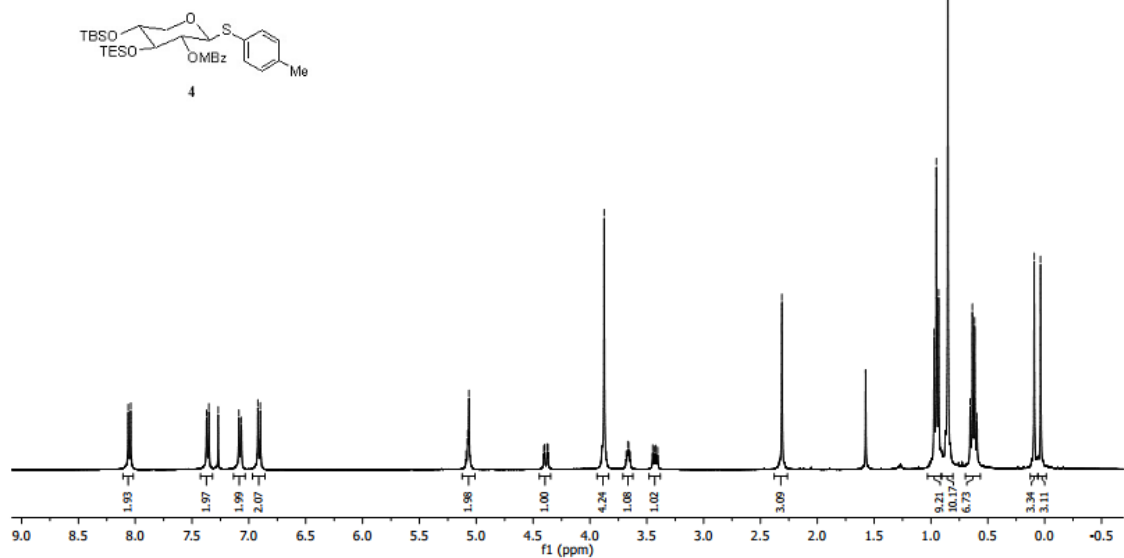
Figure S1. ^{13}C NMR of compound 3



WB-04-45

8.062
8.040
7.272
7.270
7.087
7.067
6.921
6.899
5.089
5.075
5.064
4.405
4.388
4.376
4.368
3.875
3.864
3.851
3.667
3.659
3.645
3.448
3.435
3.418
3.404
2.311
0.972
0.952
0.933
0.852
0.835
0.816
0.666
0.596
0.092
0.036

Figure S1. ^1H NMR of compound 4



WB-04-45

165.309
163.467

137.211
132.031
131.993
128.665
128.562
122.591
113.477

87.371
77.317
77.000
77.000
76.682
72.806
72.398
67.676
62.605
55.406

25.869
21.061
18.116

6.867
4.889
4.688

Figure S1. ^{13}C NMR of compound **4**

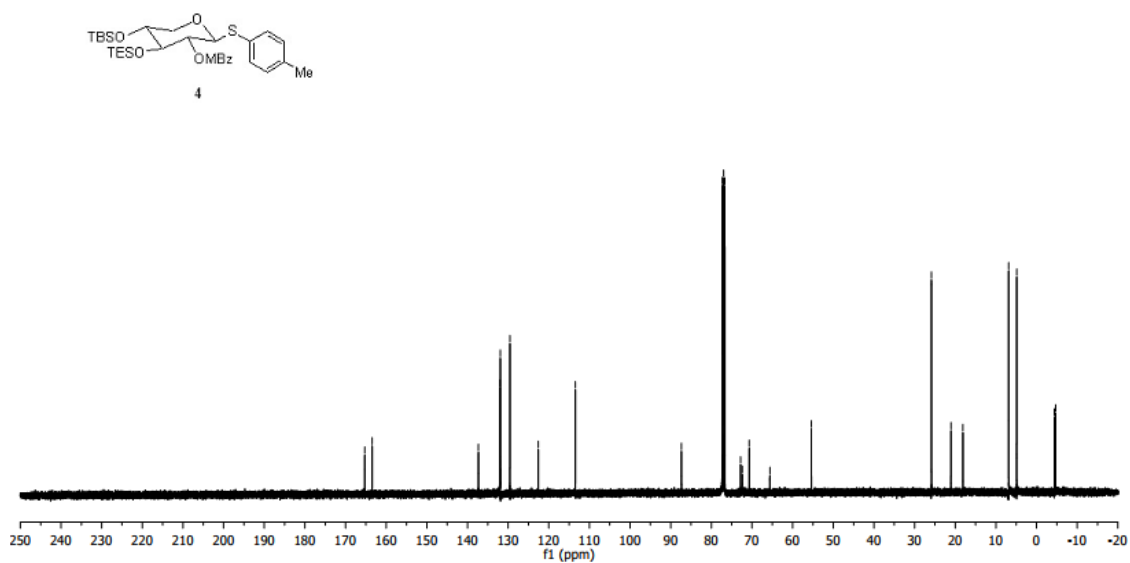
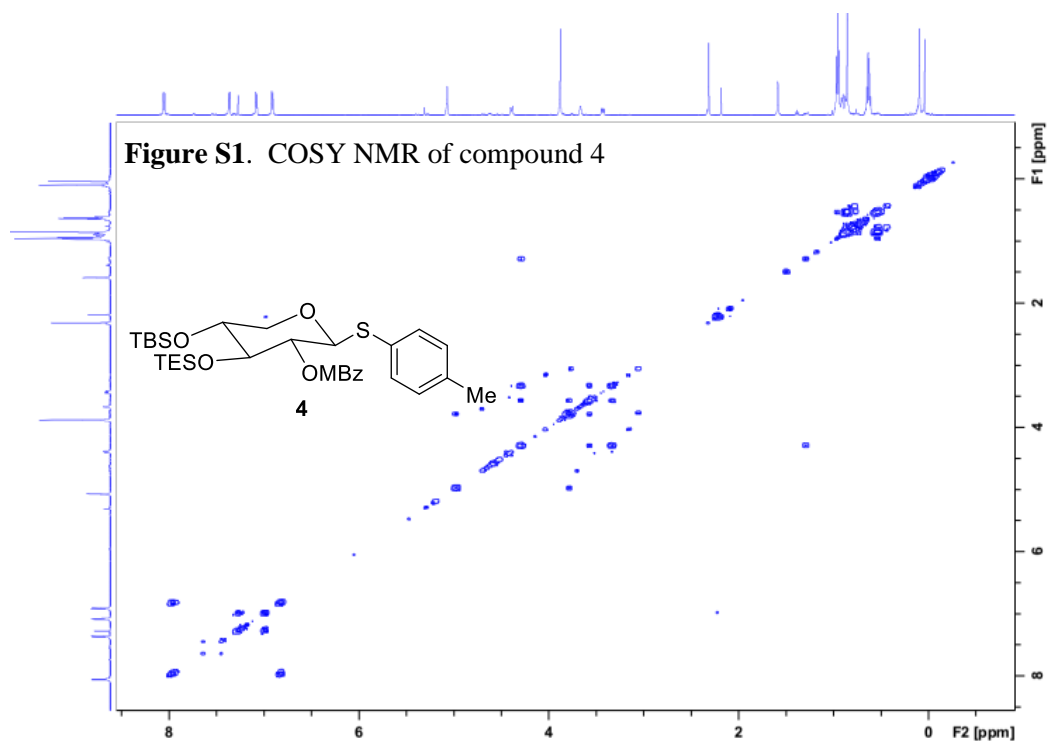
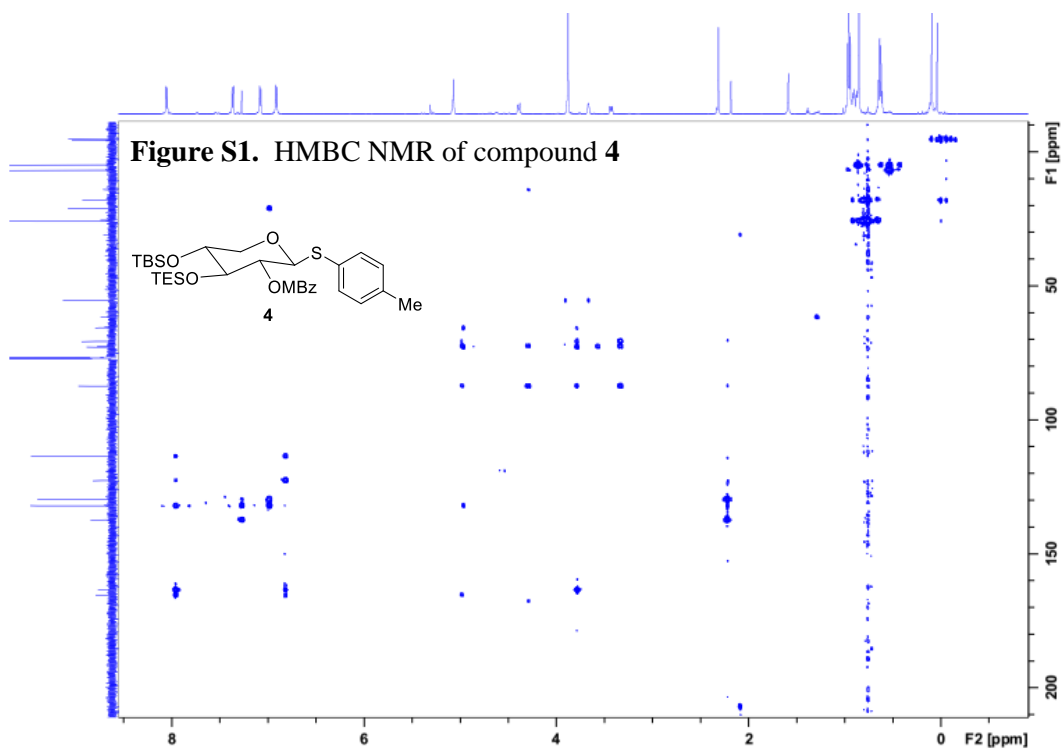
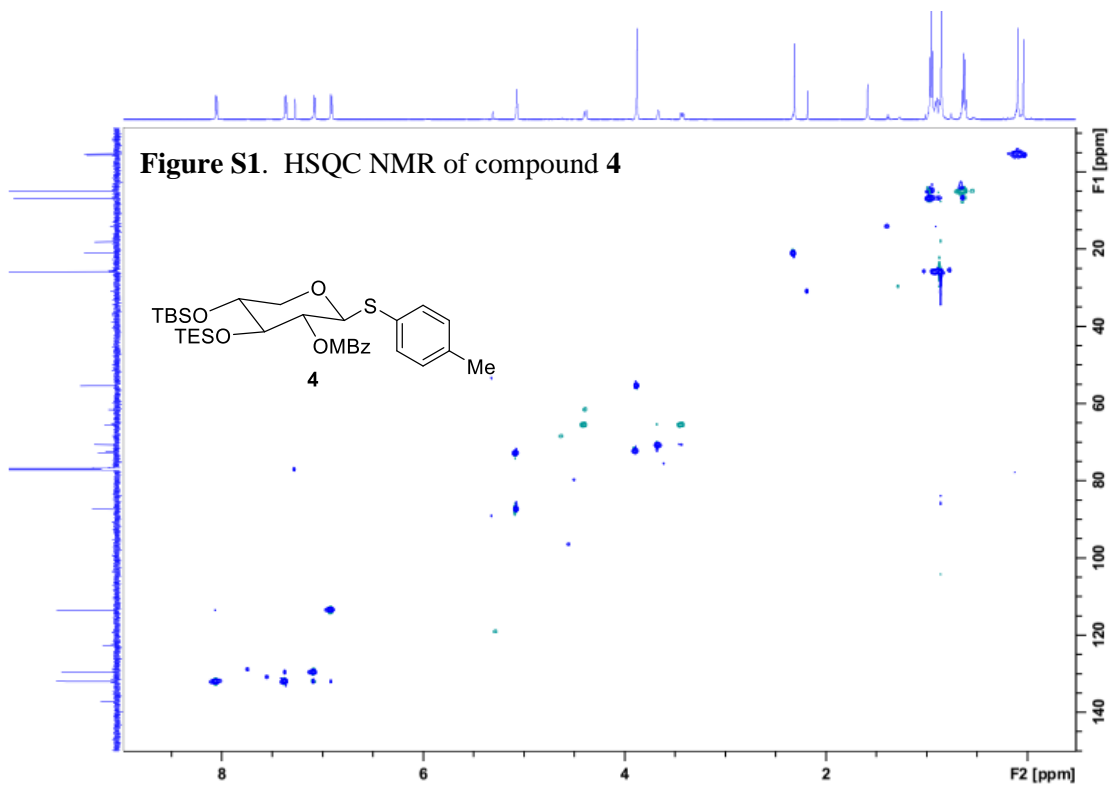
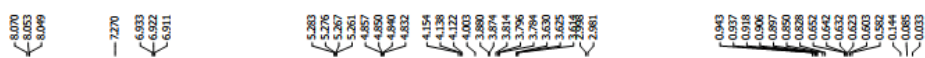
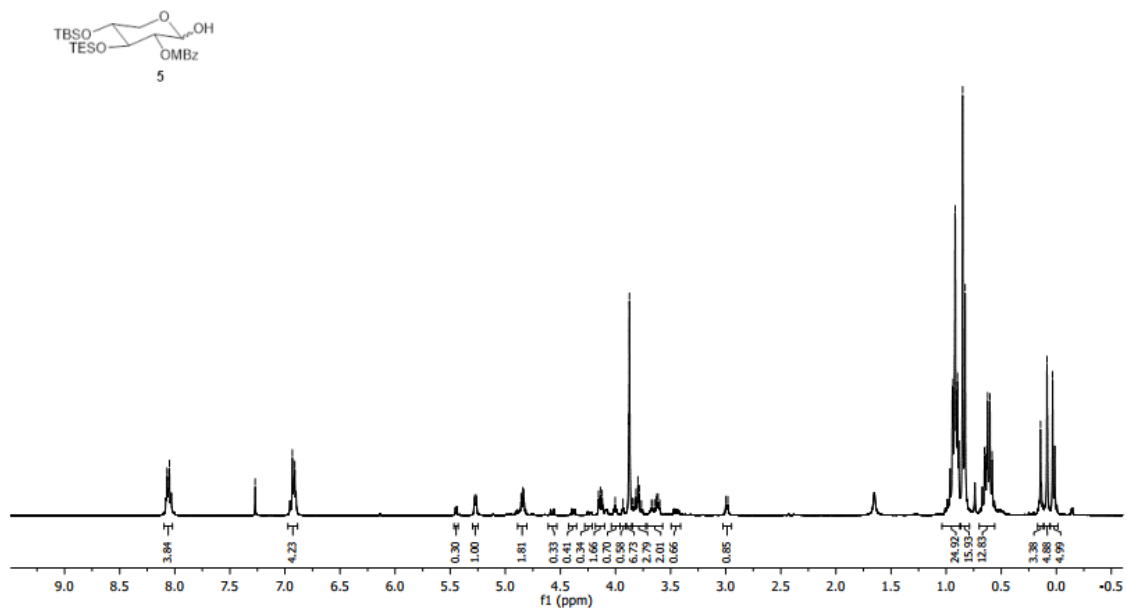


Figure S1. COSY NMR of compound **4**

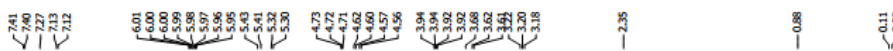
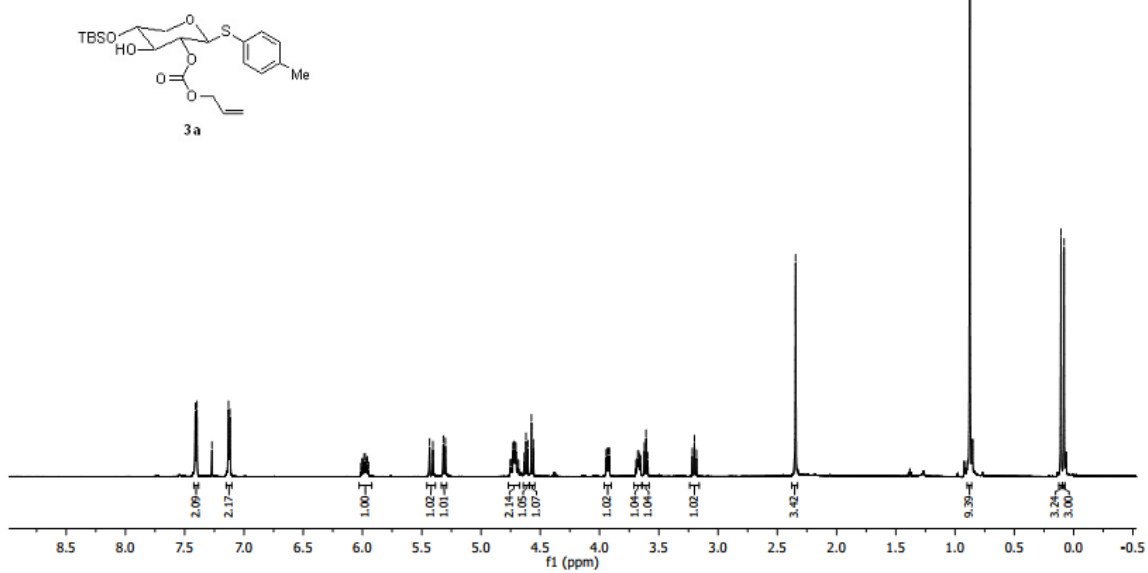




WB-04-49

Figure S1. ¹H NMR of compound 5

WB-05-32

Figure S1. ¹H NMR of compound 3a

WB-05-32

Figure S1. ^{13}C NMR of compound **3a**

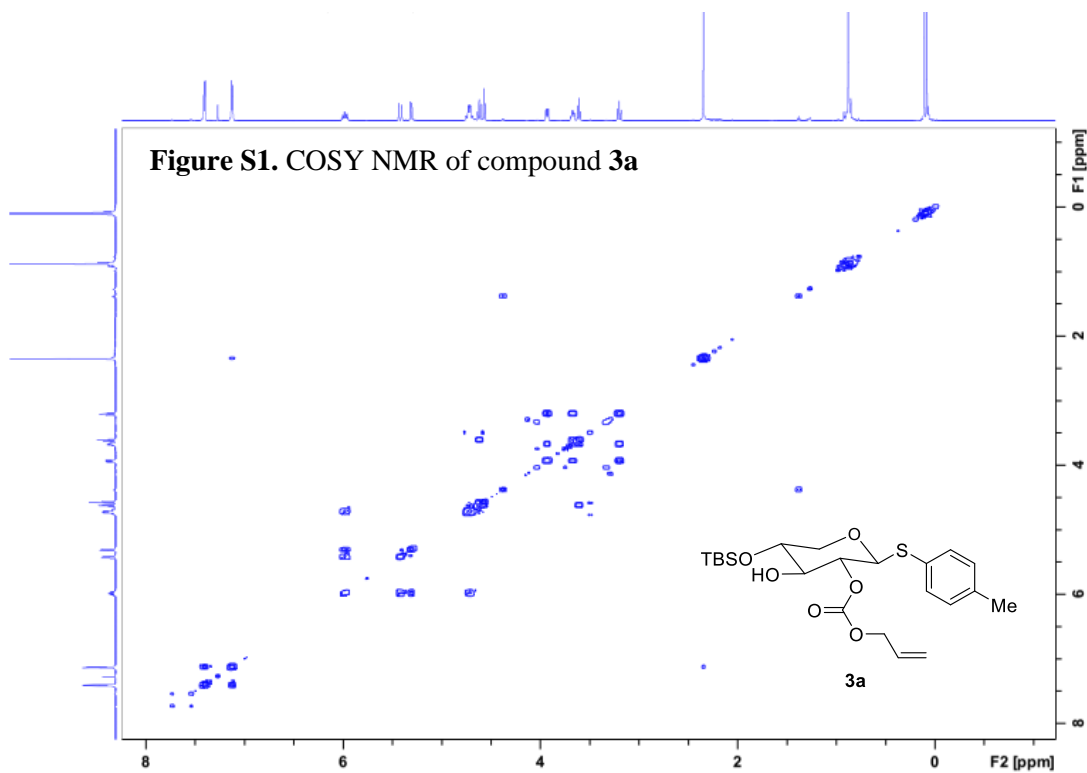
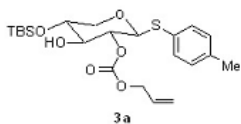
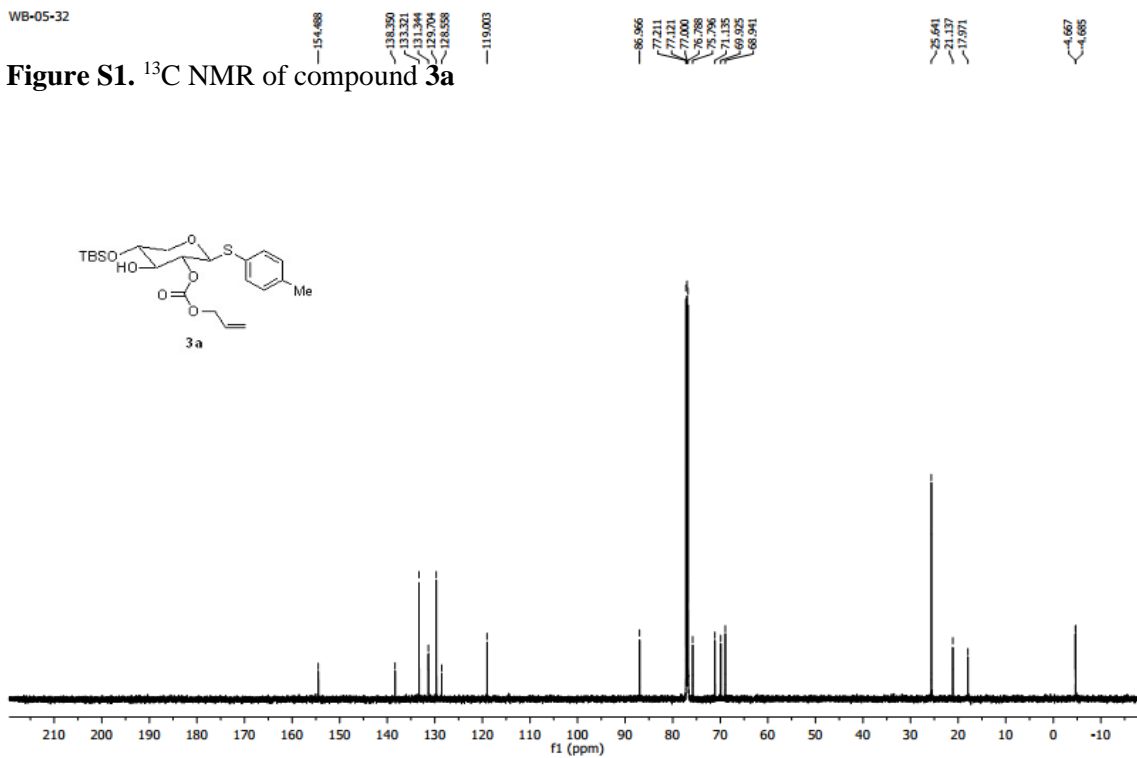
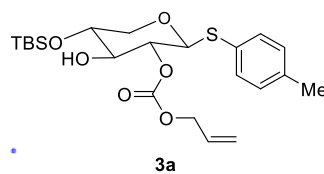


Figure S1. COSY NMR of compound **3a**



WB-05-36

7.294
7.273
7.270
7.110
7.077

6.002
5.992
5.984
5.984
5.984
5.955
5.946
5.936
5.927
5.910
5.901
5.284

4.774
4.761
4.750
4.678
4.631
4.619

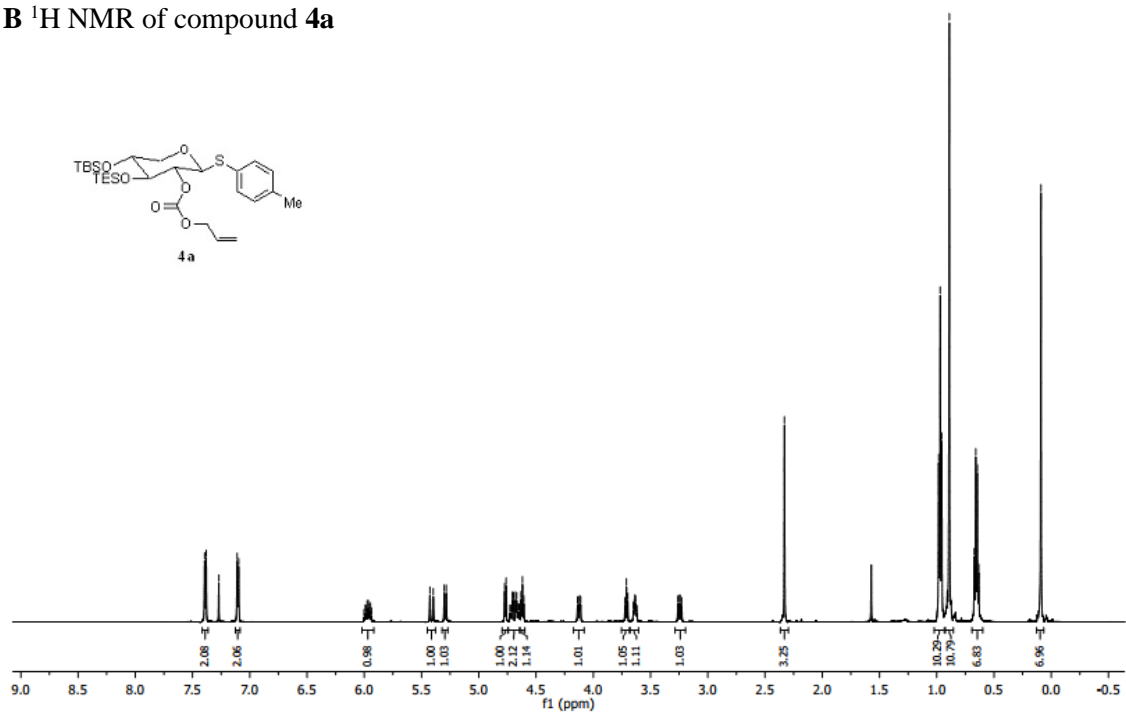
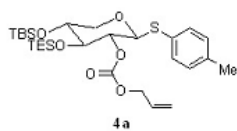
4.139
4.119
4.110
3.711
3.699
3.687
3.567
3.567
3.247
3.241
3.228

