Total Synthesis of (-)-Salicylihalamide A

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Supporting Information

General. NMR spectra were recorded at 400 MHz in $CDCl_3$ unless otherwise indicated. Chemical shifts are reported in δ and coupling constant in Hz. IR spectra are reported in cm^{-1}.

Preparation of (*S*)-2-Methyl-4-pentenal (8). A solution of *n*-BuLi in hexane (2.5 M, 59.8 mL, 149.5 mmol) was added to a solution of diisopropylamine (22.6 mL, 161.3 mmol) in THF 160 mL) at -78 ºC. The resulting solution was stirred at -78 ºC for 10 min, warmed to 0 ºC, and held at that temperature for 10 min. Borane-ammonia complex (90%, 5.27 g, 153.6 mmol) was added, and the suspension was stirred at 0 ºC for 15 min, warmed to room temperature, stirred for 15 min, and recooled to 0 ºC. A solution of (2*S*)-*N*-[1*R*, 2*R*]-(2-hydroxy-1-methyl-2-phenylethyl)-*N*,2-dimethyl 4-pentenamide (**12**)[17] (9.99 g, 38.2 mmol) in THF (100 mL) was added over 3 min. The reaction mixture was warmed to room temperature, held at that temperature for 3 h, and then cooled to 0 ºC. Excess hydride was quenched by careful addition of 3 M HCl (385 mL). The mixture was stirred for 30 min at 0 ºC and then extracted with four 150-mL portions of ether. The combined organic extracts were washed sequentially with 3 M HCl, 2 M NaOH, and brine. The ether extracts were dried over $MgSO_4$ and concentrated. Purification of the residue by flash chromatography on silica gel (3:1 pentane/ether) afforded 3.78 g (99%) of (*S*)-2-methyl-4-penten-1-ol. Swern oxidation of the alcohol (3.78 g, mmol) as reported by Overman[18] gave 2.80 g (76%) of aldehyde **8** with spectral data identical to those previously reported.[18]

Preparation of 13. A mixture of $Cu(OTf)_2$ (98%, 36.9 mg, 0.1 mmol) and (*S*)-Tol-BINAP (75 mg, 0.11 mmol) in 20 mL of THF was stirred at room temperature under N_2 for 15 min to yield a clear yellow solution.[16] A solution of $Bu_4NPh_3SiF_2$ (97%, 111 mg, 0.2 mmol) in 5 mL of THF was added via cannula and the solution was stirred for 15 min. The mixture was cooled to

-78 ºC, and **7**[19] (0.64 mL, 3 mmol) was added dropwise. A solution of **8** (300 mg, 3 mmol) in 2 mL of THF was then added dropwise. The reaction mixture was stirred at -50 ºC for 15 h. Trifluoroacetic acid (2 mL) was added at -78 ºC and the solution was allowed to warm to 23 ºC. Stirring was continued for 1 h. The reaction mixture was diluted with ether and saturated aqueous $NaHCO_3$ was added dropwise until gas evolution ceased. The organic layer was washed with brine, dried over Na_2SO_4 and concentrated. Purification of the residue by flash chromatography on silica gel (3:1 hexane/EtOAc) afforded 504 mg (64%) of an inseparable 4.2:1 mixture of **13** and the diastereomer.

Data for **13** were determined from the mixture: ^{1}H NMR 5.79 (dddd, 1, *J* = 6.2, 7.2, 10.0, 17.1), 5.35 (s, 1), 5.05 (br dd, 1, *J* = 1.2, 17.1), 5.03 (br d, 1, *J* = 10.0), 3.75 (ddd, 1, *J* = 3.2, 6.0, 9.2), 2.43 (dd, 1, *J* = 3.2, 14.7), 2.30 (dd, 1, *J* = 9.2, 14.0), 2.32-2.21 (m, 1), 1.94 (ddd, 1, *J* = 6.2, 8.0, 14.0), 1.70 (s, 6), 1.70-1.59 (m, 1), 0.92 (d, 3, *J* = 6.4); ^{13}C NMR 170.3, 161.4, 136.6, 116.1, 106.4, 94.6, 71.9, 38.7, 38.1, 36.5, 25.1, 24.4, 14.9.

Partial data for the minor diastereomer were determined from the mixture: ^{1}H NMR 5.34 (s, 1), 3.86 (ddd, 1, *J* = 4.0, 5.6, 7.6), 2.37 (d, 2, *J* = 6.6); ^{13}C NMR 170.1, 94.5, 70.8, 38.8, 38.2, 37.4, 25.0, 24.5, 13.2.

Preparation of 14. A solution of the 4.2:1 mixture of **13** and the diastereomer (549 mg, 2.29 mmol) and absolute MeOH (205 μL, 5.06 mmol) in toluene (15 mL) was heated in a 100 ºC oil bath for 2.5 h and concentrated.[22] Flash chromatography of the residue on silica gel (4:1 hexane/EtOAc) afforded 415 mg (85%) of an inseparable 4.2:1 mixture of **14** and the diastereomer.

Data for **14** were determined from the mixture: ^{1}H NMR 5.78 (dddd, 1, *J* = 7.3, 7.3, 10.2, 17.1), 5.04 (br dd, 1, *J* = 1.2, 17.1), 5.02 (br d, 1, *J* = 10.2), 3.93 (ddd, 1, *J* = 3.0, 6.1, 9.1), 3.74 (s, 3), 3.53 (s, 2), 2.72 (dd, 1, *J* = 3.2, 17.2), 2.66 (dd, 1, *J* = 9.2, 17.2), 2.27 (ddd, 1, *J* = 6.8, 7.3, 14.0), 1.94 (ddd, 1, *J* = 7.3, 7.3, 14.0), 1.72-1.58 (m, 1), 0.89 (d, 3, *J* = 7.2); ^{13}C NMR 203.7, 167.3, 136.7, 116.2, 70.9, 52.2, 49.6, 46.3, 37.9, 36.7, 14.9.

Partial data for the diastereomer were determined from the mixture: ^{1}H NMR 4.05 (ddd, 1, *J* = 3.6, 3.6, 10.0), 2.72 (dd, 1, *J* = 9.2, 16.8), 2.66 (dd, 1, *J* = 3.6, 16.8), 0.91 (d, 3, *J* = 7.2); ^{13}C NMR 203.5, 136.8, 69.9, 49.5, 47.0, 37.8, 37.3, 13.7.

