Stereocontrolled Assembly of the C3/C3' Dideoxy Core of Lomaiviticin A/B and Congeners

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Supplementary Material

General Methods: Unless indicated, all commercial reagents were used as received without further purification. All non-aqueous reactions were carried out under an argon atmosphere using glassware that had been dried overnight at 120 °C and cooled to room temperature under an argon atmosphere. Tetrahydrofuran was distilled over Na/benzophenone, while dichloromethane, toluene, diethyl ether and dimethylformamide were dried using an MBRAUN-SPS solvent drying system. Benzene was distilled from calcium hydride and stored over 4 Å molecular sieves. All solvents were determined to contain less than 50 ppm water by Karl Fisher coulometric moisture analysis. Reactions were monitored by thin-layer chromatography (TLC) using 0.25-mm E. Merck pre-coated silica gel plates. Visualization was accomplished with UV light and aqueous ceric ammonium molybdate solution or potassium permanganate stain followed by charring on a hot-plate. Flash chromatography was performed using silica gel 60 (particle size 230-400 mesh) with the indicated solvent system. Yields refer to chromatographically and spectroscopically pure compounds unless otherwise stated. Proton nuclear magnetic resonance (^{1}H NMR) spectra and carbon-13 (^{13}C NMR) spectra were recorded on a 300, 400 or 500, 600 MHz spectrometer at ambient temperature. ^{1}H and ^{13}C NMR data are reported as δ values relative to tetramethylsilane δ 0 ppm or residual non-deuterated solvent δ 7.26 ppm for $CHCl_3$, δ 7.15 ppm for C_6D_6, δ 2.04 for $(CD_3)_2CO$. For ^{13}C spectra, chemical shifts are reported relative to the δ 77.23 ppm resonance of $CDCl_3$ or the δ 128.39 resonance of C_6D_6. Infrared (IR) spectra were recorded as thin films or solutions in the indicated solvent. Optical rotations were measured on a Perkin-Elmer 341 digital polarimeter at ambient temperature. Mass spectra were obtained at the Laboratory for Biological Mass Spectrometry (Texas A&M University).

5[1]: To a solution of **4** (2.0 g, 11.9 mmol) in pyridine/CH_2Cl_2 (1:2, 37.5 mL) at 0°C was added a solution of iodine (7.55 g, 29.7 mmol) in pyridine/CH_2Cl_2 (1:1, 25.0 mL) slowly over a period of 3 h. Upon complete addition, DMAP (0.29 g, 2.38 mmol) was added and the ice bath was removed. After 3 H the reaction mixture was diluted with Et_2O (500 mL), washed with water (100 mL), 1 N HCl (2 x 100 mL), water (100 mL), 20% $Na_2S_2O_3$ (100 mL), and brine. The organic layer was dried (Na_2SO_4) and concentrated *in vacuo*. The residue was subjected to flash chromatography (2:1, hexanes/EtOAc) to afford iodoenone **5** (2.2 g, 63%; 74% BRSM) as a pale yellow solid. The ^1H and ^{13}C data for the prepared compounds are fully consistent with those reported in the literature.[1]

6:To a suspension of NaH (544 mg, 13.6 mmol, 60% in mineral oil, washed with hexanes prior to use) in toluene (50.0 mL) were added $NiCl_2(PPh_3)_2$ (556 mg, 0.850 mmol), PPh_3 (446 mg, 1.70 mmol), zinc dust (333 mg, 5.10 mmol) and **5** (500 mg, 1.70 mmol) simultaneously. The mixture was immediately evacuated and flushed with Ar (4 x). The reaction mixture was placed in 88ºC oil bath. After 4 h the oil bath was removed and the mixture was cooled to 0ºC by ice bath. A solution of 1 N HCl (2 mL) was added to reaction mixture. The organic layer was separated and the aqueous layer was extracted with CH_2Cl_2 (3 x 30 mL). The combined organic extracts were washed with brine (30 mL) and dried (Na_2SO_4). The solvent was concentrated *in vacuo* and the residue was subjected to flash chromatography (1:1, hexanes/EtOAc) to give dimer **6** (182 mg, 64%) as a white solid: $[\alpha]_D^{20}$ –48.7° (c 1.0, $CHCl_3$); IR (neat) ν 1684, 1230, 1060, 1040 cm^{-1}; ^1H NMR (300 MHz, $CDCl_3$) δ 6.46 (t, *J* = 2.1 Hz, 2H), 4.84-4.75 (m, 2H), 4.72-4.65 (m, 2H), 2.99-2.80 (m, 4H), 1.37 (s, 12H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 193.2, 142.6, 135.7, 109.6, 73.6, 71.0, 39.3, 27.7, 26.3; HRMS (ESI) calcd for $C_{18}H_{22}O_6Li$ $[(M+Li)^+]$ 341.1576, found 341.1582.