2.330

0.983
0.969
0.956
0.890
0.872
0.659
0.635
0.635

0.090

B ^1H NMR of compound **4a**



WB-05-36

154.341

137.685
137.672
131.457
130.678
129.633

118.882

87.635

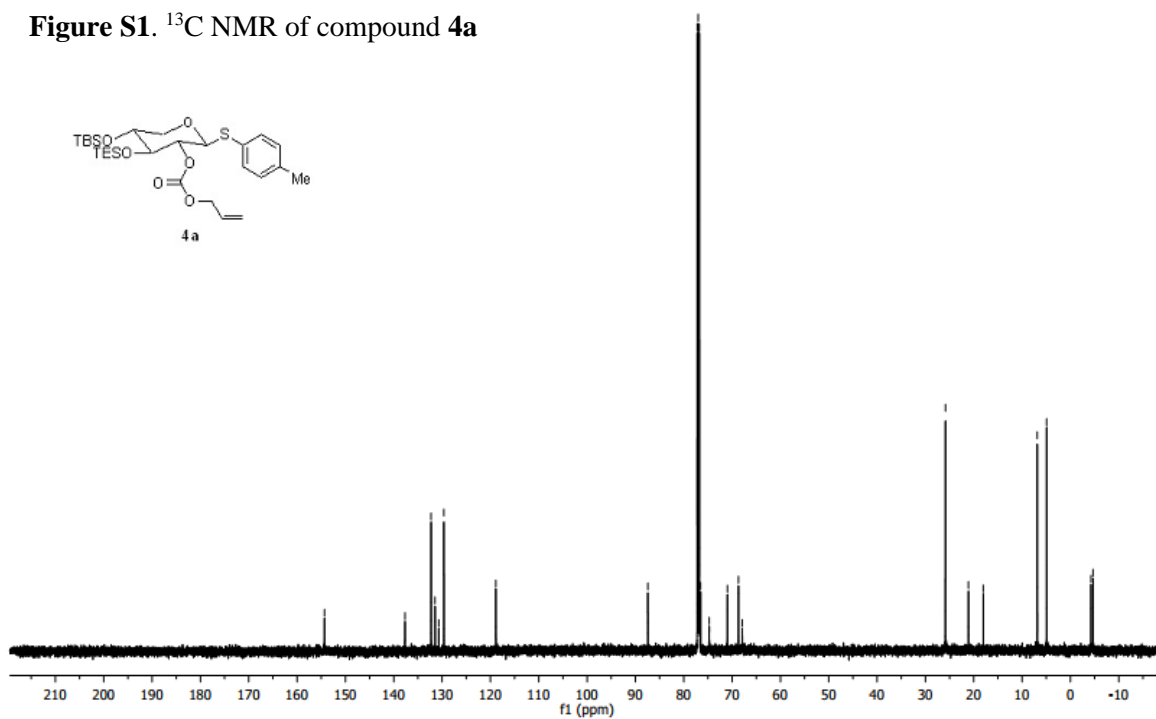
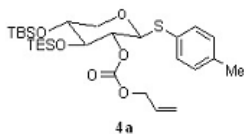
77.211
77.000
76.808
76.600
74.744
70.574
69.692
67.500

25.860
21.092
18.027

6.873
4.918

4.254
-1.667

Figure S1. ^{13}C NMR of compound **4a**



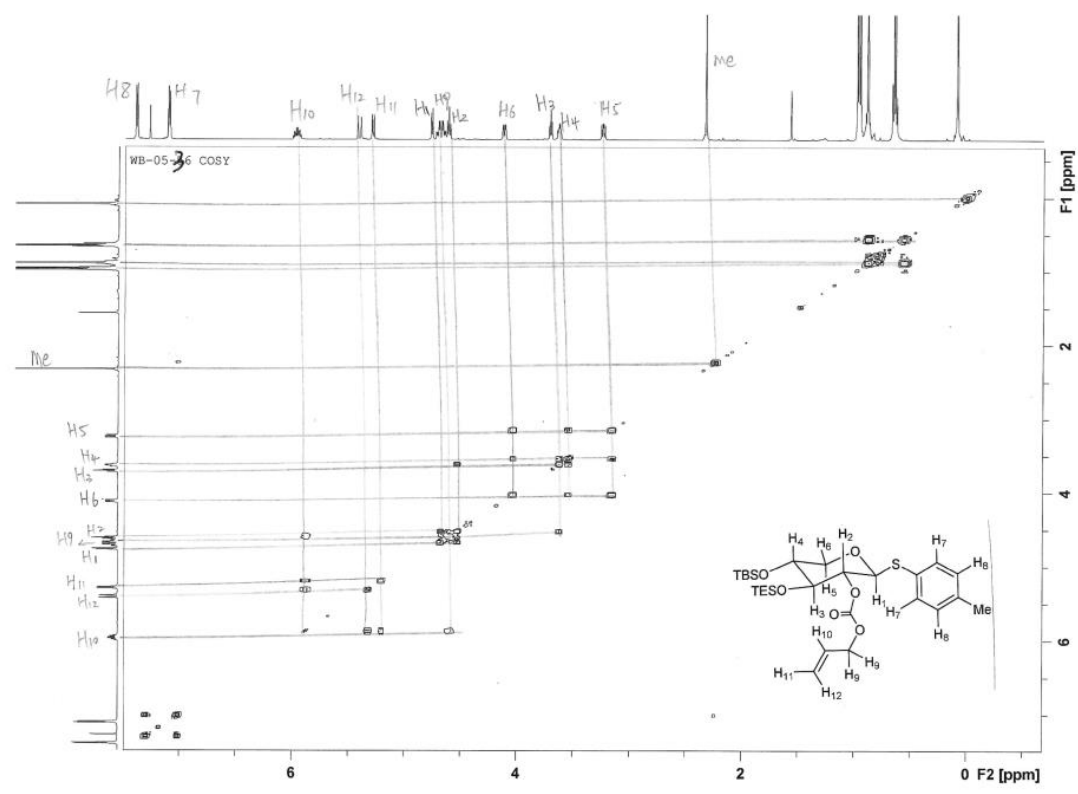
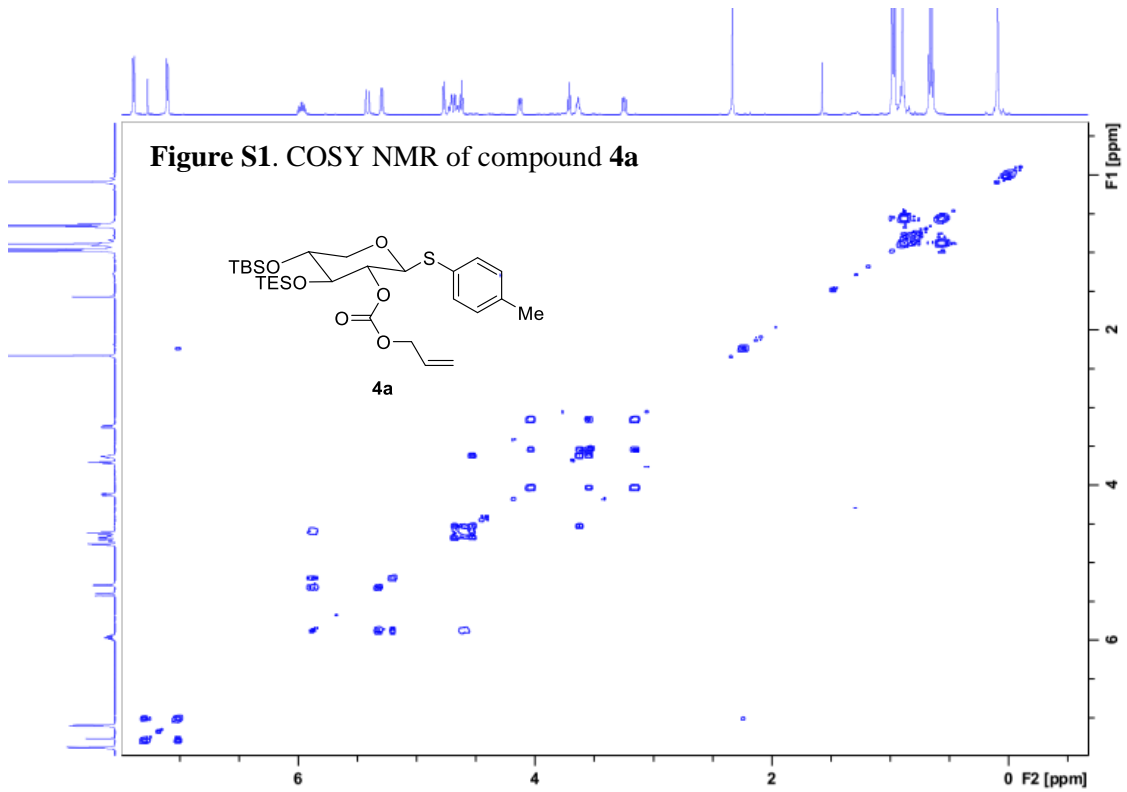
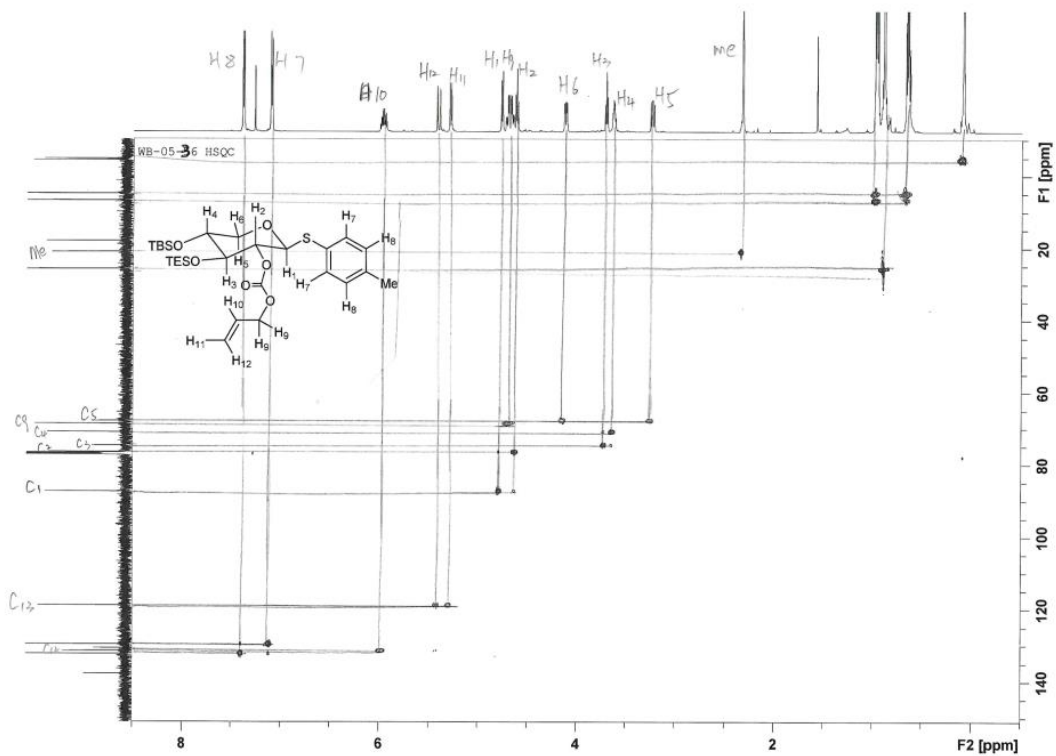
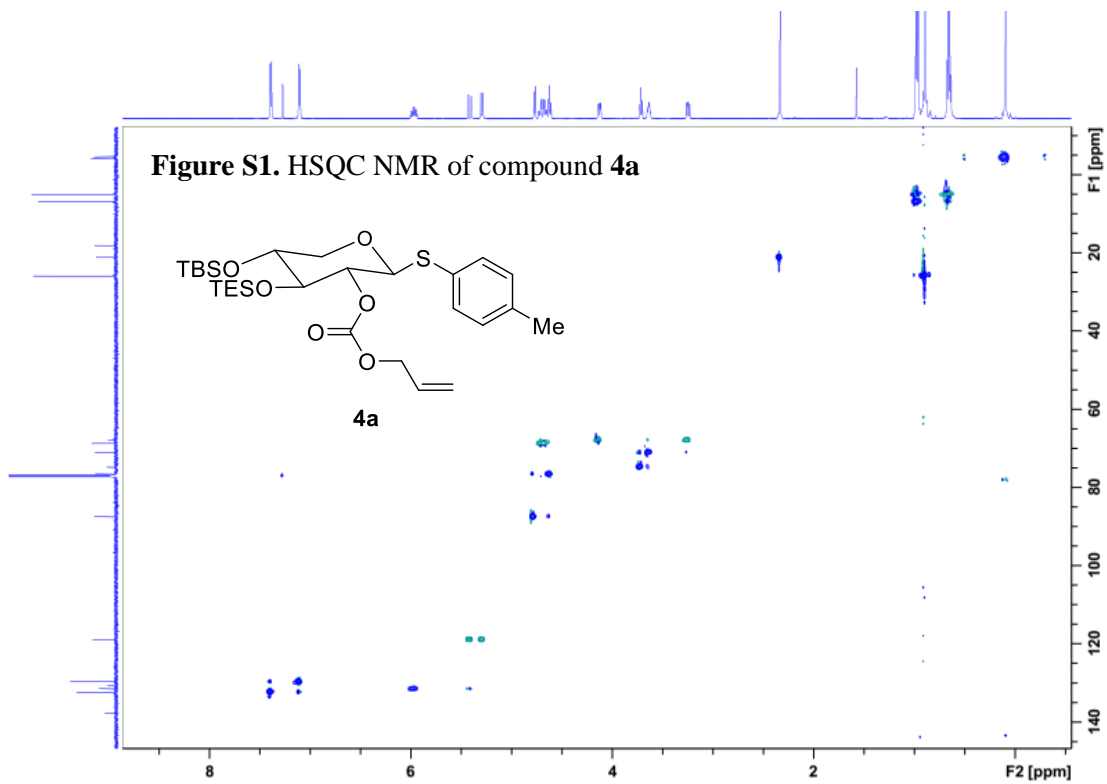
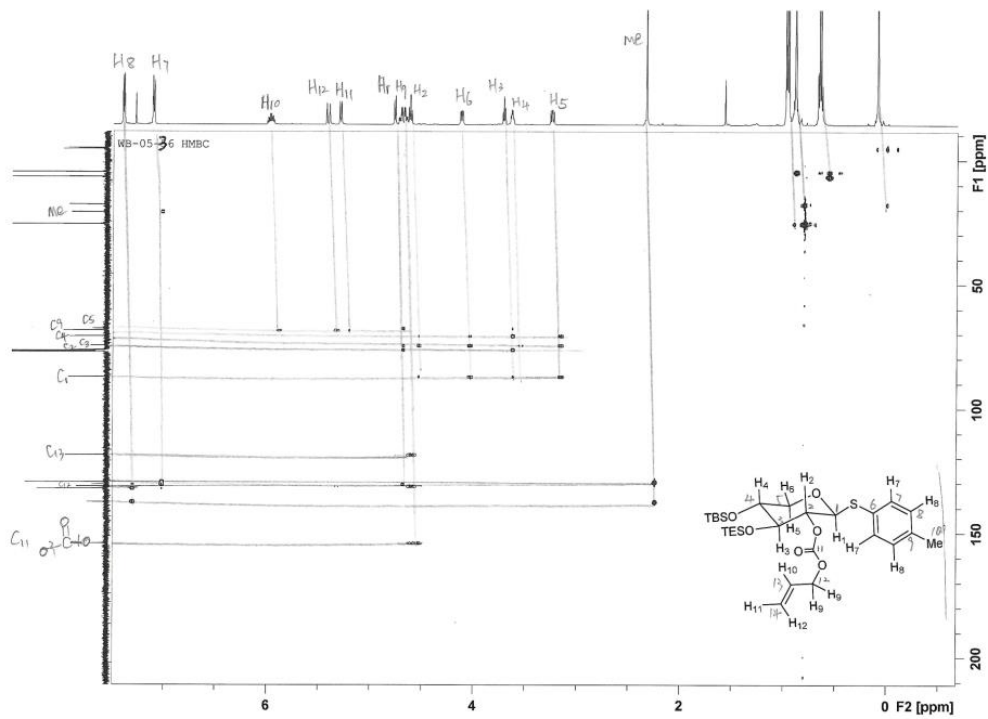
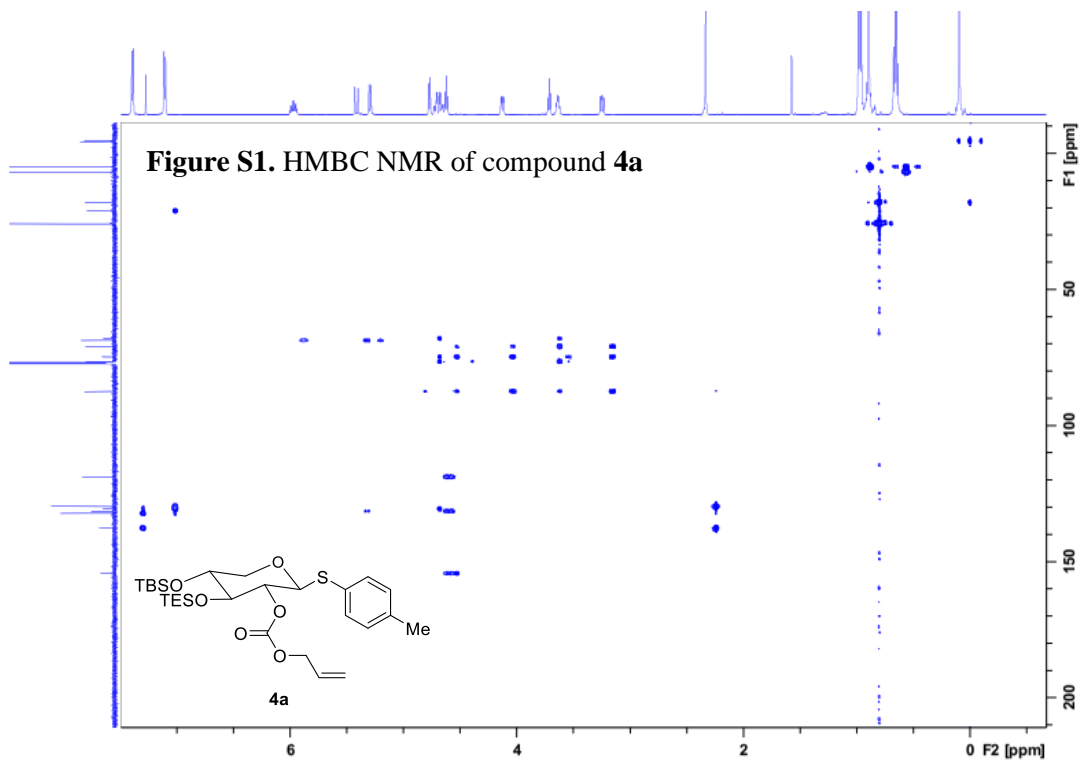


Figure S1. HSQC NMR of compound 4a

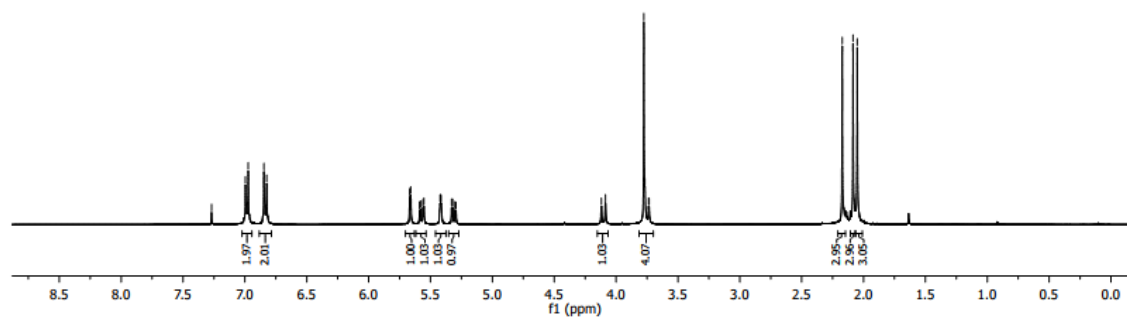
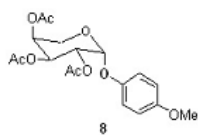




WB-04-56

7.270
6.996
6.973
6.947
6.824
5.668
5.588
5.580
5.571
5.553
5.422
5.418
5.414
5.330
5.321
5.295
5.294
4.118
4.086
3.776
3.767
3.738
3.733
2.172
2.085
2.051

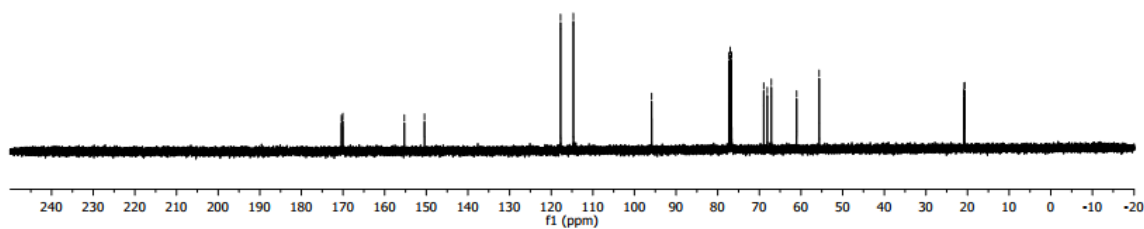
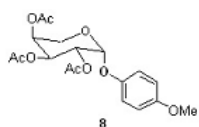
Figure S1. ¹H NMR of compound 8

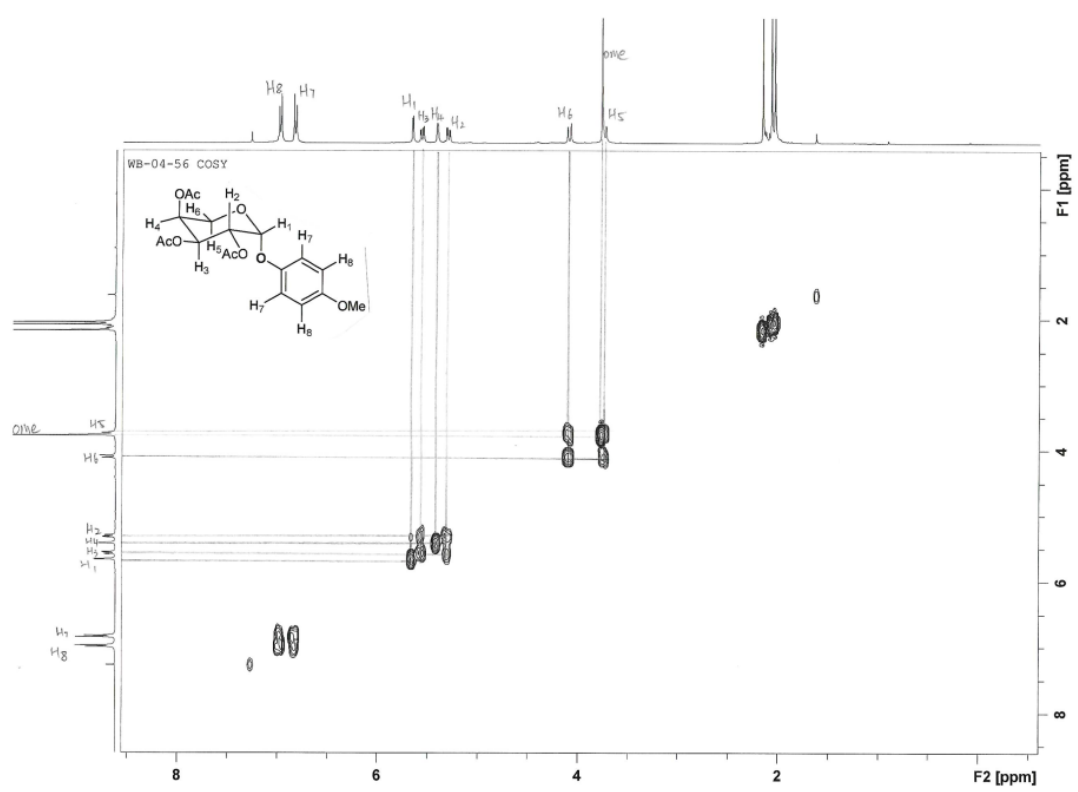
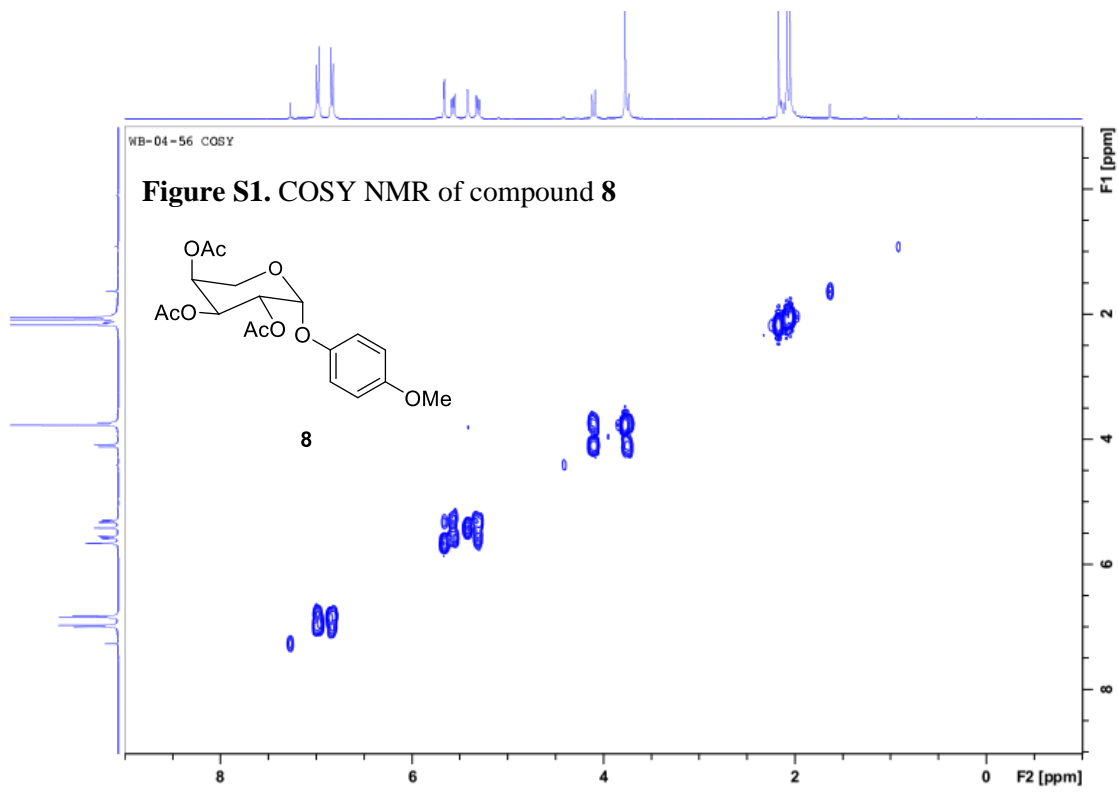


WB-04-56

170.368
170.282
170.039
155.277
150.408
117.756
114.676
95.877
77.318
77.000
76.683
68.363
68.110
61.056
55.642
20.911
20.741
20.715

