Supporting Information

Total Synthesis of Microcarpalide

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Experimental Section

General Methods: All reactions were carried out under argon or nitrogen in oven-dried glassware using standard gas-light syringes, cannulas and septa. Solvents and reagents were purified and dried by standard methods prior to use. Optical rotations were measured at room temperature. IR spectra were recorded on an FT-IR instrument. ^1H NMR spectra were recorded on 200 MHz, 300 MHz and 500 MHz and are reported in parts per million (δ) downfield relative to CDCl_3 as internal standard and ^{13}C NMR spectra were recorded at 50 MHz, 75 MHz and 125 MHz and assigned in parts per million (δ) relative to CDCl_3 . Column chromatography was performed on silica gel (100-200 and 230-400 mesh) using a mixture of petroleum ether and ethyl acetate as the eluent.

4-(4-Methoxybenzyloxy)-butan-1-ol (3): To a solution of 1,4-butanediol **2** (7.0 g, 77.67 mmol) in dry DMF (200 mL) was added sodium hydride (50%, 3.73 g, 77.70 mmol) at 0 °C. The reaction mixture was then stirred at room temperature for 30 min after which it was again cooled to 0 °C. To this was added slowly *p*-methoxybenzyl bromide (15.63 g, 77.7 mmol) and tetra *n*-butylammonium iodide (2.50 g, 6.77 mmol) with further stirring for 1 h at the same temperature. The reaction mixture was quenched with addition of cold water at 0 °C. The two phases were separated and the aqueous phase was extracted with EtOAc (3 x 100 mL). The combined organic layers were washed with water (3 x 100 mL), brine, dried (Na₂SO₄) and concentrated. The residual oil was purified by silica gel column chromatography using petroleum ether/EtOAc (8:2) as eluent to furnish the mono-PMB protected alcohol **3** (14.71 g, 90%) as a colourless oil. IR (CHCl₃, cm⁻¹): ν_{max} 3400, 2937, 2863, 1612, 1513, 1248, 1174, 1097; ¹H NMR (500 MHz, CDCl₃): δ 7.26 (d, 2H, *J* = 10 Hz); 6.88 (d, 2H, *J* = 10 Hz), 4.45 (s, 2 H), 3.80 (s, 3 H) 3.62 (t, 2H, *J* = 5 Hz), 3.49 (t, 2H, *J* = 5 Hz), 1.64-1.71 (m, 4H); ¹³C NMR (125 MHz, CDCl₃): δ 159.2, 130.3, 129.3, 113.8, 72.5, 69.9, 62.2, 55.1, 29.6, 26.3. Anal. Calcd. for C₁₂H₁₈O₃ (210.27): C, 68.54; H, 8.63, Found: C, 68.49; H, 8.66.

6-(4-Methoxybenzyloxy)-hex-2-enoic acid ethyl ester (4). (a) Swern oxidation. To a solution of oxalyl chloride (9.06 g, 71.38 mmol) in dry CH₂Cl₂ (100 mL) at -78 °C was added dropwise dry DMSO (11.15 g, 10.12 mL, 142.71 mmol) in CH₂Cl₂ (20 mL). After 30 min, alcohol **3** (10.0 g, 47.56 mmol) in CH₂Cl₂ (20 mL) was added over 10 min giving copious white precipitate. After stirring for 1 h at -78 °C the reaction mixture was brought to -60 °C and Et₃N (19.25 g, 26.52 mL, 190.24 mmol) was added slowly and stirred for

30 min allowing the reaction mixture to warm to room temperature. The reaction mixture was then diluted with water (150 mL) and CH₂Cl₂. The organic layer was separated and washed with water and brine, dried (Na₂SO₄) and passed through short pad of celite. The filtrate was concentrated to give the aldehyde (9.86 g, 95%) as pale yellow oil, which was used as such for the next step without purification.