Preparation of Methyl (3*S*,5*S*,6*S*)-3,5-Dihydroxy-6-methyl-8-nonenoate. Diethylmethoxyborane[25] (98%, 269 mg, 2.64 mmol) was added dropwise to a solution of a 4.2:1 mixture of **14** and the diastereomer (512 mg, 2.39 mmol) in dry THF (19.2 mL) and anhydrous MeOH (4.8 mL) at -78 ºC under N_2. The resulting solution was stirred at that temperature for 15 min. $NaBH_4$ (99%, 101 mg, 2.64 mmol) was added and the mixture was stirred for 5 h at -78 ºC and quenched with acetic acid (2.4 mL). The mixture was diluted with EtOAc, washed with saturated aqueous $NaHCO_3$, dried over Na_2SO_4 and concentrated. The residue was azeotroped a few times with methanol until the hydrolysis of the boronate was complete. Purification of the residue by flash chromatography on silica gel (1:1 hexane/EtOAc) afforded 507 mg (98%) of an inseparable 4.2:1 mixture of the title compound and the diastereomer.

Data for the major diastereomer were determined from the mixture: ^{1}H NMR 5.80 (dddd, 1, *J* = 7.2, 7.4, 10.4, 17.1), 5.03 (br d, 1, *J* = 17.1), 5.01 (br d, 1, *J* = 10.4), 4.31-4.23 (m, 1), 3.75 (ddd, 1, *J* = 2.4, 5.6, 8.0), 3.72 (s, 3), 2.52 (d, 2, *J* = 6.8), 2.23 (ddd, 1, *J* = 6.0, 7.2, 14.0), 1.95 (ddd, 1, *J* = 7.2, 8.0, 14.0), 1.70-1.50 (m, 3), 0.90 (d, 3, *J* = 6.8).

Partial data for the minor diastereomer were determined from the mixture: ^{1}H NMR ($CDCl_3$) 3.85 (ddd, 1, *J* = 3.0, 3.0, 10.0), 0.87 (d, 3, *J* = 6.8).

Preparation of 15. A solution of the 4.2:1 mixture of diastereomeric diols (507 mg, 2.34 mmol) in CH_3CN (60 mL) containing 1.5 mL of aqueous 50% HF was stirred at room temperature for 2 h.[27] Saturated aqueous $NaHCO_3$ (15 mL) was added and the mixture was extracted with five portions of CH_2Cl_2. The combined organic layers were dried over Na_2SO_4 and concentrated. Purification of the residue by flash chromatography on silica gel (1:1 hexane/EtOAc) afforded 415 mg (96%) of an inseparable 4.2:1 mixture of **15** and the diastereomer.

Data for **15** were determined from the mixture: ^{1}H NMR 5.78 (dddd, 1, *J* = 6.7, 7.2, 9.1, 16.8), 5.06 (br d, 1, *J* = 16.8), 5.05 (br d, 1, *J* = 9.1), 4.59 (ddd, 1, *J* = 3.2, 6.2, 11.6), 4.45-4.39 (m, 1), 2.71 (dd, 1, *J* = 3.7, 17.8), 2.63 (ddd, 1, *J* = 1.8, 3.7, 17.8), 2.32 (br ddd, 1, *J* = 5.0, 6.7, 14.0), 2.05-1.86 (m, 3), 1.83-1.70 (m,1), 0.95 (d, 3, *J* = 6.8); ^{13}C NMR 171.6, 135.8, 116.6, 79.1, 61.9, 38.25, 36.7, 36.1, 31.7, 14.2.

Partial data for the diastereomer were determined from the mixture: ^{1}H NMR 4.69 (ddd, 1, *J* = 3.6, 3.6, 11.6), 0.98 (d, 3, *J* = 6.8); ^{13}C NMR ($CDCl_3$) 171.7, 136.0, 116.5, 78.6, 62.0, 38.28, 36.60, 36.55, 32.3, 13.7.

Preparation of 6. A solution of DIBAL-H in toluene (1.5 M, 3.53 mL, 5.3 mmol) was added dropwise over 10 min to a stirred solution of the 4.2:1 mixture of **15** and the diastereomer (440 mg, 2.39 mmol) in toluene (25.5 mL), THF (14.5 mL) and hexane (3.5 mL) at -78 ºC. The resulting solution was stirred at -78 ºC for 30 min and the reaction was quenched with MeOH (850 mg, 26.5 mmol). The mixture was warmed to room temperature, diluted with H_2O (1.4 mL), treated with Celite and stirred for an additional 15 min. Anhydrous Na_2SO_4 was added and stirring was continued for another 15 min. The mixture was filtered and the filtrate was evaporated to provide a mixture of lactols.

The crude lactols were dissolved in 27.5 mL of MeOH containing TsOH•H_2O (77 mg, 0.4 mmol). The solution was refluxed through a Soxhlet extractor containing molecular sieves (3 Å) for 15 min. The reaction mixture was cooled and diluted with ether (500 mL). The solution was washed with saturated aqueous $NaHCO_3$, H_2O and brine. The organic layer was dried over Na_2SO_4 and concentrated. Purification of the residue by flash chromatography on silica gel (5:1 hexane/EtOAc) gave 108 mg (23%) of an inseparable 4.2:1 mixture of **6** with an α-methoxy group and its side chain diastereomer, followed by 285 mg (60%) of an inseparable 4.2:1 mixture of **6** with β-methoxy group and its side chain diastereomer.

Data for **6** with an α-methoxy group were determined from the mixture: ^{1}H NMR 5.80 (dddd, 1, *J* = 6.0, 8.0, 10.0, 17.2), 5.05 (br d, *J* = 16.0), 5.02 (br d, 1, *J* = 10.0), 4.86 (br d, 1, *J* = 3.2), 4.08 (m, 1), 3.79 (ddd, 1, *J* = 1.9, 6.7, 12.0), 3.61 (d, 1, *J* = 10.0, OH), 3.38 (s, 3), 2.48-2.41

(m, 1), 1.98-1.88 (m, 1), 1.77-1.88 (m, 3), 1.69-1.58 (m, 1), 1.51 (ddd, 1, *J* = 2.8, 13.6, 13.8), 0.90 (d, 3, *J* = 7.3); ^{13}C NMR 137.2, 115.9, 99.4, 66.3, 64.1, 55.0, 37.5, 36.8, 35.15, 34.9, 14.9.

Partial data for the side chain diastereomer of **6** with an α-methoxy group were determined from the mixture: ^{1}H NMR 3.89 (ddd, 1, *J* = 2.4, 4.6, 11.6), 3.62 (d, 1, *J* = 10.0, OH), 3.37 (s, 3), 2.32-2.24 (m, 1), 0.95 (d, 3, *J* = 7.3); ^{13}C NMR 137.2, 115.9, 99.4, 65.7, 64.3, 54.9, 37.4, 37.2, 35.20, 35.1, 14.3.