Figure S1. ¹³C NMR of compound 8





WB-04-14

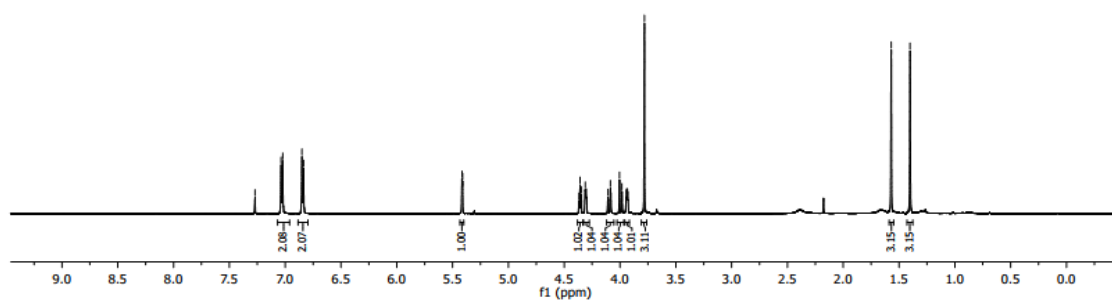
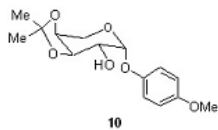
7.270
7.037
7.022
6.890
6.835

5.416
5.411

4.368
4.357
4.346
4.311
4.302
4.286
4.096
4.005
3.982
3.944
3.939
3.922
3.920
3.781

1.570
1.401

Figure S1. ^1H NMR of compound 10



WB-04-14

155.263
150.434

117.848
114.678
109.405

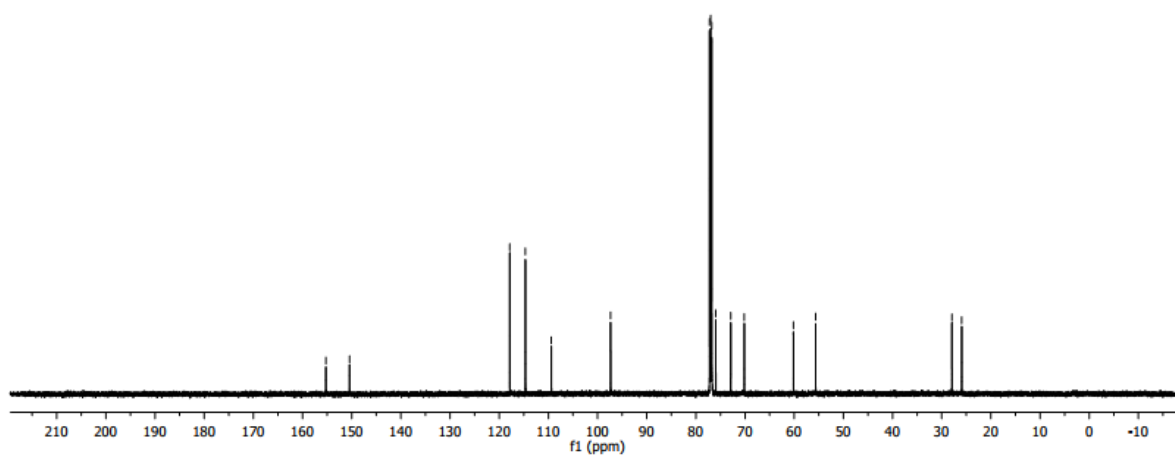
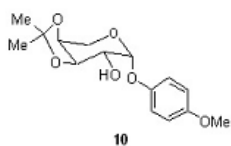
97.355

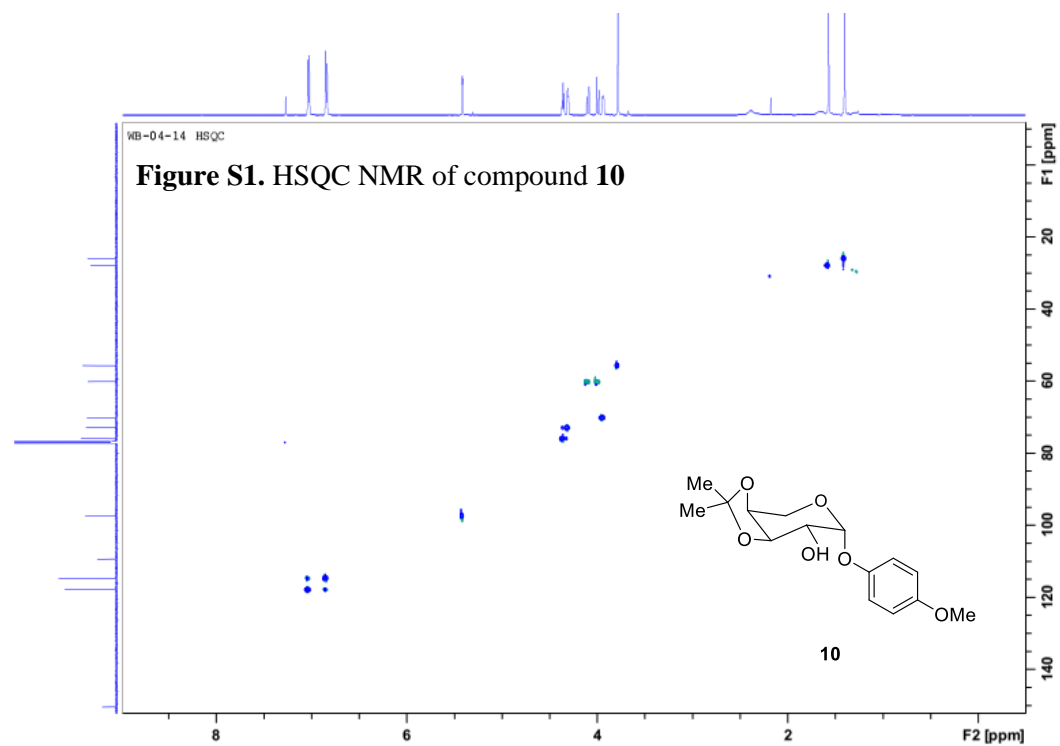
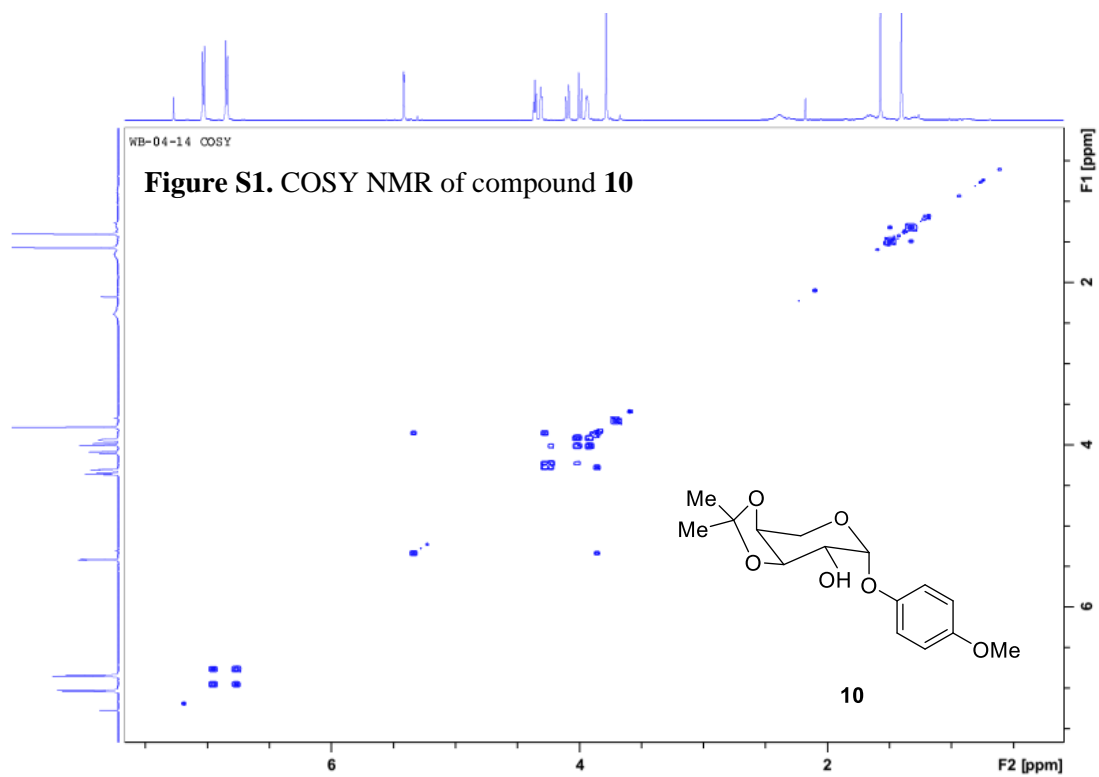
77.212
77.000
76.788
76.576
72.808
70.151

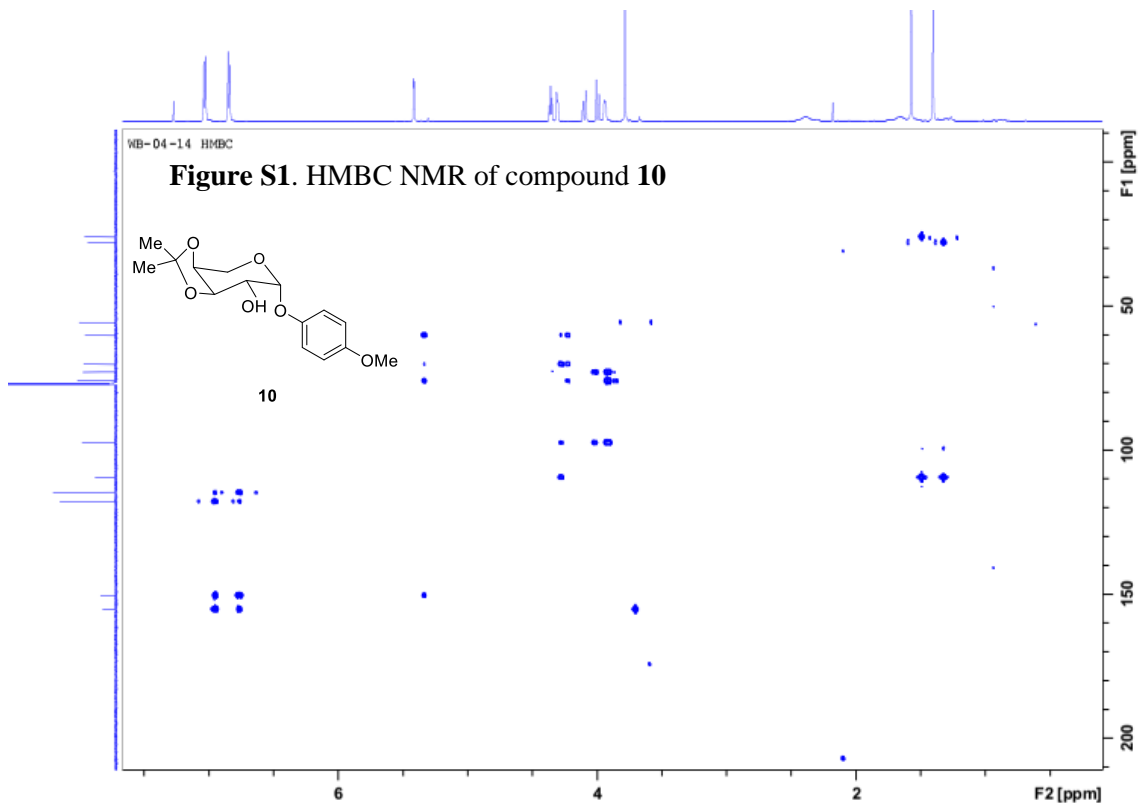
60.154
55.647

27.923
25.932

Figure S1. ^{13}C NMR of compound 10







WB-04-16

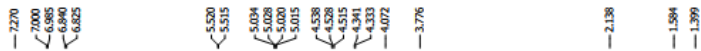
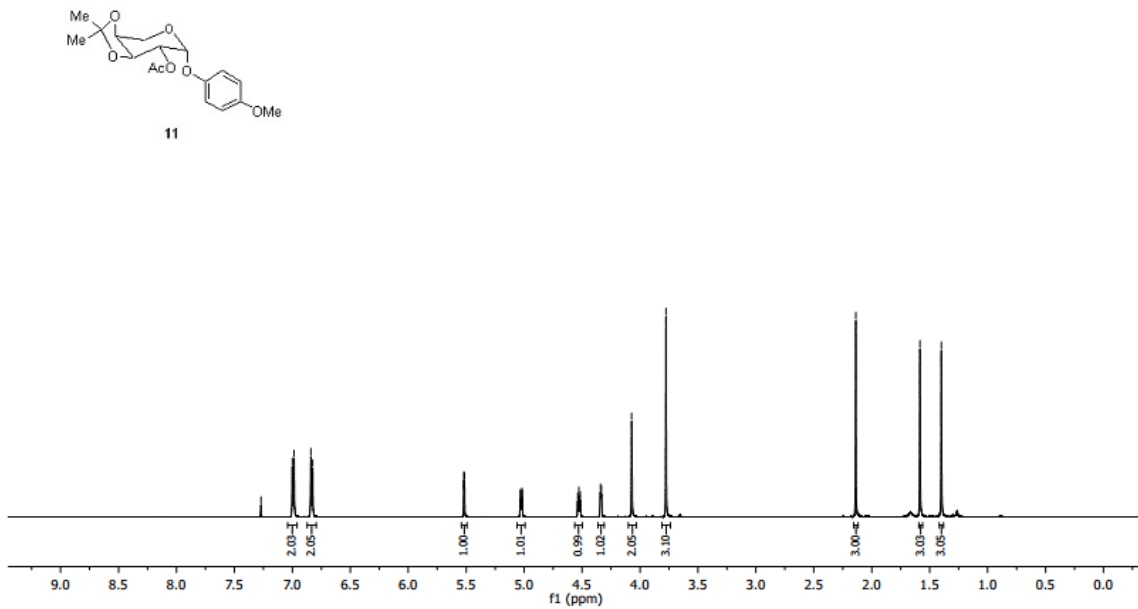


Figure S1. ¹H NMR of compound 11



WB-04-16

170.987

155.188

150.502

117.572

114.655

109.559

95.364

77.211

77.000

76.788

73.410

72.006

72.019

59.195

55.648

27.071

26.301

20.958

Figure S1. ^{13}C NMR of compound **11**

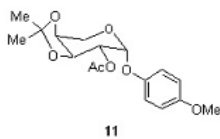
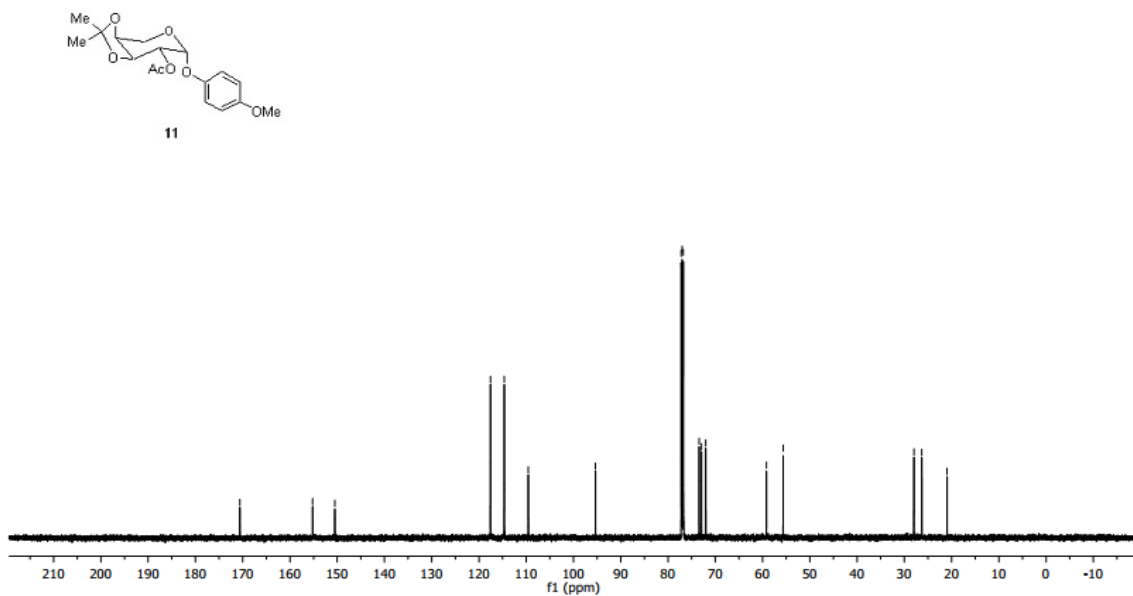
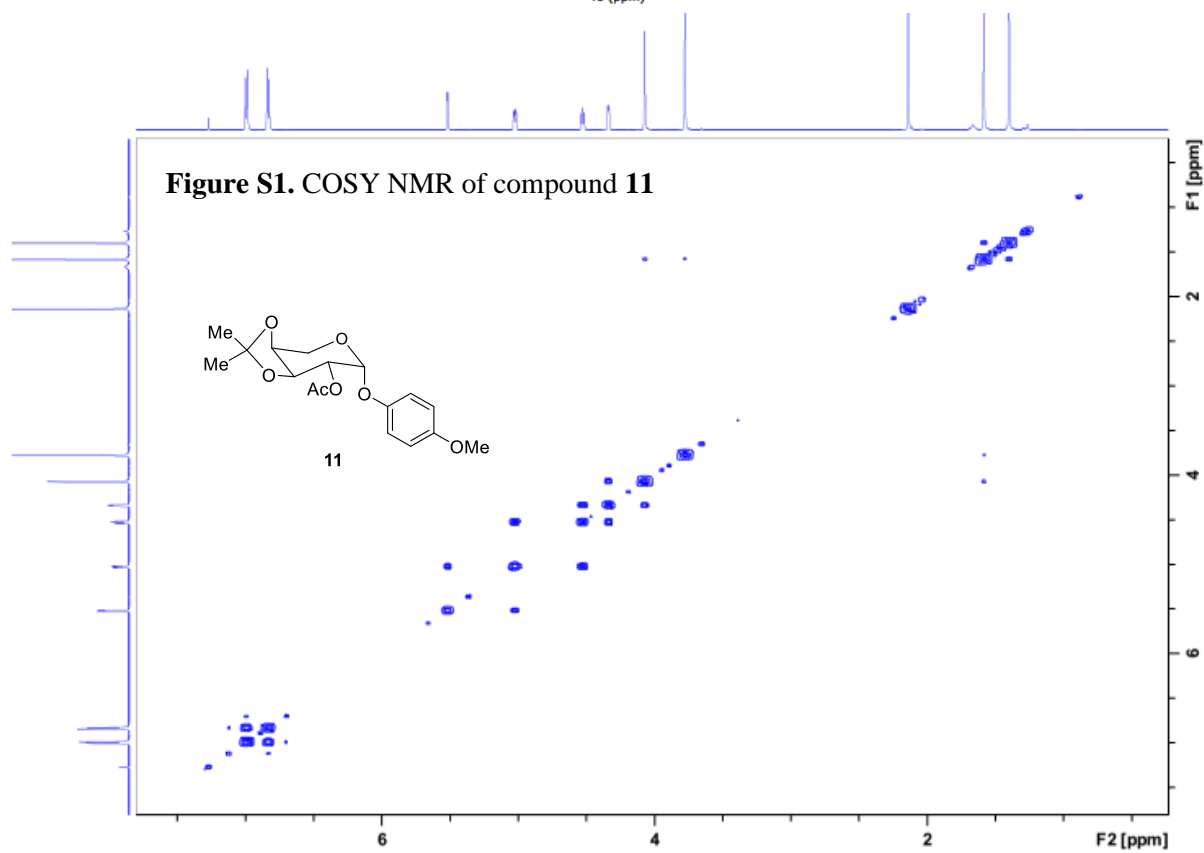


Figure S1. COSY NMR of compound **11**



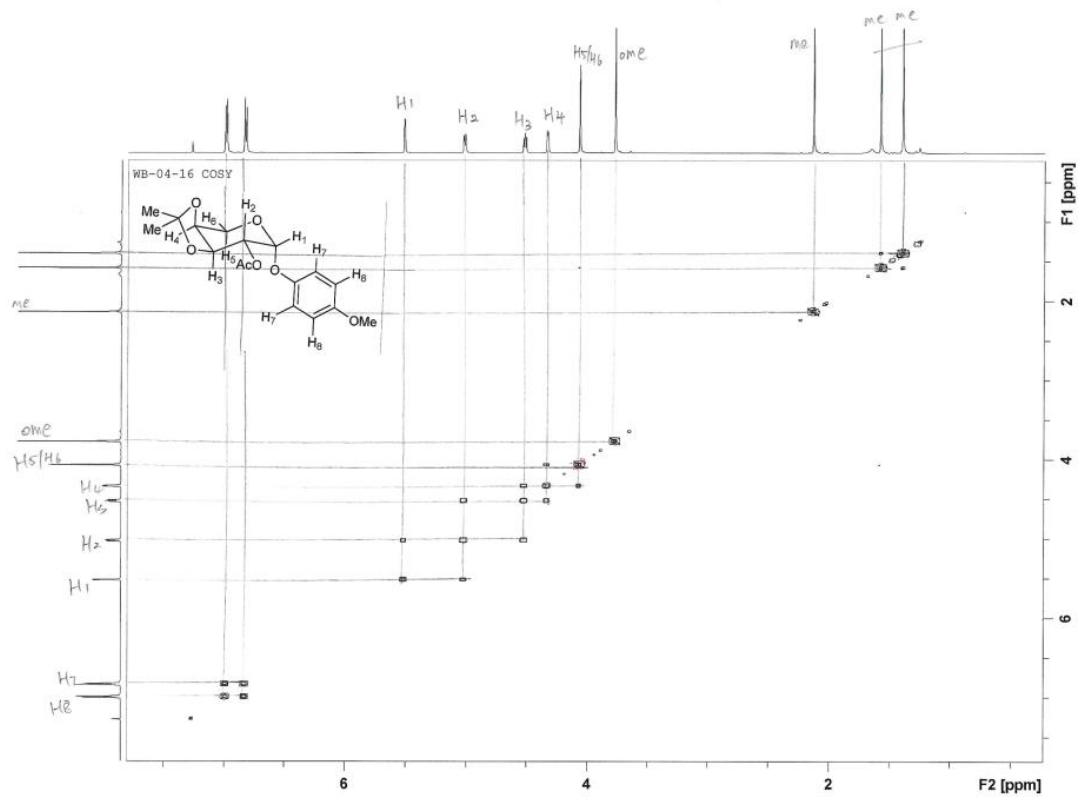
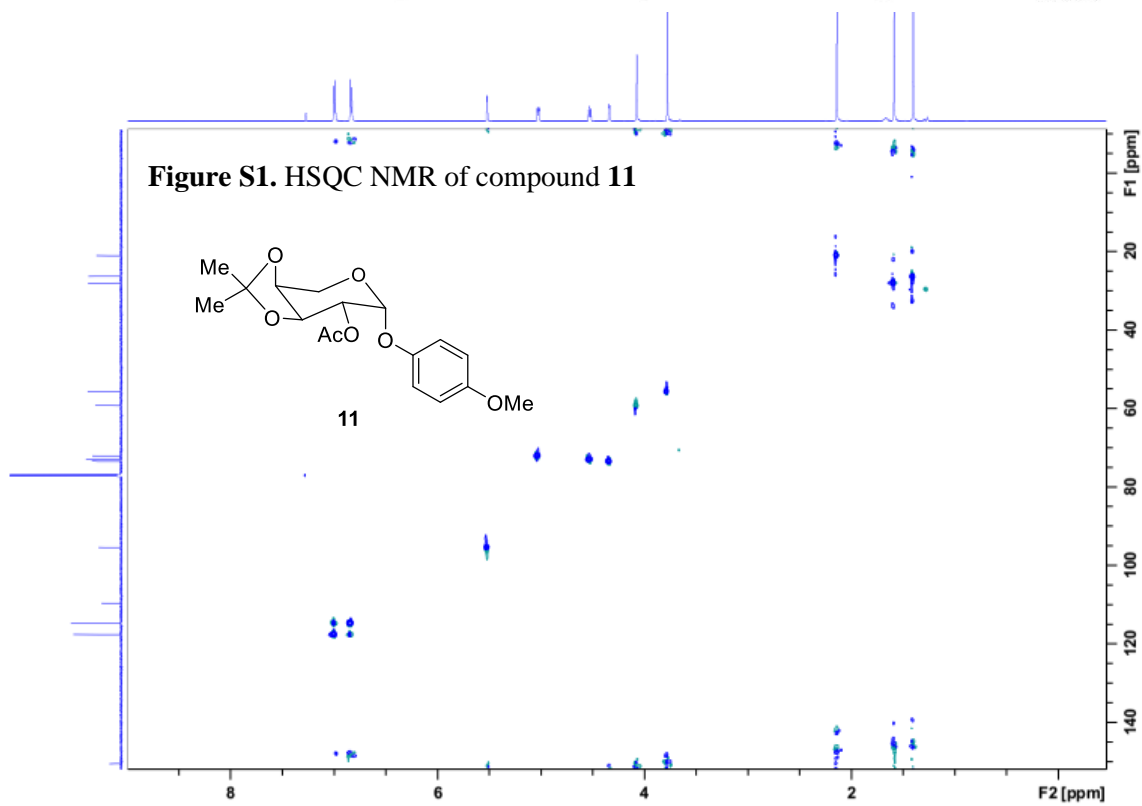