(b) Wittig olefination. To a solution of (ethoxycarbonylmethylene)triphenylphosphorane (18.14 g, 52.07 mmol) in dry benzene (150 mL) was added a solution of the above aldehyde in dry benzene (100 mL). The reaction mixture was refluxed for 6 h. It was then concentrated and purified by silica gel column chromatography using petroleum ether/EtOAc (8.5:1.5) as eluent to afford the α,β -unsaturated olefin **4** (11.73 g, 89%) as a pale yellow liquid. IR (CHCl₃, cm⁻¹): $\nu_{\max}$ 2956, 2858, 1724, 1654, 1038, 1300, 1204, 1100; ¹H NMR (500 MHz, CDCl₃): δ 7.28 (d, 2H, J = 9Hz); 6.98 (dt, 1 H, J = 15, 10 Hz), 6.91 (d, 2H, J = 9 Hz), 5.86 (d, 1H, J = 15 Hz), 4.45 (s, 2 H), 4.20 (q, 2H, J = 8 Hz), 3.83 (s, 3H), 3.48 (t, 2H, J = 6Hz), 2.31 (q, 2H, J = 7 Hz), 1.75-1.81 (m, 2 H), 1.31(t, 3H, J = 8 Hz); ¹³C NMR (125 MHz, CDCl₃): δ 166.4, 158.9, 148.4, 130.2, 129.0, 121.4, 113.5, 72.3, 68.7, 59.9, 54.9, 28.7, 27.9, 14.0; Mass (ESI): 279 (M+1), 241, 204, 121, 91. Anal. Calcd. for C₁₆H₂₂O₄ (278.34): C, 69.04; H, 7.97, Found: C, 69.10; H, 7.75.

5-[3-(4-Methoxybenzyloxy)-propyl]-2,2-dimethyl-[1,3]dioxolane-4-carboxylic acid ethyl ester (6). To a solution of the diol **5** (4.50 g, 14.41 mmol), *p*-TSA (100 mg) in CH₂Cl₂ (100 mL) was added 2,2-dimethoxypropane (2.25 g, 21.60 mmol) and reaction mixture stirred overnight at room temperature. Solid NaHCO₃ (1 g) was added and

mixture again stirred for 30 min. The reaction mixture was filtered through a pad of neutral alumina and filtrate concentrated. Silica gel column chromatography using petroleum ether/EtOAc (9:1) as eluent gave **6** (4.82 g, 95%) as a colourless liquid. $[\alpha]_D^{25} +24.2$ (*c* 1.9, CHCl₃); IR (neat): $\nu_{\max}$ 2864, 1736, 1612, 1513, 1248, 1130, 1032 cm⁻¹; ¹H NMR (500 MHz, CDCl₃): δ 7.26 (d, 2H, *J* = 10.0 Hz), 6.91 (d, 2H, *J* = 10.0 Hz), 4.52 (s, 2H), 4.22 (q, 2H, *J* = 7.3 Hz), 4.10-4.14 (m, 1H), 3.80 (s, 3H), 3.53 (t, 3H, *J* = 5.8 Hz), 1.72-1.93 (m, 4H), 1.47 (s, 3H), 1.44 (s, 3H), 1.29 (t, 3H, *J* = 6.8 Hz); ¹³C NMR (125 MHz, CDCl₃): δ 170.5, 158.9, 130.4, 128.8, 113.5, 110.4, 78.89, 78.71, 72.2, 69.2, 60.9, 54.9, 29.8, 26.9, 25.5, 25.4, 13.8. Anal. Calcd for C₁₉H₂₈O₆ (352.42): C, 64.75; H, 8.01, Found C, 64.86; H, 8.44.

{5-[3-(4-Methoxybenzyloxy)-propyl]-2,2-dimethyl-[1,3]dioxolan-4-yl}-methanol

(7). To a solution of **6** (4.0 g, 11.35 mmol) in dry CH₂Cl₂ (80 mL) at 0 °C was added dropwise DIBAL-H (22.70 mL, 22.70 mmol, 1M in toluene) through a syringe. The reaction mixture was allowed to warm to room temperature over 2 h, then re-cooled to 0 °C and treated with saturated solution of sodium/potassium tartrate. The solid material was filtered through a pad of celite and concentrated. Silica gel column chromatography of the crude product using petroleum ether/EtOAc (7:3) as eluent gave **7** (3.38 g, 96%) as a colourless oil. $[\alpha]_D^{25} +12.1$ (*c* 1.9, CHCl₃); IR (neat): $\nu_{\max}$ 3440, 2938, 2860, 1361, 1204, 1126, 1038 cm⁻¹; ¹H NMR (500 MHz, CDCl₃): δ 7.25 (d, 2H, *J* = 8.7 Hz), 6.89 (d, 2H, *J* = 8.7 Hz), 4.44 (s, 2H), 3.90 (dt, *J* = 7.6, 4.0 Hz, 1H), 3.81 (s, 3H), 3.76 (m, 2H), 3.60 (dd, 1H, *J* = 7.5, 4.4 Hz), 3.46-3.53 (m, 2H), 2.18 (s, 1H), 1.62-1.84 (m, 4H), 1.41 (s, 3H), 1.40 (s, 3H); ¹³C NMR (125 MHz, CDCl₃): δ 159.1, 130.5, 129.1, 113.7, 108.5,

81.5, 76.7, 72.4, 69.6, 62.1, 55.1, 29.7, 27.2, 26.9, 26.0. Anal. Calcd for C₁₇H₂₆O₅ (310.39): C, 65.78; H, 8.44, Found C, 65.94; H, 8.64.