7: To a suspension of CuCN (429 mg, 4.78 mmol) in Et_2O (8.0 mL) at –78ºC was added vinyllithium[2] (9.6 mL, 1.0 M in Et_2O) slowly. After 10 min the reaction mixture was warmed to –40ºC at which point THF (3.0 mL) was added, followed by addition of the solution of ketone **6** (160 mg, 0.478 mmol) in THF (5.0 mL) dropwise. After 20 min the mixture was warmed to –30ºC and saturated NH_4Cl solution was added. The cold bath was removed and the solution was extracted with CH_2Cl_2 (3 x 15 mL). The combined organic layers were washed with brine (20 mL) and dried (Na_2SO_4). The solvent was removed *in vacuo* and the residue was subjected to

flash chromatography (hexanes/EtOAc, 2:1) to give ketone **7** (130 mg, 70%) as a pale yellow thick oil: $[\alpha]_D^{20}$ –175.5° (c 0.98, $CHCl_3$); IR (neat) ν 1712, 1264, 1212, 1058 cm^{-1}; ^1H NMR (300 MHz, $CDCl_3$) δ 5.52-5.37 (m, 2H), 5.31-5.19 (m, 4H), 4.37 (q, *J* = 7.2 Hz, 2H), 4.04 (dd, *J* = 7.2, 9.6 Hz, 2H), 3.05 (dd, *J* = 9.6, 21.6 Hz, 2H), 2.75 (d, *J* = 7.2 Hz, 4H), 2.39 (d, *J* = 12.0 Hz, 2H), 1.48 (s, 6H), 1.32 (s, 6H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 208.8, 137.0, 120.1, 109.2, 77.8, 71.1, 48.3, 46.5, 43.9, 27.3, 24.6; HRMS (ESI) calcd for $C_{22}H_{30}O_6Li$ $[(M+Li)^+]$ 397.2202, found 397.2200.

8: A mixture of **7** (50 mg, 0.13 mmol) and 10% Pd/C (20 mg) in EtOAc (10.0 mL) was applied to the atmosphere of H_2. After 2 h the suspension was filtered through the celite pad. The solvent was concentrated *in vacuo* and the residue was subjected to flash chromatography (2:1, hexanes/EtOAc) to give ketone **8** (43 mg, 85%) as a colorless thick oil: $[\alpha]_D^{20}$ –73.4° (c 2.23, $CHCl_3$); IR (neat) ν 1711, 1378, 1244, 1168, 1052 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 4.42 (q, *J* = 6.4 Hz, 2H), 4.15 (dd, *J* = 6.4, 7.6 Hz, 2H), 2.69 (dq, *J* = 6.4, 15.2 Hz, 4H), 2.58-2.48 (m, 2H), 2.38 (d, *J* = 9.2 Hz, 2H), 1.79-1.67 (m, 2H), 1.50-1.38 (m, 2H), 1.43 (s, 6H), 1.32 (s, 6H), 0.94 (t, *J* = 7.2 Hz, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 209.6, 109.3, 76.8, 73.2, 48.2, 43.9, 39.6, 27.5, 25.3, 23.5, 10.3; HRMS (ESI) calcd for $C_{22}H_{34}O_6Li$ $[(M+Li)^+]$ 401.2515, found 401.2527.

