

A New Approach to Explore the Binding Space of Polysaccharide-based Ligands. Selectin Antagonists.

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I. Materials and Methods for Biological Evaluations

Immobilization of proteins on the sensor chip for surface plasmon resonance:

Immobilization of rPSGL-1 or sP-selectin to the sensor chip was done using Biacore standard amine coupling protocol. Briefly, the surface was activated with NHS/EDC (1:1) for seven minutes. Then, rPSGL-1 in 0.1 M sodium acetate at pH 4.3 was injected for seven minutes. Finally, the sensor chip surface was deactivated with the injection of 1 M Ethanolamine-HCl at pH 8.5. Final quantities of rPSGL-1 on the sensor chip range from 40 to 45 nmol while those of sP-selectin range from 500 to 600 nmol. Blank flow cells were obtained using HBS buffer (10 mM HEPES at pH 7.4, containing 150 mM NaCl, 3 mM EDTA and 0.005% (v/v) Surfactant P-20) instead of rPSGL-1 or sP-selectin solution.

Determination of the IC₅₀ by SPR: Tested compounds, at concentrations ranging from 0.05 to 1 mM, were co-injected (10 μ l per minute for 1 minute) with 50 nM of sP-selectin in modified HBS buffer (HBS buffer without 3 mM EDTA but with 3 mM CaCl₂). Injections were done onto flow cells with immobilized rPSGL-1 and blank flow cells. The IC₅₀ of non soluble compounds were obtained in a similar manner but concentrations ranging from 0.005 to 0.5 mM in 10% DMSO.

Determination of the k_{on} , k_{off} , K_A and K_D : Compounds (1 μ M) in solution in modified HBS buffer were injected (10 μ l per minute for 1 minute) onto flow cells with immobilized P-selectin. The BiaEvaluation software (version 3.0) was used to obtain k_{on} and k_{off} from the resulting curves. K_A and K_D were calculated from the k_{on} and k_{off} obtained.

II. Materials and Methods for the Synthesis of sLe^x analogs

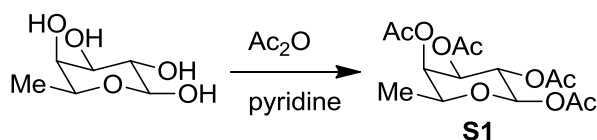
General Methods. All reactions requiring anhydrous conditions were conducted under a positive nitrogen atmosphere, in oven-dried glassware, using standard syringe techniques. The purity of the reported compounds herein was accessed by mass analysis or by NMR spectroscopic techniques. Tetrahydrofuran (THF) and ether were distilled from sodium/benzophenone immediately prior to use. Dichloromethane (CH₂Cl₂), dimethylsulfoxide

(DMSO), and Et₃N were freshly distilled from CaH₂ under N₂ atmosphere. Methanol, benzene, *p*-toluenesulfonic acid (*p*-TsOH), triflic acid (TfOH), 4-dimethylpyridine, N-iodosuccinimide (NIS), sodium hydride, 2,3-Dichloro-5,6-dicyano-1,4-benzoquinone (DDQ), benzyl bromide, benzoyl chloride, acetic acid (99.9 %), palladium (10% on activated carbon), were used as received. Flash chromatography was performed on 0.040-0.063 mm silica gel using nitrogen pressure. Analytical thin-layer chromatography (TLC) was carried out on precoated (0.25 mm) silica gel plates. Melting points were determined on an electrothermal melting point apparatus and are uncorrected. ¹H NMR spectra were recorded on a 500 MHz NMR spectrometer using CDCl₃ (δ = 7.26 ppm) as an internal reference. ¹³C NMR spectra were recorded at 125 MHz using CDCl₃ (δ = 77.1 ppm) as an internal reference. The data are reported as follows: chemical shift in ppm referenced to residual solvent (CDCl₃ δ 7.26 ppm), multiplicity (s = singlet, apps = apparent singlet, d = doublet, dd = doublet of doublets, ddd = doublet of doublets of doublets, appdd = apparent doublet of doublets, t = triplet, appt = apparent triplet, m = multiplet), coupling constants (Hz), and integration. Infrared spectra were recorded using a FTIR spectrophotometer. Electron impact (EI) mass spectra were recorded on an instrument operating at 70 eV. FAB mass spectra were recorded on a VG AutospecQ either with or without ionization.

Experimental Procedures and Characterization Data for Key Compounds (1, 3, 4, 8, 5, 6, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19) :

Precursors and intermediates not presented in the manuscript are numbered sequentially from **S1** to **S16** in the supporting information.

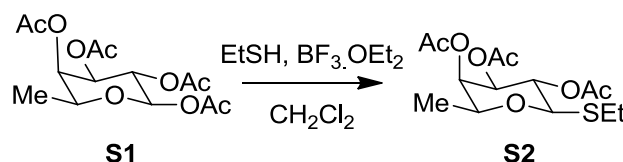
(3S,4R,5R,6S)-6-methyltetrahydro-2H-pyran-2,3,4,5-tetraol tetraacetate (**S1**)



To a solution of L-fucose (5.0 g, 30.4 mmol) in pyridine (0.5M) was added acetic anhydride (20.0 mL, 211 mmol, 6.94 eq.) portion wise over 30 min. The reaction was stirred at room

temperature over 16 hours and the mixture was covaporated with toluene *in vacuo*. Purification by flash chromatography (Hexanes:EtOAc, 50:50) provided **S1** (10.1 g, 100%) as a white solid, a mixture which the α -anomer was favored. ^1H NMR spectroscopic data correlate with the previously reported data for **1**.¹ R_f = 0.70 (Hexanes:EtOAc, 50:50); **Formula** : $\text{C}_{14}\text{H}_{20}\text{O}_9$; **MW** : 332.3032 g/mol; ^1H NMR (500 MHz, CDCl_3) δ 6.34 (d, J = 2.9 Hz, 1H), 5.37 – 5.25 (m, 3H), 4.27 (qd, J = 6.4, 0.9 Hz, 1H), 2.19 (s, 3H), 2.12 (s, 3H), 2.04 (s, 3H), 1.99 (s, 3H), 1.23 (t, J = 6.4 Hz, 3H) ppm.

(3S,4R,5R,6S)-2-(ethylthio)-6-methyltetrahydro-2H-pyran-3,4,5-triyl triacetate (S2)



To a solution of **S1** (10.0 g, 30.4 mmol) in CH_2Cl_2 (0.2M) was added EtSH (2.5 mL, 33.4 mmol, 1.1 eq.). The mixture was cooled at 0°C , $\text{BF}_3\cdot\text{OEt}_2$ (5.0 mL, 33.4 mmol, 1.3 eq.) was then added. The reaction was stirred overnight and a saturated solution of NaHCO_3 was added. The aqueous layer was extracted with CH_2Cl_2 (3 x 150 mL). The combined organic layers were washed with brine (100 mL), dried over MgSO_4 and concentrated *in vacuo*. Purification by flash chromatography (Hexanes:EtOAc, 80:20) provided **S2** (10.1 g, 100%) as a colorless oil. R_f = 0.43 (Hexanes:EtOAc, 70:30); $[\alpha]_D^{25}$ +8.4 (c 0.01, CH_2Cl_2); **Formula** : $\text{C}_{14}\text{H}_{22}\text{O}_7\text{S}$; **MW** : 334.3853 g/mol; **IR** (neat) ν_{max} 2984, 2938, 2373, 1749, 1370, 1246, 1224 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 5.27 (d, J = 3.4 Hz, 1H), 5.22 (appt, J = 10.0 Hz, 1H), 5.04 (dd, J = 10.0, 3.4 Hz, 1H), 4.45 (d, J = 10.0 Hz, 1H), 3.82 (qd, J = 6.4, 0.8 Hz, 1H), 2.80 – 2.66 (m, 2H), 2.17 (s, 3H), 2.06 (s, 3H), 1.98 (s, 3H), 1.27 (t, J = 7.5 Hz, 3H), 1.21 (d, J = 6.4 Hz, 3H) ppm; ^{13}C NMR (125

¹ Iselin, T. Reichstein, *Helv. Chim. Acta* 1944, 27, 1200-1203.

MHz, CDCl₃) δ 170.9, 170.4, 169.9, 83.8, 73.4, 72.6, 70.7, 67.6, 24.4, 21.1, 21.0, 20.9, 16.7, 15.0 ppm; **MS** (**ES**⁺) m/z 357 ([M+Na]⁺,100); **HRMS** calcd for C₁₄H₂₂ O₇NaS (M+Na)⁺ 357.0984; found : 357.0969 (-2.6 ppm).

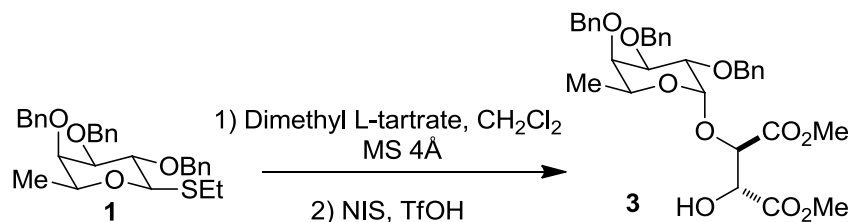
(2R,3S,4R,5R,6S)-3,4,5-tris(benzyloxy)-2-(ethylthio)-6-methyltetrahydro-2H-pyran (1)



To a suspension of **S2** (7.49 g, 22.4 mmol) in MeOH (0.1M) at room temperature was added a solution MeONa (0.1M in MeOH, 11.2 mL, 11.2 mmol, 0.5 eq.). After the completion of reaction as indicated by TLC, Amberlite resin IR 120 (H⁺) was added until reaching acidic pH. The reaction mixture was filtered and concentrated *in vacuo*. The resulting triol **S3** was diluted in DMF (0.1M) and NaH (60% in oil, 3.60 g, 89.6 mmol, 4.0 eq.) was added at 0°C. After stirring the reaction for 15 minutes, BnBr (10.6 mL, 89.6 mmol, 4.0 eq.) was added. The reaction was stirred overnight at room temperature and water was added. The aqueous layer was extracted with EtOAc (3 x 150 ml) and the combined organic layers were washed with brine (60 ml), dried over MgSO₄ and concentrated *in vacuo*. Purification by flash chromatography (Hexanes:EtOAc, 85:15) provided **1** (10.27 g, 96%) as a colorless oil. R_f = 0.55 (Hexanes:EtOAc, 75:25); $[\alpha]_D^{25}$ – 50 (*c* 0.07, CH₂Cl₂); **Formula** : C₂₉H₃₄O₄S; **MW** : 478.6429 g/mol; **IR** (neat) ν_{\max} 3088, 3061, 3030, 2977, 2929, 2868, 1497, 1454 cm⁻¹; **¹H NMR** (500 MHz, CDCl₃) δ 7.44 – 7.27 (m, 15H), 5.03 – 4.98 (m, 1H), 4.93 – 4.90 (m, 1H), 4.84 – 4.68 (m, 5H), 3.84 (t, *J* = 9.4 Hz, 1H), 3.63 (d, *J* = 2.7 Hz, 1H), 3.58 (dd, *J* = 9.4, 2.7 Hz, 1H), 3.49 (q, *J* = 6.4 Hz, 1H), 2.83 – 2.68 (m, 2H), 1.31 (t, *J* = 7.4 Hz, 3H), 1.22 (d, *J* = 6.4 Hz, 3H) ppm; **¹³C NMR** (125 MHz, CDCl₃) δ 138.8, 138.6, 138.5, 128.7, 128.5, 128.4, 128.3, 128.3, 127.8, 127.8, 127.7, 127.6, 85.1, 84.6, 78.5, 76.6, 75.8,

74.7, 74.6, 73.0, 24.8, 17.4, 15.1 ppm; **MS** (ES^+) m/z 501 ($[\text{M}+\text{Na}]^+$, 100); **HRMS** calcd for $\text{C}_{29}\text{H}_{34}\text{NaO}_4\text{S}$ ($\text{M}+\text{Na}$) $^+$: 501.2075, found: 501.2056 (-2.7 ppm).