Data for **6** with a β-methoxy group were determined from the mixture: ^{1}H NMR 5.80 (dddd, 1, *J* = 6.0, 8.0, 10.0, 17.2), 5.04 (br d, 1, *J* = 17.2), 5.02 (br d, 1, *J* = 10.0), 4.69 (dd, 1, *J* = 1.8, 9.8), 4.35 (m, 1), 3.59 (ddd, 1, *J* = 2.4, 7.6, 11.6), 3.52 (s, 3), 2.48-2.39 (m, 1), 2.02 (ddd, 1, *J* = 8.0, 8.4, 14.0), 1.90 (ddd, 1, *J* = 2.2, 5.2, 14.0), 1.76-1.67 (m, 2), 1.61-1.53 (m, 1), 1.46 (ddd, 1, *J* = 2.4, 14.0, 14.0), 0.88 (d, 3, *J* = 6.8); ^{13}C NMR 136.9, 116.1, 99.4, 73.5, 65.6, 56.1, 38.4, 37.6, 37.0, 35.3, 15.1.

Partial data for the side chain isomer of **6** with a β-methoxy group were determined from the mixture: ^{1}H NMR 3.72 (ddd, 1, *J* = 3.6, 5.4, 11.0), 3.51 (s, 3), 2.32-2.24 (m, 1), 0.98 (d, 3, *J* = 6.8); ^{13}C NMR 137.1, 115.9, 99.5, 72.7, 65.7, 56.1, 37.3, 35.2, 14.6 (two C in the δ 35-38 range are obscured).

Preparation of 2,2-Dimethyl-5-(2-propenyl)-4*H*-1,3-benzodioxin-4-one. Triflate **16**[28] (3.342 g, 10.25 mmol) was dissolved in *N*-methylpyrrolidinone (25 mL) and treated with anhydrous LiCl (1.31 g, 30.9 mmol), tri-2-furylphosphine (191 mg, 0.82 mmol), and Pd_2dba_3 (94 mg, 0.10 mmol).[29] The solution was stirred at room temperature for 10 min. Allyltributyltin (3.5 mL, 11.29 mmol) was added dropwise and the solution was stirred for 44 h. The reaction mixture was diluted with a saturated KF solution and extracted with EtOAc. The combined organic extracts were dried over Na_2SO_4 and concentrated. Purification of the residue by flash chromatography on silica gel (10:1 hexane/EtOAc) afforded 1.94 g (87%) of the title compound: ^{1}H NMR 7.44 (dd, 1, *J* = 7.9, 7.9), 6.97 (d, 1, *J* = 7.9), 6.84 (d, 1, *J* = 7.9), 6.04 (ddt, 1, *J* = 10.4, 17.1, 6.7), 5.06 (d, 1, *J* = 10.4), 5.05 (d, 1, *J* = 17.1), 3.90 (d, 2, *J* = 6.7), 1.70 (s, 6).

Preparation of 6-(2-Propenyl)-Salicylic Acid (17). A solution of 2,2-dimethyl-5-(2-

propenyl)-4*H*-1,3-benzodioxin-4-one (316 mg, 1.45 mmol) and KOH (336 mg, 6 mmol) in 6 mL of THF and 6 mL of H_2O was heated in a 65 ºC oil bath for 12 h. The reaction mixture was cooled to room temperature and acidified with 1 M HCl. The mixture was extracted with six portions of EtOAc. The combined organic extracts were dried over Na_2SO_4 and concentrated. Purification of the residue by flash chromatography on silica gel (EtOAc containing 0.1% HCO_2H) afforded 249 mg (96%) of **17**: mp 103-104.5 ºC (lit[10b] mp 98-99 ºC); ^{1}H NMR 12.10-10.60 (br s, 1, OH), 7.40 (dd, 1, *J* = 7.9, 7.9), 6.92 (d, 1, *J* = 7.9), 6.82 (d, 1, *J* = 7.9), 6.05 (ddt, 1, *J* = 10.4, 17.2, 6.4), 5.06 (br dd, 1, *J* = 1.6, 10.4), 5.02 (br dd, 1, *J* = 1.6, 17.2) 3.79 (d, 2, *J* = 6.4); ^{13}C NMR 176.1, 163.6, 144.4, 137.3, 135.7, 122.8, 116.5, 115.8, 110.5, 40.1.

Preparation of 5. A solution of a 4.2:1 mixture of the diastereomers of **6** with a β-methoxy group (275 mg, 1.38 mmol) and PPh_3 (99%, 478 mg, 1.80 mmol) in Et_2O (6 mL) was added over 1 h by syringe pump to a solution of **17** (245 mg, 1.38 mmol) and DEAD (231 μL, 1.47 mmol) in Et_2O at room temperature. The reaction mixture was stirred for 30 min after addition was complete. The mixture was filtered and the filtrate was evaporated. The residue was passed through a silica gel column to remove excess PPh_3 and Ph_3PO. The mixture thus obtained was dissolved in MeOH (4 mL) containing K_2CO_3 (28 mg, 0.2 mmol). The reaction mixture was stirred for 2 h at room temperature to hydrolyze the 1:2 adduct resulted from esterification of the phenol of **5**. The solution was neutralized by addition of 1 M HCl and was extracted with three portions of EtOAc. The combined extracts were dried over Na_2SO_4 and concentrated. Purification of the residue by flash chromatography on silica gel (15:1 hexane/EtOAc) afforded 393 mg (79%) of an inseparable 4.2:1 mixture of **5** and the diastereomer with a β-methoxy group.

Data for **5** with a β-methoxy group were determined from the mixture: ^{1}H NMR 11.16 (s, 1, OH), 7.32 (t, 1, *J* = 7.8), 6.87 (dd, 1, *J* = 1.0, 7.8), 6.73 (d, 1, *J* = 7.8), 5.97 (dddd, 1, *J* = 5.8, 5.8, 10.0, 17.2), 5.79 (dddd, 1, *J* = 6.4, 8.0, 10.4, 16.4), 5.22 (dddd, 1, *J* = 4.8, 4.8, 11.5, 11.5), 5.05 (br d, 1, *J* = 17.2), 5.04 (br d, 1, *J* = 10.0), 5.00 (br d, 1, *J* = 1.4, 10.4), 4.90 (br dd, 1, *J* = 2.0, 16.4), 4.37 (dd, 1, *J* = 2.0, 9.6), 3.69 (dd, 1, *J* = 5.8, 15.6), 3.63 (dd, 1, *J* = 5.8, 15.6), 3.54 (s, 3),

3.20 (ddd, 1, *J* = 1.6, 7.4, 11.5), 2.44-2.30 (m, 2), 2.22-2.16 (m, 1), 2.05 (ddd, 1, *J* = 8.0, 8.0, 14.0), 1.86-1.77 (m, 1), 1.68-1.59 (m, 1), 1.41 (ddd, 1, *J* = 11.5, 11.5, 11.5), 0.93 (d, 3, *J* = 6.8); ^{13}C NMR 170.5, 162.8, 142.6, 137.5, 136.5, 134.5, 122.7, 116.4, 116.2, 115.3, 111.9, 100.7, 74.9, 71.0, 56.4, 40.2, 37.4, 37.0 (2 C), 33.6, 15.2.