9: To a solution of ketone **7** (50 mg, 0.13 mmol) in benzene (10 mL) at 0ºC was added DBU (98 mg, 0.65 mmol) dropwise. After 24 h the reaction mixture was diluted with EtOAc (60 mL), washed with 1 N HCl (30 mL), water, and brine. The organic layer was dried (Na_2SO_4). The solvent was removed *in vacuo*, and the residue was subjected to flash chromatography (EtOAc) to give enone **9** (19 mg, 56%) as a colorless thick oil: $[\alpha]_D^{20}$ –162.8° (c 0.65, $CHCl_3$); IR (neat) ν 3408 (br), 1667, 1056, 924 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 6.91 (d, *J* = 10.8 Hz, 1H), 6.89 (d, *J* = 10.0 Hz, 1H), 6.00 (dd, *J* = 2.0, 10.0 Hz, 1H), 5.94 (dd, *J* = 2.0, 10.4 Hz, 1H), 5.61-5.48 (m, 2H), 5.40-5.20 (m, 4H), 4.32 (d, *J* = 9.2 Hz, 1H), 4.25 (d, *J* = 9.6 Hz, 1H), 3.59 (d, *J* = 12.4 Hz, 1H), 3.33 (q, *J* = 10.0 Hz, 1H), 2.74 (q, *J* = 10.0 Hz, 1H), 2.44 (d, *J* = 12.0 Hz, 1H), 2.16 (s, 1H), 2.06 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 197.8, 150.8, 150.4, 137.0, 136.9, 128.9, 128.2, 122.2, 121.3, 70.4, 69.4, 54.8, 51.6, 48.2, 46.2; HRMS (ESI) calcd for $C_{16}H_{19}O_4$ $[(M+H)^+]$ 275.1283, found 275.1288.

10: To a solution of ketone **8** (34 mg, 0.086 mmol) in THF (10 mL) at 0ºC was added freshly prepared aqueous solution of NaOH (0.20 mL, 0.5 M, 0.10 mmol) dropwise. The ice bath was removed. After 24 h water (20 mL) was added and the mixture was extracted with EtOAc (3 x 25 mL). The combined organic layers were washed with brine and dried (Na_2SO_4). The solvent was removed *in vacuo* and the residue was subjected to flash chromatography (1:1, hexanes/EtOAc) to give ketone **10** (22 mg, 76%).

Ketone **10** was also prepared by the treatment of **8** with DBU: To a solution of ketone **8** (10 mg, 0.025 mmol) in benzene (3.0 mL) at 0ºC was added the solution of DBU (8.5 mg, 0.056 mmol) in benzene (1.0 mL) dropwise. After 4 h the reaction mixture was directly subjected to flash chromatography (1:1, hexanes/EtOAc) to give ketone **10** (4.2 mg, 49%) as a thick oil: $[\alpha]_D^{20}$ -12.1° (c 1.20, $CHCl_3$); IR (neat) ν 1717, 1177, 1094, 1003 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 4.63 (quint, *J* = 2.4 Hz, 1H), 4.35 (d, *J* = 6.0 Hz, 1H), 4.28 (dt, *J* = 1.6, 4.8 Hz, 1H), 3.84 (dd, *J* = 4.8, 9.2 Hz, 1H), 2.79 (dd, *J* = 3.2, 19.2 Hz, 1H), 2.74 (quint, *J* = 2.4 Hz, 1H), 2.39 (dd, *J* = 1.6, 19.2 Hz, 1H), 2.32 (dd, *J* = 1.6, 16.0 Hz, 1H), 2.18 (t, *J* = 8.8 Hz, 1H), 2.13 (dd, *J* = 4.8, 15.6 Hz, 1H), 1.80-1.66 (m, 3H), 1.65-1.55 (m, 1H), 1.43 (s, 3H), 1.30 (s, 3H), 1,37-1.27 (m, 1H), 1.17-1.05 (m, 1H), 0.92 (t, *J* = 7.6 Hz, 3H), 0.81 (t, *J* = 7.6 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 211.1, 108.6, 106.4, 75.8, 73.6, 73.4, 72.5, 50.6, 44.9, 43.6, 41.0, 38.5, 33.3, 28.6, 26.2, 23.6, 17.7, 12.0, 7.5; HRMS (ESI) calcd for $C_{19}H_{28}O_5Li$ $[(M+Li)^+]$ 343.2097, found 343.2092.