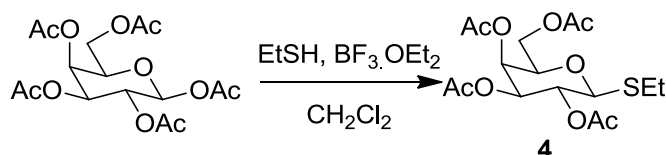
(2*R*, 3*R*) - 2 - Hydroxy- 3 - (3, 4, 5 - tri - O- benzyl - α - L- fucopyranos-1-yl)-succinic acid dimethyl ester (3)



A solution of benzylated fucose **1** (1.19 g, 2.49 mmol) and dimethyl-*L*-tartrate (2.21 g, 12.4 mmol, 5.0 eq.) in CH_2Cl_2 (0.3M) was stirred 4 hours with 4Å molecular sieves (3.5 g/mmol). The mixture was cooled at -30°C and then NIS (1.68 g, 7.46 mmol, 3.0 eq.) was added followed by triflic acid (68 μL , 0.80 mmol, 0.2 eq.). After 1 hour, the mixture was diluted with EtOAc to remove the molecular sieves and washed with a saturated solution of NaHCO_3 and 0.1M aqueous solution of $\text{Na}_2\text{S}_2\text{O}_3$. The organic layer was washed with water (2 x 50 mL) and brine, dried over MgSO_4 , filtered and concentrated *in vacuo* to give a mixture of glycosides β : α 1:8. Purification by flash chromatography (Hexanes:EtOAc, 70:30) provided exclusively the α -glycoside **3** (1.30 g, 88%) as a colorless oil. R_f = 0.39 (Hexanes:EtOAc, 70:30); $[\alpha]_{\text{D}}^{25}$ -87.5 (c 1.0, CH_2Cl_2); **Formula**: $\text{C}_{33}\text{H}_{38}\text{O}_{10}$; **MW**: 594.6488 g/mol; **IR** (neat) ν_{max} 3451 (broad), 3063, 3030, 2951, 2686, 1759, 1453 cm^{-1} ; **^1H NMR** (500 MHz, CDCl_3) δ 7.40 – 7.27 (m, 15H), 4.98 (d, J = 11.5 Hz, 1H), 4.91 (d, J = 3.2 Hz, 1H), 4.82 (d, J = 11.7 Hz, 1H), 4.80 (d, J = 11.7 Hz, 1H), 4.76 (d, J = 11.7 Hz, 1H), 4.74 (d, J = 11.7 Hz, 1H), 4.65 (d, J = 11.5 Hz, 1H), 4.58 (d, J = 4.2 Hz, 1H), 4.49 (d, J = 4.2 Hz, 1H), 4.26 (q, J = 7.0 Hz, 1H), 4.08 (dd, J = 3.3, 10.2 Hz, 1H), 4.05 (dd, J =

3.3, 10.2 Hz, 1H), 3.78 (s, 3H), 3.75 – 3.72 (m, 1H), 3.68 (s, 3H), 1.11 (d, $J = 7$ Hz, 3H) ppm; ^{13}C NMR (125 MHz, CDCl_3) δ 171.1, 169.8, 138.9, 138.8, 138.4, 128.6, 128.6, 128.5, 128.5, 128.3, 127.9, 127.9, 127.8, 127.7, 100.8, 79.7, 77.7, 77.5, 76.0, 75.1, 74.1, 73.1, 72.5, 68.1, 52.9, 52.6, 16.8 ppm; **HRMS** calcd for $\text{C}_{33}\text{H}_{38}\text{O}_{10}\text{Na}$ ($\text{M}+\text{Na}$) $^+$: 617.2326, found : 617.2354 (+2.8 ppm); **Anal.** Calcd for $\text{C}_{33}\text{H}_{38}\text{O}_{10}$: C 66.65, H 6.44; found: C 66.29, H 6.44.

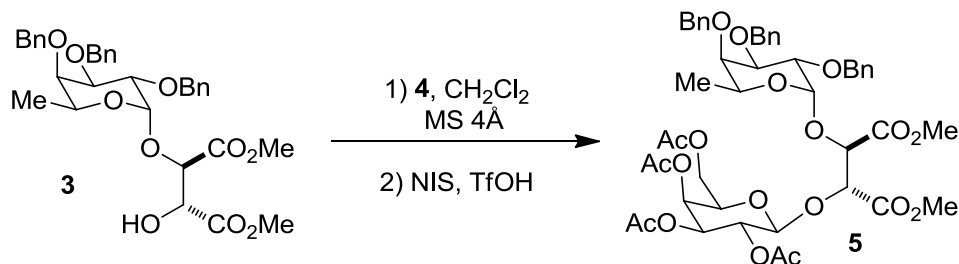
Ethyl 2,3,4,6-tetra-*O*-acetyl-1-thio- β -D-galactopyranoside (**4**)



To a solution of the β -D-galactose pentaacetate (5.3 g, 13.6 mmol) in CH_2Cl_2 (0.2M) was added EtSH (1.4 mL, 19.0 mmol, 1.4 eq.). The mixture was cooled at 0°C , $\text{BF}_3\cdot\text{OEt}_2$ (2.8 mL, 22.5 mmol, 1.66 eq.) was then added. The reaction was stirred 5 hours and a saturated solution of NaHCO_3 was added. The aqueous layer was extracted with CH_2Cl_2 (3 x 150 mL). The combined organic layers were washed with brine (100 mL), dried over MgSO_4 and concentrated *in vacuo*. Purification by flash chromatography (Hexanes:EtOAc, 60:40) provided **4** (5.21 g, 98%) as a colorless oil. ^1H NMR spectroscopic data correlate with the previously reported data for **24**². R_f = 0.53 (Hexanes:EtOAc, 50:50); **Formula** : $\text{C}_{16}\text{H}_{24}\text{O}_9\text{S}$; **MW** : 392.4214 g/mol; ^1H NMR (500 MHz, CDCl_3) δ 5.44 (d, $J = 3.7$ Hz, 1H), 5.25 – 5.20 (m, 1H), 5.04 (dd, $J = 10.1, 3.7$ Hz, 2H), 4.49 (d, $J = 10.1$ Hz, 1H), 4.18 – 4.09 (m, 2H), 3.92 (td, $J = 6.6, 0.9$ Hz, 1H), 2.78 – 2.65 (m, 2H), 2.16 (s, 3H), 2.04 (s, 3H), 2.02 (s, 3H), 2.00 (s, 3H), 1.27 (t, $J = 7.2$ Hz, 1H) ppm.

² M. Weiwer, T. Sherwood, R. J. Linhardt, Journal of Carbohydrate Chemistry, 2008, 27:7, 420-427.

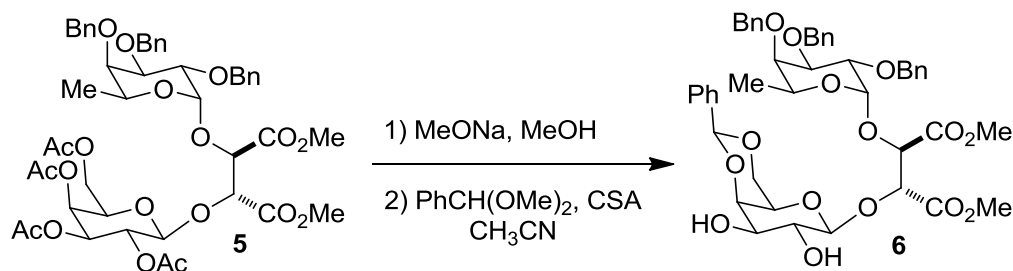
(2*R*, 3*R*)-dimethyl 2-(3,4,5-triacetoxy-6-(acetoxymethyl)tetrahydro-2*H*-pyran-2-yloxy)-3-(3,4,5-tris(benzyloxy)-6-methyltetrahydro-2*H*-pyran-2-yloxy)succinate (**5**)



A solution of fucose **3** (2.32 g, 3.90 mmol) and thiogalactose **4** (1.20 g, 7.80 mmol, 2.0 eq.) in CH₂Cl₂ (0.1M) was stirred 4 hours with 4Å molecular sieves (3.5 g/mmol) . The mixture was cooled at -30°C and then the NIS (2.60 g, 11.7 mmol, 3.0 eq.) was added followed by triflic acid (0.1 mL, 0.78 mmol, 0.2 eq.). After 1 hour, mixture was diluted with EtOAc to remove the molecular sieves and washed with a saturated solution of NaHCO₃ and 0.1M aqueous solution of Na₂S₂O₃. The organic layer was washed with water (2 x 100 mL) and brine, dried over MgSO₄ filtered and concentrated *in vacuo*. Purification by flash chromatography (Hexanes:EtOAc, 60:40) provided exclusively β-glycoside **5** (1.29 g, 60%) as a colorless oil. **R_f** = 0.55 (Hexanes:EtOAc, 60:40); [**α**]_D²⁵ -63.0 (c 1.0, CH₂Cl₂); **Formula** : C₄₇H₅₆O₁₉; **MW** : 924.9361 g/mol; **IR** (neat) ν_{max} 2937, 1751, 1369, 1222, 1082 cm⁻¹; **¹H NMR** (500 MHz, CDCl₃) δ 7.43 – 7.26 (m, 15H), 5.25 (d, *J* = 3.2 Hz, 1H), 5.23 (dd, *J* = , 8.1, 10.0 Hz, 1H), 4.97 (d, *J* = 11.6 Hz, 1H), 4.91 – 4.60 (m, 10H), 4.27 (qd, *J* = 6.4, 0.8 Hz, 1H), 4.13 (dd, *J* = 6.3, 11.4 Hz, 1H), 4.03 – 3.99 (m, 2H), 4.05 (dd, *J* = 3.4, 10.0, 1H), 3.77 – 3.75 (m, 1H), 3.74 (s, 3H), 3.68 (td, *J* = 6.4, 0.8 Hz, 1H), 3.60 (s, 3H), 2.14 (s, 3H), 2.09 (s, 3H), 2.01 (s, 3H), 1.99 (s, 3H), 1.09 (d, *J* = 7.5 Hz, 3H) ppm; **¹³C NMR** (125 MHz, CDCl₃) δ 170.4, 170.1, 169.6, 169.0, 168.8, 138.8, 138.7, 128.53, 128.47, 128.4, 128.3, 128.1, 127.97, 127.86, 127.70, 127.69, 127.68, 127.4, 100.6, 100.2, 79.6, 78.2, 77.8, 77.5, 75.7, 74.9, 73.6, 72.7, 71.1, 70.6, 68.9, 67.8, 67.0, 60.9, 52.5, 52.4, 21.0,

20.80, 20.78, 20.7, 16.7 ppm; **HRMS** calcd for $C_{47}H_{56}O_{19}Na$ ($M+Na$)⁺ : 947.3313, found : 974.3312 (+0.44 ppm); Anal. Calcd for $C_{47}H_{56}O_{19}$: C 61.03, H 6.10; found: C 60.76, H 6.19.