Figure S1. HSQC NMR of compound 11



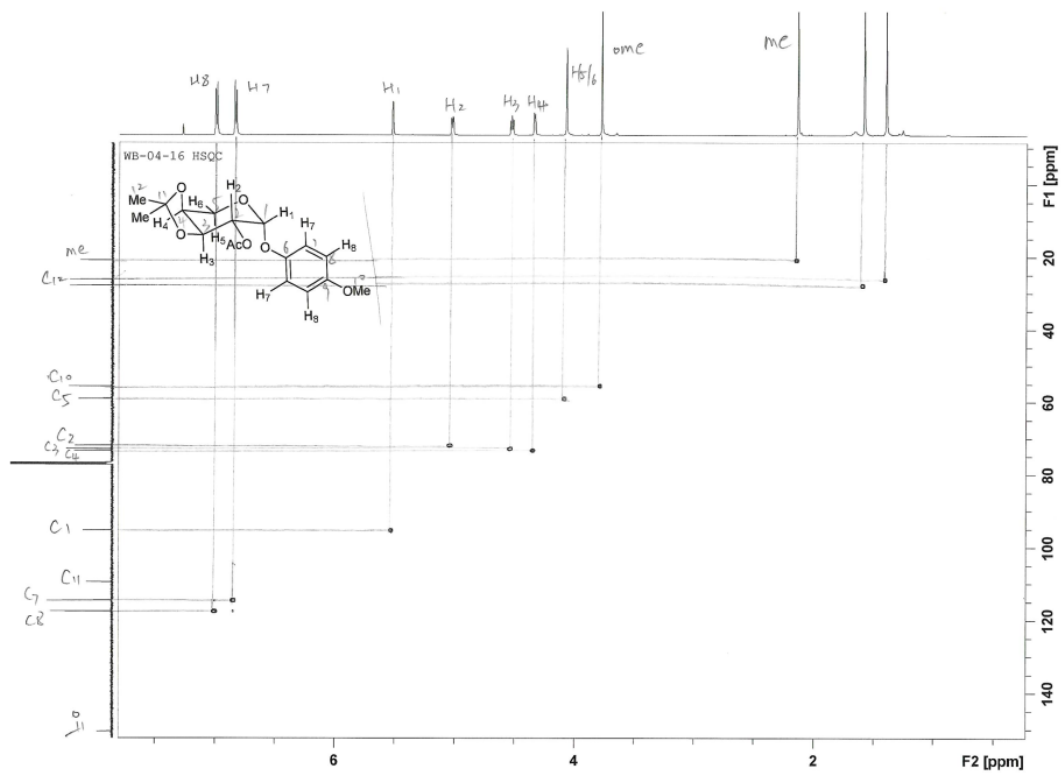
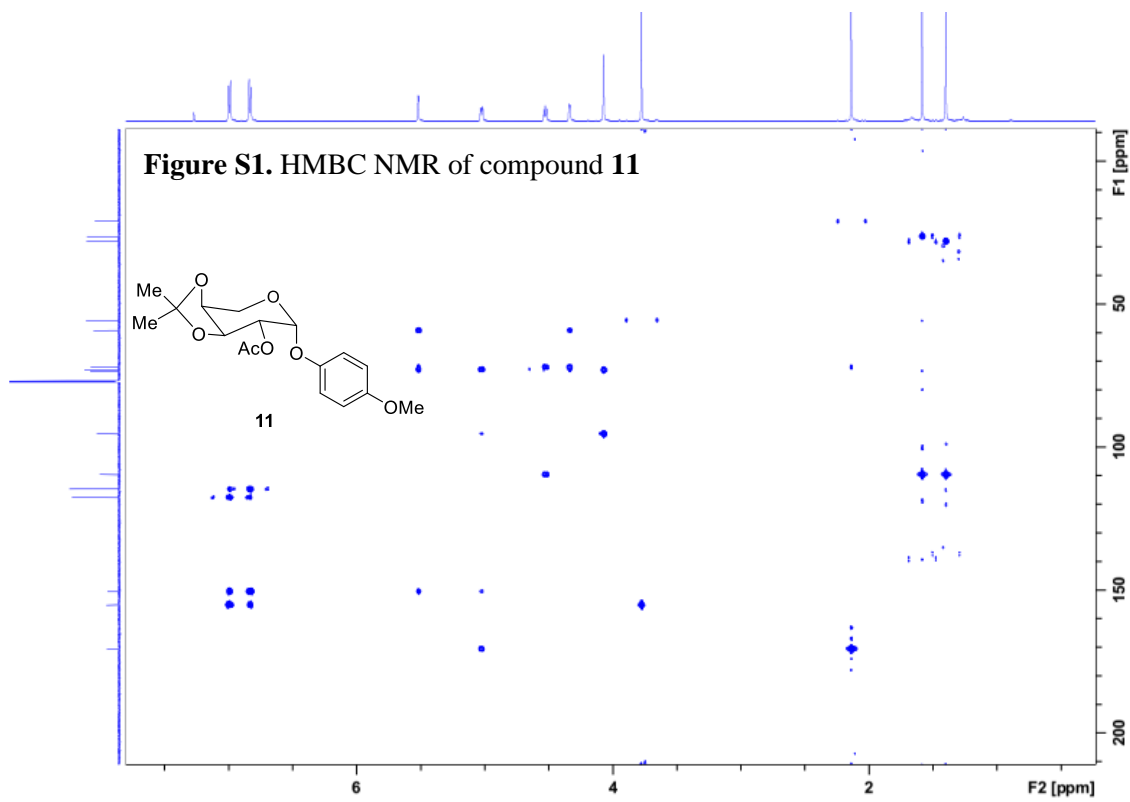
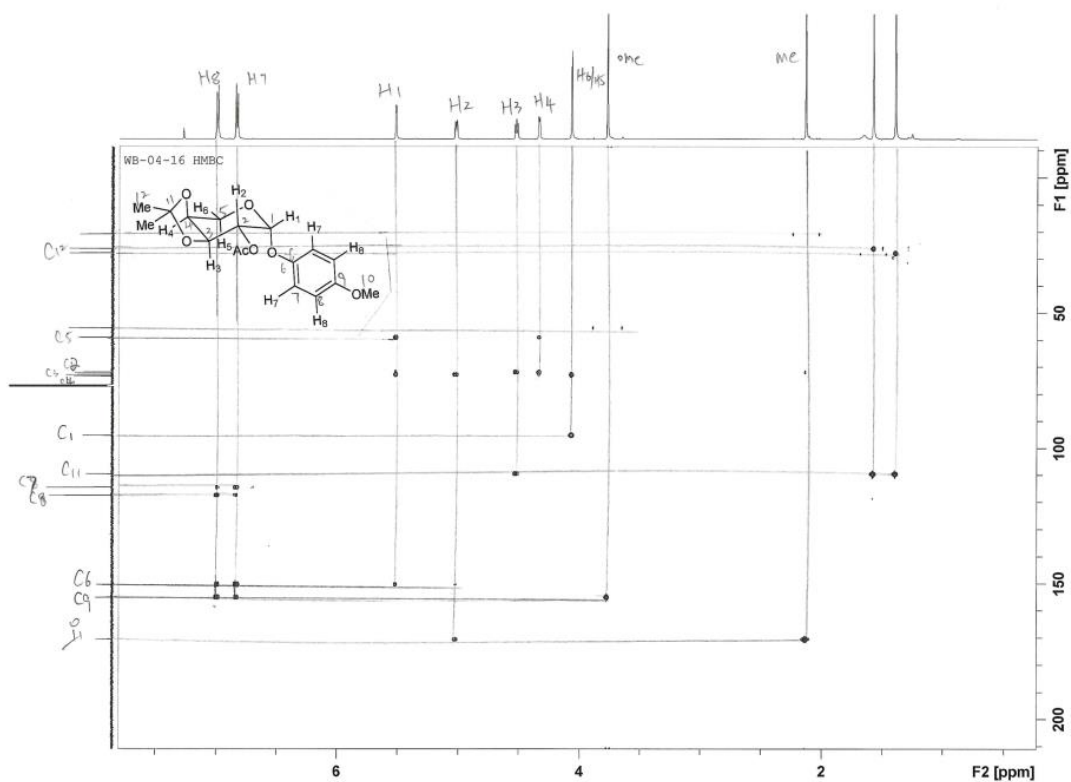


Figure S1. HMBC NMR of compound 11

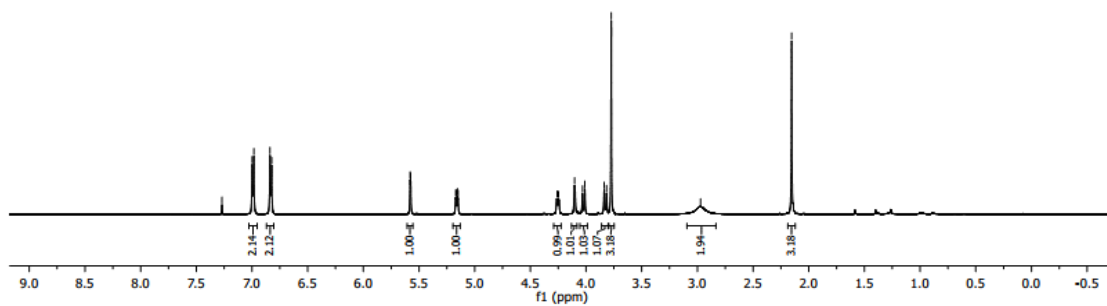
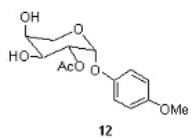




WB-04-55

7.270
 6.999
 6.884
 6.838
 6.823
 5.580
 5.575
 5.171
 5.166
 5.154
 5.149
 4.380
 4.367
 4.102
 4.032
 4.011
 3.837
 3.822
 3.774
 2.971
 2.154

Figure S1. ¹H NMR of compound 12



WB-04-55

171.613

155.203

150.637

117.958

114.647

96.230

77.211

77.000

76.789

71.582

69.343

67.761

62.837

55.646

20.968

Figure S1. ^{13}C NMR of compound **12**

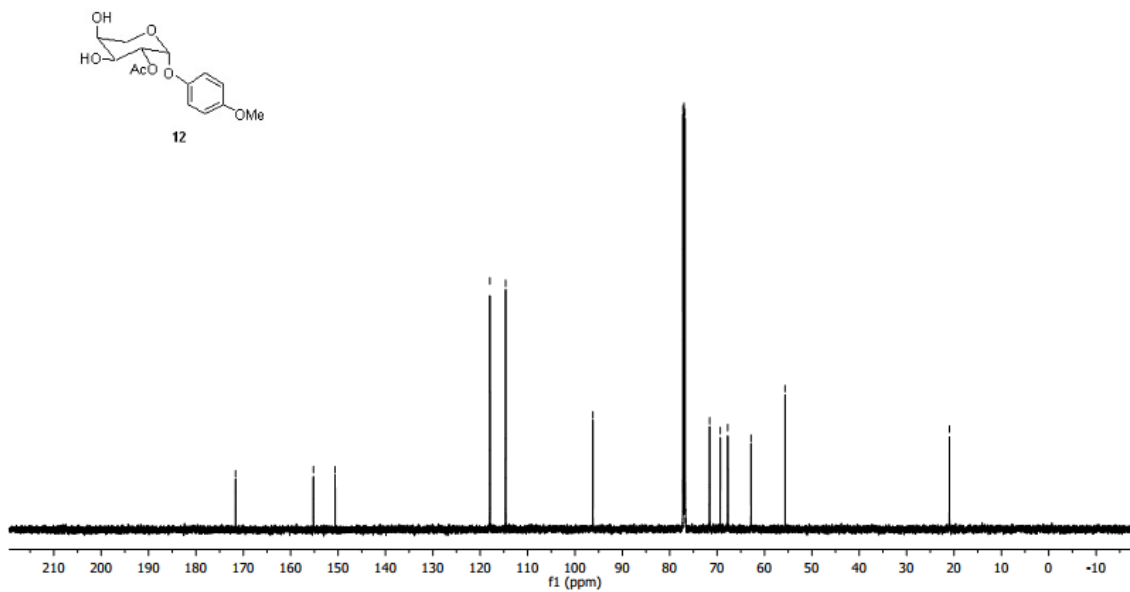
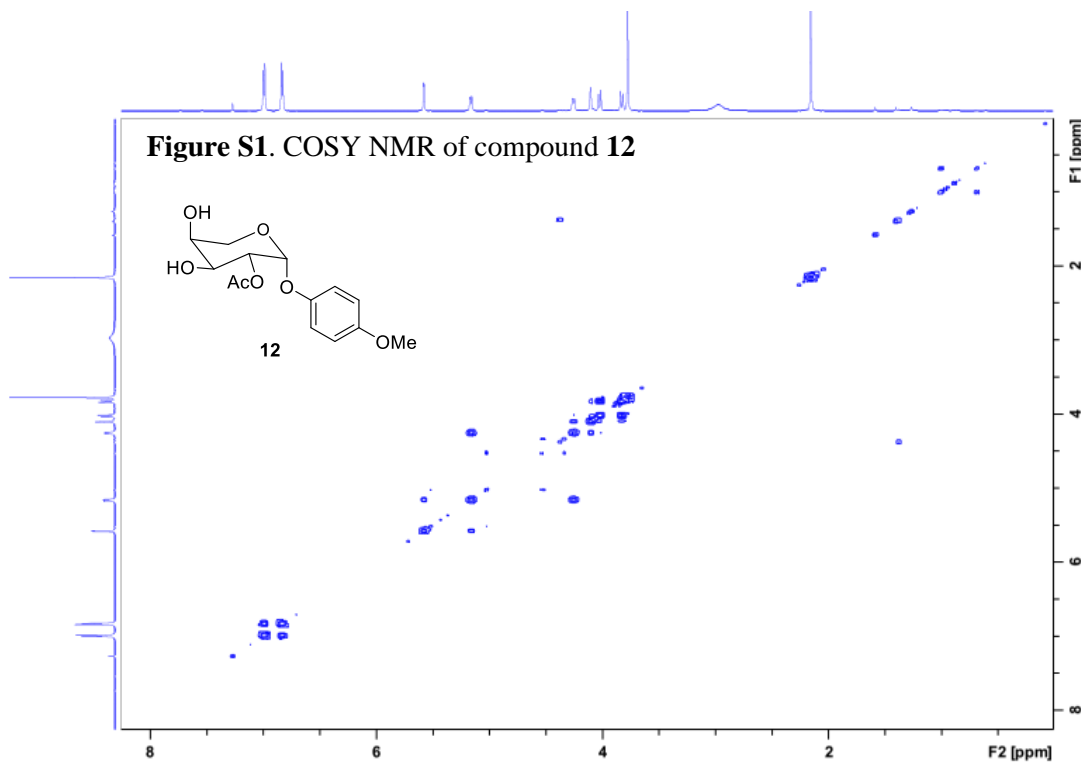
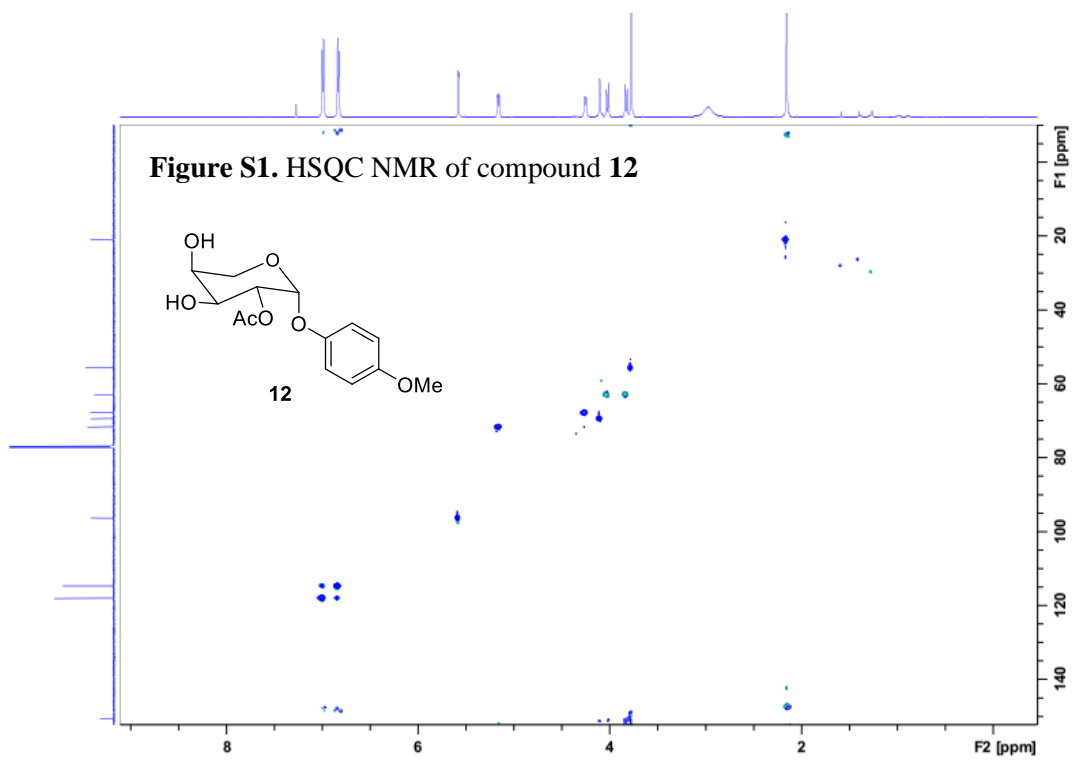
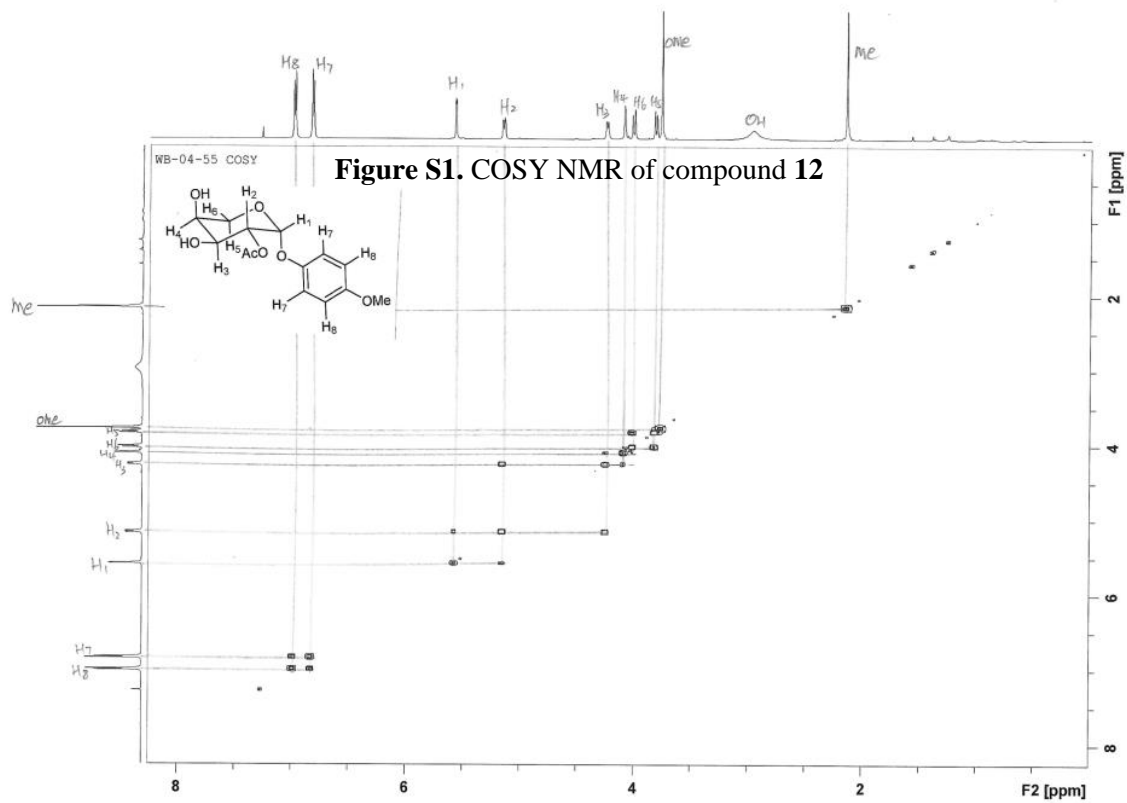


Figure S1. COSY NMR of compound **12**





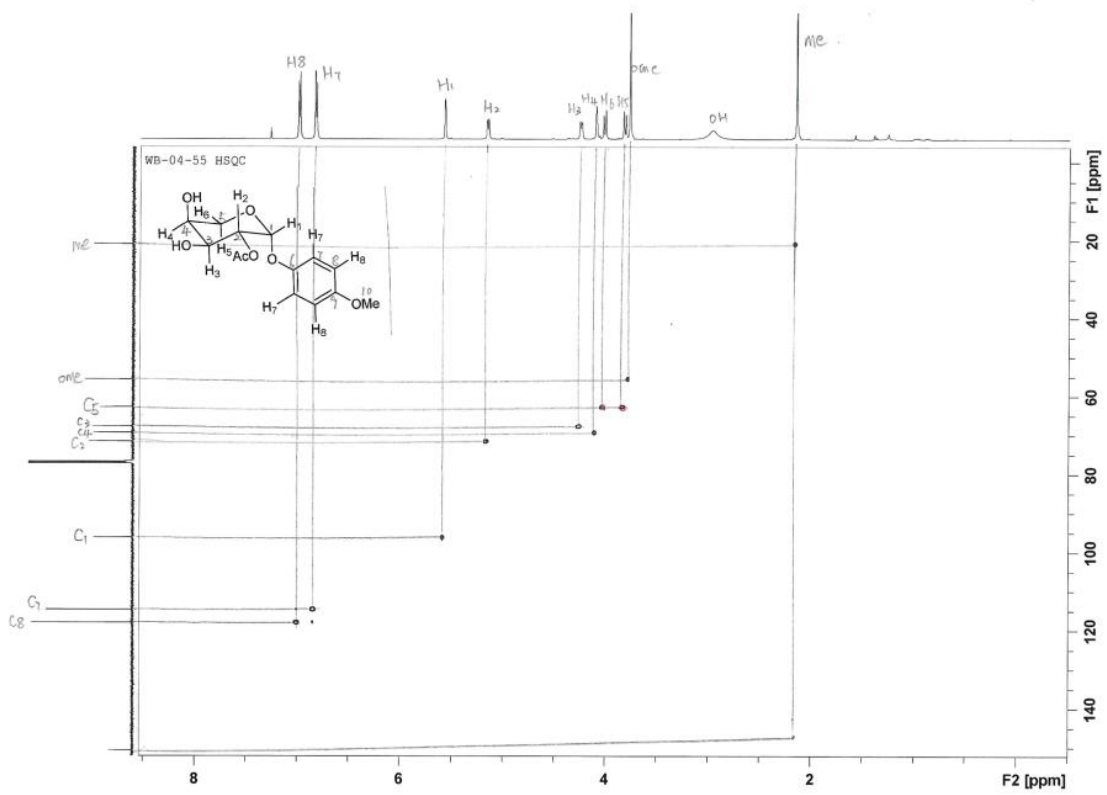
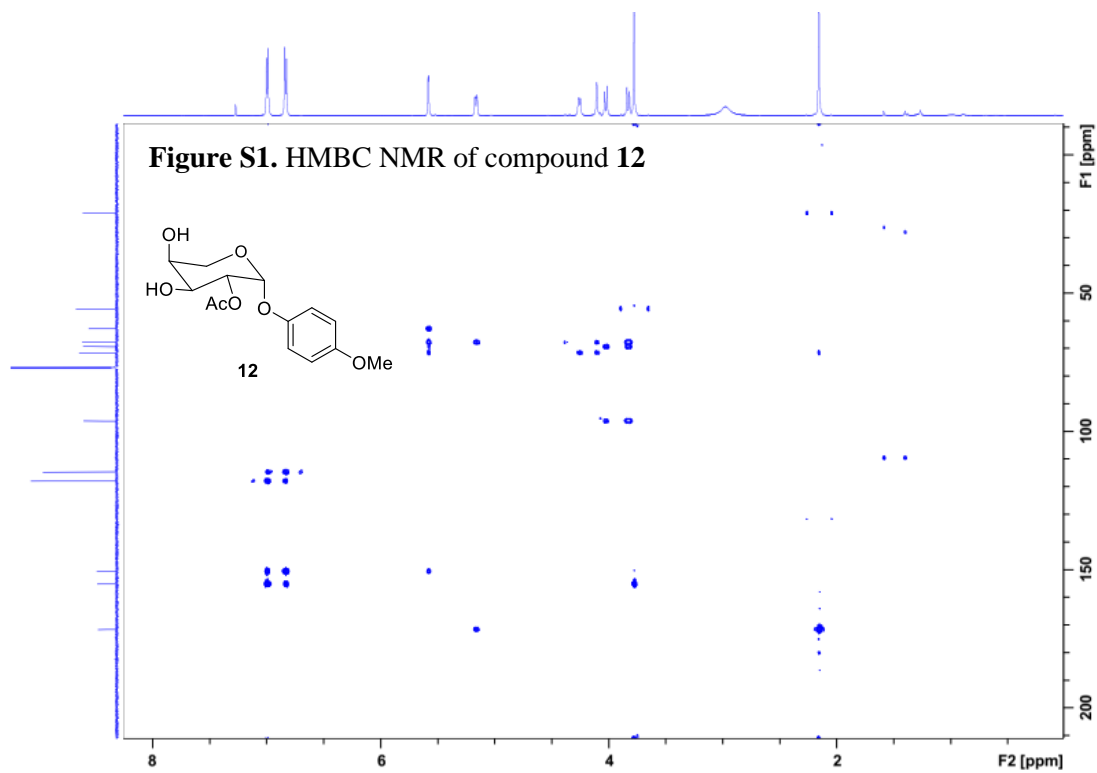
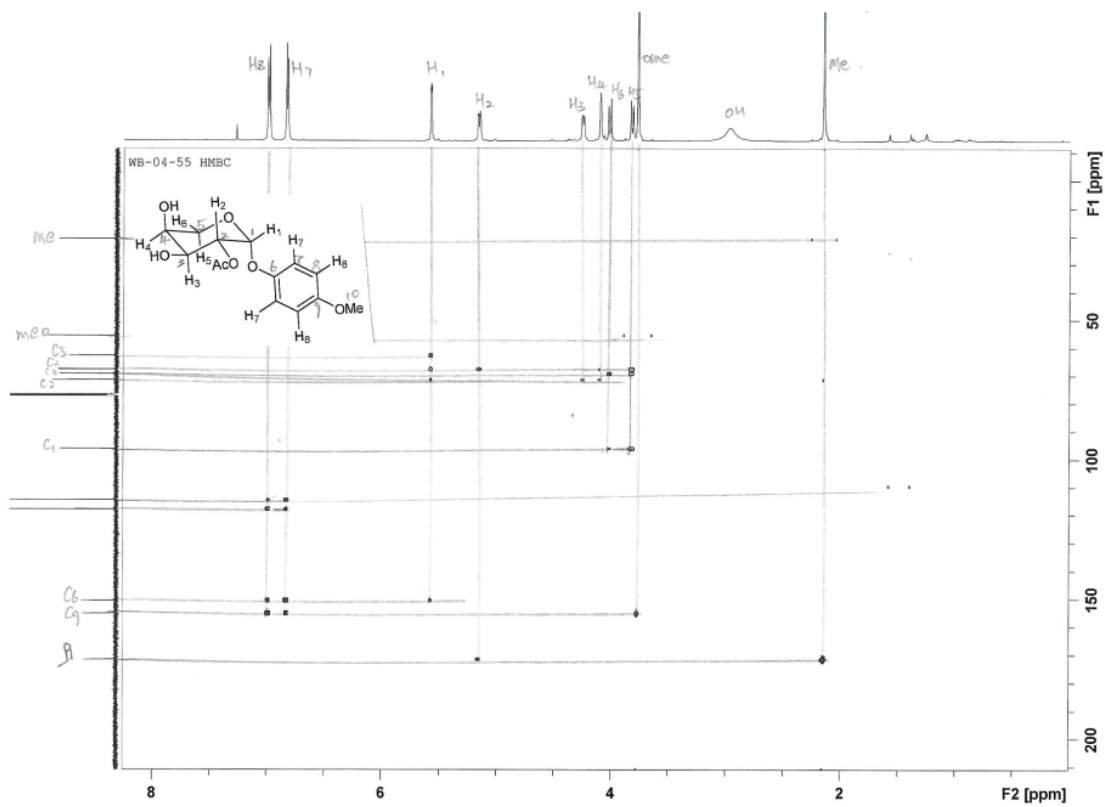