4-(2,2-Dibromovinyl)-5-[3-(4-methoxybenzyloxy)-propyl]-2,2-dimethyl-[1,3]dioxolane (9). To a solution of oxalyl chloride (2.45 g, 1.69 mL, 19.30 mmol) in dry CH₂Cl₂ (100 mL) at -78 °C was added dropwise dry DMSO (3.02 g, 2.74 mL, 38.65 mmol) in CH₂Cl₂ (20 mL). After 30 min, alcohol **7** (4.0 g, 12.89 mmol) in CH₂Cl₂ (20 mL) was added over 10 min giving a copious white precipitate. After stirring for 1 h at -78 °C the reaction mixture was brought to -60 °C and Et₃N (5.22 g, 7.18 mL, 51.59 mmol) was added slowly and stirred for 30 min allowing the reaction mixture to warm to room temperature. The reaction mixture was poured into water (150 mL) and the organic layer separated. The aqueous layer was extracted with CH₂Cl₂ (2 x 50 mL) and combined organic layers were washed with water (3 x 50 mL), brine (50 mL), dried (Na₂SO₄) and passed through short pad of silica gel. The filtrate was concentrated to give the aldehyde **8** (3.9 g) as pale yellow oil, which was used as such for the next step without purification.

To a cooled (0 °C) and stirred solution of carbon tetrabromide (7.74 g, 23.34 mmol) in CH₂Cl₂ (100 mL) was added triphenylphosphine (12.25 g, 46.70 mmol) in CH₂Cl₂ (30 mL) under argon. After 10 min, the reaction mixture was cooled to -78 °C and a solution of the above aldehyde **8** (3.6 g, 11.66 mmol) in CH₂Cl₂ (20 mL) was introduced into the yellowish ylide solution. The mixture was stirred for 2 h at -78 °C, quenched with saturated NaHCO₃ solution and extracted with CH₂Cl₂ (3 x 50 mL). The combined organic layers were washed with brine, dried (Na₂SO₄) and concentrated. Silica gel column chromatography of the crude product using petroleum ether/EtOAc (9:1) as

eluent gave **9** (5.31 g, 98%) as a yellow syrup. $[\alpha]_D^{25} +9.7$ (*c* 2.8, CHCl₃); IR (CHCl₃): $\nu_{\max}$ 2938, 2864, 1613, 1514, 1248, 1130, 1032 cm⁻¹; ¹H NMR (500 MHz, CDCl₃): δ 7.30 (d, 2H, *J* = 8.3 Hz), 6.92 (d, 2H, *J* = 8.3 Hz), 6.44 (d, 1H, *J* = 8.7 Hz), 4.46 (s, 2H), 4.32 (t, 1H, *J* = 8.7 Hz), 3.83 (s, 3H), 3.72-3.80 (m, 1H), 3.49-3.56 (m, 2H), 1.67-1.81 (m, 4H), 1.43 (s, 3H), 1.40 (s, 3H); ¹³C NMR (125 MHz, CDCl₃): δ 158.9, 135.6, 130.4, 129.0, 113.5, 109.1, 93.7, 80.4, 79.4, 72.2, 69.2, 55.0, 28.4, 27.0, 26.5, 25.8. Anal. Calcd. for C₁₈H₂₄Br₂O₄ (464.19): C, 46.57; H, 5.21; Br, 34.43, Found C, 46.85; H, 5.38; Br, 34.48.

4-Ethynyl-5-[3-(4-methoxybenzyloxy)-propyl]-2,2-dimethyl-[1,3]dioxolane (10).