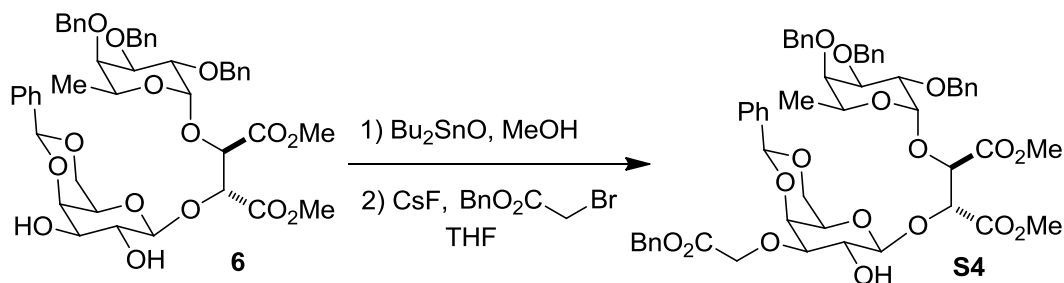
(2*R*, 3*R*)-dimethyl 2-(7,8-dihydroxy-2-phenylhexahydropyrano[3,2-*d*][1,3]dioxin-6-yloxy)-3-(3,4,5-tris(benzyloxy)-6-methyltetrahydro-2*H*-pyran-2-yloxy)succinate (6)



To a suspension of **5** (570 mg, 0.61 mmol) in MeOH (0.07M) at 5°C was added a solution MeONa (0.1M in MeOH, 120 μ L, 0.12 mmol, 0.1 eq.). After the completion of reaction, as indicated by TLC, resin Amberlite IR 120 (H^+) was added until reaching acidic pH. The reaction mixture was then filtered, concentrated *in vacuo* and diluted in anhydrous acetonitrile (0.2M) at room temperature. Benzylaldehyde dimethyl acetal (270 μ L, 1.80 mmol, 3.0 eq.) and camphrosulphonic acid (71 mg, 0.30 mmol, 0.5 eq.) were subsequently added. The reaction was stirred over 2 hours and Et_3N (2.0 eq.) was added. The mixture was concentrated *in vacuo*. Purification by flash chromatography using silica gel pre-treated with 5% Et_3N in hexanes (Hexanes:EtOAc, 80:20) provided **6** (310 mg, 60%) as a white solid. R_f = 0.48 (CH_2Cl_2 :MeOH, 95:5); P_{fus} : 173.3 °C; $[\alpha]_D^{25}$ –44.0 (c 1.0, CH_2Cl_2); **Formula** : $C_{46}H_{52}O_{15}$; **MW** : 844.8961 g/mol; **IR** (neat) ν_{max} 3470, 2921, 1745, 1093, 1050 cm^{-1} ; **1H NMR** (500 MHz, $CDCl_3$) δ 7.54 – 7.50 (m, 2H), 7.44 – 7.19 (m, 18H), 5.52 (s, 1H), 4.97 (d, J = 11.6 Hz, 1H), 4.90 (d, J = 3.6 Hz, 1H), 4.87 (d, J = 12.1 Hz, 1H), 4.84 (d, J = 12.4 Hz, 1H), 4.77 (d, J = 11.6 Hz, 1H), 4.64 (d, J = 11.6 Hz, 1H), 4.54 (d, J = 7.6 Hz, 1H), 4.44 (d, J = 7.7 Hz, 1H), 4.41 (d, J = 7.6 Hz, 1H), 4.29 (d, J = 2.9

Hz, 1H), 4.21 (d, $J = 11.3$ Hz, 1H), 4.17 – 4.07 (m, 2H), 4.10 (dd, $J = 3.8, 10.4$ Hz, 1H), 4.03 (dd, $J = 2.8, 10.1$ Hz, 1H), 4.02 (dd, $J = 1.8, 12.5$ Hz, 1H), 3.73 (s, 6H), 3.71 – 3.68 (m, 1H), 3.57 (ddd, $J = 3.6, 7.2, 10.0$ Hz, 1H), 3.52 (ddd, $J = 2.4, 7.6, 10.0$ Hz, 1H), 3.41 (s, 1H), 2.20 (d, $J = 7.0$ Hz, 1H), 1.05 (d, $J = 6.6$ Hz, 3H) ppm; ^{13}C NMR (125 MHz, CDCl_3) δ 169.8, 169.6, 141.3, 138.9, 138.8, 138.0, 137.9, 129.4, 128.7, 128.6, 128.6, 128.5, 128.4, 128.4, 128.1, 127.8, 127.8, 127.7, 126.7, 105.3, 101.5, 101.2, 79.8, 79.5, 79.4, 77.8, 77.6, 76.0, 75.2, 75.1, 74.3, 73.1, 72.6, 71.0, 69.3, 67.9, 67.1, 52.9, 52.6, 16.7 ppm; HRMS calcd for $\text{C}_{46}\text{H}_{52}\text{O}_{15}\text{Na}$ ($\text{M}+\text{Na}$) $^+$: 867.3204, found : 867.3204.

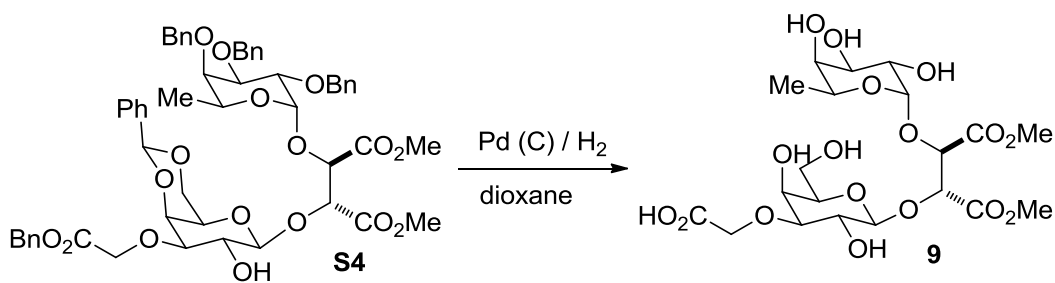
(2R, 3R)-dimethyl 2-(8-(2-(benzyloxy)-2-oxoethoxy)-7-hydroxy-2-phenylhexahydropyrano[3,2-d][1,3]dioxin-6-yloxy)-3-(3,4,5-tris(benzyloxy)-6-methyltetrahydro-2H-pyran-2-yloxy)succinate (S4)



To a solution of alcohol **6** (140 mg, 0.16 mmol) in anhydrous MeOH (0.07M) was added Bu_2SnO (57.7 mg, 0.21 mmol, 1.3 eq.). After the reaction was refluxed for 2 hours under an argon atmosphere, the solvent was removed and the resulting colorless foam was dried *in vacuo* for 16 h. To the residue dissolved in THF (0.1M) was added CsF (125 mg, 0.80 mmol, 5.0 eq.) and the benzylbromoacetate (183 mg, 0.80 mmol, 5.0 eq.). After the reaction was stirred 1.25 hours, the solvent was evaporated *in vacuo*. Purification by flash chromatography with pre-treated silica with 5% Et_3N in hexanes (Hexanes:EtOAc, 80:20) provided **S4** (159 mg, 100%) as

a colorless oil. $R_f = 0.45$ (Hexanes:EtOAc, 80:20); $[\alpha]_D^{25} -32.40$ (c 1.0, CH_2Cl_2); **Formula** : $\text{C}_{55}\text{H}_{60}\text{O}_{17}$; **MW** : 993.0547 g/mol; **IR** (CHCl_3) ν_{max} 3463, 2925, 1749, 1130, 1002 cm^{-1} ; **^1H NMR** (500 MHz, CDCl_3) δ 7.55 – 7.19 (m, 25H), 5.51 (s, 1H), 5.18 (d, $J = 12.3$ Hz, 1H), 5.09 (d, $J = 12.3$ Hz, 1H), 4.98 (d, $J = 11.6$ Hz, 1H), 4.87 (d, $J = 3.2$ Hz, 1H), 4.84 (dd, $J = 12.0, 6.9$ Hz, 2H), 4.75 (dd, $J = 12.0, 10.5$ Hz, 2H), 4.66 – 4.55 (m, 3H), 4.49 – 4.35 (m, 5H), 4.20 – 4.13 (m, 2H), 4.08 (dd, $J = 10.4, 3.4$ Hz, 1H), 4.04 (dd, $J = 10.0$ Hz, 1H), 3.99 (d, $J = 12.2$ Hz, 1H), 3.99 (d, $J = 12.2$ Hz, 1H), 3.93 (t, $J = 8.5$ Hz, 1H), 3.72 (s, 3H), 3.71 (s, 3H), 3.55 (dd, $J = 9.8, 3.4$ Hz, 1H), 1.05 (d, $J = 6.0$ Hz, 3H) ppm; **^{13}C NMR** (125 MHz, CDCl_3) δ 171.5, 169.8, 169.7, 138.9, 138.8, 138.1, 138.0, 135.6, 129.2, 128.9, 128.7, 128.6, 128.5, 128.44, 128.42, 128.3, 128.1, 128.0, 127.8, 127.70, 127.69, 127.68, 127.6, 126.7, 105.3, 101.6, 101.2, 79.6, 79.3, 79.2, 77.9, 75.7, 75.4, 75.0, 73.9, 73.1, 70.8, 69.2, 68.8, 67.9, 67.1, 66.7, 52.9, 52.6, 16.7 ppm; **HRMS** calcd for $\text{C}_{55}\text{H}_{60}\text{O}_{17}\text{Na}$ ($\text{M}+\text{Na}$) $^+$: 1015.3728, found : 1015.3728.

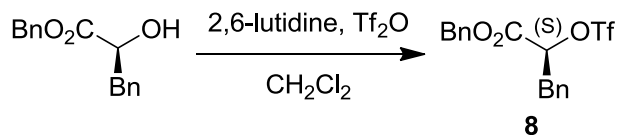
2-((2S,3R,4S,5S,6R)-2-((2R,3R)-1,4-dimethoxy-1,4-dioxo-3-((2S,3S,4R,5S,6S)-3,4,5-trihydroxy-6-methyltetrahydro-2H-pyran-2-yloxy)butan-2-yloxy)-3,5-dihydroxy-6-(hydroxymethyl)tetrahydro-2H-pyran-4-yloxy)acetic acid (9)



To a solution of compound **S4** (45.7 mg, 0.046 mmol) in dioxane (0.1M) was added Pd/C (10 % wt., 49.0 mg, 1.0 eq.). The system was purged with H_2 three times, and then the reaction was stirred at room temperature overnight under an atm of H_2 . The mixture was filtered on Celite[®],

washed with MeOH and concentrated *in vacuo*. Purification by flash chromatography (reverse silica, CH₃CN:H₂O, 35:65) provided **9** (19.0 mg, 75%) as a white solid. **R_f** = 0.20 (EtOAc:*i*-PrOH:H₂O, 6:3:1); **Formula** : C₂₀H₃₂O₁₇; **MW** : 544.4579 g/mol; **¹H NMR** (400 MHz, D₂O) δ 5.07 – 5.00 (m, 2H), 4.59 (d, *J* = 8.2 Hz, 1H), 4.37 (q, *J* = 6.3 Hz, 1H), 4.13 (d, *J* = 3.0 Hz, 1H), 4.09 – 3.94 (m, 3H), 3.90 (dd, *J* = 10.6, 3.0 Hz, 1H), 3.85 (s, 3H), 3.84 – 3.81 (m, 2H), 3.80 (s, 3H), 3.77 – 3.64 (m, 6H), 1.13 (d, *J* = 6.6 Hz, 3H) ppm; **¹³C NMR** (100 MHz, D₂O) δ 178.4, 171.2, 169.9, 102.6, 97.3, 79.0, 78.3, 74.4, 71.6, 71.2, 69.1, 68.6, 68.0, 67.6, 67.1, 65.8, 60.6, 53.3, 53.0, 15.2 ppm.