Partial data for the side chain diastereomer of **5** with a β-methoxy group were determined from the mixture: ^{1}H NMR 3.53 (s, 3), 3.32 (ddd, 1, *J* = 1.6, 4.8, 11.5), 1.51 (ddd, 1, *J* = 11.5, 11.5, 11.5), 1.01 (d, 3, *J* = 6.8); ^{13}C NMR 136.7, 116.3, 100.8, 73.9, 71.1, 37.5, 37.1, 33.8, 14.6.

The 4.2:1 mixture of diastereomers of **6** with an α-methoxy group (108 mg, 0.54 mmol) was coupled with **17** by the same procedure to give 156 mg (80%) of an inseparable 4.2:1 mixture of **5** and the diastereomer with an α-methoxy group.

Data for **5** with an α-methoxy group were determined from the mixture: ^{1}H NMR 11.25 (s, 1, OH), 7.32 (t, 1, *J* = 7.9), 6.87 (d, 1, *J* = 7.9), 6.73 (d, 1, *J* = 7.9), 5.98 (dddd, 1, *J* = 5.6, 6.4, 9.8, 17.1), 5.80 (dddd, 1, *J* = 6.8, 8.2, 10.4, 17.6), 5.49 (dddd, 1, *J* = 4.8, 4.8, 11.4, 11.4), 5.08-4.88 (m, 5), 3.70-3.61 (m, 3), 3.352 (s, 3), 2.52–2.39 (m, 1), 2.31-2.11 (m, 2), 1.90 (ddd, 1, *J* = 8.2, 8.2, 14.0), 1.78 (ddd, 1, *J* = 4.8, 11.4, 11.4), 1.73-1.63 (m, 1), 1.47 (ddd, 1, *J* = 11.4, 11.4, 11.4), 0.92 (d, 3, *J* = 6.8); ^{13}C NMR 170.5, 162.8, 142.6, 137.6, 137.0, 134.3, 122.5, 116.21, 116.19, 115.3, 112.1, 98.6, 70.6, 69.6, 54.7, 40.2, 37.5, 36.9, 35.7, 33.9, 15.1.

Partial data for the side chain diastereomer of **5** with an α-methoxy group were determined from the mixture: ^{1}H NMR 3.77-3.67 (m, 3), 3.347 (s, 3), 1.55 (ddd, 1, *J* = 11.4, 11.4, 11.4), 0.97 (d, 3, *J* = 6.8); ^{13}C NMR 137.2, 137.0, 116.1, 98.7, 70.0, 69.7, 54.6, 35.7, 34.2, 14.9.

Hydrolysis of 5 to the Lactol. A solution of a 4.2:1 mixture of **5** with a β-methoxy group and the side chain diastereomer (337 mg, 0.94 mmol) in H_2O (6 mL) and acetic acid (2 mL) was heated in a 110 ºC oil bath for 2.5 h. The reaction mixture was cooled and poured into Et_2O and saturated aqueous $NaHCO_3$ cooled in an ice bath. The aqueous layer was extracted with three portions of Et_2O. The combined extracts were washed with brine, dried over Na_2SO_4 and concentrated. Purification of the residue by flash chromatography on silica gel (6:1 hexane/EtOAc) afforded 259 mg, (80%) of a mixture of lactols: ^{1}H NMR 11.25 (s, 0.6, OH),

11.16 (s, 0.4, OH), 7.36-7.30 (m, 1), 6.88 (d, 1, *J* = 7.9), 6.76-6.72 (m, 1), 6.04-5.93 (m, 1), 5.81-5.72 (m, 1), 5.62 –5.52 (m, 0.6), 5.52-5.47 (m, 0.6), 5.28-5.18 (m, 0.4), 5.10-4.80 (m, 4.4), 4.07-4.01 (m, 0.1), 3.98-3.91 (m, 0.5), 3.74-3.62 (m, 2), 3.42-3.38 (m, 0.1), 3.41 (d, 0.4, *J* = 6.4, OH), 3.36-3.29 (m, 0.3), 2.72-2.68 (m, 0.6, OH), 2.44-1.39 (m, 7), 0.99-0.90 (m, 3).

A similar sequence starting with the 4.2:1 mixture of **5** with an α-methoxy group and the side chain diastereomer (150 mg, 0.42 mmol) gave 112 mg (78%) of the same mixture of lactols.

Preparation of 4a. A solution of the above lactols (228 mg, 0.66 mmol) and methyl (triphenylphosphoranylidene)acetate (98%, 676 mg, 1.98 mmol) in toluene (16 mL) was refluxed for 10 min. The cooled reaction mixture was concentrated to dryness and the residue was dissolved in EtOAc. The mixture was washed successively with 1 M HCl, saturated $NaHCO_3$, brine, dried over Na_2SO_4, filtered and concentrated. Flash chromatography on silica gel (6:1 hexane/EtOAc) gave 25 mg (10%) of an inseparable 4.2:1 mixture of the *Z*-isomers of **4a** and the diastereomer, followed by 201 mg (76%) of an inseparable 4.2:1 mixture of **4a** and the diastereomer.

Data for **4a** were determined from the mixture: ^{1}H NMR 11.10 (s, 1, OH), 7.35 (t, 1, *J* = 8.0), 6.95 (dt, 1, *J* = 16.1, 6.8), 6.89 (dd, 1, *J* = 1.0, 8.0), 6.75 (d, 1, *J* = 8.0), 5.98 (ddt, 1, *J* = 10.0, 17.0, 6.0), 5.93 (d, 1, *J* = 16.1), 5.76 (ddt, 1, *J* = 10.0, 16.8, 6.8), 5.63 (dddd, 1, *J* = 10.0, 6.0, 6.0, 2.0), 5.03 (br d, 1, *J* = 10.0), 5.02 (br d, 1, *J* = 17.6), 4.98 (br d, 1, *J* = 10.0), 4.90 (br d, 1, *J* = 17.0), 3.72 (s, 3), 3.70 (br dd, 1, *J* = 6.0, 16.0), 3.62 (br dd, 1, *J* = 6.0, 16.0), 3.46 (br ddd, 1, *J* = 4.8, 4.8, 10.8), 2.68 (t, 2, *J* = 6.0), 2.56 (d, 1, *J* = 4.8, OH), 2.26 (ddd, 1, *J* = 5.2, 6.2, 14.0), 1.97-1.83 (m, 2), 1.73-1.60 (m, 2), 0.88 (d, 3, *J* = 6.8); ^{13}C NMR 171.3, 166.3, 162.8, 143.1, 142.5, 137.5, 136.9, 134.6, 124.3, 122.7, 116.4, 116.2, 115.6, 111.8, 72.2, 70.9, 51.5, 40.0, 38.7, 38.3, 37.6, 36.9, 15.2.