To a cooled (-78 °C) and stirred solution of **9** (5.8 g, 12.49 mmol) in THF (50 mL) was added n-BuLi (1.6 M solution in hexane, 39.06 mL, 62.47 mmol) dropwise under argon. After 1 h, the reaction mixture was quenched with saturated aqueous NH₄Cl solution and extracted with ethyl acetate (3 x 50 mL). The combined organic layers were washed with brine, dried (Na₂SO₄) and concentrated. Silica gel column chromatography of the crude product using petroleum ether/EtOAc (8:2) as eluent gave **10** (3.49 g, 92%) as a yellowish oil. $[\alpha]_D^{25} +13.4$ (*c* 1.6, CHCl₃); IR (CHCl₃): $\nu_{\max}$ 2943, 2859, 1615, 1518, 1244, 1132, 1030 cm⁻¹; ¹H NMR (500 MHz, CDCl₃): δ 7.25 (d, 2H, *J* = 8.0 Hz), 6.89 (d, 2H, *J* = 7.6 Hz), 4.44 (s, 2H), 4.22 (d, 1H, *J* = 7.9 Hz), 4.05 (dt, *J* = 7.9, 3.6 Hz, 1H), 3.80 (s, 3H), 3.47-3.52 (m, 2H), 2.51 (s, 1H), 1.70-1.81 (m, 4H), 1.45 (s, 3H), 1.40 (s, 3H); ¹³C NMR (125 MHz, CDCl₃): δ 159.0, 130.5, 129.0, 113.6, 109.8, 81.2, 80.7, 74.5, 72.4, 70.1, 69.4, 55.1, 28.9, 26.9, 26.0, 25.7. Anal. Calcd. for C₁₈H₂₄O₄ (304.38): C, 71.03; H, 7.95, Found C, 71.21; H, 8.01.

Non-2-yn-1-ol (14): This compound was prepared in 95% yield by a slight modification of the procedure by Van Aar et al.¹ Instead of only 1.5 eqv, 3 eqv. of propargyl alcohol **13**, was used in the reaction. Colourless syrupy liquid. IR (CHCl₃): ν_{max} 3610, 3400, 2920, 2850, 2290, 2220 cm⁻¹; ¹H NMR (200 MHz, CDCl₃): δ 4.25 (t, J = 2.2 Hz, 2H), 2.18-2.23 (m, 2H), 1.77 (br s, 1H), 1.23-1.55 (m, 8H), 0.89 (t, J = 6.6 Hz, 3H); ¹³C NMR (125 MHz, CDCl₃): δ 85.7, 78.1, 50.5, 31.1, 28.37, 28.31, 22.2, 18.4, 13.7.

Non-2-en-1-ol (15): This compound was prepared in 96% yield according to a literature procedure.¹ The NMR data were in full accord with those described.²

1-Chloro-non-2-ene (16): To a solution of alcohol **15** (3.5 g, 24.61 mmol) and Ph₃P (7.74 g, 29.51 mmol) in 50 mL of dry CH₂Cl₂ was added NCS (3.61 g, 27.04 mmol) at 0 °C under nitrogen. The reaction mixture was stirred at 0 °C for 1 h, then allowed to warm to room temperature, and stirred for 2 h. The mixture was diluted with 100 mL of hexane and passed through a pad of celite under suction to remove the precipitate of Ph₃PO. The filtrate was concentrated, and resulting residue was dissolved in 100 mL of hexane and passed through a pad of celite to remove the precipitate of Ph₃PO again. Evaporation of solvent gave **16** (3.2 g, 89%) as a colourless oil. ¹H NMR (200 MHz, CDCl₃): δ 5.73-5.83 (m, 1H), 5.56-5.66 (m, 1H), 4.05 (d, J = 6.1 Hz, 2H), 2.05 (q, J = 15.0 Hz, 2H), 1.28-1.43 (m, 8H), 0.89 (t, J = 6.2 Hz, 3H); ¹³C NMR (125 MHz, CDCl₃): δ 134.6, 125.9, 48.0,

32.6, 32.5, 30.3, 30.1, 23.1, 14.0. Anal. Calcd. for C₉H₁₇Cl (160.68): C, 67.27; H, 10.66, Found C, 67.15; H, 10.74.

1-Chloro-nonane-2,3-diol (17): To a mixture of K₃Fe(CN)₆ (19.68 g, 59.77 mmol), K₂CO₃ (8.26 g, 59.76 mmol), NaHCO₃ (5.02 g, 59.75), and (DHQ)₂PHAL (155 mg, 1 mol%), in *t*-BuOH-H₂O (1:1, 100 mL) cooled at 0 °C was added K₂OsO₂(OH)₄ (37 mg, 0.5 mol%) followed by methanesulfonamide (1.89 g, 19.87 mmol). After being stirred for 5 min at 0 °C, the olefin **16** (3.2 g, 19.92 mmol) was added in one portion. The reaction mixture was stirred at 0 °C for 10 h and then quenched with solid sodium sulfite (25 g). The stirring was continued for 45 min and the solution was extracted with EtOAc (3 x 50 mL). The combined extracts were dried (Na₂SO₄), and concentrated. Silica gel column chromatography of the crude product using petroleum ether/EtOAc (8:2) as eluent gave the diol **17** (5.63 g, 96%) as a white solid. mp 85-86 °C (lit.² mp 82-84 °C); [α]_D²⁵ -9.3 (*c* 1.2, MeOH) (lit.² [α]_D²⁵ -9.0 (*c* 1.0, MeOH). The spectroscopic data (IR, ¹H NMR, & ¹³C NMR) were in accord with those described.