(S)-benzyl 3-phenyl-2-(trifluoromethylsulfonyloxy)propanoate (8**)**

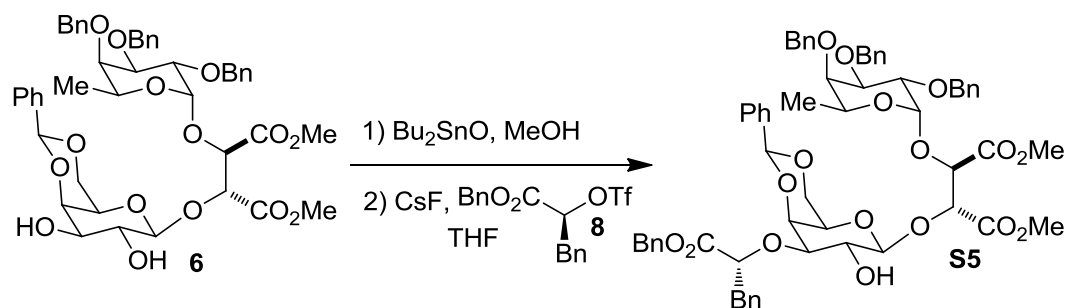


To a solution of the benzyl (2S)-2-hydroxy-3-phenylpropanoate (1.5 g, 5.85 mmol) in CH₂Cl₂ (0.2M) cooled at -78 °C was added the 2,6-lutidine (0.9 mL, 7.61 mmol, 1.3 eq) and Tf₂O (1.18 mL, 7.02 mmol, 1.2 eq). The reaction was stirred 2 hours. The mixture was poured on ice. The aqueous layer was extracted with CH₂Cl₂ (3 x 150 mL). The combined organic layers were washed with brine (100 ml), dried over MgSO₄ and concentrated *in vacuo*. Purification by flash chromatography (CH₂Cl₂:MeOH, 95:5) provided **8** (2.23 g, 98%) as a colorless oil. **¹H NMR** spectroscopic data correlate with the previously reported data for **23**³. **R_f** = 0.38 (CH₂Cl₂:MeOH, 90:10); **Formula** : C₁₇H₁₅F₃O₅S; **MW** : 388.3582 g/mol; **¹H NMR** (500 MHz, CDCl₃) δ 7.41 –

³ Degerbeck, F., Franssom, B., Grehn, L. & Ragnarsson U. J. Chem. Soc., Perkin Trans. 1, 11-14 (1993).

7.14 (m, 10H), 5.27 (dd, $J = 8.5, 4.3$ Hz, 1H), 5.24 (apps, 2H), 3.37 – 3.31 (m, 1H), 3.24 – 3.17 (m, 1H) ppm.

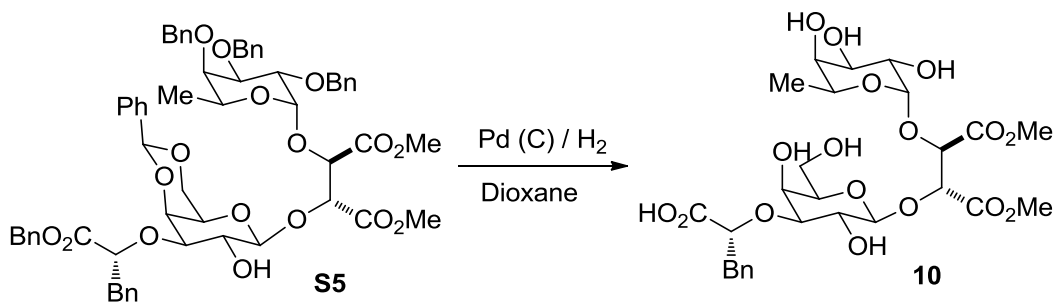
(2R, 3R)-dimethyl 2-(8-((R)-1-(benzyloxy)-1-oxo-3-phenylpropan-2-yloxy)-7-hydroxy-2-phenylhexahydropyrano[3,2-d][1,3]dioxin-6-yloxy)-3-(3,4,5-tris(benzyloxy)-6-methyltetrahydro-2H-pyran-2-yloxy)succinate (S5)



To a solution of the alcohol **6** (126 mg, 0.16 mmol) in anhydrous MeOH (0.07M) was added Bu₂SnO (57.7 mg, 0.21 mmol, 1.3 eq.). After the reaction was stirred 1.25 hours, the solvent was evaporated *in vacuo*. After the reaction was refluxed for 2 hours under an argon atmosphere, the solvent was removed and the resulting colorless foam dried *in vacuo* for 16 h. To the residue dissolved in THF (0.1M) was added CsF (125 mg, 0.80 mmol, 5.0 eq.) and the ester **23** (310 mg, 0.80 mmol 2.0 eq.). After the reaction was stirred 1.25 hours, the solvent was evaporated *in vacuo*. Purification by flash chromatography with pre-treated silica with 5% Et₃N in hexanes (Hexanes:EtOAc, 80:20) provided **S5** (122 mg, 75%) as a colorless oil. $R_f = 0.50$ (Hexanes:EtOAc, 70:30); $[\alpha]_D^{25} +30.2$ (c 1.0, CHCl₃); **Formula** : C₆₂H₆₆O₁₇; **MW** : 1083.1772 g/mol; **IR** (CHCl₃) ν_{max} 3515, 1711, 1640, 1347, 1081 cm⁻¹; **¹H NMR** (400 MHz, CDCl₃) δ 7.45 – 7.02 (m, 30H), 5.19 (s, 1H), 5.08 (d, $J = 12.2$ Hz, 1H), 4.99 (d, $J = 12.2$ Hz, 1H), 4.96 – 4.92 (m, 2H), 4.79 (d, $J = 12.2$ Hz, 1H), 4.78 (d, $J = 12.2$ Hz, 1H), 4.73 (d, $J = 12.2$ Hz, 1H), 4.70 (d, $J = 12.2$ Hz, 1H), 4.62 (d, $J = 10.3$ Hz, 1H), 4.59 (d, $J = 6.1$ Hz, 1H), 4.23 (dd, $J = 8.8, 4.1$ Hz,

1H), 4.20 – 4.18 (m, 1H), 4.11 – 4.04 (m, 2H), 4.03 – 4.00 (m, 2H), 3.91 (t, $J = 9.3$ Hz, 1H), 3.79 (d, $J = 12.4$ Hz, 1H), 3.68 (s, 3H), 3.55 (d, $J = 3.6$ Hz, 1H), 3.63 (s, 3H), 3.50 – 3.48 (m, 4H), 3.13 (dd, $J = 9.5, 3.3$ Hz, 1H), 3.05 (s, 1H), 3.03 (dd, $J = 10.1, 3.8$ Hz, 1H), 2.94 (dd, $J = 10.1, 8.8$ Hz, 1H), 1.03 (d, $J = 7.0$ Hz, 3H) ppm; ^{13}C NMR (100.6 MHz, CDCl_3) δ 172.1, 169.6, 169.5, 138.8, 138.6, 138.5, 137.8, 137.3, 135.4, 128.9, 128.6, 128.5, 128.4, 128.4, 128.3, 128.2, 128.1, 127.9, 127.6, 127.5, 127.4, 126.6, 126.4, 103.9, 100.8, 100.5, 80.9, 80.0, 79.3, 78.6, 78.2, 77.5, 77.4, 77.3, 77.1, 76.7, 75.2, 74.8, 73.4, 73.1, 72.8, 68.9, 68.8, 67.5, 66.8, 66.6, 52.6, 52.3, 39.5, 16.5 ppm; MS FAB m/z 1105 ($[\text{M}+\text{Na}]^+$, 100), 905 (22), 489 (20), 149 (94); Anal. Calcd for $\text{C}_{62}\text{H}_{66}\text{O}_{17} \cdot \text{H}_2\text{O}$: C 67.62, H 6.22; found: C 67.86, H 6.31.

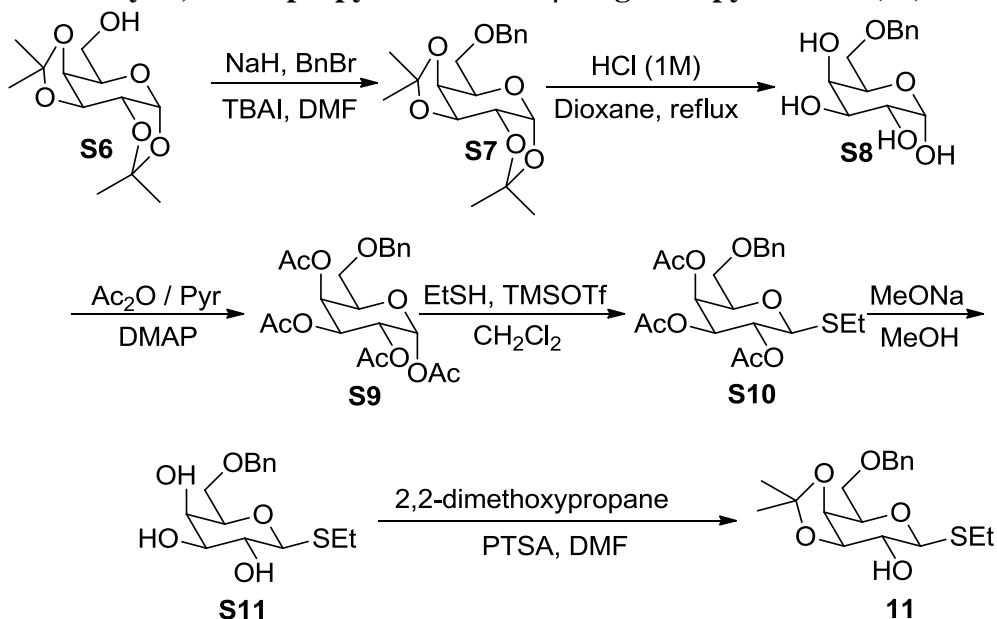
(R)-2-((2S,3R,4S,5S,6R)-2-((2R,3R)-1,4-dimethoxy-1,4-dioxo-3-((2S,3S,4R,5S,6S)-3,4,5-trihydroxy-6-methyltetrahydro-2H-pyran-2-yloxy)butan-2-yloxy)-3,5-dihydroxy-6-(hydroxymethyl)tetrahydro-2H-pyran-4-yloxy)-3-phenylpropanoic acid (10)



To a solution of compound **S5** (50.0 mg, 0.046 mmol) in dioxane (0.1M) under a nitrogen atmosphere was added Pd/C (10 % wt., 49.0 mg, 1.0 eq.). The system was purged with H_2 three times, and the reaction was then stirred at room temperature overnight under an atm of H_2 . The mixture was filtered on Celite[®], washed with MeOH and concentrated *in vacuo*. Purification by flash chromatography (reverse silica, $\text{CH}_3\text{CN}:\text{H}_2\text{O}$, 35:65) provided **10** (29.2 mg, 77 %) as a white solid. $R_f = 0.25$ ($\text{EtOAc}:\text{i-PrOH}:\text{H}_2\text{O}$, 6:3:1); **Formula** : $\text{C}_{27}\text{H}_{38}\text{O}_{17}$; **MW** : 634.5804

g/mol; **¹H NMR** (400 MHz, D₂O) δ 7.37 – 7.21 (m, 5H), 4.90 (d, J = 3.9 Hz, 1H), 4.84 (d, J = 4.0 Hz, 1H), 4.72 (d, J = 3.9 Hz, 1H), 4.30 (t, J = 6.6 Hz, 2H), 4.16 (dd, J = 9.2, 4.1 Hz, 1H), 3.85 (dd, J = 10.5, 3.4 Hz, 1H), 3.77 (s, 3H), 3.73 (s, 3H), 3.66 (dd, J = 10.5, 4.1 Hz, 1H), 3.59 – 3.46 (m, 5H), 3.43 – 3.38 (m, 1H), 3.27 (dd, J = 10.0, 3.4 Hz, 1H), 3.11 (dd, J = 14.3, 4.4 Hz, 1H), 2.84 (dd, J = 14.3, 9.2 Hz, 1H), 1.09 (d, J = 6.6 Hz, 3H) ppm; **MS FAB** m/z 657 ([M+Na]⁺, 47), 460 (47), 154 (100); **Anal.** Calcd for C₂₇H₃₈O₁₇•5H₂O: C 44.75, H 6.68; found: C 45.10, H 6.62.