Partial data for the diastereomer of **4a** were determined from the mixture: ^{1}H NMR 11.09 (s, 1, OH), 3.60-3.54 (m, 2), 2.35 (d, 1, *J* = 4.8, OH), 2.24-2.17 (m, 1), 1.82-1.74 (m, 1), 1.62-1.54 (m, 1), 0.91 (d, 3, *J* = 6.8); ^{13}C NMR 136.9, 116.3, 72.3, 69.9, 38.9, 38.5, 37.6, 37.5, 13.7.

Data for the *Z*-isomer of **4a** were determined from the mixture: ^{1}H NMR 11.13 (s, 1, OH), 7.35 (dd, 1, *J* = 7.8, 8.3), 6.90 (dd, 1, *J* = 0.9, 8.3), 6.75 (d, 1, *J* = 7.8), 6.27 (ddd, 1, *J* = 7.3, 7.3, 11.2), 5.98 (dddd, 1, *J* = 6.0, 6.0, 10.2, 17.0), 5.91 (ddd, 1, *J* = 1.5, 2.0, 11.2), 5.76 (dddd, 1, *J* = 6.8, 7.8, 10.4, 18.0), 5.66-5.59 (m, 1), 5.05-4.96 (m, 3), 4.89 (br d, 1, *J* = 17.0), 3.74-3.68 (m, 1), 3.71 (s, 3), 3.64-3.56 (m, 1), 3.48-3.42 (m, 1), 3.27-3.10 (m, 2), 2.53 (d, 1, *J* = 4.8, OH), 2.33-2.20 (m, 1), 1.97–1.86 (m, 2), 1.76-1.59 (m, 2), 0.88 (d, 3, *J* = 6.8).

Partial data for the diastereomer of the *Z*-isomer of **4a** were determined from the mixture: ^{1}H NMR 11.14 (s, 1, OH), 0.91 (d, 3, *J* = 6.8).

Preparation of 4b. A solution of the 4.2:1 mixture of **4a** and the diastereomer (159 mg, 0.396 mmol), 2,6-lutidine (0.78 mL, 6.7 mmol) and TBSOTf (98%, 0.61 mL, 2.6 mmol) in CH_2Cl_2 (15 mL) was stirred at room temperature for 14 h. The reaction mixture was poured into a mixture of ice and 1 M HCl. The aqueous layer was extracted with CH_2Cl_2. The combined organic layers were washed with saturated $NaHCO_3$, brine, dried over Na_2SO_4 and concentrated. Purification by flash chromatography on silica gel afforded 249 mg (99%) of an inseparable 4.2:1 mixture of **4b** and the diastereomer.

Data for **4b** were determined from the mixture: ^{1}H NMR 7.18 (t, 1, *J* = 8.0), 6.97 (dt, 1, *J* = 15.2, 7.4), 6.80 (d, 1, *J* = 8.0), 6.73 (d, 1, *J* = 8.0), 5.93 (d, 1, *J* = 15.2), 5.92 (ddt, 1, *J* = 10, 16.4, 6.8), 5.75 (ddt, 1, *J* = 10.0, 17.2, 7.2), 5.17 (dddd, 1, *J* = 5.5, 5.5, 5.5, 5.5), 5.08 (br d, 1, *J* = 10.0), 5.06 (br d, 1, *J* = 16.4), 4.98 (br d, 1, *J* = 17.0), 4.95 (br d, 1, *J* = 10.0), 3.84 (ddd, 1, *J* = 3.0, 3.7, 8.6), 3.73 (s, 3), 3.34 (br d, 2, *J* = 6.4), 2.72-2.62 (m, 2), 2.06 (ddd, 1, *J* = 6.0, 7.2, 14.0), 1.91-1.75 (m, 2), 1.75-1.60 (m, 2), 0.97 (s, 9), 0.91 (s, 9), 0.87 (d, 3, *J* = 6.8), 0.25 (s, 3), 0.24 (s, 3), 0.10 (s, 3), 0.07 (s, 3); ^{13}C NMR 167.7, 166.4, 152.6, 144.0, 138.2, 137.2, 136.2, 129.9, 126.4, 123.9, 121.6, 116.8, 116.5, 115.9, 72.9, 72.5, 51.4, 38.9, 37.6, 37.4, 37.0, 36.2, 25.9 (3 C), 25.8 (3 C), 18.4, 18.0, 13.8, -4.06, -4.11, -4.3 (2 C).

Partial data for the diastereomer of **4b** were determined from the mixture: ^{1}H NMR 3.82-3.77 (m, 1), 2.31 (ddd, 1, *J* = 6.0, 7.2, 14.0); ^{13}C NMR ($CDCl_3$) (partial) 167.6, 166.4, 143.8, 137.8, 129.8, 124.1, 121.7, 115.8, 72.6, 72.0, 38.4, 37.1, 36.1, 14.0, -4.2.

Preparation of 18. Solutions of the 4.2:1 mixture of **4b** and the diastereomer (91 mg, 0.144 mmol) and bis(tricyclohexylphosphine)benzylidineruthenium dichloride (18 mg, 0.022 mmol) in CH_2Cl_2 (15 mL each) were slowly added over 1.5 h by syringe pump to CH_2Cl_2 (30 mL) at room temperature. The resulting solution was stirred at room temperature for 3 h. The solution was concentrated. Purification of the residue by flash chromatography on silica gel impregnated with 20% $AgNO_3$ (40:1 hexane/EtOAc) afforded 49 mg (57%, 71% from **4b** in the mixture) of **18**, followed by 33 mg (38%) of a 5:4:1 mixture of the *Z*-isomer of **18**, the diastereomer of **18**, and the *Z*-isomer of the diastereomer of **18**. One fraction contained the pure diastereomer of **18**.