Figure S1. HMBC NMR of compound 12





WB-04-57

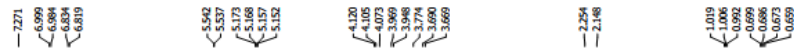
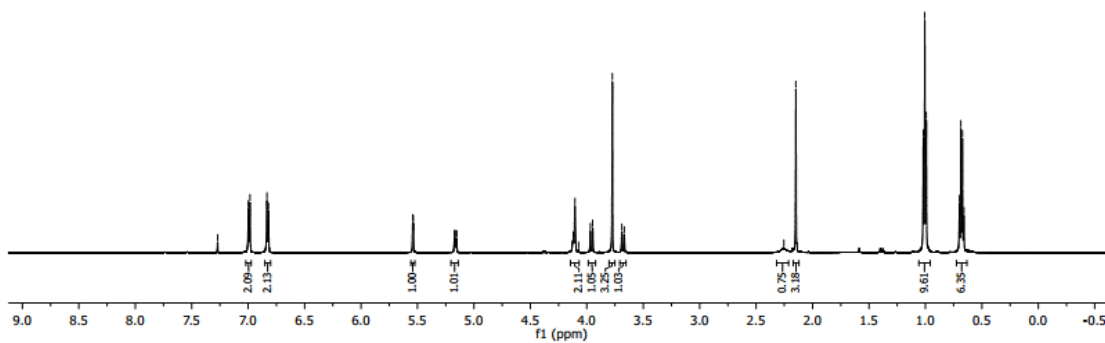
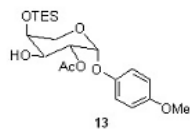


Figure S1. ^1H NMR of compound 13a



WB-04-57

171.198

155.120

150.772

117.996

114.593

96.532

77.212

77.000

76.788

76.576

70.568

67.877

63.840

55.637

21.002

6.689

4.883

Figure S1. ^{13}C NMR of compound **13a**

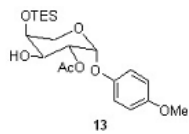
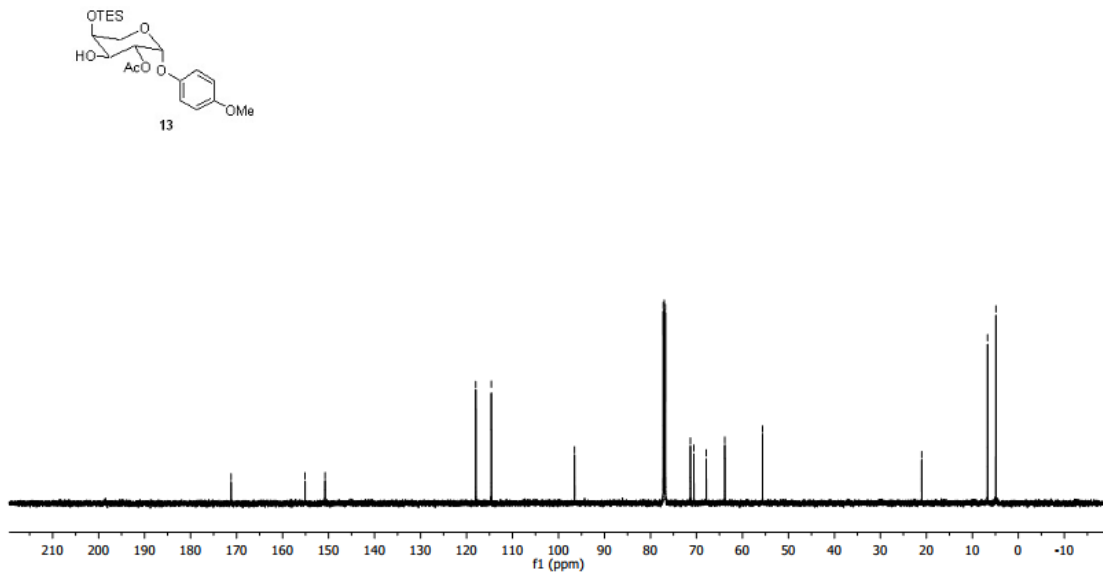


Figure S1. COSY NMR of compound **13a**

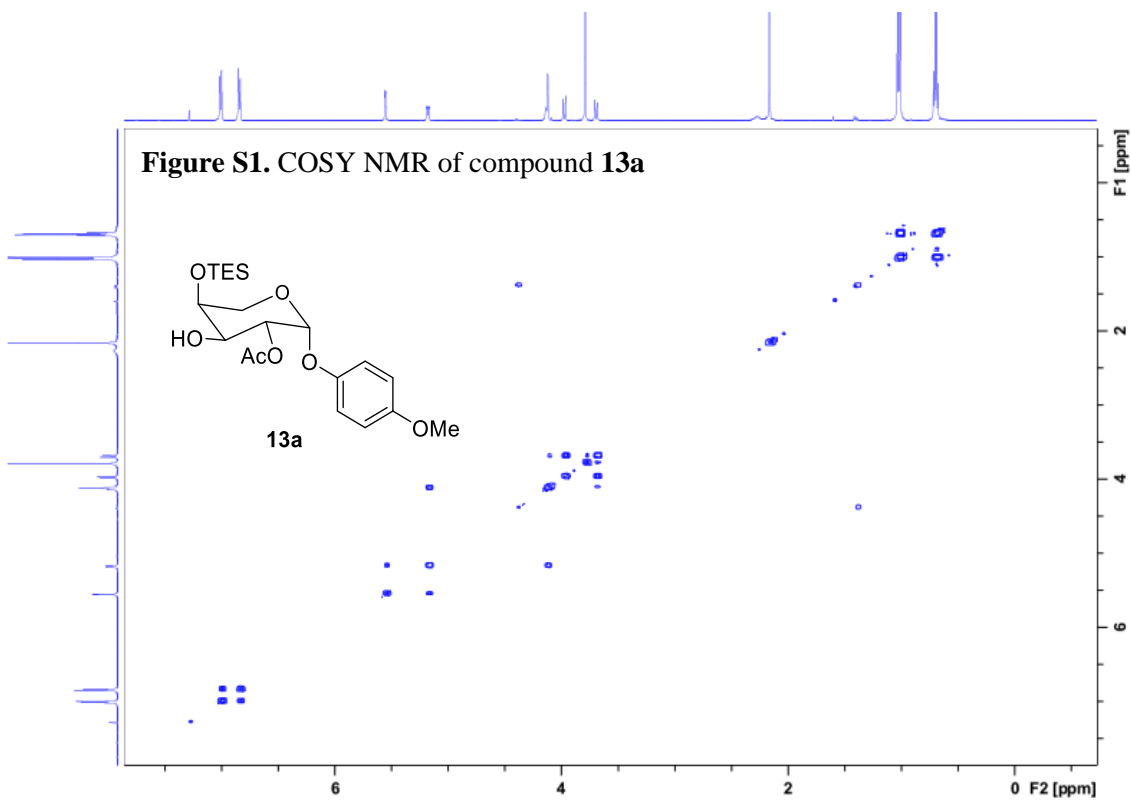


Figure S1. HSQC NMR of compound 13a

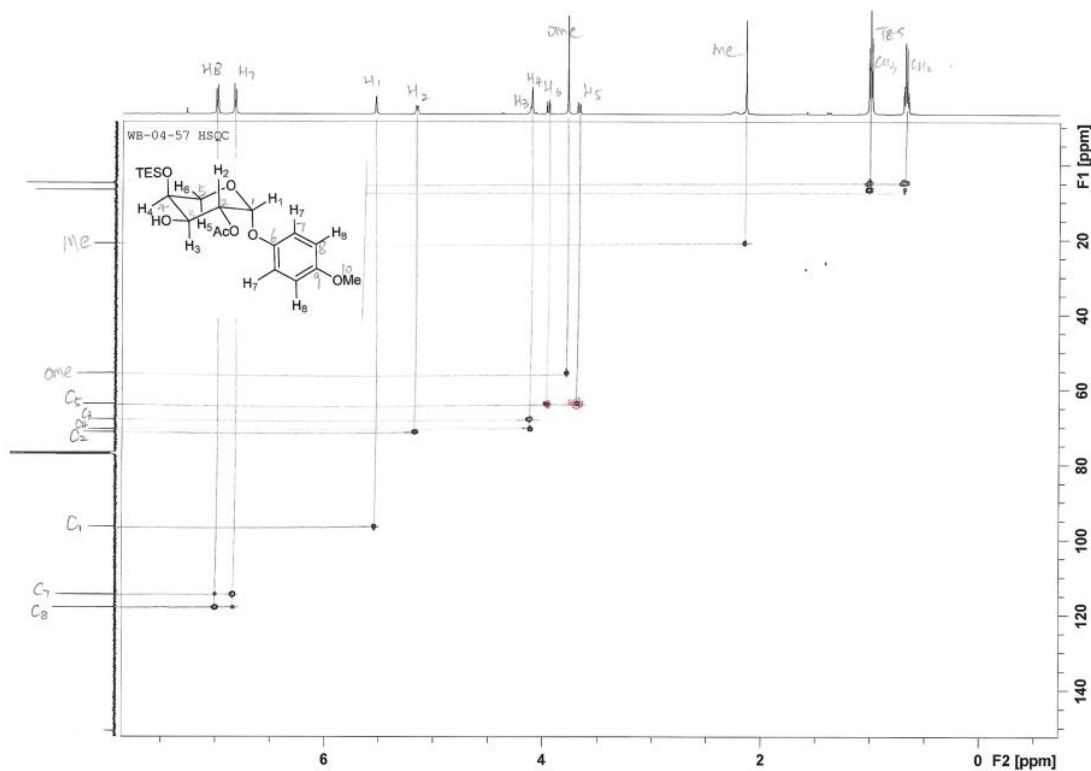
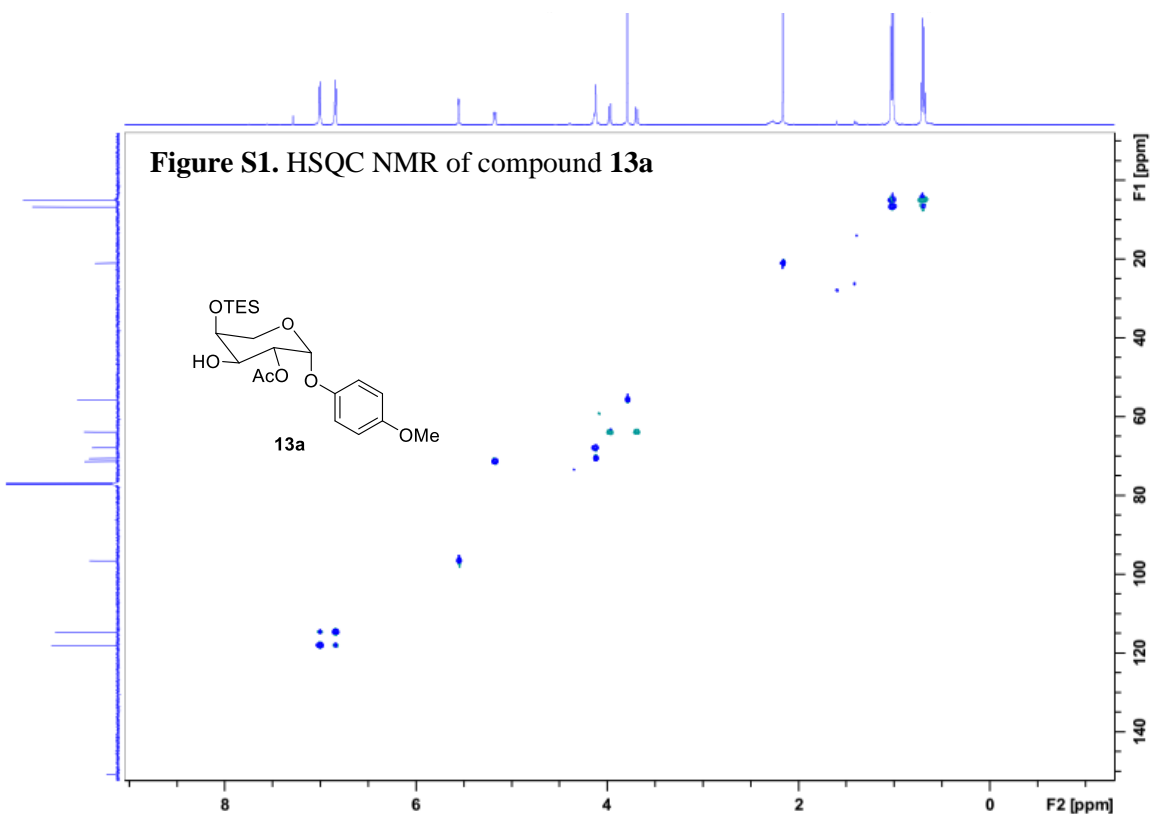
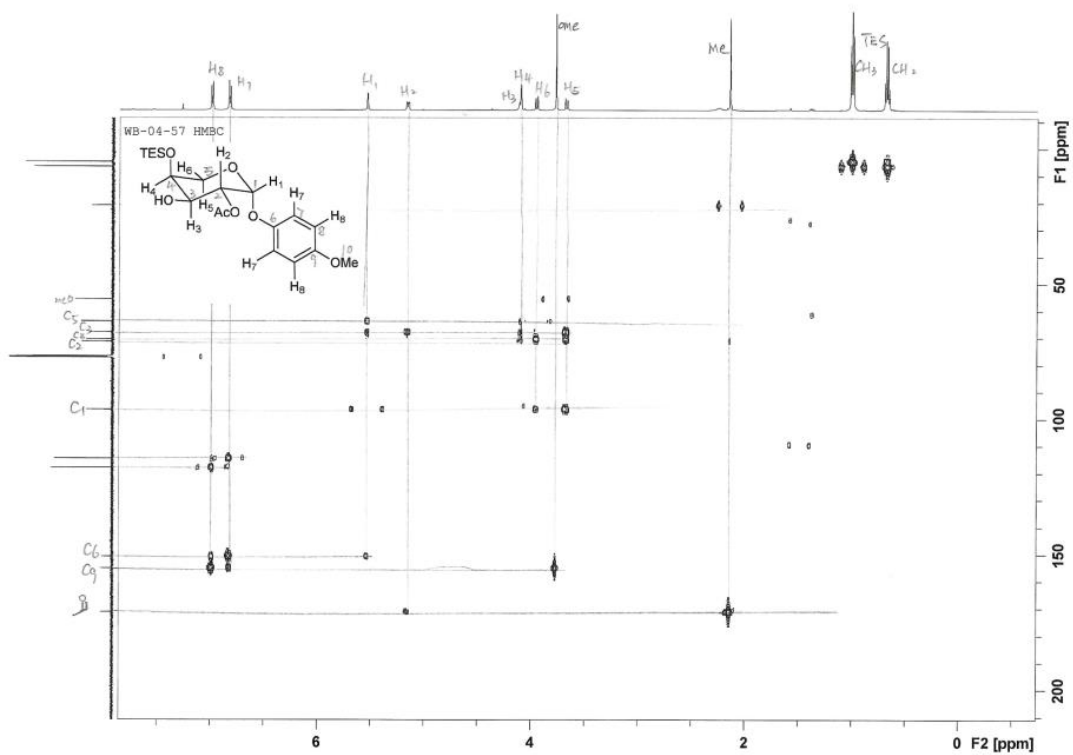
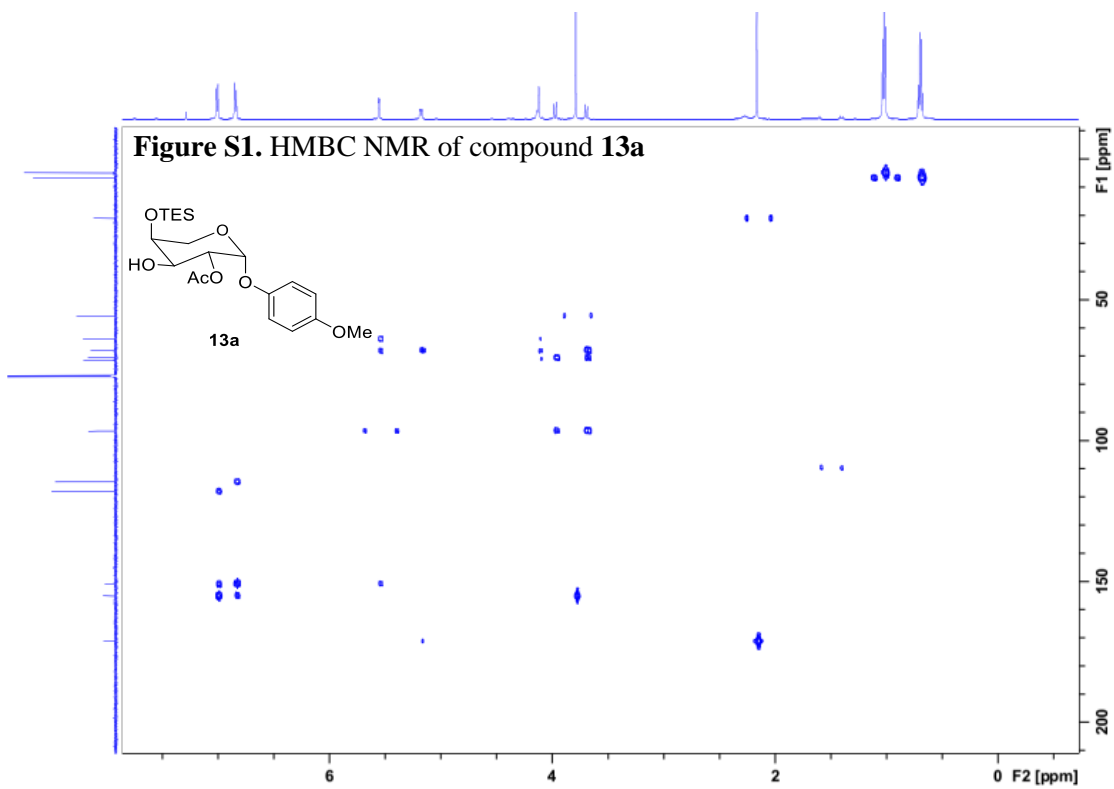


Figure S1. HMBC NMR of compound 13a



WB-04-57A

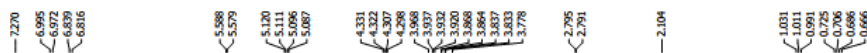


Figure S1. ^1H NMR of compound **13b**

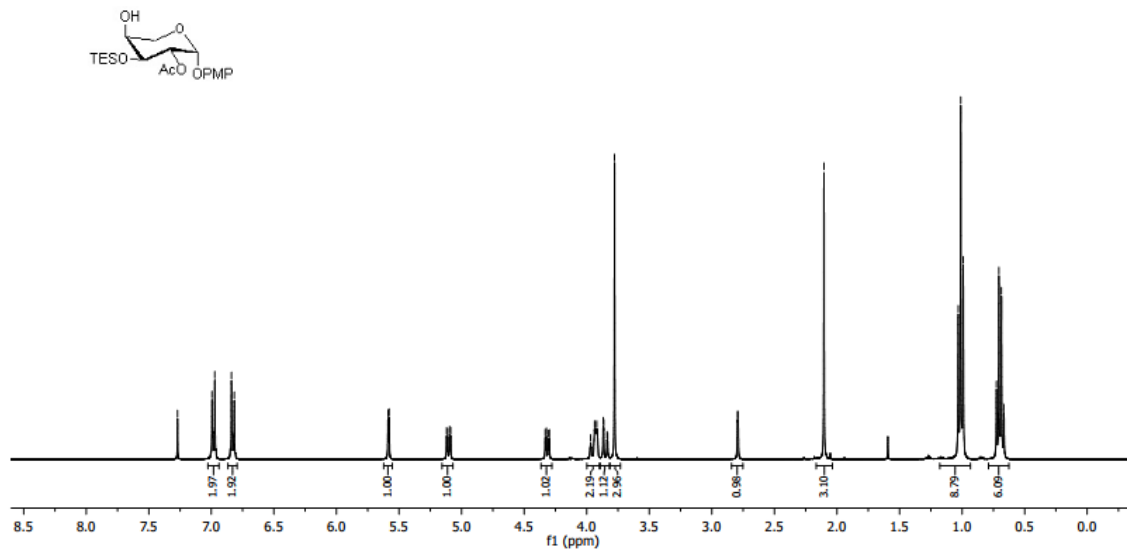
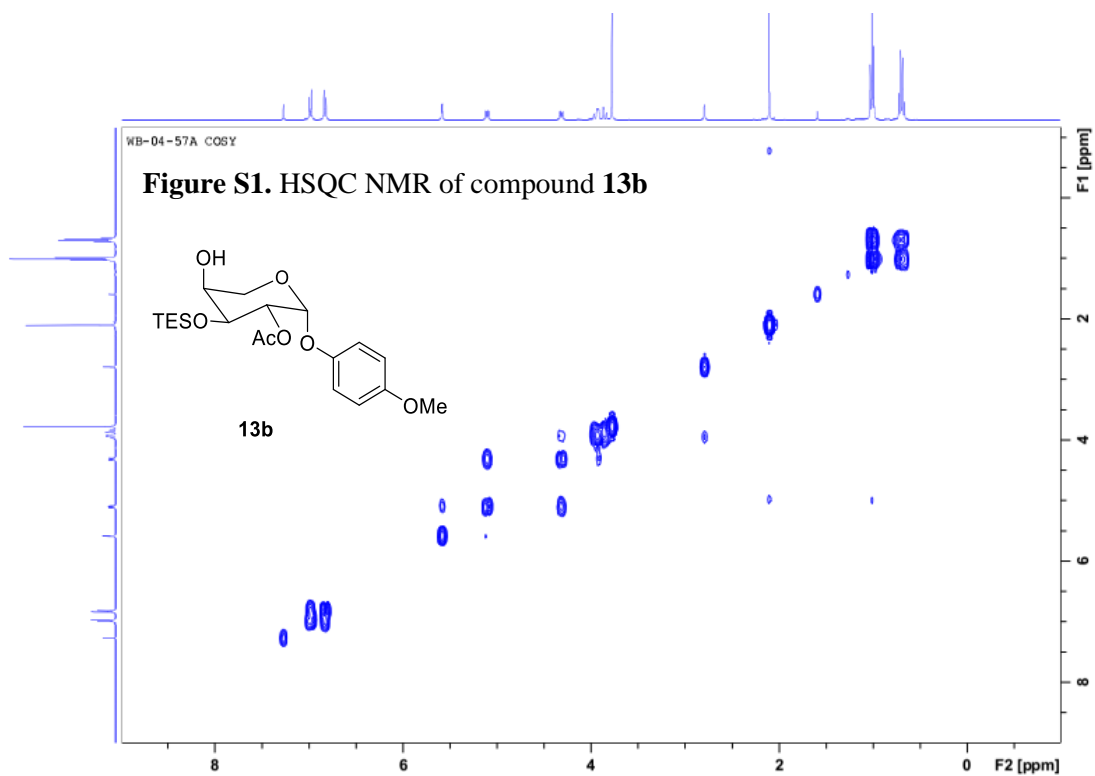


Figure S1. ^{13}C NMR of compound **13b**



WB-04-67

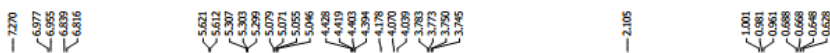
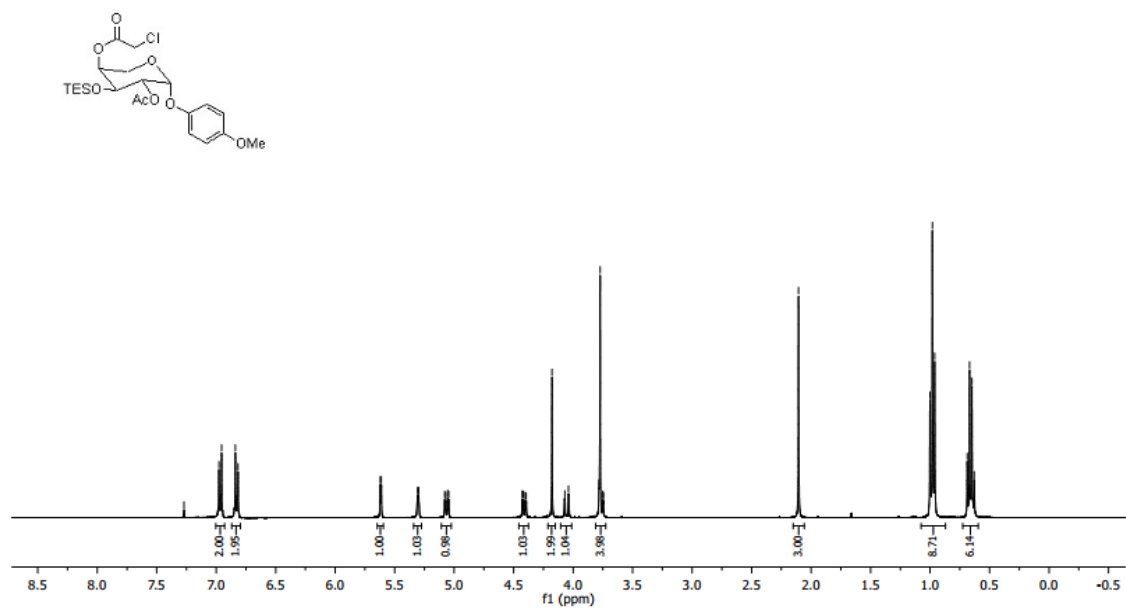


Figure S1. ¹H NMR of compound WB-04-67



WB-04-67

170.374
167.004
155.278
150.690
118.004
114.613
96.345
77.317
77.060
76.803
73.543
71.294
66.173
60.901
55.603
40.857
20.833
6.624
4.695