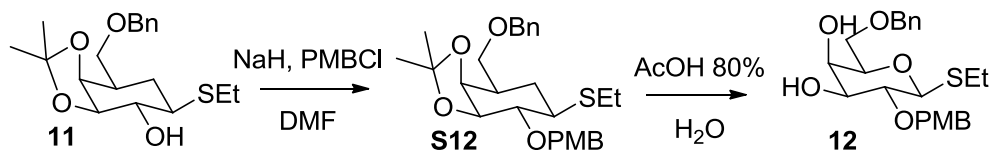
Ethyl 6-*O*-Benzyl-3,4-*O*-isopropylidene-1-thio- β -D-galactopyranoside (11)



¹H and ¹³C NMR spectroscopic data of **S7**, **S8**, **S9**, **S10**, **S11** and **11** correlate with the previously reported data.⁴

Ethyl 6-*O*-Benzyl-2-*O*-(4-methoxybenzyl)-thio- β -D-galactopyran-3,4-diol (12)

⁴ A) Xia, J.; Srikrishnan, T.; Alderfer, J. L.; Jain, R. K.; Piskorz, C. F.; Matta, K. L. *Carbohydr. Res.* **2000**, 329, 561. B) Sato, S.; Mori, M.; Ito, Y.; Ogawa, T. *Carbohydr. Res.* **1986**, 155, C6-C10. C) Wang, C.-C.; Lee, J.-C.; Luo, S.-Y.; Fan, H.-F.; Pai, C.-L.; Yang, W.-C.; Lu, L.-D.; Hung, S.-C. *Angew. Chem., Int. Ed.* **2002**, 41, 2360–2362.

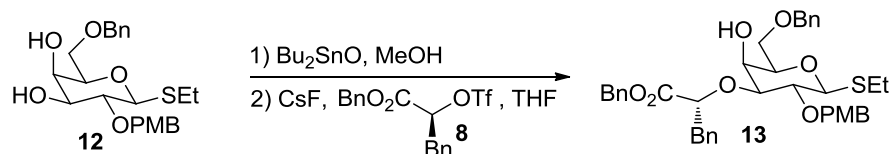


To a solution of the alcohol **11** (734 mg, 2.1 mmol) in DMF (0.1M) at 0°C was added NaH (60% in oil, 3.15 mmol, 130 mg, 1.5 eq.). After the reaction was stirred 20 minutes, PMBCl (3.15 mmol, 427 μ L, 1.5 eq.) was added. The reaction was stirred overnight at room temperature and water was added. The aqueous layer was extracted with EtOAc (3 x 50 ml) and the combined organic layers were washed with brine (50 ml), dried over MgSO₄ and concentrated *in vacuo*. Purification by flash chromatography (Hexanes:EtOAc, 90:10) provided **S12** (730 mg, 74%) as a colorless oil.

The acetone intermediate **S12** (700 mg, 1.5 mmol) was dissolved in 80% acetic acid/water under an argon atmosphere. The reaction was heated to 50°C overnight, and then water was added. The aqueous layer was extracted with EtOAc (3 x 50 ml) and the combined organic layers were washed with brine (50 ml), dried over MgSO₄ and concentrated *in vacuo*. Purification by flash chromatography (Hexanes:EtOAc, 45:55) provided diol **12** (463 mg, 73%) as a white foam. R_f = 0.24 (Hexanes:EtOAc, 45:55); $[\alpha]_D^{25}$ +15.9 (*c* 1.2, MeOH); **Formula** : C₂₃H₃₀O₆S; **MW** : 434.5457 g/mol; **IR** (neat) ν_{max} 3385 (broad), 2913, 2865, 1612, 1513, 1248, 1097, 1035 cm⁻¹; **¹H NMR** (500 MHz, CDCl₃) δ 7.38 – 7.30 (m, 7H), 6.93 – 6.89 (m, 2H), 4.91 (d, *J* = 10.7 Hz, 1H), 4.64 (d, *J* = 10.7 Hz, 1H), 4.60 (d, *J* = 11.8 Hz, 1H), 4.58 (d, *J* = 11.8 Hz, 1H), 4.43 (d, *J* = 9.8 Hz, 1H), 4.06 (td, *J* = 3.2, 0.9 Hz, 1H), 3.82 (s, 3H), 3.79 (dd, *J* = 6.8, 11.4 Hz, 1H), 3.75 (dd, *J* = 6.7, 11.4 Hz, 1H), 3.65 – 3.59 (m, 2H), 3.52 (t, *J* = 9.3 Hz, 1H), 2.87 – 2.72 (m, 2H), 2.59 (d, *J* = 3.4 Hz, 1H), 2.42 (d, *J* = 5.4 Hz, 1H), 1.35 (t, *J* = 7.3 Hz, 3H) ppm; **¹³C NMR** (125 MHz, CDCl₃) δ 159.8, 138.0, 130.4, 130.3, 128.7, 128.1, 128.0, 114.3, 85.3, 78.7, 77.2, 75.2, 75.1,

74.0, 69.8, 69.7, 55.5, 25.3, 15.4 ppm; **HRMS** calcd for C₂₃H₃₁O₆S₁ (M+H)⁺ : 435.1836, found : 435.1830 (-1.4 ppm).

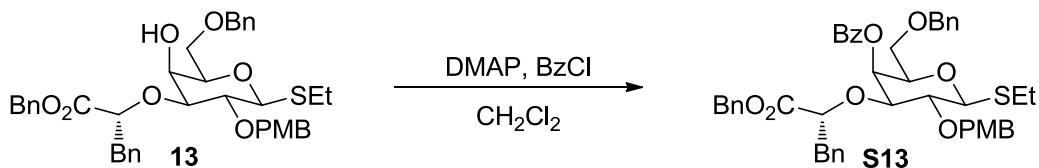
(R)-benzyl-2-((2R,3S,4S,5R,6S)-2-(benzyloxymethyl)-6-(ethylthio)-3-hydroxy-5-(4-methoxybenzyloxy)tetrahydro-2H-pyran-4-yloxy)-3-phenylpropanoate (13)



To a solution of the alcohol **12** (223 mg, 0.51 mmol) in anhydrous MeOH (0.1M) was added Bu₂SnO (166 mg, 0.67 mmol, 1.3 eq.). After the reaction was refluxed for 2 hours under an argon atmosphere, the solvent was removed and resulting colorless foam dried *in vacuo* for 16 h. To the residue dissolved in THF (0.1M) was added CsF (390 mg, 2.56 mmol, 5.0 eq.). The reaction was stirred over 15 minutes before the addition of ester **8** (396 mg, 1.02 mmol, 2.0 eq.). After the reaction was stirred 1.25 hours under an argon atmosphere, water was added. The aqueous layer was extracted with EtOAc (3 x 50 ml) and the combined organic layers were washed with brine (50 ml), dried over MgSO₄ and concentrated *in vacuo*. Purification by flash chromatography (Hexanes:EtOAc, 90:10 to 80:20) provided **13** (292 mg, 85%) as a colorless oil. **R_f** = 0.46 (Hexanes:EtOAc, 60:40); [**α**]_D²⁵ +10.9 (*c* 1.3, CH₂Cl₂); **Formula** : C₃₉H₄₄O₈S; **MW** : 672.8269 g/mol; **IR** (neat) *v*_{max} 3552 (broad), 2926 (broad), 1746, 1513, 1248, 1097, 699 cm⁻¹; **¹H NMR** (500 MHz, CDCl₃) δ 7.41 – 7.22 (m, 17H), 6.88 – 6.84 (m, 2H), 5.10 (d, *J* = 12.2 Hz, 1H), 5.03 (d, *J* = 12.2 Hz, 1H), 4.82 (d, *J* = 10.0 Hz, 1H), 4.72 (d, *J* = 10.0 Hz, 1H), 4.54 (d, *J* = 11.7 Hz, 1H), 4.50 (d, *J* = 12.0 Hz, 1H), 4.34 (dd, *J* = 4.4, 9.3 Hz, 1H), 4.31 (d, *J* = 9.5 Hz, 1H), 3.80 (s, 3H), 3.65 – 3.63 (m, 1H), 3.61 (d, *J* = 6.1 Hz, 2H), 3.56 (appt, *J* = 9.5 Hz, 1H), 3.45 (dd, *J* = 2.9, 8.8 Hz, 1H), 3.40 – 3.36 (m, 1H), 3.14 (dd, *J* = 4.4, 13.9 Hz, 1H), 3.04 (dd, *J* = 9.5, 13.9

Hz, 1H), 2.79 – 2.62 (m, 2H), 1.59 – 1.57 (m, 1H), 1.29 (t, $J = 7.4$ Hz, 3H) ppm; ^{13}C NMR (125 MHz, CDCl_3) δ 171.1, 159.4, 138.2, 137.0, 130.8, 130.5, 129.5, 129.0, 128.8, 128.7, 128.6, 128.53, 128.51, 128.0, 127.8, 127.5, 113.8, 85.0, 82.9, 78.3, 76.8, 76.6, 75.2, 73.8, 69.3, 67.1, 65.9, 55.5, 39.6, 24.8, 15.3 ppm; HRMS calcd for $\text{C}_{39}\text{H}_{44}\text{O}_8\text{NaS}$ ($\text{M}+\text{Na}$) $^+$: 695.2649, found : 695.2664 (+2.2 ppm).