Data for **18**: 7.13 (t, 1, *J* = 8.0), 6.92 (dt, 1, *J* = 16.0, 7.2), 6.76 (d, 1, *J* = 8.0), 6.73 (d, 1, *J* = 8.0), 5.93 (d, 1, *J* = 16.0), 5.47-5.28 (m, 3), 4.28 (dd, 1, *J* = 3.0, 8.8), 3.74 (s, 3), 3.67 (dd, 1, *J* = 8.8, 16.0), 3.33 (br d, 1, *J* = 16.0), 2.57 (t, 2, *J* = 6.1), 2.27 (br d, 1, *J* = 12.8), 1.86-1.66 (m, 1), 1.76-1.68 (m, 1), 1.66 (dd, 1, *J* = 6.3, 15.2), 1.41 (dd, 1, *J* = 8.8, 15.2), 0.97 (s, 9), 0.92 (s, 9), 0.83 (d, 3, *J* = 6.4), 0.23 (s, 3), 0.21 (s, 3), 0.15 (s, 3), 0.12 (s, 3); ^{13}C NMR 168.1, 166.5, 152.7, 143.6, 138.7, 131.3, 129.5, 128.3, 127.4, 123.8, 123.2, 117.8, 72.5, 71.9, 51.4, 38.3, 38.1, 37.9, 37.1, 36.1, 25.8 (3 C), 25.6 (3 C), 18.3, 17.9, 13.1, -4.1, -4.44, -4.47, -4.6; IR 2954, 1727, 1582, 1460, 1254, 1067; $[\alpha]_D$ = -4.7 (c = 0.35, MeOH); HRMS (DCI) Calcd for $C_{33}H_{55}O_6Si_2$ (MH^+) 603.3437, found 603.3522.

Data for the diastereomer of **18**: ^{1}H NMR 7.16 (dd, 1, *J* = 7.6, 7.6), 6.92 (dt, 1, *J* = 15.6, 7.6), 6.78 (d, 1, *J*= 7.6), 6.76 (d, 1, *J* = 7.6), 5.91 (br d, 1, *J* = 15.6), 5.45 (dd, 1, *J* = 2.8, 8.0, 15.2), 5.42-5.36 (m, 1), 5.24 (ddd, 1, *J* = 7.6, 7.6, 15.2), 3.83 (dd, 1, *J* = 4.4, 8.4), 3.66 (dd, 1, *J* = 8.0, 16.4), 3.26 (br d, 1, *J* = 16.4), 2.66-2.58 (m, 1), 2.53 (ddd, 1, *J* = 8.4, 8.4, 14.4), 2.05-1.83 (m, 3), 1.55 (ddd, 1, *J* = 1.8, 4.4, 14.8), 1.46-1.38 (m, 1), 0.95 (s, 9), 0.92 (d, 3,*J* = 6.8), 0.89 (s, 9), 0.22 (s, 3), 0.20 (s, 3), 0.14 (s, 3), 0.12 (s, 3).

Hydrolysis of 18. A solution of **18** (49 mg, 0.0814 mmol) and $(Bu_3Sn)_2O$ (96%, 202 mg, 0.325 mmol) in toluene was refluxed for 2 d and concentrated.[31] Water was added and the mixture was extracted three times with EtOAc. The combined extracts were dried over Na_2SO_4 and concentrated. Purification of the residue by flash chromatography on silica gel (5:1

hexane/EtOAc) afforded 7 mg (14%) of recovered **18**, followed by 39 mg (81%, 94% based on recovered **18**) of the carboxylic acid: ^{1}H NMR 7.14 (t, 1, *J* = 7.6), 7.03 (dt, 1, *J* = 15.6, 6.8), 6.76 (d, 1, *J* = 7.6), 6.73 (d, 1, *J* = 7.6), 5.95 (d, 1, *J* = 15.6), 5.47-5.31 (m, 3), 4.28 (dd, 1, *J* = 3.2, 8.8), 3.67 (dd, 1, *J* = 9.0, 16.0), 3.33 (br d, 1, *J* = 16.0), 2.61 (t, 2, *J* = 6.8), 2.27 (br d, 1, *J* = 12.8), 1.86-1.76 (m, 1), 1.76-1.60 (m, 2), 1.45-1.39 (m, 1), 0.97 (s, 9), 0.92 (s, 9), 0.84 (d, 3, *J* = 6.4), 0.23 (s, 3), 0.21 (s, 3), 0.15 (s, 3), 0.12 (s, 3); ^{13}C NMR 169.7, 168.1, 152.7, 146.2, 138.7, 131.4, 129.6, 128.3, 127.3, 123.2 (2 C), 117.8, 72.3, 71.9, 38.5, 38.1, 37.9, 37.1, 36.2, 25.8 (3 C), 25.7 (3 C), 18.3, 18.0, 13.1, -4.1, -4.40, -4.44, -4.6; IR 2954 (br), 1725, 1703, 1582, 1461, 1254; $[\alpha]_D$ = 1.2 (*c* = 0.26, $CHCl_3$); HRMS (DCI) Calcd for $C_{32}H_{53}O_6Si_2$ (MH^+) 589.3381, found 589.3405.

Preparation of the Acyl Azide. A solution of the carboxylic acid (39 mg, 0.0663 mmol), DPPA (97%, 23 mg, 0.081 mmol) and Et_3N (11 μL) in benzene (3 mL) was stirred at room temperature for 6 h and concentrated. Flash chromatography of the residue on silica gel (12:1 hexane/EtOAc) gave 37 mg (91%) of the acyl azide: ^{1}H NMR (benzene-d_6) 7.09 (dt, 1, *J* = 15.6, 7.2), 6.90 (t, 1, *J* = 7.6), 6.67 (d, 1, *J* = 7.6), 6.55 (d, 1, *J* = 7.6), 5.86 (d, 1, *J* = 15.6), 5.55 (dt, 1, *J* = 3.2, 8.0), 5.37-5.27 (m, 2), 4.46 (dd, 1, *J* = 3.4, 8.4), 3.66 (dd, 1, *J* = 7.6, 16.4), 3.18 (dd, 1, *J* = 4.0, 16.4), 2.56-2.48 (m, 1), 2.42 (ddd, 1, *J* = 7.2, 8.0, 15.2), 2.12-2.04 (m, 1), 1.80-1.69 (m, 1), 1.64 (dd, 1, *J* = 9.0, 15.6), 1.60-1.50 (m, 1), 1.42 (dd, 1, *J* = 9.2, 15.6), 1.04 (s, 9), 0.97 (s, 9), 0.84 (d, 1, J = 6.4), 0.48 (s, 3), 0.27 (s, 3), 0.10 (s, 3), 0.09 (s, 3); ^{13}C NMR (benzene-d_6) 171.0, 168.5, 153.6, 146.3, 139.4, 131.8, 130.1, 129.1, 128.8, 126.2, 124.0, 118.7, 72.8, 72.5, 39.2, 38.8, 38.6, 37.8, 37.0, 26.6 (3 C), 26.2 (3 C), 18.8, 18.7, 13.5, -3.6, -3.7, -4.0, -4.1.