11: To a solution of enone **6** (200 mg, 0.598 mmol) and allyltributyltin (792 mg, 2.39 mmol) in CH_2Cl_2 (20.0 mL) at –78ºC was added TBSOTf (632 mg, 2.39 mmol) dropwise. After 4 h the 5% aqueous solution of $NaHCO_3$ was added and the cold bath was removed. The organic layer was separated and the aqueous layer was extracted with CH_2Cl_2 (3 x 30 mL). The combined organic extracts were washed with brine and dried (Na_2SO_4). The solvent was concentrated *in vacuo* and the residue was subjected to flash chromatography (10:1, hexanes/EtOAc) to give silylenol ether **11** (375 mg, 97%) as colorless, thick oil: $[\alpha]_D^{20}$ $+30.6^{\circ}$ (c 1.06, $CHCl_3$); IR (neat) ν 2931, 1373, 1246, 1200, 1043, 835, 777 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 5.84-5.71 (m, 2H), 5.02-4.94 (m, 4H), 4.50-4.43 (m, 2H), 4.25 (d, *J* = 6.8 Hz, 2H), 2.44 (dd, *J* = 4.8, 16.0 Hz, 4H), 2.25 (d, *J* = 14.8 Hz, 4H), 1.88 (q, *J* = 11.6 Hz, 2H), 1.34 (s, 6H), 1.26 (s, 6H), 0.86 (s, 18H), 0.14 (s, 6H),

0.12 (s, 6H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 142.0, 137.8, 115.8, 112.1, 107.3, 74.6, 74.0, 40.1, 34.6, 33.5, 26.4, 26.1, 24.2, 18.1, –2.5, –3.4; HRMS (ESI) calcd for $C_{36}H_{62}O_6Si_2Li$ [$(M+Li)^+$] 653.4245, found 653.4222.

12: A mixture of **11** (430 mg, 0.665 mmol) and 10% Pd/C (150 mg) in EtOAc (30.0 mL) was applied to the atmosphere of H_2. After 2 h the suspension was filtered through celite pad. The solvent was removed *in vacuo* and the residue was subjected to flash chromatography (10:1, hexanes/EtOAc) to give silylenol ether **12** (420 mg, 97%) as a white solid: $[\alpha]_D^{20}$ +30.4° (c 1.04, $CHCl_3$); IR (neat) ν 1370, 1245, 1203, 1046, 901, 773 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 4.53-4.41 (m, 2H), 4.33-4.20 (m, 2H), 2.44 (dd, *J* = 5.2, 16.8 Hz, 2H), 2.35-2.28 (m, 2H), 2.20 (dd, *J* = 1.6, 16.4 Hz, 2H), 1.47-1.21 (m, 6H), 1.34 (s, 6H), 1.28 (s, 6H), 1.17-1.07 (m, 2H), 0.83 (t, *J* = 6.8 Hz, 6H), 0.85 (s, 18H), 0.13 (s, 6H), 0.12 (s, 6H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 141.0, 113.0, 107.1, 75.4, 74.1, 40.3, 33.4, 32.7, 26.2, 26.1, 24.1, 21.5, 18.1, 14.3, –2.4, –3.5; HRMS (ESI) calcd for $C_{36}H_{66}O_6Si_2Na$ [$(M+Na)^+$] 673.4290, found 673.4283.

14: To a solution of enol ether **12** (200 mg, 0.31 mmol) in THF (16 mL) at 0ºC was added TBAF (0.92 mL, 1.0 M in THF) dropwise. After 1 h H_2O (15 mL) was added to the reaction mixture. The organic layer was separated and the aqueous layer was extracted with EtOAc (5x 25 mL). The combined organic layers were washed with brine (30 mL) and dried (Na_2SO_4). The solvent was removed *in vacuo* and the residue was subjected to flash chromatography (EtOAc) to give diol **13** (62 mg) which was taken to the next step.

To a solution of diol **13** (62 mg, 0.20 mmol) and pyridine (80 mg, 1.0 mmol) in CH_2Cl_2 (12.0 mL) at 0ºC were added Ac_2O (103 mg, 1.0 mmol), DMAP (cat). The ice bath was removed. After 2 h the solution of 1 N HCl (20 mL) was added to the reaction mixture. The organic layer was separated and the aqueous layer was extracted with CH_2Cl_2 (3 x 25 mL). The combined organic layers were dried (Na_2SO_4). The solvent was removed *in vacuo* and the residue was subjected to flash chromatography (3:1, hexanes/EtOAc) to give bis-acetate **14** (59 mg, 50% for two steps) as a thick oil: $[\alpha]_D^{20}$ –141.4° (c 0.73, $CHCl_3$); IR (neat) ν 1739, 1674, 1231, 1028 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.67 (dd, *J* = 2.4, 10.4 Hz, 2H), 6.00 (dd, *J* = 2.4, 10.4 Hz, 2H), 5.51 (td, *J* = 2.4, 9.6 Hz, 2H), 2.93-2.82 (m, 2H), 2.73-2.62 (m, 2H), 2.12 (s, 6H), 1.51-1.40 (m,

2H), 1.36-1.18 (m, 6H), 0.86 (t, J = 6.8 Hz, 6H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 198.8, 170.5, 146.6, 129.8, 71.6, 47.9, 42.3, 31.6, 21.0, 18.8, 14.4; HRMS (ESI) calcd for $C_{22}H_{30}O_6Li$ [$(M+Li)^+$] 397.2202, found 397.2195.