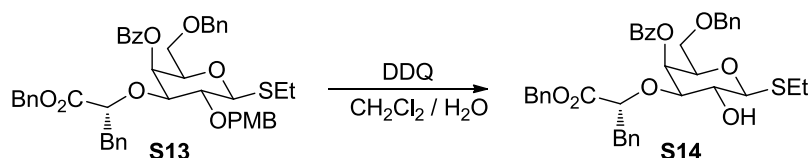
(2*R*,3*S*,4*S*,5*R*,6*S*)-4-((*R*)-1-(benzyloxy)-1-oxo-3-phenylpropan-2-yloxy)-2-(benzyloxymethyl)-6-(ethylthio)-5-(4-methoxybenzyloxy)tetrahydro-2*H*-pyran-yl benzoate (S13)



To a solution of the alcohol **13** (1.03 g, 1.53 mmol) in CH_2Cl_2 (0.1M) was added DMAP (560 mg, 4.59 mmol, 3.0 eq.) and BzCl (360 μL , 3.06 mmol, 2.0 eq.) at room temperature. The reaction was stirred over 3 hours and concentrated. Purification by flash chromatography (Hexanes:EtOAc, 90:10) provided **S13** (1.17 g, 98%) as a colorless oil. $R_f = 0.60$ (Hexanes:EtOAc, 40:60); $[\alpha]_D^{25} +19.9$ (c 1.10, CH_2Cl_2); **Formula** : $\text{C}_{46}\text{H}_{48}\text{O}_9\text{S}$; **MW** : 776.9329 g/mol; **IR** (neat) ν_{max} 2868 (broad), 1747, 1722, 1513, 1453, 1271, 1105, 700 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 8.11 – 8.08 (m, 2H), 7.66 – 7.61 (m, 1H), 7.53 – 7.48 (m, 2H), 7.34 – 7.05 (m, 17 H), 6.86 – 6.82 (m, 2H), 5.82 (d, $J = 2.9$ Hz, 1H), 5.03 (dd, $J = 8.0, 12.2$ Hz, 1H), 4.99 (dd, $J = 7.5, 12.2$ Hz, 1H), 4.74 (d, $J = 9.8$ Hz, 1H), 4.63 (dd, $J = 5.0, 9.8$ Hz, 1H), 4.58 (d, $J = 10.0$ Hz, 1H), 4.50 (d, $J = 12.0$ Hz, 1H), 4.46 (d, $J = 9.5$ Hz, 1H), 4.43 (d, $J = 11.7$ Hz, 1H), 3.80 (s, 3H), 3.77 – 3.72 (m, 2H), 3.64 – 3.58 (m, 2H), 3.52 (dd, $J = 7.2, 9.4$ Hz, 1H), 3.02 (dd, $J = 5.0, 13.4$ Hz, 1H), 2.95 (dd, $J = 7.8, 13.4$ Hz, 1H), 2.85 – 2.69 (m, 2H), 1.34 (t, $J = 7.6$ Hz, 3H)

ppm; ^{13}C NMR (125 MHz, CDCl_3) δ 171.2, 166.0, 159.4, 137.8, 136.0, 135.7, 133.5, 130.8, 130.7, 130.2, 130.0, 129.9, 128.9, 128.71, 128.68, 128.6, 128.5, 128.4, 128.2, 128.0, 126.9, 113.7, 85.4, 80.7, 77.0, 76.8, 76.0, 75.4, 74.0, 68.4, 67.0, 66.8, 55.5, 39.5, 25.1, 15.3 ppm; HRMS calcd for $\text{C}_{46}\text{H}_{48}\text{O}_9\text{NaS}$ ($\text{M}+\text{Na}$) $^+$: 799.2911, found : 799.2937 (+3.2 ppm).

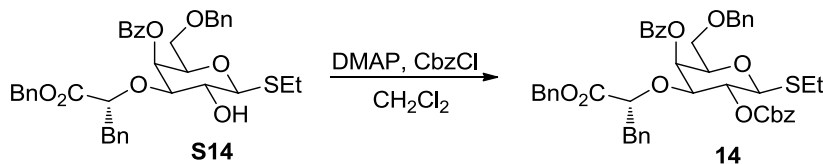
(2*R*,3*S*,4*R*,5*R*,6*S*)-4-((*R*)-1-(benzyloxy)-1-oxo-3-phenylpropan-2-yloxy)-2-(benzyloxymethyl)-6-(ethylthio)-5-hydroxytetrahydro-2*H*-pyran-3-yl benzoate (S14**)**



To a solution of alcohol **S13** (1.1 g, 1.40 mmol) in $\text{CH}_2\text{Cl}_2:\text{H}_2\text{O}$ (10:1, 0.1M) was added DDQ (381 mg, 1.68 mmol, 1.2 eq.) at room temperature. After the reaction was stirred 2 hours under an argon atmosphere, a saturated solution of NaHCO_3 (100 mL) was added. The aqueous layer was extracted with EtOAc (3 x 50 ml) and the combined organic layers were washed with brine (50 ml), dried over MgSO_4 and concentrated *in vacuo*. Purification by flash chromatography (Hexanes:EtOAc, 95:5) provided **S14** (870 mg, 95 %) as a colorless oil. R_f = 0.20 (Hexanes:EtOAc, 60:40); $[\alpha]_D^{25}$ -30.4 (c 1.1, CH_2Cl_2); **Formula** : $\text{C}_{38}\text{H}_{40}\text{O}_8\text{S}$; **MW** : 656.7844 g/mol; **IR** (neat) ν_{max} 3442 (broad), 2964 (broad), 1725, 1453, 1271, 1105, 1027, 736, 700 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 8.11 – 8.03 (m, 2H), 7.65 – 7.59 (m, 1H), 7.51 – 7.43 (m, 2H), 7.38 – 7.31 (m, 3H), 7.27 – 6.94 (m, 12H), 5.76 (d, J = 3.2 Hz, 1H), 5.11 (d, J = 12.2 Hz, 1H), 5.07 (d, J = 12.2 Hz, 1H), 4.56 (dd, J = 6.5, 5.4 Hz, 1H), 4.51 (d, J = 12.0 Hz, 1H), 4.46 (d, J = 9.8 Hz, 1H), 4.42 (d, J = 11.7 Hz, 1H), 4.0 (s, 1H), 3.92 – 3.81 (m, 2H), 3.64 (dd, J = 5.9, 9.5 Hz, 1H), 3.56 (dd, J = 7.4, 9.5 Hz, 1H), 3.45 (dd, J = 3.4, 9.0 Hz, 1H), 3.02 (dd, J = 5.2, 13.7 Hz,

1H), 2.94 (dd, $J = 6.4, 13.7$ Hz, 1H), 2.88 – 2.76 (m, 2H), 1.36 (t, $J = 7.5$ Hz, 3H) ppm; ^{13}C NMR (125 MHz, CDCl_3) δ 173.1, 166.1, 137.8, 135.7, 135.0, 133.6, 130.2, 129.82, 129.78, 129.0, 128.85, 128.84, 128.7, 128.6, 128.4, 128.1, 128.0, 126.9, 86.2, 81.5, 77.8, 76.4, 73.9, 69.2, 68.3, 67.5, 66.9, 39.5, 24.8, 15.3 ppm; HRMS calcd for $\text{C}_{38}\text{H}_{40}\text{O}_8\text{NaS}$ ($\text{M}+\text{Na}$) $^+$: 679.2336, found : 679.2351 (+2.2 ppm).

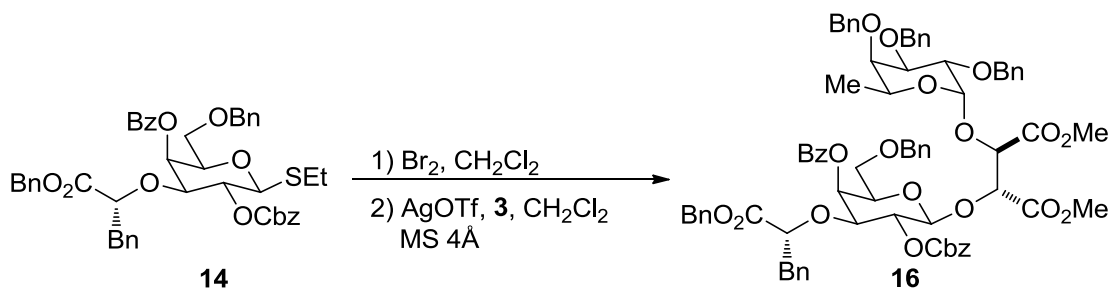
(2R,3S,4S,5R,6S)-4-((R)-1-(benzyloxy)-1-oxo-3-phenylpropan-2-yloxy)-5-(benzyloxycarbonyloxy)-2-(benzyloxymethyl)-6-(ethylthio)tetrahydro-2H-pyran-3-yl benzoate (14)



To a solution of thiogalactoside **S14** (375 mg, 0.57 mmol) in CH_2Cl_2 (0.1M) at 0°C under an argon atmosphere was added DMAP (210 mg, 1.71 mmol, 3.0 eq.) and CbzCl (165 μL , 1.14 mmol, 2.0 eq.). The reaction was stirred overnight at room temperature, and then concentrated *in vacuo*. Purification by flash chromatography (Hexanes:EtOAc, 85:15) provided **14** (225 mg, 50 %) as a high viscous colorless oil. $R_f = 0.73$ (Hexanes:EtOAc, 70:30); $[\alpha]_D^{25} +29.5$ (c 1.70, CH_2Cl_2); **Formula** : $\text{C}_{46}\text{H}_{46}\text{O}_{10}\text{S}$; **MW** : 790.9164 g/mol; **IR** (neat) ν_{max} 2929 (broad), 1753, 1723, 1496, 1453, 1258, 1110, 909, 738, 700 cm^{-1} ; ^1H NMR (500 MHz, C_6D_6) δ 8.19 – 8.14 (m, 2H), 7.30 – 6.88 (m, 23H), 5.81 (d, $J = 3.2$ Hz, 1H), 5.58 (appt, $J = 9.7$ Hz, 1H), 5.07 (d, $J = 12.2$ Hz, 1H), 5.03 (d, $J = 12.2$ Hz, 1H), 5.02 (d, $J = 12.2$ Hz, 1H), 4.93 (d, $J = 12.2$ Hz, 1H), 4.66 (dd, $J = 5.9, 7.3$ Hz, 1H), 4.30 (d, $J = 10.0$ Hz, 1H), 4.18 (d, $J = 12.0$ Hz, 1H), 4.10 (d, $J = 12.0$ Hz, 1H), 3.76 (dd, $J = 3.3, 9.5$ Hz, 1H), 3.46 (dd, $J = 6.2, 9.3$ Hz, 1H), 3.42 (dd, $J = 6.4, 9.3$ Hz, 1H), 3.27 (t, $J = 6.4$ Hz, 1H), 3.06 (dd, $J = 5.5, 13.4$ Hz, 1H), 3.02 (dd, $J = 7.3$ Hz, 1H), 2.77 – 2.62

(m, 2H), 1.13 (t, $J = 7.4$ Hz, 3H) ppm; ^{13}C NMR (125 MHz, CDCl_3) δ 171.0, 165.9, 154.6, 137.6, 136.0, 135.7, 135.53, 135.52, 133.6, 130.2, 130.0, 129.6, 128.8, 128.70, 128.66, 128.65, 128.52, 128.50, 128.31, 128.28, 128.2, 128.1, 126.7, 83.9, 77.9, 77.6, 76.4, 74.0, 73.0, 70.0, 68.1, 66.74, 66.66, 39.3, 24.5, 15.2 ppm; HRMS calcd for $\text{C}_{46}\text{H}_{46}\text{O}_{10}\text{S NaS}$ ($\text{M}+\text{Na}$) $^+$: 813.2709, found : 813.2725 (+2.6 ppm).