Preparation of 19, 20, and 21. A solution of the acyl azide (15 mg, 0.0245 mmol) in benzene (2 mL) was refluxed for 4 h. The solvent was evaporated to give isocyanate **3,** which was used without further purification.

tert-BuLi (1.7 mL, 1.7 M solution in pentane, 2.89 mmol) was added dropwise to a solution of iodoethane (203 mg, 1.30 mmol) in 5 mL of pentane and 3.5 mL of ether at –78 ºC. The solution was stirred at –78 ºC for 10 min and then at room temperature for 1 h. The resulting

solution was added by cannula to a suspension of $CuBr \cdot SMe_2$ (133 mg, 0.65 mmol) in 1.0 mL of ether at -40 ºC. The mixture was stirred at -30 ºC for 30 min. The solution was cooled to -50 ºC, and gaseous acetylene (50 mL, 2.2 mmol) was slowly passed into the solution through a syringe needle. The resulting solution was stirred at -30 ºC for 25 min. The solution was warmed to -10 ºC, and the temperature was carefully maintained at -10 ºC while more acetylene (100 mL, 4.5 mmol) was added during a period of less than 10 min. The resulting solution was cooled in a dry ice-acetone bath giving a stock solution of cuprate **2** which was best made up on this scale or larger.

A portion of the above solution of cuprate **2** (1.5 mL of the total volume of 11.2 mL, approx 0.09 mmol, 3.5 equiv) was added via a dry ice-cooled syringe to the isocyanate **3** at -78 ºC, followed by the addition of HMPA (15 μL) and $(EtO)_3P$ (5 μL). The solution was stirred at –78 ºC for 30 min and the temperature was slowly raised to 0 ºC over 1h. Ether was added to the reaction mixture and the reaction was quenched with a phosphate buffer (pH = 7.2). The aqueous layer was extracted with three portions of ether. The combined extracts were washed with phosphate buffer (pH = 7.2) and dried over Na_2SO_4. The solvent was removed. The residue was passed through silica gel (10:1 hexane/EtOAc) to give 95% of a 2:4:1 mixture of **19**, **20**, and **21** with about 15% of nonpolar impurities. Flash chromatography on silica gel impregnated with 10% $AgNO_3$ (20:1 hexane/EtOAc) gave 3.5 mg (22%) of **19**, followed by 7 mg (43%) of **20** and 1.5 mg (9%) of **21**.

Data for **19**: ^{1}H NMR (CD_3OD) 7.18 (t, 1, *J* = 7.9), 6.80 (d, 1, *J* = 14.8), 6.79 (d, 1, *J* = 7.9), 6.79 (d, 1, *J* = 7.9), 6.10 (dt, 1, *J* =11.4, 7.6), 5.74 (d, 1, *J* = 11.4), 5.46-5.18 (m, 4), 4.31 (dd, 1, *J* = 2.4, 7.6), 3.60 (dd, 1, *J* = 9.2, 16.4), 3.35 (br d, 1, *J* = 16.4), 2.67 (ddq, 2, *J* = 1.2, 7.6, 7.6), 2.47-2.32 (m,2), 2.32-2.22 (m, 1), 1.86-1.70 (m, 2), 1.67 (dd, 1, *J* = 8.4, 15.2), 1.49 (dd, 1, *J* = 8.8, 15.2), 1.04 (t, 3, *J* = 7.6), 1.00 (s, 9), 0.91 (s, 9), 0.85 (d, 1, *J* = 6.8), 0.24 (s, 3), 0.23 (s, 3), 0.16 (s, 3), 0.13 (s, 3); ^{13}C NMR (CD_3OD) 170.1, 166.0, 154.2, 150.3, 140.0, 132.6, 130.9, 129.9, 129.2, 126.9, 124.5, 122.0, 119.1, 109.1, 76.2, 73.5, 39.1 (2 C), 38.6, 37.5, 36.8, 26.6 (3

C), 26.5 (3 C), 23.5, 19.4, 19.1, 14.2, 13.6, -3.7, -3.8, -4.05, -4.10; $[\alpha]_D$ = -15.5 (*c* = 0.20, MeOH); HRMS (DCI) Calcd for $C_{36}H_{60}NO_5Si_2$ (MH^+) 642.4010, found 642.4004.

Data for **20**: ^{1}H NMR (CD_3OD) 7.31 (ddd, 1, *J* = 1.2, 11.0, 11.6), 7.18 (t, 1, *J* = 7.6), 6.88 (dd, 1, *J* = 11.6, 11.6), 6.84 (d, 1, *J* = 14.0), 6.80 (d, 1, *J* = 7.6), 6.80 (d, 1, *J* = 7.6), 5.84 (dt, 1, *J* = 11.0, 7.6), 5.68 (d, 1, *J* = 11.6), 5.46-5.18 (m, 4), 4.31 (dd, 1, *J* = 3.0, 8.5), 3.60 (dd, 1, *J* = 9.4, 15.8), 3.35 (br d, 1, *J* = 15.8), 2.46-2.34 (m, 2), 2.29 (ddq, 2, *J* = 1.0, 7.6, 7.6), 2.33-2.25 (m, 1), 1.86-1.71 (m, 2), 1.67 (dd, 1, *J* = 8.6, 15.4), 1.49 (dd, 1, *J* = 8.6, 15.4), 1.03 (t, 3, *J* = 7.6), 1.01 (s, 9), 0.91 (s, 9), 0.85 (d, 3, *J* = 6.8), 0.24 (s, 3), 0.23 (s, 3), 0.16 (s, 3), 0.13 (s, 3); ^{13}C NMR (CD_3OD) 170.5, 166.0, 154.2, 142.8, 140.0, 137.9, 132.6, 130.9, 129.8, 129.2, 127.0, 125.5, 124.5, 120.5, 119.1, 109.2, 76.1, 73.5, 39.1 (2 C), 38.8, 37.6, 36.8, 26.6 (3 C), 26.5 (3 C), 21.7, 19.4, 19.1, 14.5, 13.6, -3.7, -3.8, -4.05, -4.15; $[\alpha]_D$ = -17.5 (*c* = 0.32, MeOH), HRMS (DCI) Calcd for $C_{38}H_{62}NO_5Si_2$ (MH^+) 668.4176, found 668.4159.