Figure S1. ^{13}C NMR of compound **WB-04-67**

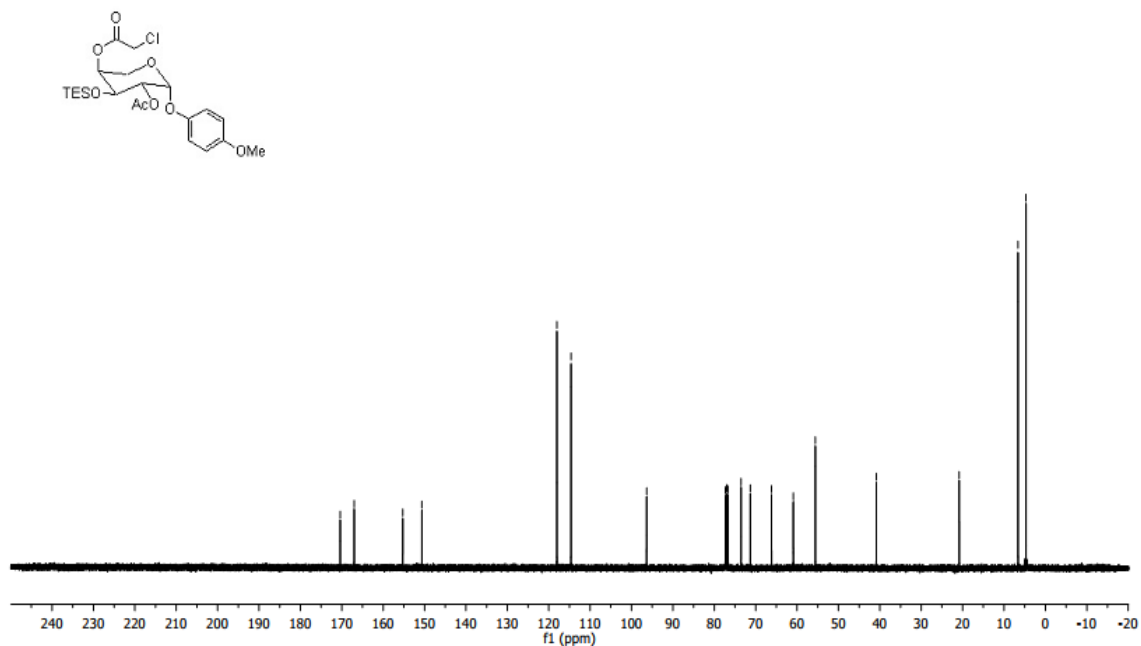


Figure S1. COSY NMR of compound **WB-04-67**

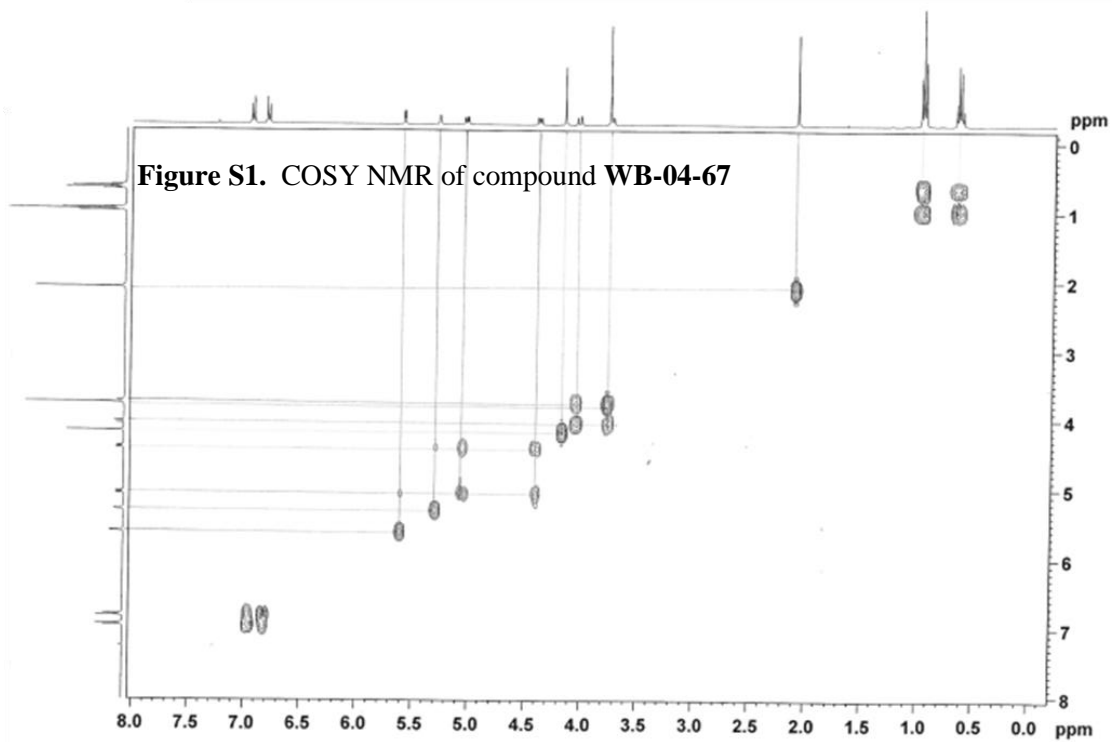


Figure S1. HSQC NMR of compound WB-04-67

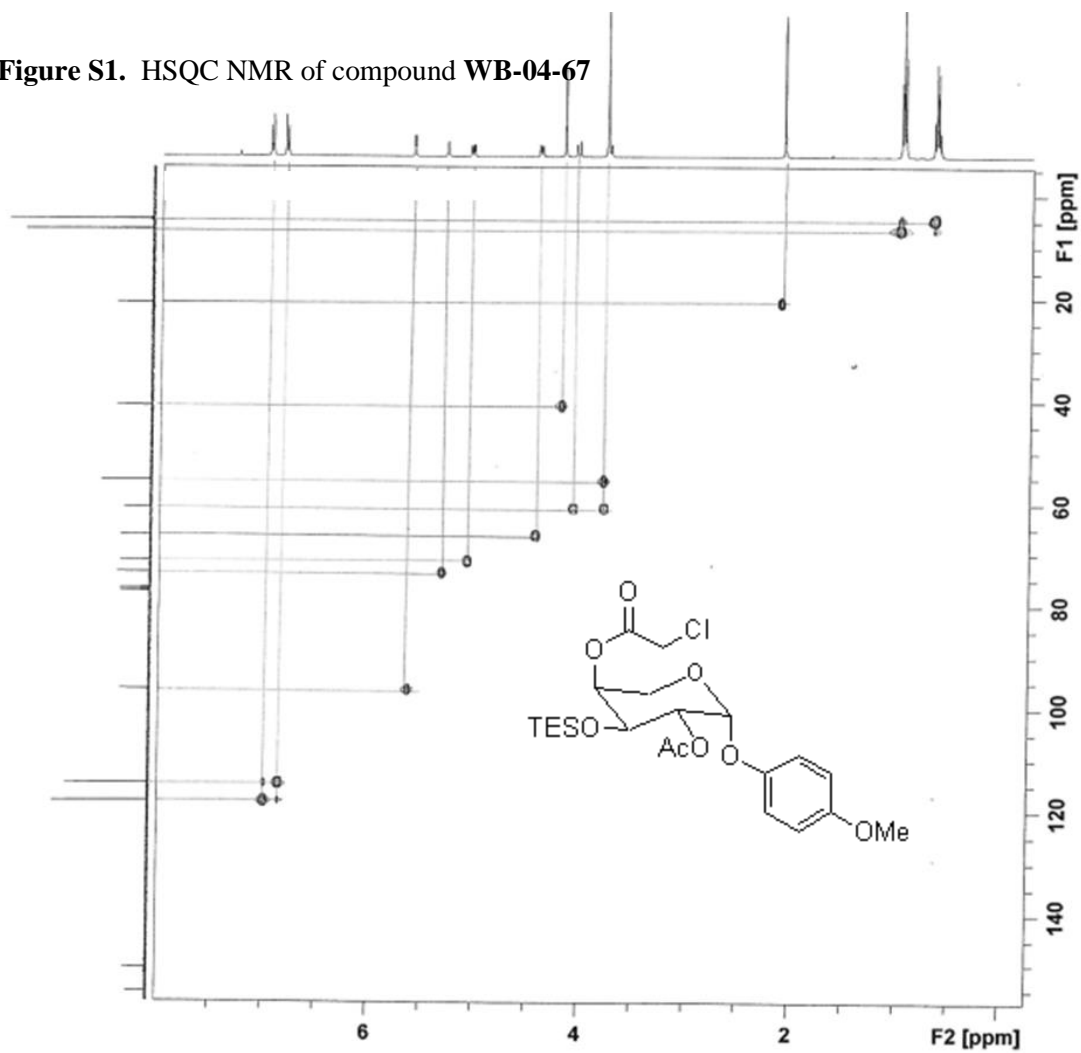
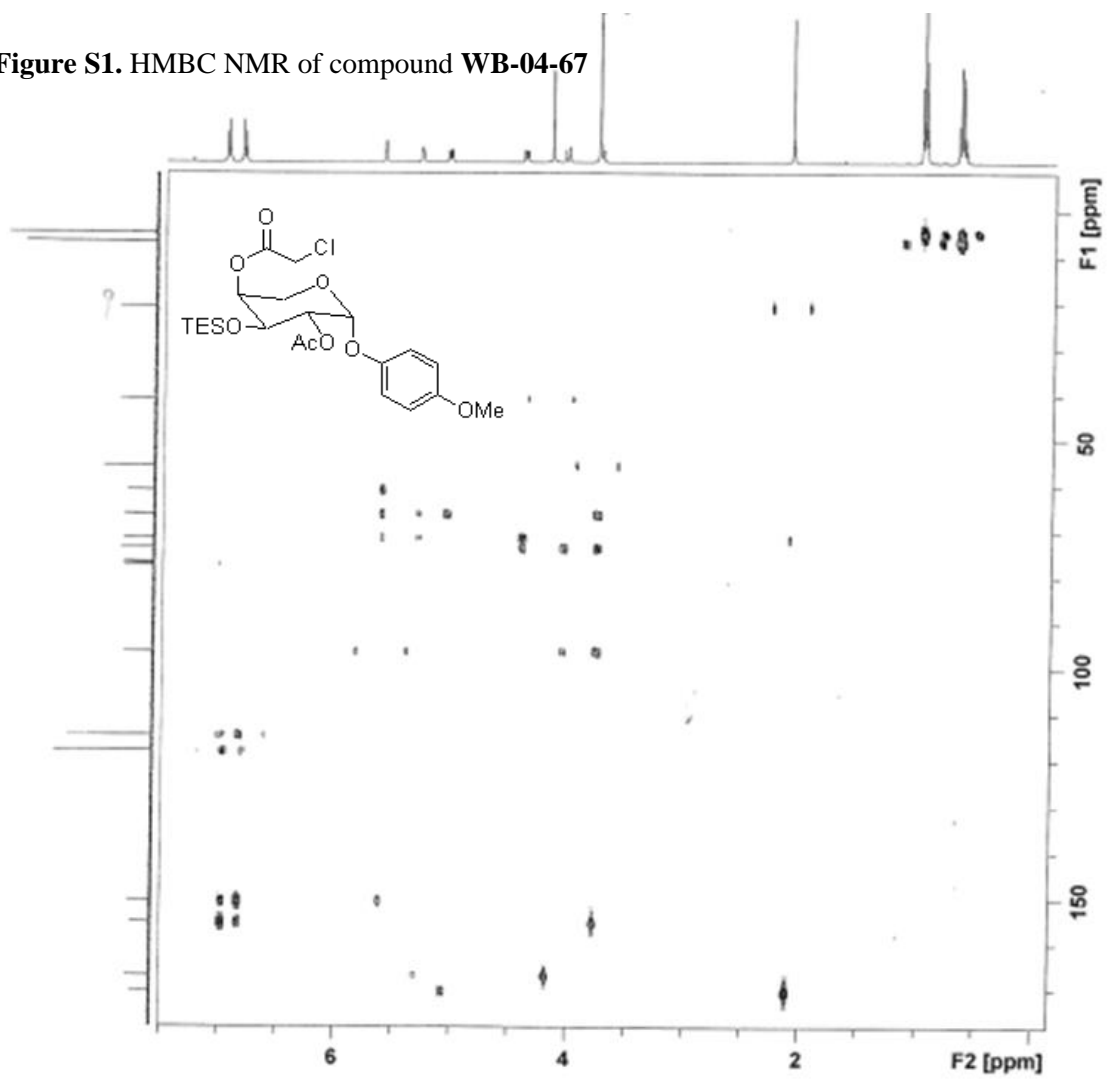
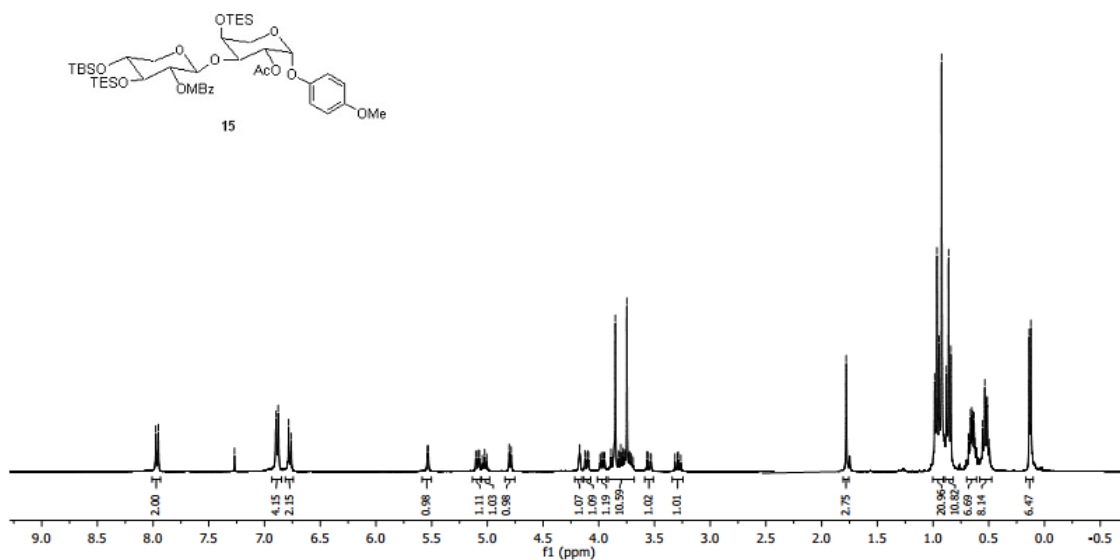


Figure S1. HMBC NMR of compound WB-04-67



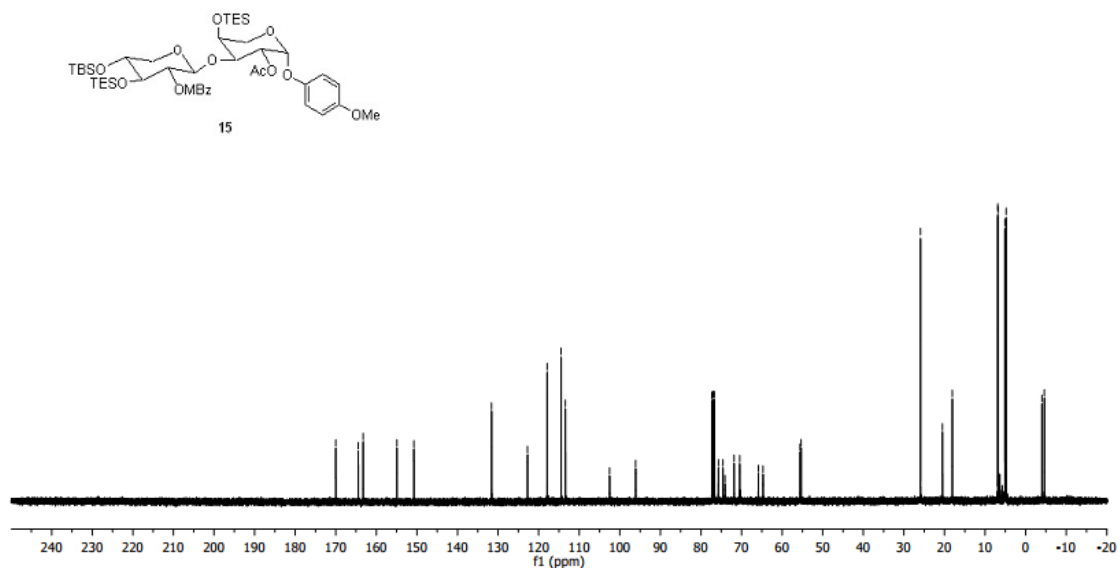
WB-05-46

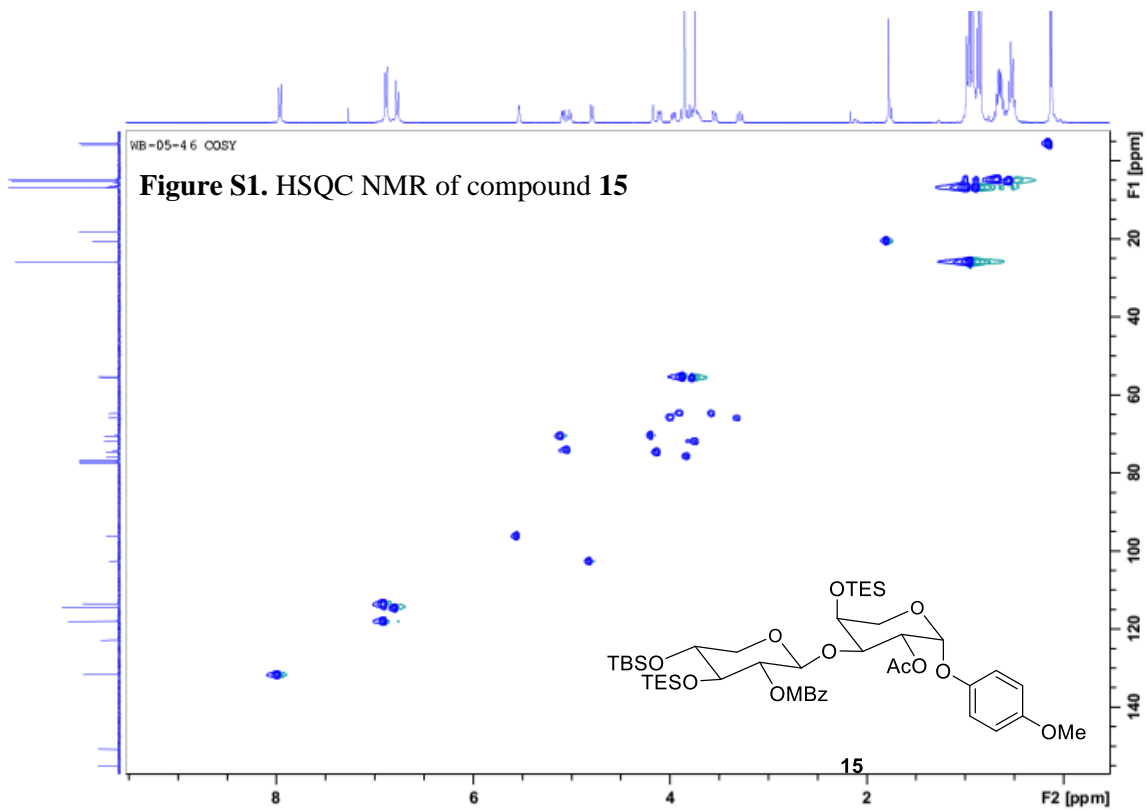
7.975
7.953
7.270
6.886
6.877
6.784
6.761
5.539
5.531
5.104
5.096
5.089
5.072
5.024
4.994
4.786
4.172
4.124
4.117
4.099
4.092
3.976
3.959
3.947
3.891
3.852
3.824
3.801
3.783
3.778
3.766
3.761
3.728
3.727
3.567
3.560
3.288
0.986
0.966
0.946
0.927
0.881
0.861
0.841
0.663
0.635
0.615
0.517
0.515
0.123

Figure S1. ¹H NMR of compound 15

WB-05-46

169.986
164.451
163.250
154.949
150.732
131.606
122.745
117.921
114.495
113.451
102.524
96.103
77.317
77.000
76.682
75.702
74.584
74.074
73.665
70.468
69.867
64.699
55.572
55.321
25.927
20.697
18.079
6.882
6.782
5.104
4.801
4.003
4.619

Figure S1. ¹³C NMR of compound 15



WB-5-49

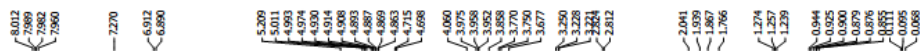
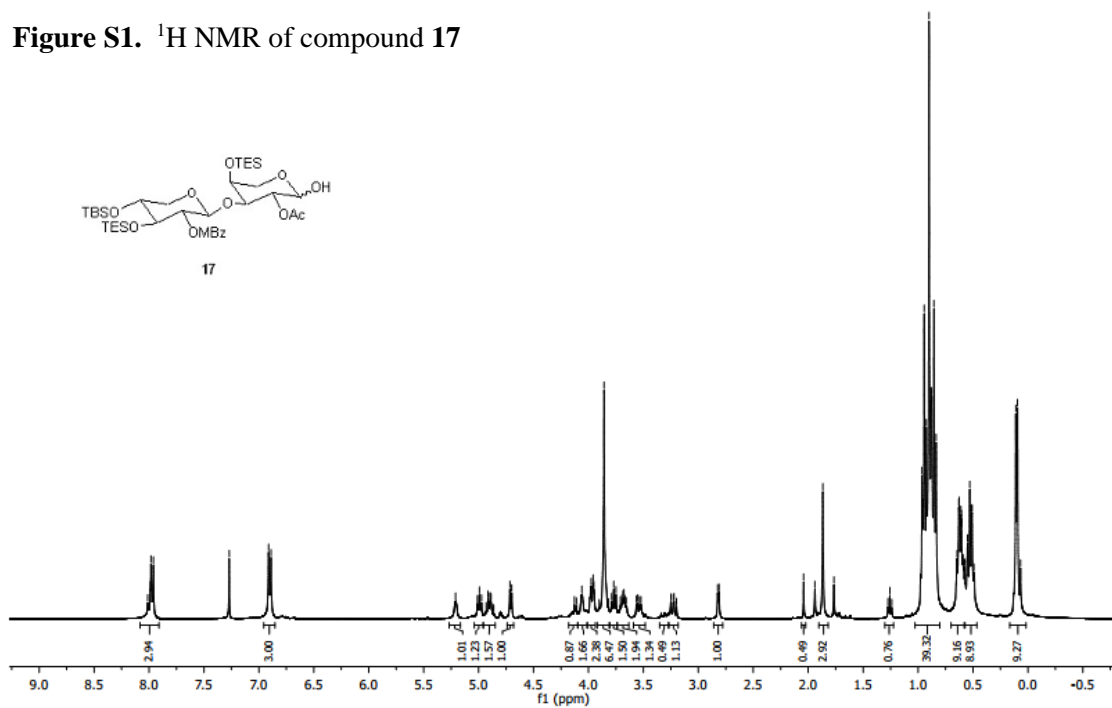


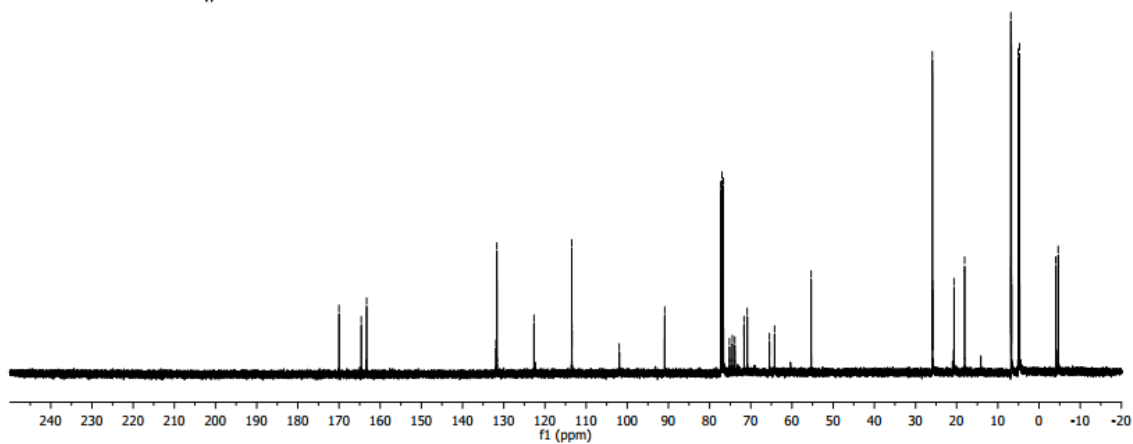
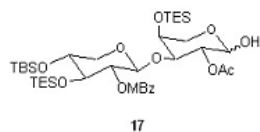
Figure S1. ¹H NMR of compound 17



WB-05-49

169.993
164.999
163.307
131.901
131.679
122.665
113.491
113.469
101.949
90.919
77.318
77.201
77.000
76.682
74.498
73.871
70.871
65.499
58.332
58.258
25.918
20.76
20.64
18.076
6.548
6.813
6.746
5.075
4.762
4.654

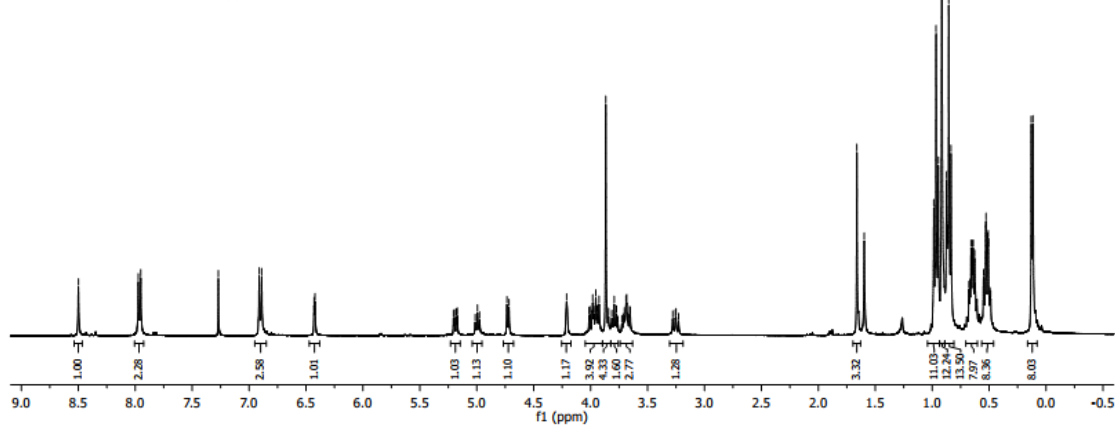
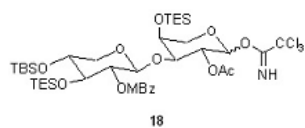
Figure S1. ^{13}C NMR of compound 17



WB-05-52

8.499
7.977
7.951
7.270
6.911
6.889
6.429
6.421
5.205
5.196
5.171
5.014
4.995
4.975
4.955
4.211
3.982
3.955
3.942
3.926
3.906
3.793
3.689
3.669
3.256
3.251
3.228
1.652
1.597
0.986
0.966
0.946
0.916
0.875
0.855
0.835
0.528
0.512
0.370
0.350
0.115