15: To a solution of enone **14** (59 mg, 0.15 mmol) in pyridine-CH_2Cl_2 (1:2, 3.0 mL) at RT was added the solution of iodine (192 mg, 0.756 mmol) in pyridine-CH_2Cl_2 (1:1, 4.0 mL) dropwise. Upon complete addition, DMAP (cat.) was added. After 24 h the reaction mixture was diluted with Et_2O (100 mL), washed with water (30 mL), 1 N HCl (2 x 30 mL), water (30 mL), 20% $Na_2S_2O_3$ (30 mL), and brine (30 mL). The organic layer was dried (Na_2SO_4) and concentrated *in vacuo*. The residue was subjected to flash chromatography (3:1, hexanes/EtOAc) to afford iodoenone **15** (61 mg, 63%) as white solids: $[\alpha]_D^{20}$ –140.2° (c 1.29, $CHCl_3$); IR (neat) ν 1739, 1686, 1227, 1031, 737 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.44 (d, J = 2.4 Hz, 2H), 5.45 (dd, J = 2.4, 9.6 Hz, 2H), 3.01-2.86 (m, 2H), 2.85-2.71 (m, 2H), 2.12 (s, 6H), 1.52-1.42 (m, 2H), 1.34-1.13 (m, 6H), 0.86 (t, J = 6.8 Hz, 6H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 191.8, 170.3, 155.3, 104.3, 72.9, 46.8, 42.4, 31.1, 20.8, 18.4, 14.3; HRMS (ESI) calcd for $C_{22}H_{28}I_2O_6Li$ [$(M+Li)^+$] 649.0135, found 649.0105.

17: To a solution of **11** (100 mg, 0.15 mmol) in t-BuOH/H_2O (2:1, 22.5 mL) were added OsO_4 (0.002 mg, 0.0093 mmol), NMO (42.0 mg, 0.31 mmol). After 24 h the solution was transferred to the mixture of Na_2SO_3 (20 %) and ethyl acetate (1:1, 20 mL). The organic layer was separated and the aqueous layer was extracted with EtOAc (4 x 20 mL). The organic layers were combined and dried ($MgSO_4$). The solvent was concentrated *in vacuo*.

The crude residue was dissolved in dichloroethane (10 mL) and $Pb(OAc)_4$ (0.14 g, 0.32 mmol) was added. After 30 min the solution was diluted with Et_2O (20 ml). The organic layer was washed with $NaHCO_3$ (15 ml), brine (15ml), dried ($MgSO_4$). The solvent was concentrated *in vacuo* to provide the crude residue - aldehyde **16** that was taken to the next step.

To a solution of **16** in EtOH (10 ml) at 0°C was added $NaBH_4$ (12 mg, 0.31 mmol). After 30 min at 0°C MeOH was added to the reaction mixture and the ice bath was removed. The solvent was evaporated *in vacuo*. The residue was purified by flash chromatography (1:1, hexanes/EtOAc) to provide the alcohol **17** (76 mg, 75% over three steps) as a thick oil: $[\alpha]_D^{20}$ -18.6º (c 0.01, $CHCl_3$);

IR (neat) ν 3424, 2930, 2856, 1652, 1464 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 4.50 (t, *J* = 6.1 Hz, 2 H), 4.30 (d, *J* = 5.5 Hz, 2 H), 3.79 – 3.65 (m, 2 H), 3.62 – 3.51 (m, 2 H), 3.07 – 2.96 (m, 2 H), 2.94 – 2.86 (m, 2 H), 2.55 (dd, *J* = 16.8 Hz, *J* = 6 Hz , 2 H), 2.29 (d, *J* = 16.8 Hz, 2 H), 1.60 – 1.50 (m, 4 H), 1.49 (s, 6 H), 1.36 (s, 6 H), 0.88 (s, 18 H), 0.21 (s, 6 H), 0.19 (s, 6 H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 142.8, 110.8, 107.6, 77.6, 73.9, 59.7, 34.5, 34.4, 33.7, 26.1, 25.9, 24.0, 18.0, -2.2, -3.1; HRMS (ESI) calcd for $C_{34}H_{63}O_8Si_2$ $[(M+H)^+]$ 655.4062, found 655.4037.