1-Oxiranyl-heptan-1-ol (18): To a solution of diol **17** (2.5 g, 12.84 mmol) in THF (50 ml) was added pulverized NaOH (1.02 g, 25.5 mmol) at 0 °C and reaction mixture was stirred at room temperature for 2 h. The reaction mixture was quenched by addition of water (50 mL) and then extracted with diethyl ether (3 x 50 mL). The combined extracts were dried (Na₂SO₄), and concentrated. Silica gel column chromatography of the crude product using petroleum ether/EtOAc (8:2) as eluent gave the epoxide **18** (1.83 g, 90%) as a colourless liquid. [α]_D²⁵ -64.2 (*c* 1.0, CHCl₃). IR (CHCl₃): $\nu_{\max}$ 3400, 2929, 2858,

1740, 1466, 1241, 1075 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3): δ 3.41 (m, 1H), 2.96-2.98 (m, 1H), 2.81 (t, $J = 5.2$ Hz, 1H), 2.70 (dd, $J = 4.8, 2.8$ Hz, 1H), 2.21 (br s, 1H), 1.55-1.63 (m, 2H), 1.43-1.49 (m, 1H), 1.26-1.37 (m, 7H), 0.89 (t, $J = 6.0$ Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3): δ 71.6, 55.4, 44.9, 34.0, 31.5, 29.0, 25.0, 22.3, 13.7. Anal. Calcd. for $\text{C}_9\text{H}_{18}\text{O}_2$ (158.23): C, 68.31; H, 11.47, Found C, 68.28; H, 11.53.

1-{5-[3-(4-Methoxybenzyloxy)-propyl]-2,2-dimethyl-[1,3]dioxolan-4-yl}-5-methoxymethoxy-undec-1-en-4-ol (20): (a) **Reaction with stannane 11.** To a solution of **11** (641 mg, 1.08 mmol) in THF (10 mL) was added *n*-BuLi (0.93 mL, 1.48 mmol, 1.6 M solution in hexane) at -78°C . After that reaction mixture was stirred at -78°C for 1h and at -50°C for 1.5 h. The reaction mixture was sequentially treated with cuprous cyanide (66 mg, 0.74 mmol), and epoxide **19** (100mg, 0.49 mmol) at -78°C . Stirring was continued at -50°C for 24 h, and -15°C for an additional 24 h. The reaction mixture was quenched with aqueous NH_4Cl and aqueous layer was extracted with EtOAc. The combined organic extracts were washed with brine, dried (Na_2SO_4), and concentrated. Silica gel column chromatography of the crude product using petroleum ether/EtOAc (8.5:1.5) as eluent gave **20** (128 mg, 51%) as a yellow syrupy liquid. $[\alpha]_{\text{D}}^{25} +14.1$ (c 0.9, CHCl_3); IR (CHCl_3): ν_{max} 3426, 2938, 2867, 1610, 1514, 1467, 1242, 1092; ^1H NMR (200 MHz, CDCl_3): δ 7.25 (d, $J = 8.6$ Hz, 2H), 6.89 (d, $J = 8.6$ Hz, 2H), 5.47-5.52 (m, 1H), 5.39 (dd, $J = 15.6, 6.4$ Hz, 1H), 4.69 (s, 2H), 4.45 (s, 2H), 4.21 (d, $J = 7.4$ Hz, 1H), 3.98 (dt, $J = 7.4, 4.4$ Hz, 1H), 3.81 (s, 3H), 3.70-3.79 (m, 1H), 3.54 (m, 1H), 3.46-3.50 (m, 2H), 3.24 (s, 3H), 2.84 (br s, 1H), 2.24-2.36 (m, 2H), 1.67-1.79 (m, 6H), 1.44 (s, 3H), 1.39 (s, 3H), 1.23-1.39 (m, 8H), 0.89 (t, $J = 6.4$ Hz, 3H); ^{13}C NMR (50 MHz, CDCl_3): δ

160.1, 131.7, 131.5, 131.1, 128.1, 113.7, 109.3, 81.4, 80.7, 72.9, 72.4, 71.0, 69.6, 55.6, 55.1, 35.3, 30.7, 29.9, 28.9, 27.1, 26.3, 25.3, 24.1, 22.6, 14.1. Anal. Calcd. for C₂₉H₄₈O₇ (508.68): C, 68.47; H, 9.51, Found C, 68.74; H, 9.12.