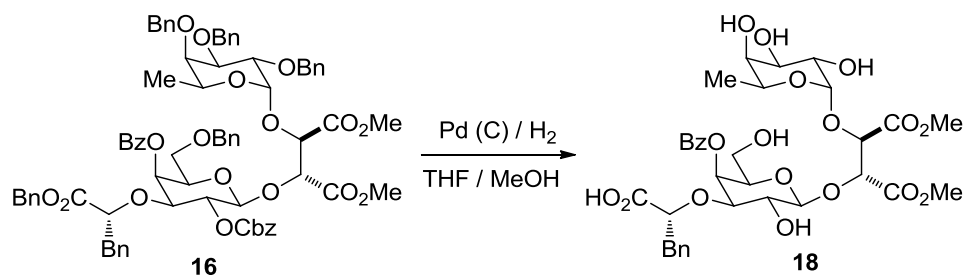
(2*R*,3*R*)-dimethyl 2-((2*S*,3*R*,4*S*,5*S*,6*R*)-5-(benzoyloxy)-4-((*R*)-1-(benzyloxy)-1-oxo-3-phenylpropan-2-yloxy)-3-(benzyloxycarbonyloxy)-6-(benzyloxymethyl)tetrahydro-2*H*-pyran-2-yloxy)-3-((2*S*,3*S*,4*R*,5*R*,6*S*)-3,4,5-tris(benzyloxy)-6-methyltetrahydro-2*H*-pyran-2-yloxy)succinate (16)



A solution of the thioglycoside **14** (353 mg, 0.54 mmol) in CH_2Cl_2 (0.1M) with molecular sieves 4Å was stirred 2 hours at room temperature under an argon atmosphere. The reaction was cooled at -78°C before adding Br_2 (30 μL , 0.56 mmol, 1.3 eq.). After one hour, the fucoside **3** was added (535 mg, 0.90 mmol, 2.0 eq.), and then AgOTf (289 mg, 1.13 mmol, 2.5 eq.). The reaction was stirred at -78°C over 1.25 hour, and then drops of water were added. The mixture was filtered on Celite[®]. The filtrate was extracted with EtOAc (3 x 100 ml) and the combined organic layers were washed with brine (50 ml), dried over MgSO_4 and concentrated *in vacuo*. Purification by flash chromatography (Hexanes:EtOAc, 80:20) provided **16** (396 mg, 64 %) as a colorless oil. $R_f = 0.41$ (Hexanes:EtOAc, 60:40); $[\alpha]_{\text{D}}^{25} -10.6$ (c 0.8, CH_2Cl_2); **Formula** :

$C_{77}H_{78}O_{20}$; **MW** : 1323.4312 g/mol; **IR** (neat) ν_{\max} 2933 (broad), 1759, 1725, 1453, 1255, 1102, 738, 699 cm^{-1} ; **^1H NMR** (500 MHz, C_6D_6) δ 8.14 – 8.07 (m, 2H), 7.48 – 7.42 (m, 2H), 7.39 – 7.26 (m, 8H), 7.23 – 6.87 (m, 28H), 5.69 (d, J = 3.4 Hz, 1H), 5.62 (dd, J = 8.1, 9.5 Hz, 1H), 5.20 (d, J = 3.7 Hz, 1H), 5.15 (d, J = 12.2 Hz, 1H), 5.07 (d, J = 12.0 Hz, 1H), 5.04 (d, J = 8.1 Hz, 1H), 5.01 (d, J = 5.9 Hz, 1H), 4.93 (d, J = 4.9 Hz, 1H), 4.90 (d, J = 5.6 Hz, 1H), 4.84 (d, J = 12.2 Hz, 1H), 4.79 (d, J = 5.9 Hz, 1H), 4.74 (d, J = 12.2 Hz, 1H), 4.70 (d, J = 12.2 Hz, 1H), 4.59 (d, J = 12.0 Hz, 1H), 4.55 (dd, J = 5.9, 7.3 Hz, 1H), 4.48 (d, J = 11.2 Hz, 1H), 4.46 (d, J = 11.0 Hz, 1H), 4.41 (qd, J = 6.5, 0.9 Hz, 1H), 4.22 (dd, J = 3.5, 11.0 Hz, 1H), 4.22 (d, J = 11.0 Hz, 1H), 4.13 (d, J = 11.5 Hz, 1H), 4.10 (dd, J = 2.7, 10.3 Hz, 1H), 3.66 (dd, J = 3.5, 9.8 Hz, 1H), 3.52 – 3.40 (m, 6H), 3.36 (d, J = 1.2 Hz, 1H), 3.24 (s, 3H), 3.00 (dd, J = 5.7, 13.4 Hz, 1H), 2.94 (dd, J = 5.6, 13.4 Hz, 1H), 1.25 (d, J = 6.6 Hz, 3H) ppm; **^{13}C NMR** (125 MHz, CDCl_3) δ 170.9, 169.4, 169.0, 165.9, 154.4, 139.14, 139.09, 138.9, 137.9, 135.9, 135.7, 135.64, 135.63, 135.5, 133.5, 130.3, 129.9, 129.6, 128.7, 128.6, 128.53, 128.51, 128.50, 128.44, 128.43, 128.42, 128.41, 128.32, 128.31, 128.03, 127.97, 127.8, 127.6, 127.5, 126.7, 100.8, 100.6, 79.7, 79.0, 78.3, 78.2, 77.7, 77.6, 77.5, 77.4, 77.0, 75.8, 75.0, 74.8, 73.9, 73.3, 73.0, 72.8, 69.9, 68.1, 67.8, 66.7, 66.6, 52.5, 39.4, 16.8 ppm; **HRMS** calcd for $C_{77}H_{78}O_{20}\text{Na}$ ($\text{M}+\text{Na}$) $^+$: 1345.4979, found : 1345.5005 (+1.9 ppm).

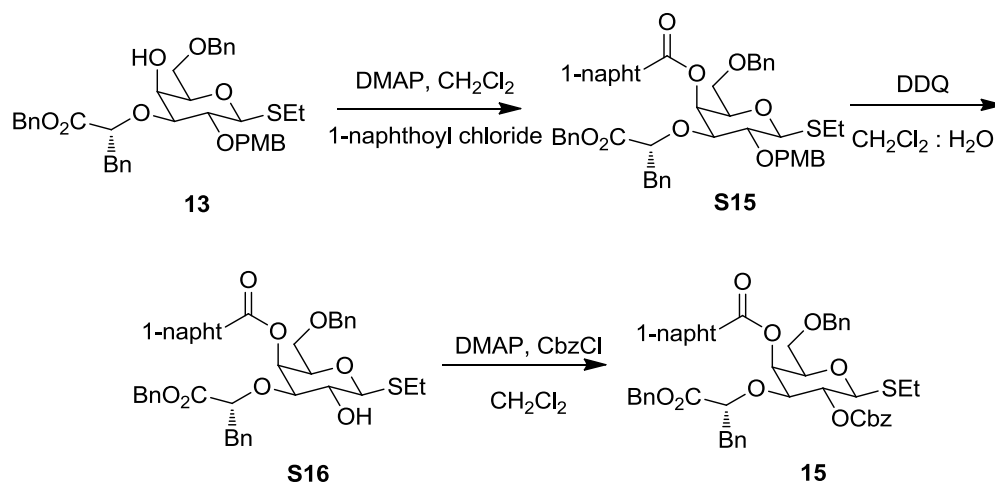
(*R*)-2-((2*R*,3*S*,4*R*,5*R*,6*S*)-3-(benzoyloxy)-6-((2*R*,3*R*)-1,4-dimethoxy-1,4-dioxo-3-((2*S*,3*S*,4*R*,5*S*,6*S*)-3,4,5-trihydroxy-6-methyltetrahydro-2*H*-pyran-2-yloxy)butan-2-yloxy)-5-hydroxy-2-(hydroxymethyl)tetrahydro-2*H*-pyran-4-yloxy)-3-phenylpropanoic acid (18)



To a solution of compound **16** (116 mg, 0.09 mmol) in THF:MeOH (4:1, 0.1M) was added Pd/C (10 % wt., 116 mg, 1.0 eq.). The system was purged with H₂ three times, and then the reaction was stirred at room temperature overnight under an atm of H₂. The mixture was filtered on Celite[®], washed with MeOH and concentrated *in vacuo*. Purification by flash chromatography (reverse silica, CH₃CN:H₂O, 35:65) provided **18** (20 mg, 30 %) as a white solid. **R_f** = 0.36 (EtOAc:*i*-PrOH:H₂O, 6:3:1); **P_{fus}**: 111.3 °C; [**α**]_D²⁵ −4.3 (*c* 0.70, MeOH); **Formula** : C₃₄H₄₂O₁₈; **MW** : 738.6865 g/mol; **¹H NMR** (500 MHz, CD₃OD) δ 7.98 – 7.94 (m, 2H), 7.60 – 7.55 (m, 1H), 7.47 – 7.40 (m, 2H), 6.95 – 6.81 (m, *J* = 23.1 Hz, 5H), 5.56 (s, 1H), 5.00 – 4.78 (m, 2H), 4.68 (d, *J* = 6.6 Hz, 1H), 4.62 (d, *J* = 6.8 Hz, 1H), 4.48 (d, *J* = 6.6 Hz, 1H), 4.22 (dd, *J* = 6.6, 6.6 Hz, 1H), 3.86 – 3.72 (m, 10H), 3.72 – 3.60 (m, 2H), 3.56 (d, *J* = 5.9 Hz, 2H), 3.05 – 2.90 (m, 2H), 1.15 (d, *J* = 6.4 Hz, 3H) ppm; **¹³C NMR** (125 MHz, CD₃OD) δ 171.0, 170.8, 167.4, 138.2, 134.5, 131.2, 131.0, 130.5, 129.6, 128.9, 127.3, 127.2, 106.0, 103.4, 80.9, 80.6, 80.2, 75.7, 73.6, 71.6, 71.4, 70.1, 68.8, 68.7, 61.7, 53.1, 53.0, 40.2, 16.6 ppm; **HRMS** calcd for C₃₄H₄₁O₁₈Na (M-H)[−] : 737.2298, found : 737.2290 (+0.3 ppm). **Anal.** Calcd for C₃₄H₄₂O₁₈Na•2H₂O: C 52.71, H 5.98; found: C 53.11, H 5.68.

(2*R*,3*S*,4*S*,5*R*,6*S*)-4-((*R*)-1-(benzyloxy)-1-oxo-3-phenylpropan-2-yloxy)-5

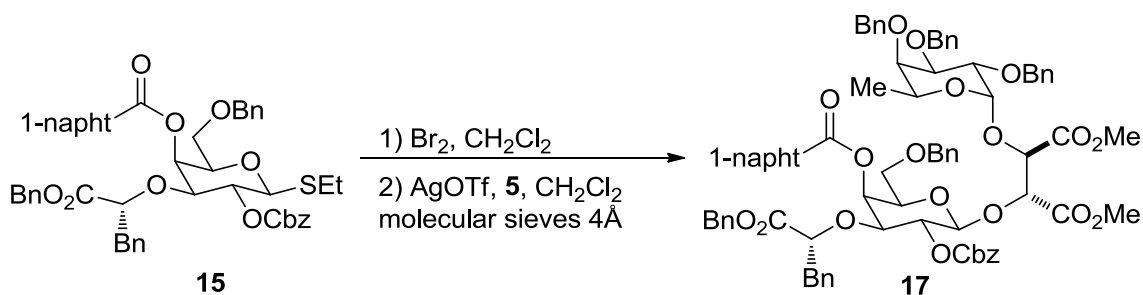
(benzyloxycarbonyloxy)-2-(benzyloxymethyl)-6-(ethylthio)tetrahydro-2*H*-pyran-3-yl 1-naphtoate (15)