18: To a solution of **17** (200 mg, 0.30 mmol) in dichloromethane (10 mL) at 0°C was added Et_3N (106 mg, 1.05 mmol), MsCl (0.90, 100 mg). After 30 min H_2O (2 mL) was added. The ice bath was removed. The aqueous layer was extracted with dichloromethane (3 x 15 mL).The combined organic layers were dried ($MgSO_4$). The solvent was concentrated *in vacuo*. The residue was purified by flash chromatography (1:1, hexanes/EtOAc) to provide the title compound **18** (210 mg, 86 %) as a thick oil: $[\alpha]_D^{20}$ -14.6º (0.01, $CHCl_3$); IR (neat) ν 2925, 2851, 1356, 1259 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 4.47 – 4.33 (m, 4 H), 4.29 (ddd, *J* = 16.9 Hz, *J* = 9.6 Hz, *J* = 7.24 Hz, 2 H), 4.22 – 4.08 (m, 2 H), 2.97 (s, 6 H), 2.62 – 2.43 (m, 2 H), 2.38 – 2.23 (m, 4 H), 2.07 – 1.96 (m, 2 H), 1.8 – 1.65 (m, 2 H), 1.41 (s, 6 H), 1.30 (s, 6 H), 0.87 (s, 18 H), 0.14 (s, 6 H), 0.12 (s, 6 H) ; ^{13}C NMR (100 MHz, $CDCl_3$) δ 143.6, 110.8, 108.1, 80.1, 73.4, 69.2, 37.8, 37.2, 34.0, 30.6, 26.7, 25.8, 24.2, 17.9, -2.6, -3.4; HRMS (ESI) calcd for $C_{36}H_{66}O_{12}Si_2S_2Na$ $[(M+Na)^+]$ 833.3432, found 833.3422.

19: To a solution of **18** (193 mg, 0.24 mmol) in acetone (39 mL) were added NaI (572 mg, 3.82 mmol), $NaHCO_3$ (320 mg, 3.82 mmol). The reaction mixture was placed in 50ºC oil bath. After 24 h the oil bath was removed. The mixture was diluted with dichloromethane (50 mL) and washed with H_2O (20 mL) and brine (20 mL). The organic layer was dried ($MgSO_4$). The solvent was concentrated *in vacuo*. The residue was purified by flash chromatography (9:1, hexanes/EtOAc) to provide the title compound **19** (142 mg, 67 %) as a thick, yellow oil: $[\alpha]_D^{20}$ +1.74º (0.01, $CHCl_3$); IR (neat): ν 2954, 2922, 2852, 1658, 1462 cm^{-3}; ^1H NMR (400 MHz, $CDCl_3$): δ 5.02 – 4.42 (m, 2 H), 4.28 – 4.18 (m, 2 H), 3.33 – 3.05 (m, 4 H), 2.53 – 2.33 (m, 4 H), 2.30 (dd, *J* = 16.4 Hz, *J* = 2.4 Hz, 2 H), 2.12 – 1.99 (m, 2 H), 1.91 – 1.78 (m, 2 H), 1.41 (s, 6 H),

1.32 (s, 6 H), 0.90 (s, 18 H), 0.19 (s, 6 H), 0.18 (s, 6 H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 142.8, 110.7, 107.5, 75.5, 73.6, 42.3, 36.2, 33.4, 26.5, 26.0, 25.6, 18.0, 4.4, -2.3, -3.4; HRMS (ESI) calcd for $C_{34}H_{61}I_2O_6Si_2$ [(M+H)] 875.2096, found 875.2088.