(b) Reaction with vinyl iodide 12. To a solution of vinyl iodide **12** (500 mg, 1.15 mmol) in THF (15 mL) was added n-BuLi (0.72 mL, 1.15 mmol, 1.6M solution in hexane) at -78 °C. The yellow mixture was warmed to 0 °C for 40 minutes before recooling to -78 °C. Then, the reaction mixture was treated with CuCN (119 mg, 1.15 mmol), followed by addition of epoxide (78 mg, 0.39 mmol) at -78 °C. Stirring was continued at -50 °C for 24 h and -15 °C for additional 24 h. The reaction mixture was quenched with aqueous NH₄Cl and aqueous layer was extracted with EtOAc. The combined organic extracts were washed with brine, dried (Na₂SO₄), and concentrated. Silica gel column chromatography of the crude product using petroleum ether/EtOAc (8.5:1.5) as eluent gave **20** (153 mg, 78%) as a yellow syrupy liquid.

***tert*-Butyl-[4-{5-[3-(4-methoxybenzyloxy)-propyl]-2,2-dimethyl-[1,3]dioxolan-4-yl}-1-(1-methoxymethoxyheptyl)-but-3-ynyloxy]-dimethylsilane (22):** To a stirred solution of compound **21** (0.76 g, 1.50 mmol) and 2,6-lutidine (1.7 mL, 14.69) in dry CH₂Cl₂ (30 mL) was treated under argon with TBSOTf (0.51 mL, 2.22 mmol) at 0 °C and the reaction mixture was stirred for 30 min. at the same temperature. The reaction mixture was quenched by addition of water (30 mL) and the mixture was extracted with CH₂Cl₂ (3 x 50 mL). The combined extracts were dried (Na₂SO₄), and concentrated. Silica gel column chromatography of the crude product using petroleum ether/EtOAc (9.5:0.5) as eluent gave the compound **22** (0.91 g, 98%) as a colourless syrupy liquid.

$[\alpha]_D^{25} +14.7$ (*c* 0.48, CHCl₃); IR (CHCl₃): $\nu_{\max}$ 3020, 2936, 2861, 2412, 1613, 1512, 1374, 1096, 758 cm⁻¹; ¹H NMR (500 MHz, CDCl₃): δ 7.26 (d, *J* = 7.9 Hz, 2H), 6.88 (d, *J* = 7.9 Hz, 2H), 4.70 (d, *J* = 6.8 Hz, 1H), 4.63 (d, *J* = 6.8 Hz, 1H), 4.44 (s, 2H), 4.22 (d, *J* = 7.6 Hz, 1H), 3.95-4.01 (m, 1H), 3.88-3.93 (m, 1H), 3.81 (s, 3H), 3.49 (m, 2H), 3.38 (s, 3H), 2.55 (d, *J* = 16.3 Hz, 1H), 2.31 (dd, *J* = 16.3, 8.1 Hz, 1H), 1.58-1.78 (m, 6H), 1.44 (s, 3H), 1.39 (s, 3H), 1.27-1.36 (m, 8H), 0.90 (m, 12 H), 0.13 (s, 3H), 0.09 (s, 3H); ¹³C NMR (125 MHz, CDCl₃): δ 159.1, 131.5, 130.6, 129.1, 113.7, 113.5, 109.4, 96.8, 83.6, 81.4, 80.8, 78.9, 74.7, 72.5, 69.6, 55.8, 55.1, 31.7, 30.8, 29.3, 28.9, 27.0, 26.2, 25.8, 25.2, 24.0, 22.5, 18.0, 13.9, -4.5, -5.2. Anal. Calcd. for C₃₅H₆₀O₇Si (620.91): C, 67.70; H, 9.74, Found C, 67.91; H, 10.57.