To a solution of the thiogalactoside **13** (1.52 g, 2.26 mmol) in CH_2Cl_2 (0.1M) at 0°C under an argon atmosphere was added DMAP (830 mg, 6.78 mmol, 3.0 eq.) and 1-naphthoyl chloride (682 μL , 4.52 mmol, 2.0 eq.). The reaction was stirred overnight at room temperature, and then concentrated *in vacuo*. Purification by flash chromatography (Hexanes:EtOAc, 90:10) provided **S15** as a colorless oil. The compound **S15** was dissolved in CH_2Cl_2 : H_2O (10:1) and DDQ was added (615 mg, 2.7 mmol, 1.2 eq.). The reaction was stirred over 2 hours at room temperature and a saturated solution of NaHCO_3 (100 mL) was added. The aqueous layer was extracted with EtOAc (3 x 50 mL) and the combined organic layers were washed with brine (50 mL), dried over MgSO_4 and concentrated *in vacuo*. Purification by flash chromatography (Hexanes:EtOAc, 85:15) provided **S16** as a colorless oil. The alcohol **S16** was dissolved in CH_2Cl_2 (0.1M) and cooled at 0°C . The DMAP (830 mg, 6.78 mmol, 3.0 eq.) and benzyl carbonate (640 μL , 4.5 mmol, 2.0 eq.) were added. After the reaction was stirred overnight at room temperature the mixture was concentrated *in vacuo*. Purification by flash chromatography (Hexanes:EtOAc, 90:10) provided **15** (759 mg, 40% 3 steps) as a colorless oil. $R_f = 0.74$ (Hexanes:EtOAc, 70:30); $[\alpha]_D^{25} +16.9$ (c 0.4, CH_2Cl_2); **Formula** : $\text{C}_{50}\text{H}_{48}\text{O}_{10}\text{S}$; **MW** : 840.9751 g/mol; **IR** (neat) ν_{max} 2870 (broad), 1753, 1719, 1380, 1255, 1110, 747 cm^{-1} ; **$^1\text{H NMR}$** (500 MHz, C_6D_6) δ 9.43 – 9.33

(m, 1H), 8.42 – 8.32 (m, $J = 7.3$ Hz, 1H), 7.58 – 7.46 (m, 3H), 7.27 – 6.81 (m, 22H), 5.96 (d, $J = 3.2$ Hz, 1H), 5.7 (t, $J = 9.8$ Hz, 1H), 5.11 (d, $J = 12.4$ Hz, 1H), 5.06 (d, $J = 12.4$ Hz, 1H), 5.02 (d, $J = 12.2$ Hz, 1H), 4.94 (d, $J = 12.2$ Hz, 1H), 4.72 (t, $J = 6.3$ Hz, 1H), 4.30 (d, $J = 10.0$ Hz, 1H), 4.20 (d, $J = 11.7$ Hz, 1H), 4.14 (d, $J = 11.9$ Hz, 1H), 3.81 (dd, $J = 3.4, 9.5$ Hz, 1H), 3.50 – 3.42 (m, 2H), 3.31 (t, $J = 6.4$ Hz, 1H), 3.11 – 3.01 (m, 2H), 2.80 – 2.63 (m, 2H), 1.09 (t, $J = 7.4$ Hz, 3H) ppm; ^{13}C NMR (125 MHz, CDCl_3) δ 171.0, 166.7, 154.7, 137.7, 135.9, 135.7, 134.1, 134.0, 131.8, 131.1, 130.0, 128.85, 128.82, 128.73, 128.69, 128.5, 128.3, 128.2, 128.1, 127.9, 126.7, 126.5, 126.1, 125.0, 83.9, 78.2, 77.8, 76.5, 74.1, 73.2, 70.0, 68.2, 66.8, 66.7, 39.4, 24.3, 15.1 ppm; HRMS calcd for $\text{C}_{50}\text{H}_{49}\text{O}_{10}\text{S}$ ($\text{M}+\text{H}$) $^+$: 841.3041, found : 841.3041.

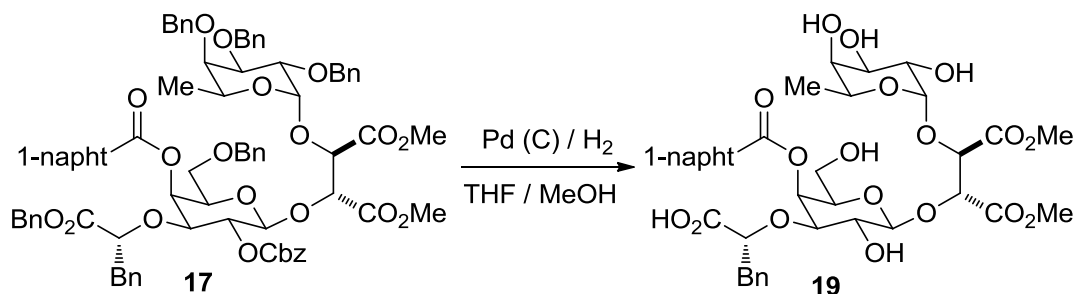
(2R,3R)-dimethyl 2-((2S,3R,4S,5S,6R)-5-(1-naphthoyloxy)-4-((R)-1-(benzyloxy)-1-oxo-3-phenylpropan-2-yloxy)-3-(benzyloxycarbonyloxy)-6-(benzyloxymethyl)tetrahydro-2H-pyran-2-yloxy)-3-((2S,3S,4R,5R,6S)-3,4,5-tris(benzyloxy)-6-methyltetrahydro-2H-pyran-2-yloxy)succinate (17)



A solution of the thioglycoside **15** (170 mg, 0.20 mmol) in CH_2Cl_2 (0.1M) with molecular sleeves 4Å was stirred 2 hours at room temperature under an argon atmosphere. The reaction was cooled at -78 °C before adding Br_2 (13 μL , 0.26 mmol, 1.3 eq.). After 1 hour, the fucoside **5** was added (238 mg, 0.40 mmol, 2.0 eq.), and then AgOTf (128 mg, 0.5 mmol, 2.5 eq.). The reaction was stirred at -78 °C over 1.25 hour, and then water drops were added. The mixture was filtered

on Celite[®]. The filtrate was extracted with EtOAc (3 x 100 ml) and the combined organic layers were washed with brine (50 ml), dried over MgSO₄ and concentrated *in vacuo*. Purification by flash chromatography (Hexanes:EtOAc, 95:5) provided **17** (160 mg, 58 %) as a colorless oil. **R_f** = 0.67 (Hexanes:EtOAc, 60:40); [α]_D²⁵ - 27.0 (*c* 0.2, CH₂Cl₂); **Formula** : C₈₁H₈₀O₂₀; **MW** : 1373.4899 g/mol; **IR** (neat) ν_{\max} 3031 (broad), 1759, 1260, 1102, 738, 698 cm⁻¹; **¹H NMR** (500 MHz, CDCl₃) δ 8.98 – 8.91 (m, 1H), 8.25 – 8.17 (m, 1H), 8.08 – 7.99 (m, 1H), 7.96 – 7.86 (m, 1H), 7.67 – 7.59 (m, 1H), 7.56 – 7.48 (m, 2H), 7.46 – 6.91 (m, 38H), 5.71 (apps, 1H), 5.21 (d, *J* = 3.4 Hz, 1H), 5.17 (d, *J* = 12.2 Hz, 1H), 5.10 (d, *J* = 12.2 Hz, 1H), 5.08 (d, *J* = 8.05 Hz, 1H), 5.01 (d, *J* = 5.9 Hz, 1H), 4.93 (d, *J* = 11.2 Hz, 1H), 4.92 (d, *J* = 12.2 Hz, 1H), 4.86 (d, *J* = 12.2 Hz, 1H), 4.79 (d, *J* = 5.9 Hz, 1H), 4.75 (d, *J* = 12.2 Hz, 1H), 4.70 (d, *J* = 12.2 Hz, 1H), 4.62 – 4.59 (m, 2H), 4.64 – 4.41 (m, 4H), 4.25 (d, *J* = 11.7 Hz, 1H), 4.22 (d, *J* = 2.4 Hz, 1H), 4.18 (d, *J* = 11.7 Hz, 1H), 4.10 (dd, *J* = 2.2, 10.0 Hz, 1H), 3.70 (dd, *J* = 3.4, 9.8 Hz, 1H), 3.54 – 3.43 (m, 3H), 3.41 (s, 3H), 3.37 (s, 1H), 3.19 (s, 3H), 3.00 (dd, *J* = 5.6, 13.4 Hz, 1H), 2.95 (dd, *J* = 7.3, 13.7 Hz, 1H), 1.25 (d, *J* = 6.3 Hz, 3H) ppm; **¹³C NMR** (125 MHz, CDCl₃) δ 170.9, 169.4, 169.0, 166.8, 154.5, 139.2, 139.1, 139.0, 137.9, 135.9, 135.7, 135.6, 134.0, 133.9, 131.8, 131.2, 129.9, 128.8, 128.7, 128.6, 128.5, 128.44, 128.39, 128.3, 128.2, 128.1, 128.0, 127.8, 127.64, 127.56, 126.7, 126.5, 126.1, 125.0, 100.9, 100.6, 79.7, 79.0, 78.5, 78.3, 77.8, 77.7, 75.8, 75.0, 74.0, 73.4, 73.0, 72.9, 70.0, 68.2, 67.8, 66.7, 52.54, 52.51, 39.5, 16.8 ppm; **HRMS** calcd for C₈₁H₈₁O₂₀ (M+H)⁺ : 1373.5316, found : 1373.5331 (+1.1 ppm).

(R)-2-((2R,3S,4R,5R,6S)-3-(1-naphthoyloxy)-6-((2R,3R)-1,4-dimethoxy-1,4-dioxo-3-((2S,3S,4R,5S,6S)-3,4,5-trihydroxy-6-methyltetrahydro-2H-pyran-2-yloxy)butan-2-yloxy)-5-hydroxy-2-(hydroxymethyl)tetrahydro-2H-pyran-4-yloxy)-3-phenylpropanoic acid (19)



To a solution of compound **17** (240 mg, 0.17 mmol) in THF:MeOH (4:1, 0.1M) was added Pd/C (10 % wt., 240 mg, 1.0 eq.). The system was purged with H₂ three times, and then the reaction was stirred at room temperature overnight under an atm of H₂. The mixture was filtered on Celite[®], washed with MeOH and concentrated *in vacuo*. Purification by flash chromatography (reverse silica, CH₃CN:H₂O, 35:65) provided **19** (17 mg, 13 %) as a white solid. **R_f** = 0.34 (EtOAc:*i*-PrOH:H₂O, 6:3:1); P_{fus}: 121.1 °C; [**α**]_D²⁵ −34.2 (c 0.3, MeOH); **Formula** : C₃₈H₄₄O₁₈; **MW** : 788.7452 g/mol; **IR** (neat) ν_{max} cm^{−1}; **¹H NMR** (500 MHz, CD₃OD) δ 8.95 (d, *J* = 8.3 Hz, 1H), 8.20 – 8.14 (m, 1H), 8.09 – 8.04 (m, 1H), 7.92 – 7.87 (m, 1H), 7.59 – 7.45 (m, 3H), 7.21 – 6.72 (m, 5H), 5.72 (apps, 1H), 4.94 (apps, 1H), 4.68 (d, *J* = 6.6 Hz, 1H), 4.62 (d, *J* = 6.6 Hz, 1H), 4.48 (d, *J* = 6.6 Hz, 1H), 4.22 (dd, *J* = 6.3, 6.3 Hz, 1H), 3.90 – 3.57 (m, 15H), 3.15 – 3.02 (m, 2H), 1.15 (d, *J* = 6.6 Hz, 3H); **¹³C NMR** (125 MHz, CD₃OD) δ 171.0, 170.8, 168.2, 137.8, 135.4, 134.9, 132.7, 132.0, 130.6, 129.7, 128.94, 128.85, 127.8, 127.3, 127.0, 125.7, 105.8, 103.5, 81.2, 80.6, 80.1, 75.7, 73.6, 71.5, 70.1, 68.74, 68.71, 61.8, 53.1, 53.0, 40.2, 16.6 ppm. **HRMS** calcd for C₃₈H₄₃O₁₈ (M-H)[−] : 787.2455, found : 787.2441 (−0.4 ppm).

III. ^1H NMR and ^{13}C NMR spectra