Figure S1. ^1H NMR of compound 18



WB-05-52

160.728
164.403
163.287
160.972

131.678

122.779

113.479

102.796

94.919

91.247

77.317

77.000

76.682

76.364

74.841

71.813

70.251

69.433

66.386

59.377

35.949

29.395

18.101

6.872

6.796

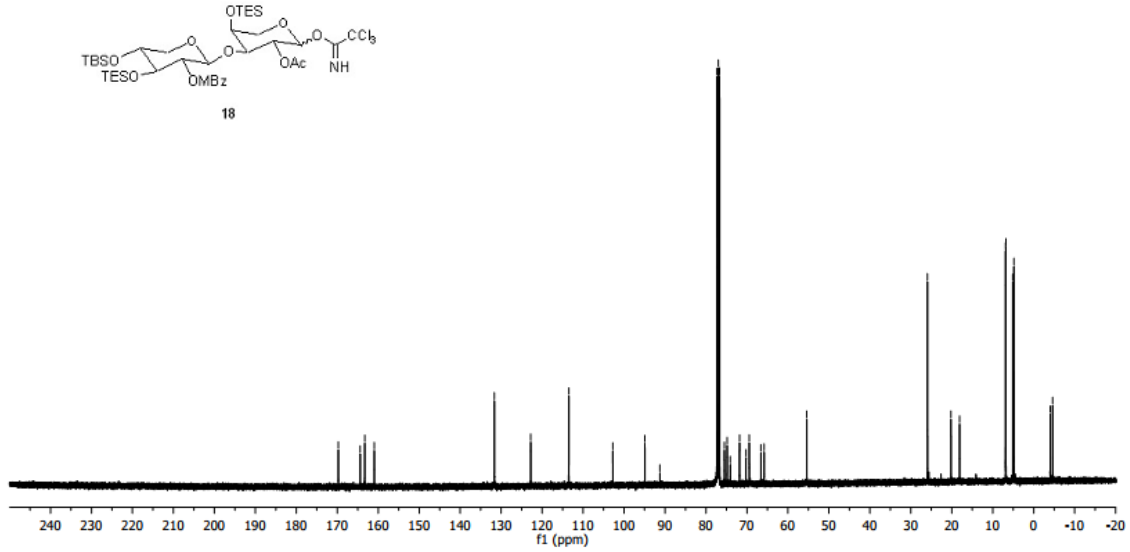
5.116

4.828

4.012

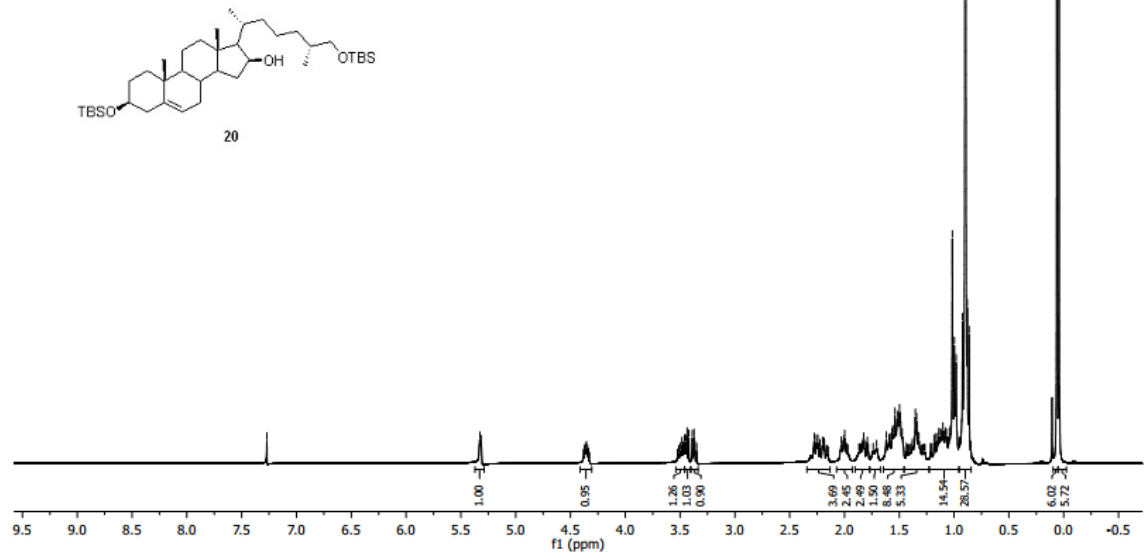
4.007

Figure S1. ^{13}C NMR of compound 18



7.276
5.326
4.314
4.304
4.356
3.695
3.684
3.672
3.600
3.605
3.435
3.421
3.389
3.373
3.365
3.348
2.256
2.243
2.224
2.200
2.195
2.185
2.181
2.030
2.021
2.007
1.999
1.989
1.986
1.889
1.883
1.824
1.817
1.799
1.791
1.781
1.658
1.628
1.618
1.593
1.594
1.594
1.557
1.557
1.550
1.517
1.498
1.489
1.475
1.475
1.380
1.380
1.364
1.353
1.342
1.340
1.340
1.206
1.183
1.172
1.158
1.150
1.139
1.129
1.115
1.103
1.093
1.078
1.071
1.071
1.042
1.032
1.032
0.998
0.982
0.966
0.966
0.923
0.900
0.896
0.880
0.883
0.883
0.063
0.043

Figure S1. ^1H NMR of compound 20



WB-04-33

Figure S1. ^{13}C NMR of compound 20

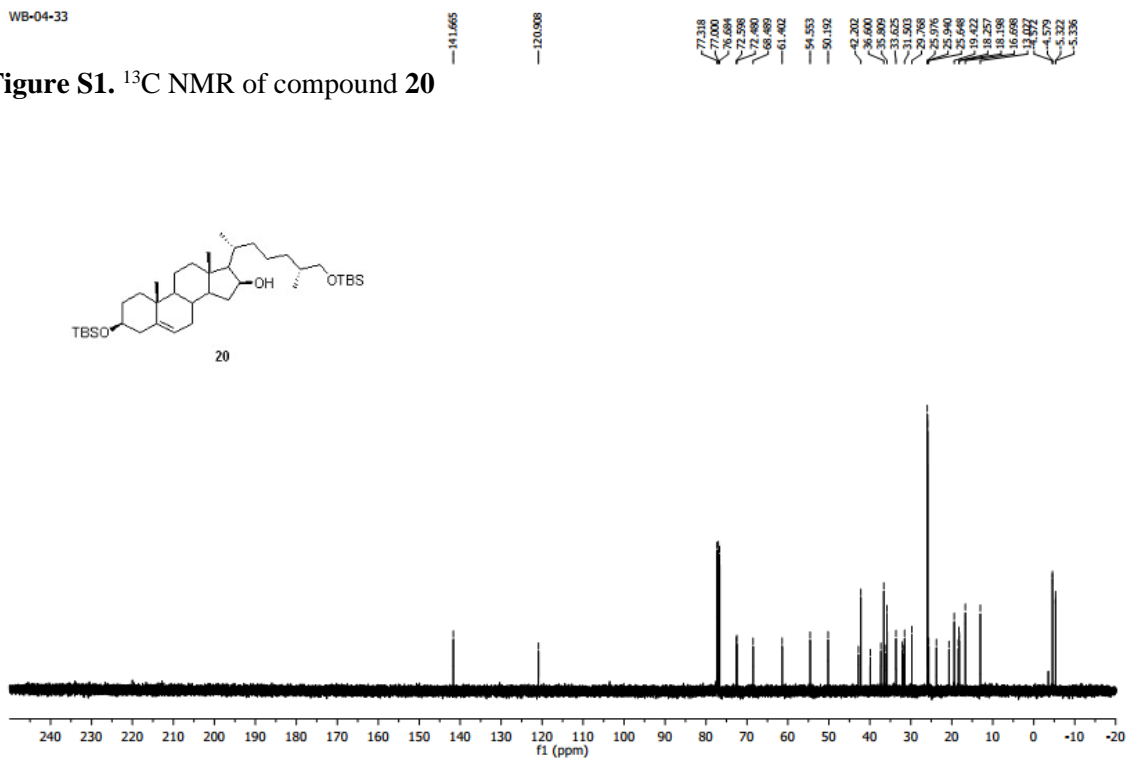
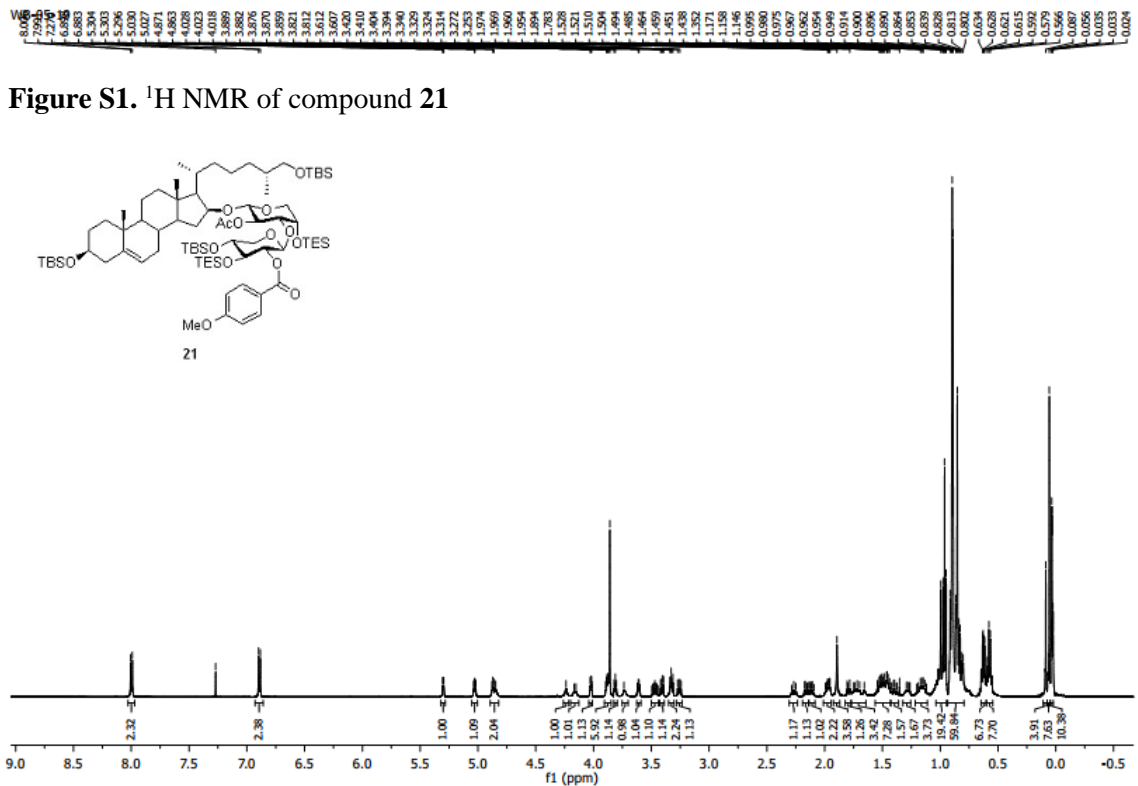
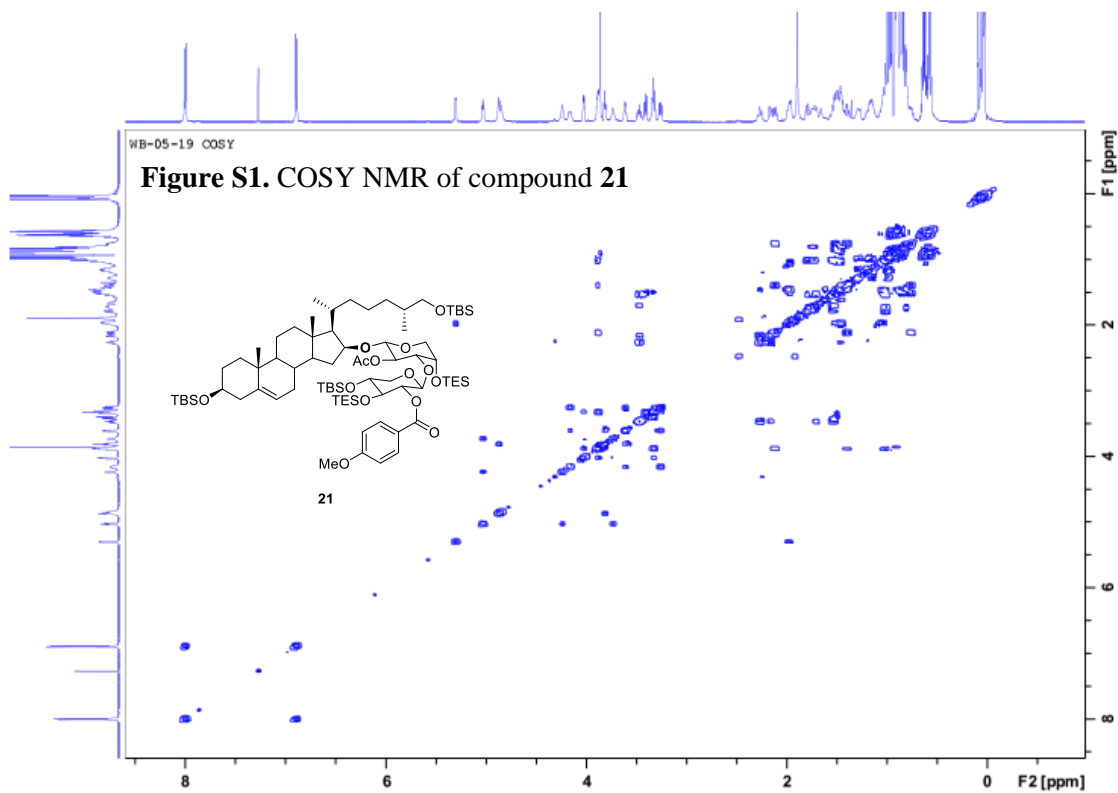
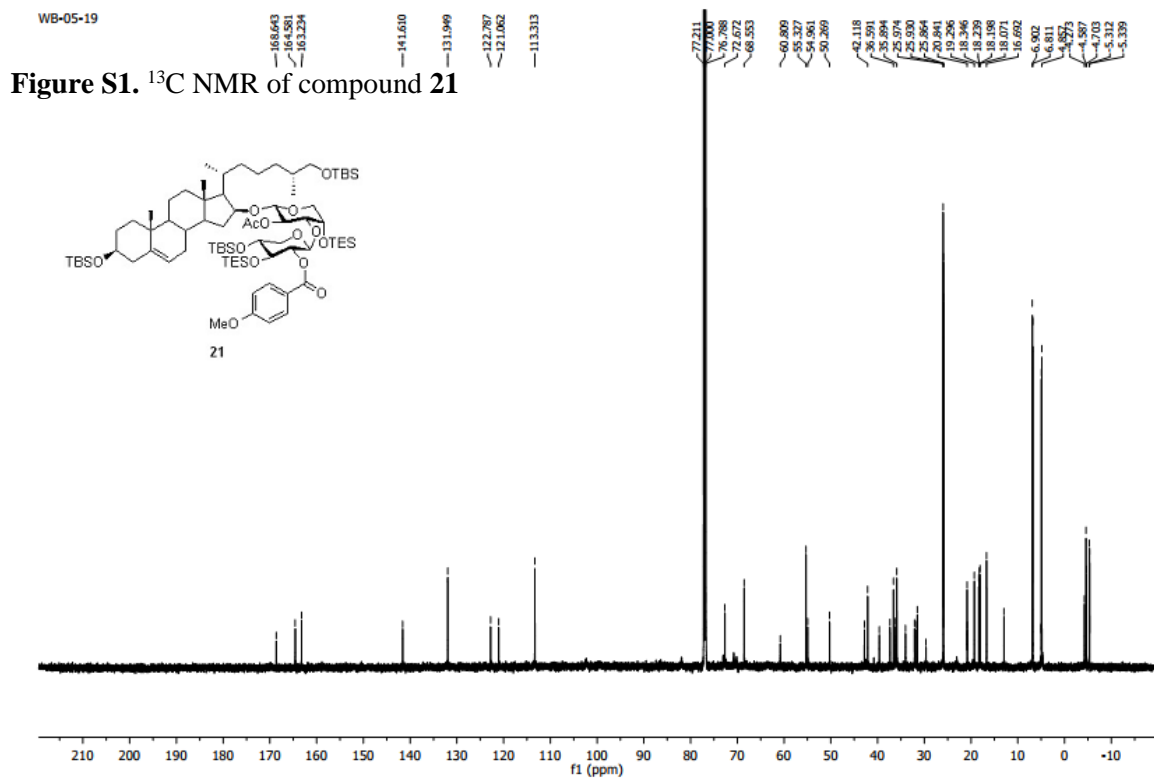
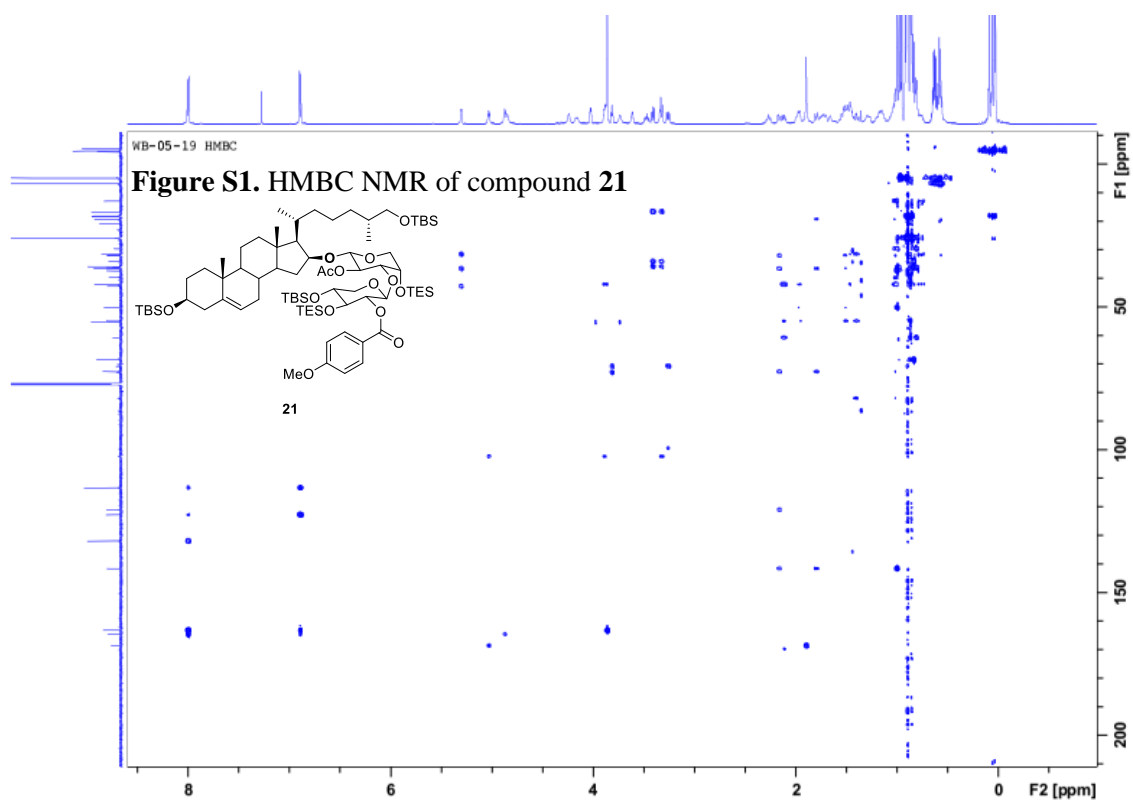
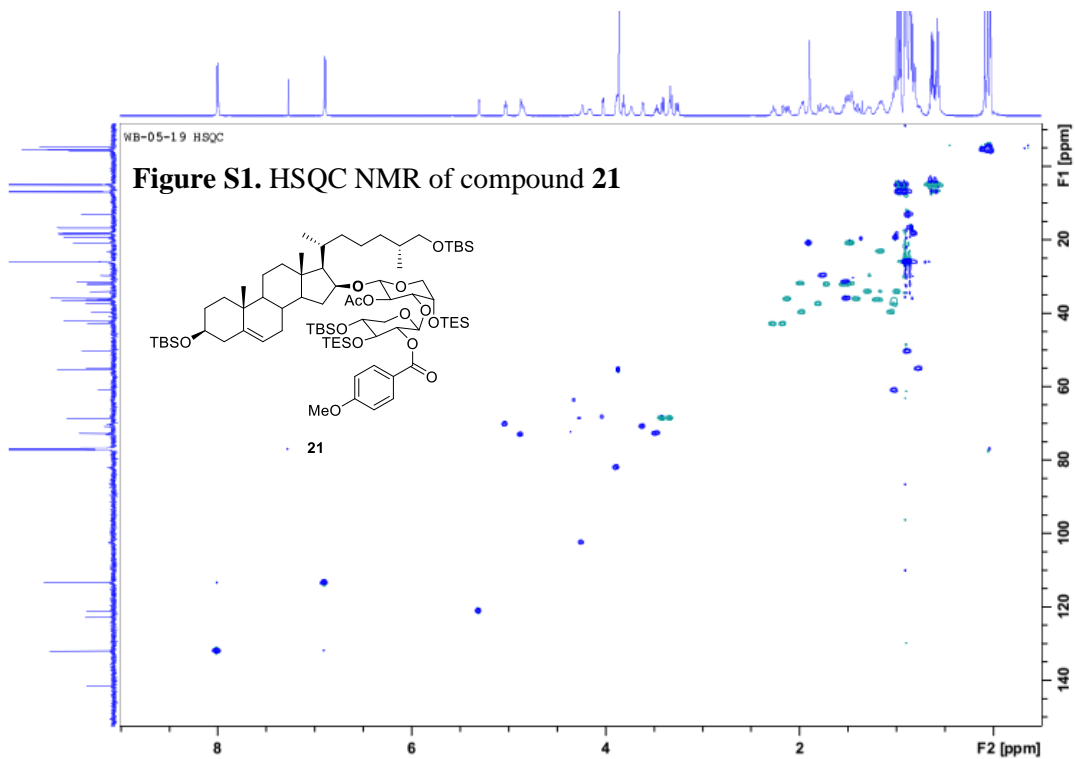
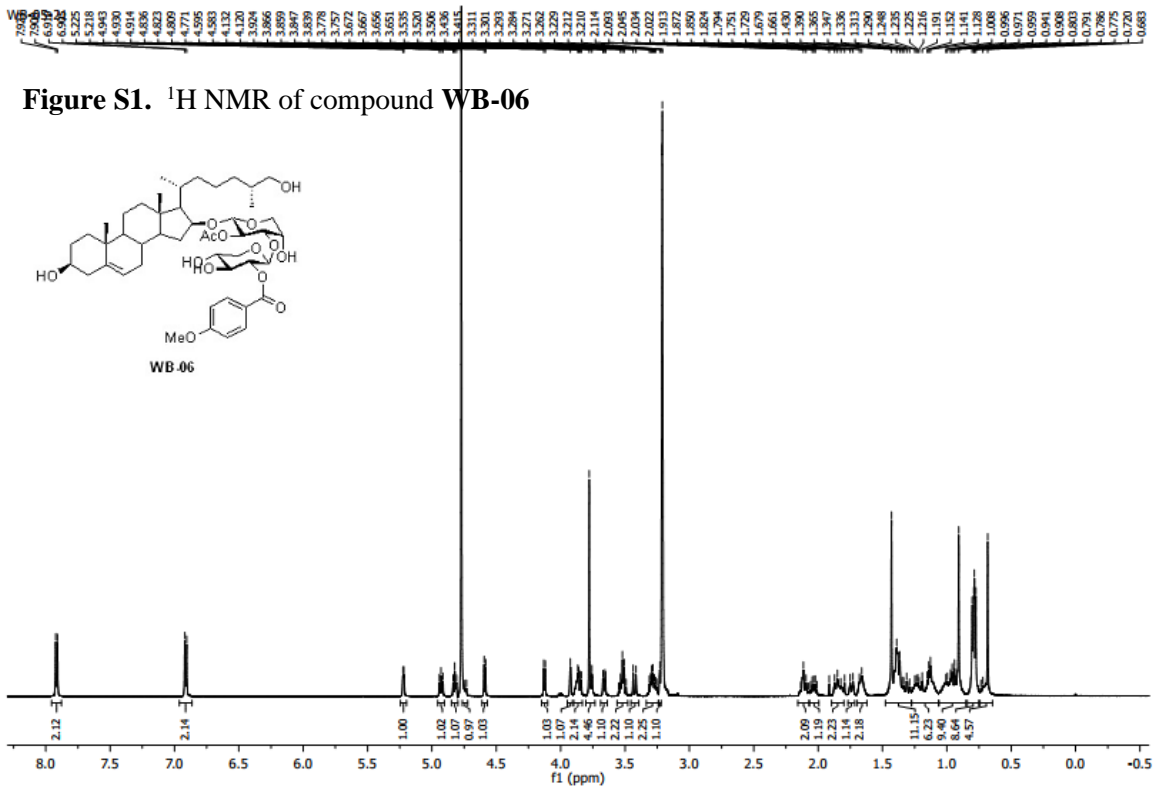
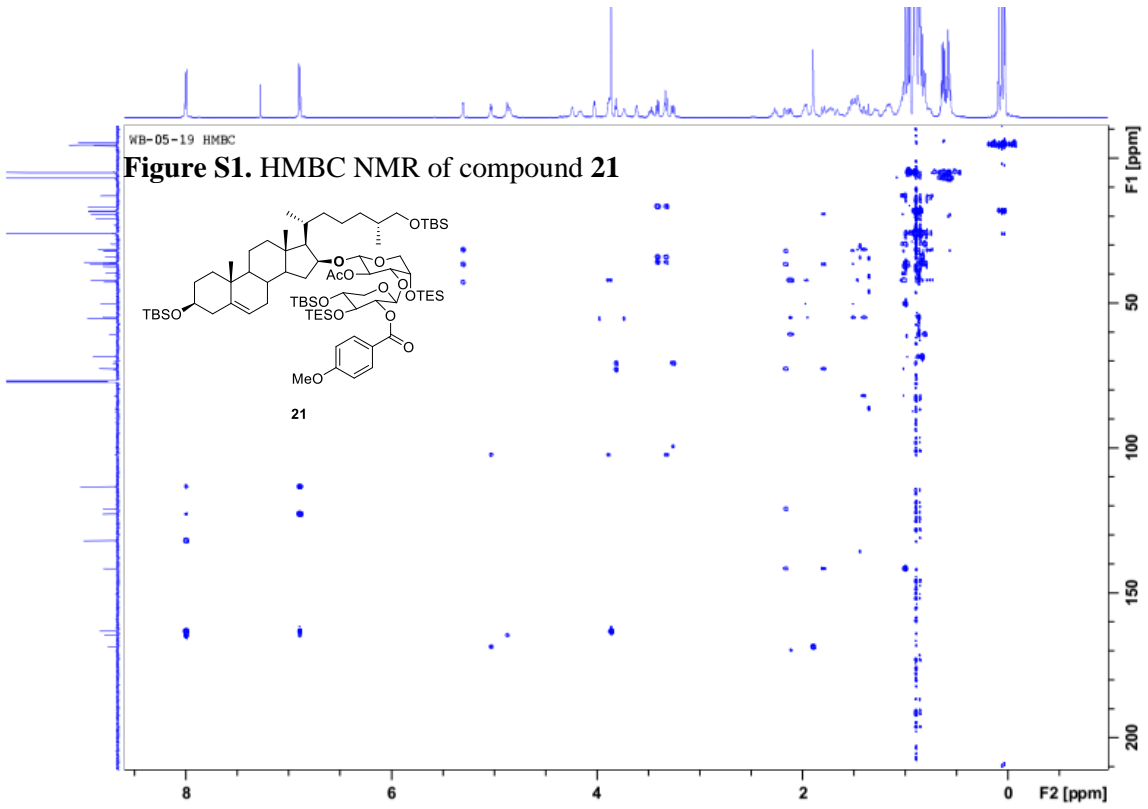