3-{5-[4-(tert-Butyldimethylsilanyloxy)-5-methoxymethoxy-undec-1-enyl]-2,2-dimethyl-[1,3]dioxolan-4-yl}-propan-1-ol (23): To a blue solution of lithium metal (100 mg, 14.41 mmol) in 50 mL of NH₃ was added dropwise a solution of **22** (445 mg, 0.72 mmol) in THF (10 ml) at -78 °C. During the addition of compound, the blue colour of the reaction mixture was maintained by adjusting the speed of the addition. After all of the compound had been added, the reaction mixture was stirred for 6 h at -40 °C. The reaction mixture was quenched by adding NH₄Cl, and the mixture was warmed to room temperature overnight, during which time the ammonia was evaporated. The mixture was then diluted with water and extracted with diethyl ether, and organic layer was dried (Na₂SO₄), and concentrated. Silica gel column chromatography of the crude product using petroleum ether/EtOAc (7:3) as eluent gave the compound **23** (327 mg, 89%) as a brown syrupy liquid. $[\alpha]_D^{25} +7.7$ (*c* 0.7, CHCl₃); IR (CHCl₃): $\nu_{\max}$ 3426, 1510, 1467,

1224; ^1H NMR (500 MHz, CDCl_3): δ 5.45-5.60 (m, 1H), 5.31 (dd, $J = 15.7, 6.7$ Hz, 1H), 4.72 (dd, $J = 7.0, 2.35$ Hz, 1H), 4.62 (d, $J = 7.0$ Hz, 1H), 4.22 (dt, $J = 8.2, 1.9$ Hz, 1H), 3.83-4.01 (m, 2H), 3.67 (t, $J = 5.8$ Hz, 2H), 3.46-3.54 (m, 1H), 3.39 (s, 3H), 2.23-2.36 (m, 2H), 1.68-1.84 (m, 6H), 1.45 (s, 3H), 1.40 (s, 3H), 1.29 (m, 8H), 0.91 (s, 9H), 0.89 (t, $J = 6.8$ Hz, 3H), 0.12 (s, 3H), 0.09 (s, 3H); ^{13}C NMR (75 MHz, CDCl_3): δ 131.7, 128.2, 109.5, 81.6, 80.9, 72.4, 71.0, 69.6, 63.4, 55.6, 55.2, 35.4, 30.8, 30.0, 28.8, 27.2, 26.4, 25.3, 24.1, 22.6, 18.1, 13.9, -4.5, -5.2. Anal. Calcd. for $\text{C}_{27}\text{H}_{54}\text{O}_6\text{Si}$ (502.78): C, 64.50; H, 10.83, Found C, 64.11; H, 10.24.

3-{5-[4-(*tert*-Butyldimethylsilanyloxy)-5-methoxymethoxy-undec-1-enyl]-2,2-

dimethyl-[1,3]dioxolan-4-yl}-propionic acid (24): A solution of oxalyl chloride (0.121 g, 0.083 mL, 0.95 mmol) in dry CH_2Cl_2 (20 mL) at -78°C was added dropwise dry DMSO (0.149 g, 0.135 mL, 1.90 mmol) in CH_2Cl_2 (5 mL). After 30 min, alcohol **23** (320 mg, 0.64 mmol) in CH_2Cl_2 (5 mL) was added over 10 min giving a copious white precipitate. After stirring for 1 h at -78°C the reaction mixture was brought to -60°C and Et_3N (0.254 g, 0.35 mL, 2.51 mmol) was added slowly and stirred for 30 min allowing the reaction mixture to warm to room temperature. The reaction mixture was poured into water (50 mL) and the organic layer was separated. The aqueous layer was extracted with CH_2Cl_2 (2 x 25 mL) and combined organic layers were washed with water (3 x 20 mL), brine (20 mL), dried (Na_2SO_4) and passed through short pad of silica gel. The filtrate was concentrated to give the aldehyde (302 mg) as pale yellow syrup, which was used as such for the next step without further purification.