20: To a solution of **19** (112 mg, 0.13 mmol) in EtOH (54 mL) were added Et_3N (28 mg, 0.30 mmol), 5 % Pd/C (60 mg). The reaction mixture was applied to the atmosphere of H_2 and placed in 40ºC oil bath. After 24 h the oil bath was removed. The solution was filtrated through the celite pad. The solvent was concentrated *in vacuo*. The residue was purified by flash chromatography (9:1, hexanes/ EtOAc) to provide the title compound **20** (81 mg, 95 %) as a white solid: $[\alpha]_D^{20}$ +34.0º (c 0.03, $CHCl_3$); IR (neat) ν 2956, 2927, 2857, 1376, 1253 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 4.55 - 4.40 (m, 2 H), 4.35 - 4.23 (m, 2H), 2.44 (dd, *J* = 5.2 Hz, *J* = 16.4 Hz, 2 H), 2.29 – 2.20 (m, 4 H), 1.54 – 1.43 (m, 4 H), 1.37 (s, 6 H), 1.31 (s, 6H), 0.95 (t, *J* = 7.36, 6 H), 0.88 (s, 18 H), 0.15 (s, 6 H), 0.14 (s, 6 H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 141.1, 113.1, 107.2, 75.2, 74.2, 42.1, 33.4, 26.2, 26.0, 24.1, 23.1, 18.1, 12.8, -2.5, -3.5; HRMS (ESI) calcd for $C_{34}H_{63}O_6Si_2$ [$(M+H)^+$] 623.4160, found 623.4163.

21: To a solution of **20** (18 mg, 0.03 mmol) in THF (1.8 mL) at 0ºC was added TBAF (0.09 mmol, 1.0 M in THF) dropwise. After 30 min H_2O (1 mL) was added to the reaction mixture. The organic layer was separated and the aqueous layer was extracted with EtOAc (4 x 5 mL). The combined organic layers were dried ($MgSO_4$). The solvent was removed *in vacuo*. The residue was purified by flash chromatography (EtOAc) to give diol **21** (5.4 mg) which was taken to the next step.

22: To a solution of **21** (8.7 mg, 0.03 mmol) and pyridine (12.3 mg, 0.16 mmol) in CH_2Cl_2 (3 mL) at 0ºC was added Ac_2O (16 mg, 0.16 mmol), DMAP (cat). The ice bath was removed. After 30 min the reaction mixture was cooled to 0ºC by ice bath and the solution of 1 N HCl (0.2 mL) was added. The organic layer was separated and the aqueous layer was extracted with CH_2Cl_2 (3 x 5 mL). The combined organic layers were dried ($MgSO_4$). The solvent was concentrated *in vacuo* and the residue was purified by flash chromatography (2:1, hexanes/EtOAc) to provide enone **22** (8.6 mg, 76 %) as a white solid: $[\alpha]_D^{20}$ -30.7º (0.01, $CHCl_3$); IR (neat) ν 1738, 1675, 1371, 1231 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.71 (dd, *J* = 2.0 Hz, *J* = 10.4, 2H), 6.02 (dd, *J* =

2.4, 10.4 Hz, 2H), 5.58 (d, *J* = 10 Hz, 2 H), 2.94 (s, 2 H), 2.73 (d, *J* = 9.2 Hz, 2 H) 2.14 (s, 6 H) 1.63-1.58 (m, 2H), 1.44-1.41 (m, 2H), 0.91 (t, *J* = 7.6 Hz, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.6, 170.5, 146.9, 129.8, 71.0, 46.8, 43.1, 21.2, 20.9, 9.5; HRMS (ESI) calcd for $C_{20}H_{26}O_6Na$ [$(M+Na)^+$] 385.1627, found 385.1635.

23: To a solution of enone **22** (13 mg, 0.03 mmol) in pyridine-CH_2Cl_2 (1:2, 0.75 mL) at RT was added the solution of iodine (45 mg, 0.18 mmol) in pyridine-CH_2Cl_2 (1:1, 0.65 ml) dropwise. Upon complete addition, DMAP (cat.) was added. After 24 h the solution was diluted with Et_2O (10 mL), washed with water (5 mL), 1 N HCl (5 mL), water (10 mL), 20% $Na_2S_2O_3$ (2 x 5 mL), and brine (5 mL). The organic layer was dried ($MgSO_4$) and the solvent was concentrated *in vacuo*. The residue was subjected to flash chromatography (3:1, hexanes/EtOAc) to afford iodoenone **23** (14 mg, 73 %) as a white solid: $[\alpha]_D^{20}$ -22.2º (c 0.01, $CHCl_3$); IR (neat) ν 2919, 2850, 1739, 1686, 1462 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.47 (d, *J* = 2.28, 2 H), 5.51 (dd, *J* = 2.28, *J* = 9.96, 2 H), 3.09 - 2.97 (m, 2 H), 2.84 - 2.76 (m, 2 H), 2.14 (s, 6 H), 1.70 – 1.57 (m, 4 H), 1.46 – 1.35 (m, 4 H), 0.89 (t, *J* = 10.0 Hz, 6 H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 191.9, 170.3, 155.5, 104.3, 72.3, 45.9, 43.4, 29.7, 20.8, 9.2; HRMS (ESI) calcd for $C_{20}H_{24}O_6I_2Na$ [$(M+Na)^+$] 636.9560, found 636.9591.