Data for **21**: ^{1}H NMR (CD_3OD) 7.36 (dd, 1, *J* = 11.6, 11.6.), 7.18 (t, 1, *J* = 8.0), 7.07 (dd, 1, *J* = 11.6, 11.6), 6.85 (d, 1, *J* = 14.4), 6.80 (d, 1, *J* = 8.0), 6.80 (d, 1, *J* = 8.0), 6.63 (dd, 1, *J* = 11.6, 11.6), 6.58 (dd, 1, *J* = 11.6, 11.6), 5.72 (d, 1, *J* = 11.6), 5.71 (dt, 1, *J* = 11.6, 7.2), 5.45-5.20 (m, 4), 4.31 (dd, 1, *J* = 3.6, 8.3), 3.60 (dd, 1, *J* = 9.2, 16.0), 3.39-3.32 (m, 1), 2.47-2.34 (m, 2), 2.28 (dq, 2, *J* = 7.2, 7.2), 2.32-2.24 (m, 1), 1.87-1.74 (m, 2), 1.68 (dd, 1, *J* = 8.3, 15.2), 1.49 (dd, 1, *J* = 8.3, 15.2), 1.03 (t, 3, *J* = 7.2), 1.01 (s, 9), 0.92 (s, 9), 0.86 (d, 3, *J* = 6.8), 0.24 (s, 3), 0.23 (s, 3), 0.16 (s, 3), 0.13 (s, 3).

Preparation of Salicylihalamide A (1*E*). Bis silyl ether **20** (4 mg, 6 μmol) was treated at room temperature with 0.4 mL of a solution prepared from 0.5 g of HF·pyridine in 1.25 mL of pyridine and 6.75 mL of THF.[3] More (0.2 mL) of the deprotection reagent mixture was added after 48 h. The reaction mixture was stirred for another 24 h. The reaction was quenched with a phosphate buffer (pH = 7.2), extracted with four portions of EtOAc, dried over Na_2SO_4 and concentrated. Purification of the residue by flash chromatography on silica gel (2:1 hexane/EtOAc) afforded 2.1 mg (78%) of synthetic (-)-**1*E***: ^{1}H NMR (CD_3OD) 7.32 (dd, 1, *J* = 11.0, 11.6), 7.13 (t, 1, *J* = 7.3), 6.88 (dd, 1, *J* = 11.6, 11.6), 6.82 (d, 1, *J* = 14.0), 6.73 (d, 1, *J* =

7.3), 6.66 (1, d, *J* = 7.3), 5.83 (dt, 1, *J* = 11.0, 7.6), 5.70 (d, 1, *J* = 11.6), 5.44-5.25 (m, 4), 4.14 (dd, 1, *J* = 3.4, 9.0), 3.57 (dd, 1, *J* = 7.9, 15.9), 3.39-3.32 (m, 1), 2.44 (ddd, 1, *J* = 6.4, 7.2, 15.0), 2.39 (ddd, 1, *J* = 6.4, 7.2, 15.0), 2.29 (ddq, 2, *J* = 1.2, 7.6, 7.6), 2.30-2.24 (m, 1), 1.94-1.83 (m, 1), 1.81-1.71 (m, 2), 1.38 (dd, 1, *J* = 9.0, 15.2), 1.03 (t, 3, *J* = 7.6), 0.86 (d, 3, *J* = 6.8); ^{13}C NMR (CD_3OD) 171.2, 166.0, 157.3, 142.8, 140.8, 137.9, 131.82, 131.78, 130.9, 126.4, 125.5, 123.2, 122.6, 120.5, 115.5, 110.6, 76.1, 72.1, 39.1, 38.9, 38.7, 37.7, 36.7, 21.7, 14.5, 13.7; $[\alpha]_D$ = -41 (*c* = 0.067, MeOH).

Preparation of 2*Z*-Pentenamide 22. Bis silyl ether **19** (4 mg, 6.24 μL) was similarly treated with the deprotection reagent mixture as described above to give 1.8 mg (70%) of **22**: ^{1}H NMR (CD_3OD) 7.13 (t, 1, *J* = 8.0), 6.80 (d, 1, *J* = 14.4), 6.73 (d, 1, *J* = 8.0), 6.66 (d, 1, *J* = 8.0), 6.10 (dt, 1, *J* = 11.6, 7.2), 5.76 (d, 1, *J* = 11.6), 5.32-5.42 (m, 4), 4.13 (dd, 1, *J* = 3.4, 9.3), 3.57 (dd, 1, *J* = 8.2, 16.2), 3.39-3.32 (m, 1), 2.67 (ddq, 2, *J* = 1.4, 7.2, 7.2), 2.44 (ddd, 1, *J* = 6.7, 7.3, 14.9), 2.38 (ddd, 1, *J* = 6.7, 7.3, 14.9), 2.32-2.24 (m, 1), 1.93-1.84 (m, 1), 1.81-1.71 (m, 2), 1.38 (dd, 1, *J* = 9.3, 15.6), 1.04 (t, 3, *J* = 7.2), 0.86 (d, 1, *J* = 6.8); ^{13}C NMR (CD_3OD) 171.2, 166.0, 157.3, 150.4, 140.8, 131.8 (2), 130.9, 126.3, 122.6, 122.0, 115.4, 110.3, 76.1, 72.1, 39.1, 38.9, 38.7, 37.6, 36.7, 23.4, 14.2, 13.7 (the quaternary carbon expected near 123 was not observed); $[\alpha]_D$ = -28 (*c* = 0.075, MeOH).

Preparation of 2*Z*,4*Z*,6*Z*-Nonenamide 23. Bis silyl ether **21** (1.5 mg, 2.16 μL) was similarly treated with the deprotection reagent mixture as described above to give 0.7 mg (70%) **23**: ^{1}H NMR (CD_3OD) 7.37 (dd, 1, *J* = 11.6, 11.6.), 7.14 (t, 1, *J* = 7.9), 7.07 (dd, 1, *J* = 11.6, 11.6), 6.83 (d, 1, *J* = 14.6), 6.73 (d, 1, *J* = 7.9), 6.66 (d, 1, *J* = 7.9), 6.63 (dd, 1, *J* =11.6, 11.6), 6.58 (dd, 1, *J* = 11.6, 11.6), 5.73 (d, 1, *J* = 11.6), 5.71 (dt, 1, *J* = 11.6, 7.2), 5.28-5.44 (m, 4), 4.14 (dd, 1, *J* = 3.1, 8.3), 3.57 (dd, 1, *J* = 8.5, 16.5), 3.39-3.32 (m, 1), 2.45 (ddd, 1, *J* = 6.4, 7.0, 14.4), 2.39 (ddd, 1, *J* = 6.4, 7.0, 14.4), 2.28 (dq, 2, *J* = 7.2, 7.2), 2.32-2.24 (m, 1), 1.93-1.84 (m, 1), 1.82-1.72 (m, 2), 1.38 (dd, 1, *J* = 8.3, 14.8), 1.03 (t, 3, *J* = 7.2), 0.87 (d, 3, *J* = 6.4).