A solution of 79% NaClO₂ (81mg, 0.90 mmol) in 1.0 mL of water was added dropwise to a stirred solution of above crude aldehyde (302 mg, 0.60 mmol) in 0.5 mL of DMSO and NaH₂PO₄ (54 mg, 0.45 mmol) in 1.0 mL of water in 5 min at room temperature. The mixture was left overnight at room temperature, then 5% aqueous solution of NaHCO₃ was added. The aqueous phase was extracted 3 times with CH₂Cl₂ and washed with brine, dried (Na₂SO₄), and concentrated. Silica gel column chromatography of the crude product using petroleum ether/EtOAc (6:4) as eluent gave the acid **24** (268 mg, 86%) as a yellow syrupy liquid. $[\alpha]_D^{25} +8.9$ (*c* 0.7, CHCl₃); IR (CHCl₃): $\nu_{\max}$ 3251, 1685, 1512, 1461, 1220; ¹H NMR (200 MHz, CDCl₃): δ 5.42-5.51 (m, 1H), 5.31 (dd, *J* = 15.8, 7.5 Hz, 1H), 4.82 (d, *J* = 6.2 Hz, 1H), 4.73 (d, *J* = 6.2 Hz, 1H), 4.29 (dt, *J* = 8.4, 2.1 Hz, 1H), 3.81-4.04 (m, 2H), 3.41-3.52 (m, 1H), 3.40 (s, 3H), 2.28 (t, *J* = 7.5 Hz, 2H), 2.12-2.43 (m, 2H), 1.72-1.88 (m, 4H), 1.44 (s, 6H), 1.21-1.38 (m, 8H), 0.92 (s, 9H), 0.89 (t, *J* = 6.6 Hz, 3H), 0.09 (s, 3H), 0.06 (s, 3H); ¹³C NMR (75 MHz, CDCl₃): δ 176.1, 131.8, 124.3, 109.3, 97.8, 81.4, 80.6, 72.5, 71.0, 70.7, 69.4, 55.7, 55.2, 30.7, 30.3, 29.2, 29.0, 27.1, 26.2, 25.8, 25.2, 24.5, 22.5, 18.1, 14.0, -4.2, -4.7. Anal. Calcd. for C₂₇H₅₂O₇Si (516.77): C, 62.75; H, 10.14, Found C, 62.32; H, 10.24.

8-(1-Methoxymethoxyheptyl)-2,2-dimethyl-3a,4,5,8,9,11a-hexahydro-1,3,7-trioxacyclopentacyclodecen-6-one (26): Compound **24** (200 mg, 0.39 mmol) was dissolved in THF (5 mL), followed by the dropwise addition of TBAF (0.58 mL, 1M solution in THF, 0.58 mmol). The reaction mixture was stirred at room temperature for overnight and the reaction mixture was quenched by addition of water, and aqueous layer was extracted with EtOAc (3 x 30 mL) and combined EtOAc extracts were washed with brine, dried

(Na₂SO₄), and concentrated to give the crude product **25**, which was used in the next step without further purification.

To a solution of above crude product **25** (155 mg, 0.39 mmol) in THF (4 mL) were added Et₃N (0.13 mL, 0.93 mmol), and 2,4,6-trichlorobenzoyl chloride (0.234 g, 0.96 mmol) and the reaction mixture was stirred for 2 h at room temperature under argon atmosphere and then diluted with benzene (150 mL). The resulting reaction mixture was added drop wise to a solution of DMAP (352 mg, 2.88 mmol) in benzene (20 mL) at 80 °C over 1 h and the mixture was stirred for additional 1 h under reflux. The reaction mixture was washed with saturated aqueous citric acid solution and brine. The organic layer was dried over Na₂SO₄ and concentrated. Silica gel column chromatography of the crude product using petroleum ether/EtOAc (8:2) as eluent gave compound **26** (128 mg, 86% from **24**) as a yellow syrupy liquid. [α]_D²⁵ -18.6 (*c* 0.8, CHCl₃); [lit.³ -18.1 (*c* 0.6, CHCl₃)]. IR (CHCl₃): ν_{max} 2955, 2932, 2888, 1732, 1452, 1372, 1238, 1167, 1038, 918, 876, 804 cm⁻¹; ¹H NMR (500 MHz, CDCl₃): δ 5.78 (ddd, *J* = 15.8, 11.6, 4.8 Hz, 1H), 5.35 (dd, *J* = 15.9, 9.5 Hz, 1H), 4.95 (ddd, *J* = 8.8, 3.9, 2.6 Hz, 1H), 4.68 (m, 2H), 3.95 (t, *J* = 8.8 Hz, 1H), 3.64 (m, 2H), 3.44 (s, 3H), 2.26-2.62 (m, 4H), 1.98-2.08 (m, 2H), 1.61 (m, 2H), 1.44 (s, 6H), 1.22-1.36 (m, 8H), 0.89 (t, *J* = 7.0 Hz, 3H); ¹³C NMR (125 MHz, CDCl₃): δ 171.8, 130.2, 129.6, 108.9, 96.6, 84.6, 79.9, 79.4, 73.6, 56.1, 34.4, 31.8, 30.8, 30.4, 29.5, 27.2, 26.8, 25.6, 25.3, 22.6, 14.1.

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