Figure S1. ^1H NMR of compound 21



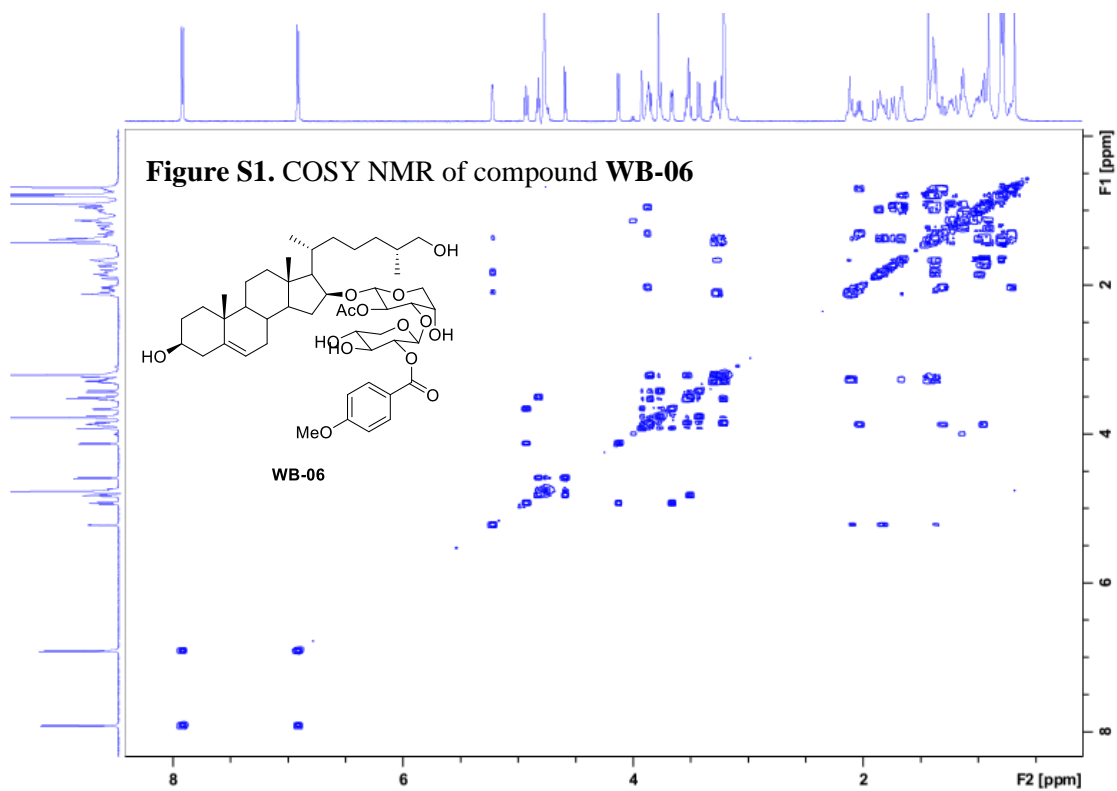
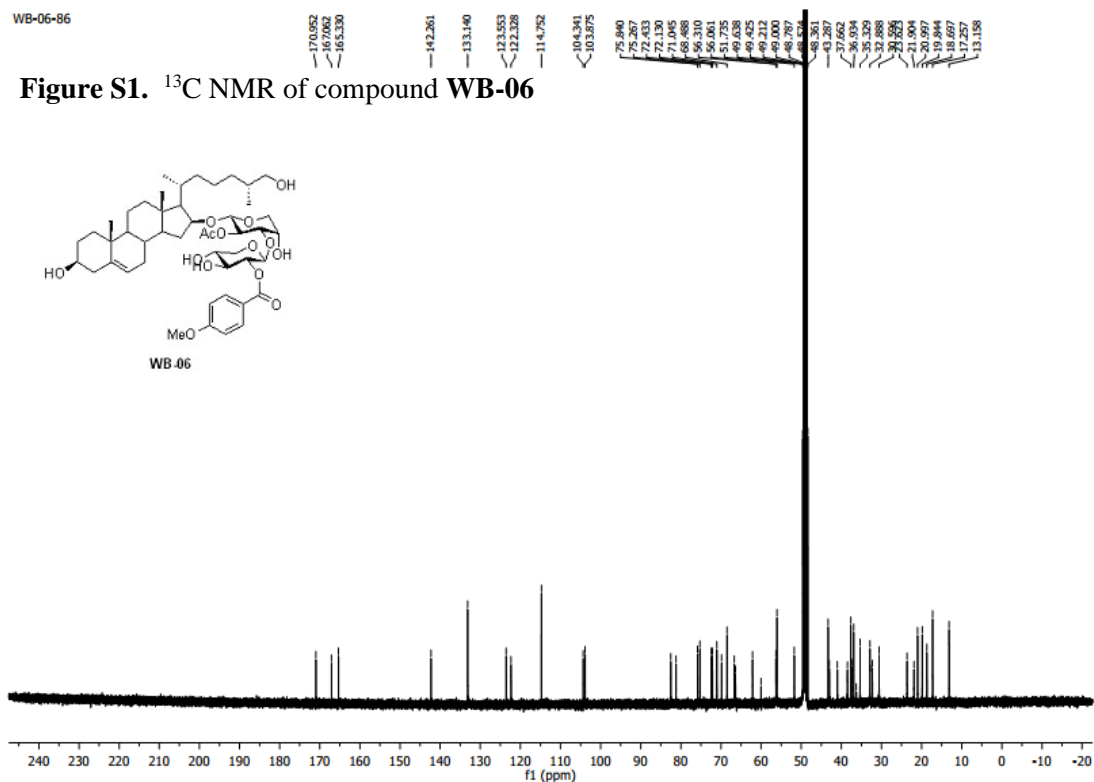






WB-06-86

Figure S1. ^{13}C NMR of compound WB-06



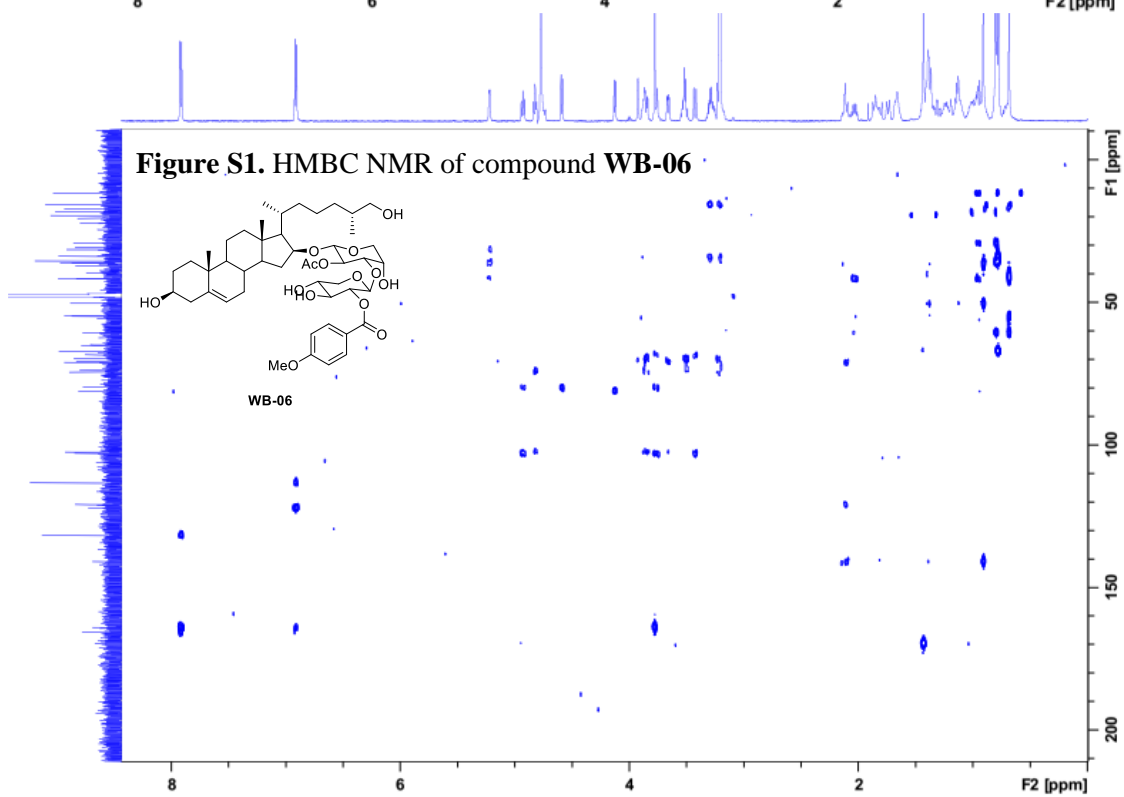
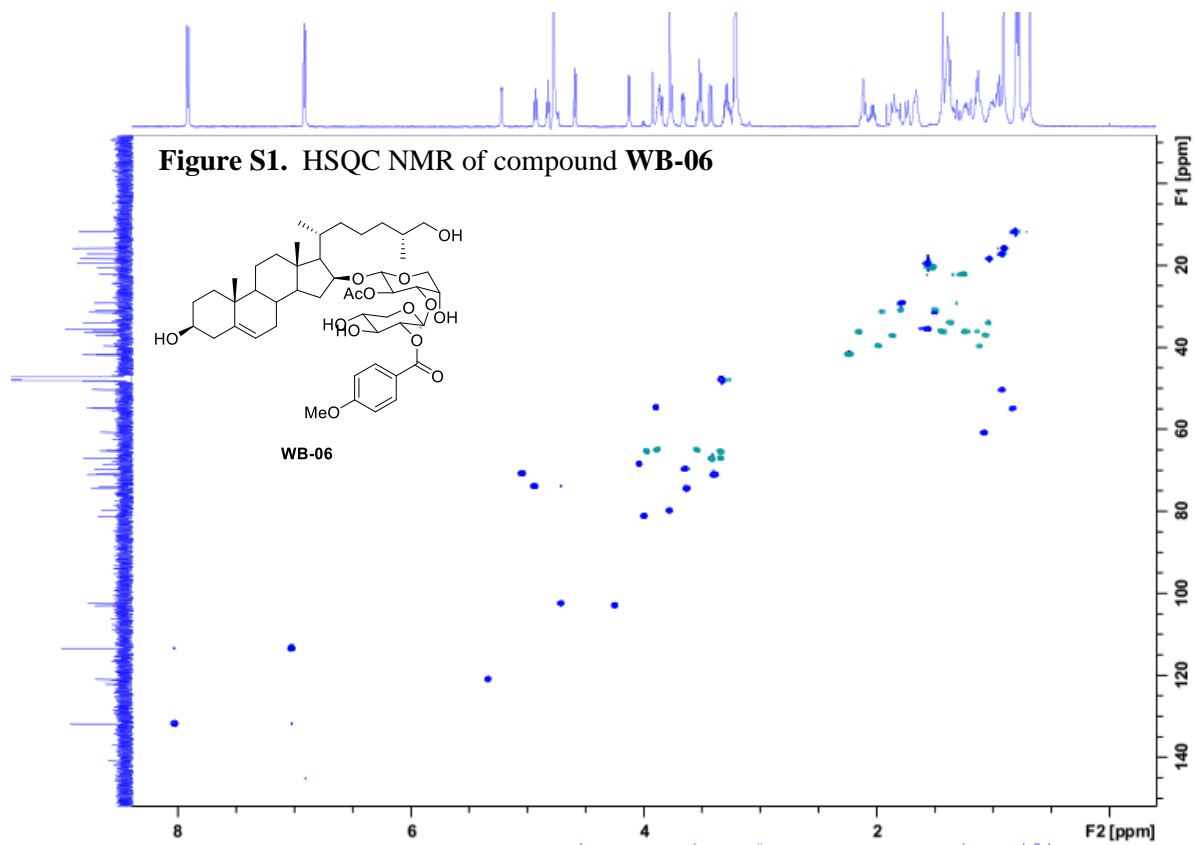


Figure S1. COSY NMR of compound WB-06

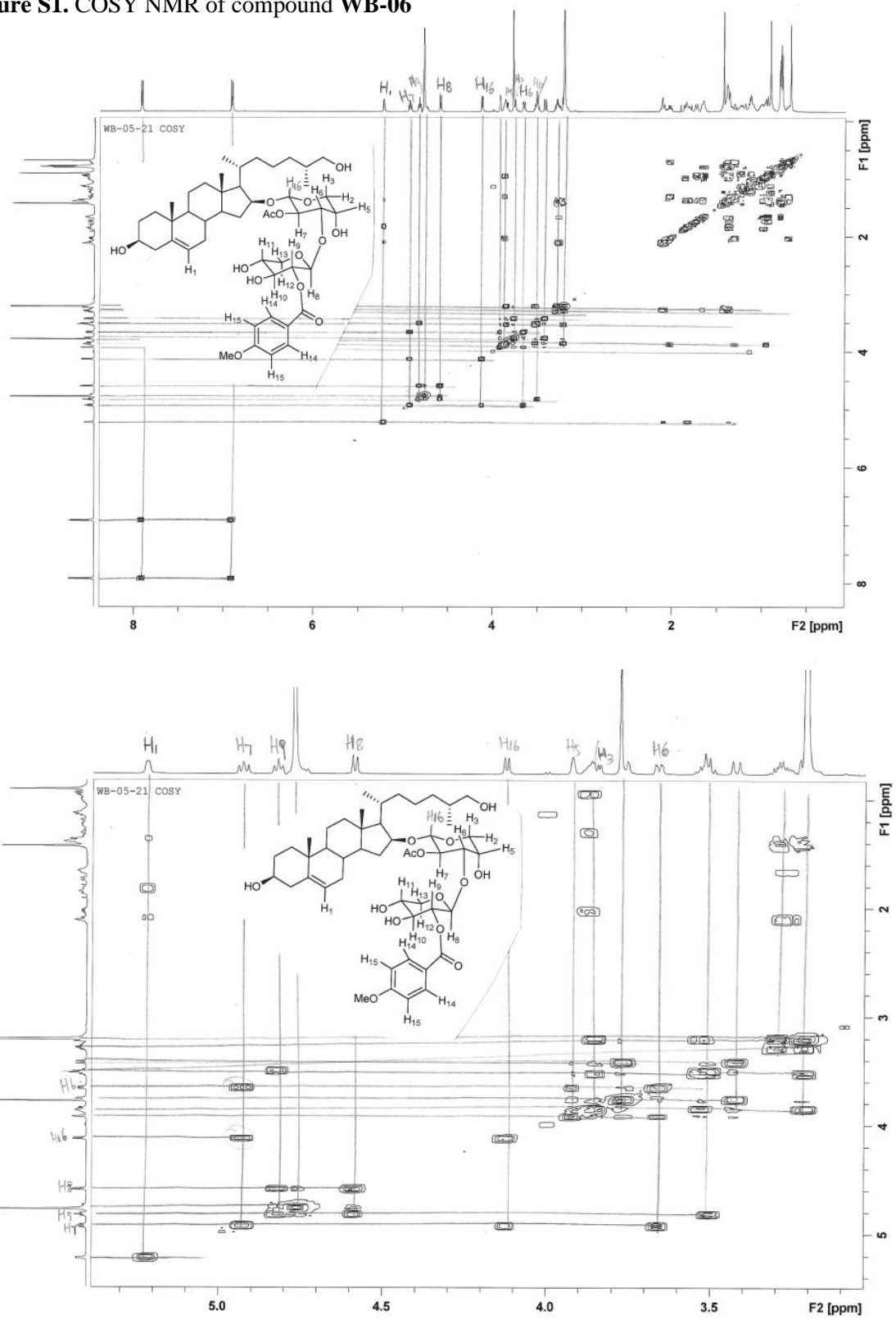


Figure S1. HSQC NMR of compound **WB-06**

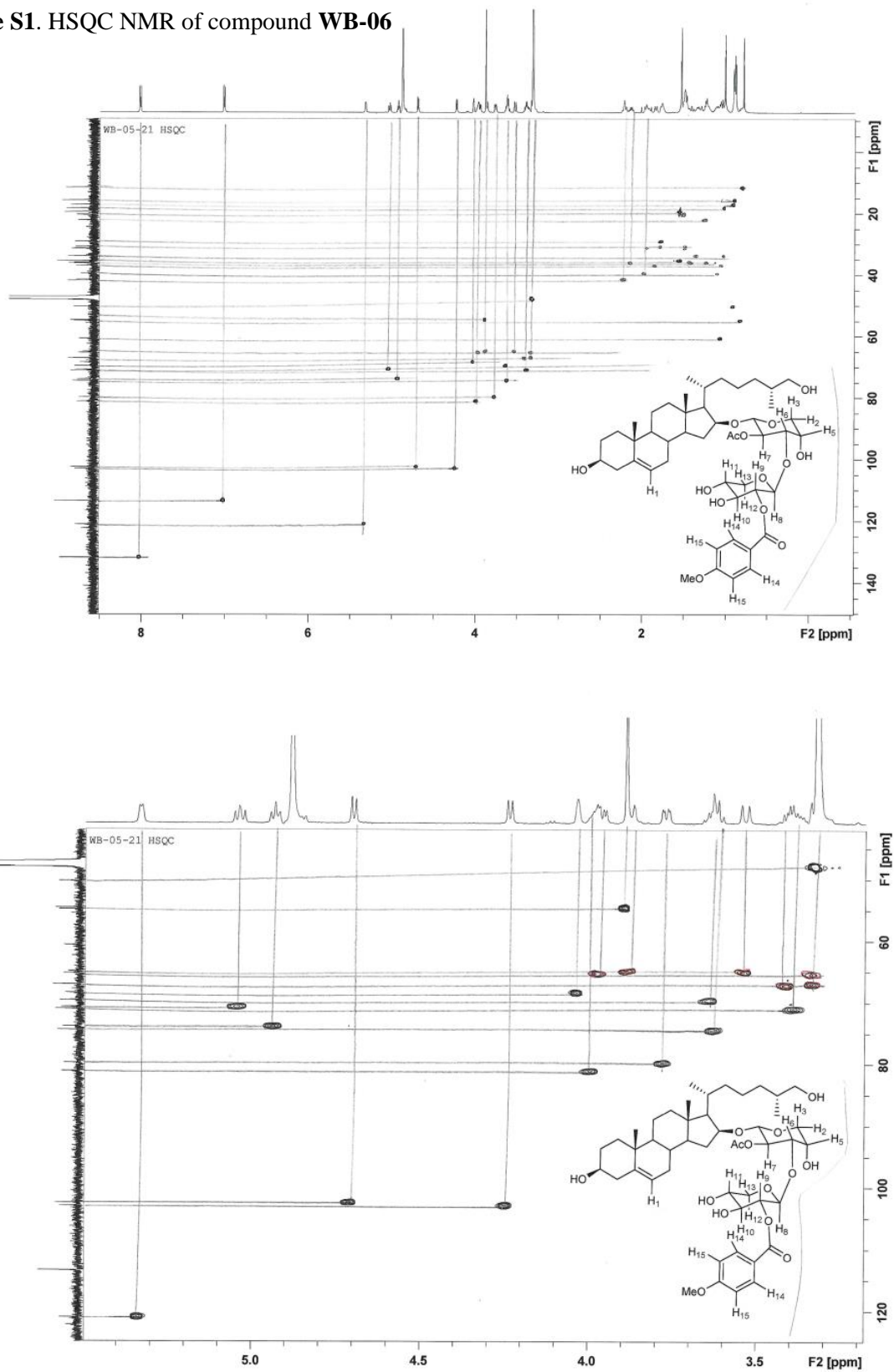
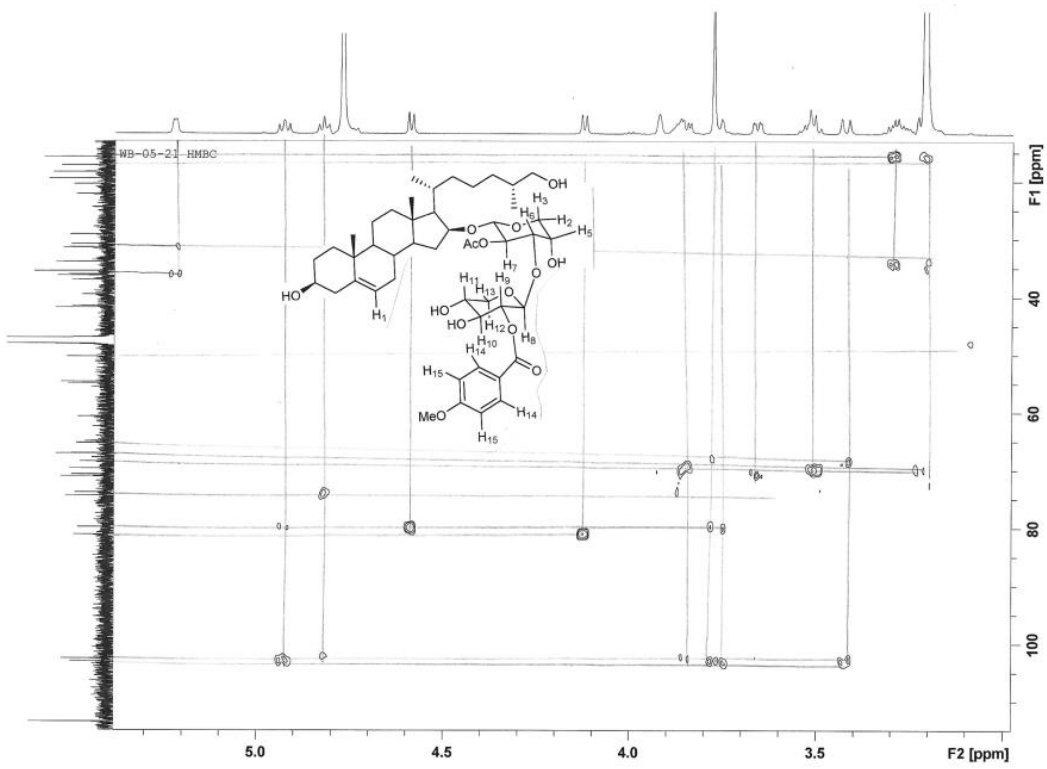
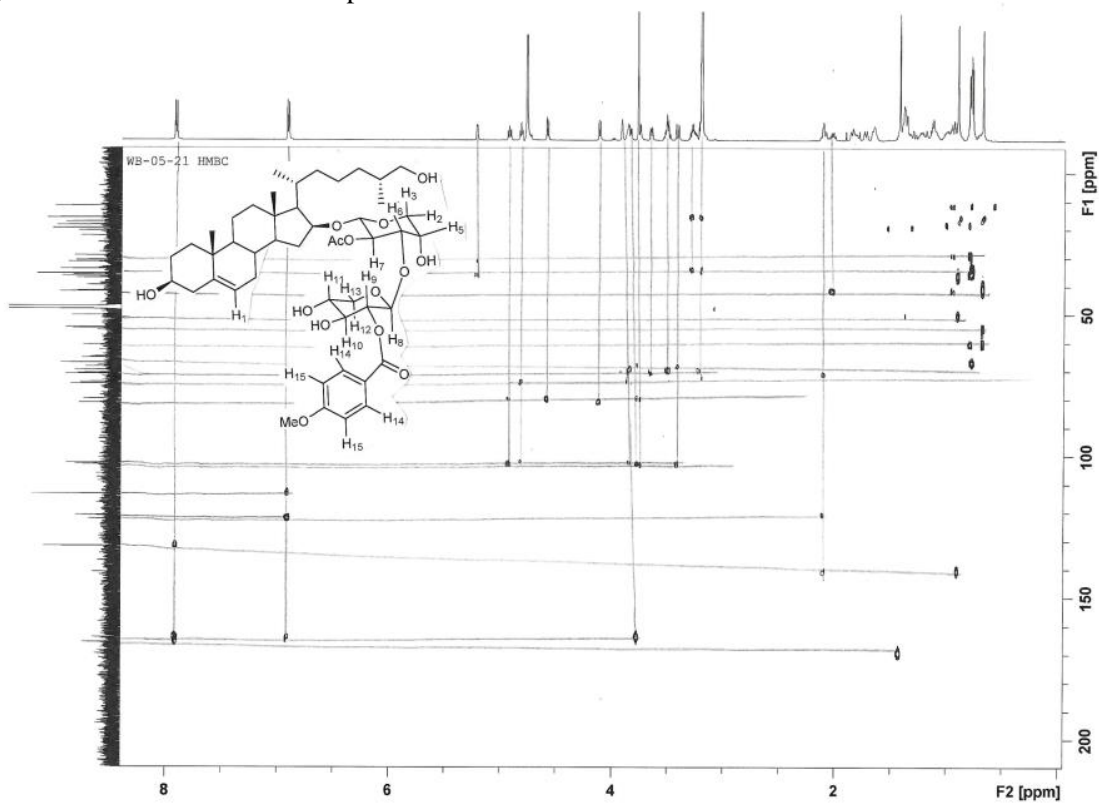


Figure S1. HMBC NMR of compound **WB-06**



Sample Name: WB-6

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Acq. Operator : SYSTEM	Seq. Line : 9
Acq. Instrument : LCMSD1	Location : 44
Injection Date : 10/20/2021 7:37:17 PM	Inj : 1
	Inj Volume : 5.000 µl

Method : D:\Chem32\1\Data\crosslink lingfei_0717test 2021-10-20 18-13-22
Sequence-LCMS.M (Sequence Method)

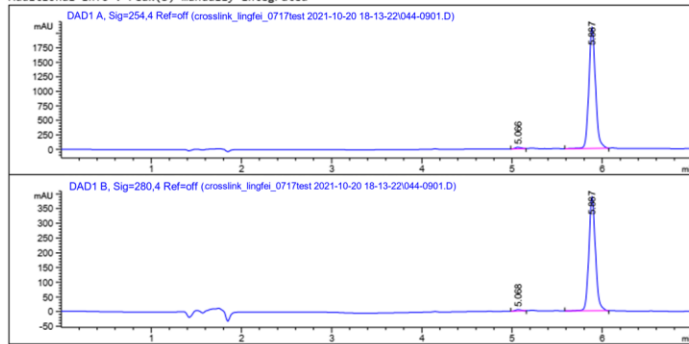
Last changed : 10/20/2021 6:13:22 PM by SYSTEM

Method Info : DON'T CHANGE THIS METHOD

Additional Info : Peak(s) manually integrated

=====

Additional Info : Peak(s) manually integrated



Sample Name: WB-6

=====

Area Percent Report

=====

Sorted By : Signal

Multiplier : 1.0000

Dilution : 1.0000

Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=254,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.066	BB	0.0706	111.88261	24.79895	1.0468
2	5.887	BB	0.0773	1.05759e4	2080.15894	98.9532
Totals :				1.06877e4	2104.95788	

Signal 2: DAD1 B, Sig=280,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.068	BB	0.0770	19.74861	4.19021	0.9959
2	5.887	BB	0.0772	1963.31653	386.58878	99.0041
Totals :				1983.06514	390.77899	

Figure S1. HPLC of compound **WB-06**