24: To a solution of silylenol ether **11** (150 mg, 0.23 mmol) in CH_3OH (8.0 mL) at 0ºC was added PTSA (8.8 mg, 0.046 mmol). The ice bath was removed. After 6 h the mixture was directly subjected to flash chromatography (2:1, hexanes/EtOAc) to give intermediate tetrol **11a** (104 mg) as a thick oil.

To a solution of tetrol **11a** (104 mg, 0.18 mmol) and pyridine (145 mg, 1.83 mmol) in CH_2Cl_2 (8.0 mL) at 0ºC were added Ac_2O (187 mg, 1.83 mmol), DMAP (5 mg). The ice bath was removed. After 2.5 h the solution of 1 N HCl (25 mL) was added to reaction mixture. The organic layer was separated and the aqueous layer was extracted with EtOAc (3 x 25 mL). The combined organic layers were washed with 1 N HCl (25 mL), saturated $NaHCO_3$ (25 mL), brine (20 mL) and dried (Na_2SO_4). The solvent was removed *in vacuo* and the residue was subjected to flash chromatography (3:1, hexanes/EtOAc) to give silylenol ether **24** (115 mg, 74% for two steps) as a thick oil: $[\alpha]_D^{20}$ –21.1° (c 0.35, $CHCl_3$); IR (neat) ν 1744, 1229, 1037, 837 cm^{-1}; ^{1}H NMR (300

MHz, $CDCl_3$) δ 5.88-5.68 (m, 2H), 5.19-4.93 (m, 8H), 2.40 (d, *J* = 7.2 Hz, 4H), 2.37-2.18 (m, 4H), 2.01 (s, 6H), 1.98 (s, 6H), 1.95-1.81 (m, 2H), 0.87 (s, 18H), 0.15 (s, 6H), 0.06 (s, 6H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 170.3, 170.2, 142.5, 136.3, 116.4, 110.1, 71.0, 67.2, 39.3, 36.5, 32.6, 25.9, 21.0, 18.0, –2.9, –4.2; HRMS (ESI) calcd for $C_{38}H_{62}O_{10}Si_2Na$ [$(M+Na)^+$] 757.3774, found 757.3772.

25: To a suspension of silylenol ether **24** (40 mg, 0.056 mmol) in CH_3CN-H_2O (5:1, 6.0 mL) at 0ºC was added CAN (90 mg, 0.16 mmol). The ice bath was removed. After 6 h H_2O was added to reaction mixture. The organic layer was separated. The aqueous layer was extracted with EtOAc (3 x 30 mL). The combined organic layers were washed with brine and dried (Na_2SO_4). The solvent was removed *in vacuo* and the residue was subjected to flash chromatography (1:1, hexanes/EtOAc) to give diketone **25** (13 mg, 98%) as colorless, thick oil: $[\alpha]_D^{20}$ +46.5° (c 0.77, $CHCl_3$); IR (neat) ν 1744, 1691 (shoulder), 1230, 1038 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 5.85-5.74 (m, 2H), 5.42-5.34 (m, 4H), 5.18-5.08 (m, 4H), 3.29-3.23 (m, 2H), 2.85 (dd, *J* = 5.5, 14.0 Hz, 2H), 2.75-2.66 (m, 2H), 2.27 (td, *J* = 7.0, 14.0 Hz, 2H), 2.21-2.12 (m, 2H), 2.10 (s, 6H), 2.02 (s, 6H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 199.2, 169.6, 169.2, 140.8, 133.0, 118.6, 70.6, 66.5, 44.6, 42.5, 36.6, 21.0, 20.8; HRMS (ESI) calcd for $C_{26}H_{32}O_{10}Li$ [$(M+Li)^+$] 511.2156, found 511.2140.

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