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Supporting Information

for

Total Synthesis of Mosin B, an Antitumor Acetogenin: Desymmetrization Approach to Stereodivergent Synthesis of *threo*/*trans*/*erythro*-Type Acetogenins

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(*R*)-1,2-*O*-Isopropylidene-6-(trimethylsilyl)-5-hexyne-1,2-diol (23). *n*BuLi (1.54 M in *n*-hexane, 3.03 mL, 4.66 mmol) was added to a solution of trimethylsilylacetylene (0.645 mL, 4.66 mmol) in THF (39 mL) with stirring at –78 °C. After 10 min, a solution of **10** (995 mg, 3.88 mmol) in HMPA (2.7 ml) was added to the mixture, and the whole was stirred for 20 min at 0 °C. The reaction was quenched with saturated NH_4Cl, and the solvent was concentrated under reduced pressure. The residue was extracted with EtOAc, and the extract was washed with saturated NH_4Cl, water, and brine prior to drying and solvent evaporation. The residue was chromatographed on silica gel with hexane–EtOAc (10:1) to give **23** (590 mg, 67%) as a colorless oil. $[\alpha]^{29}_{D}=+6.3$ (c=1.03, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$): δ=0.14 (s, 9H), 1.35 (s, 3H), 1.40 (s, 3H), 1.69–1.76 (m, 1H), 1.80–1.87 (m, 1H), 2.31 (dt, 1H, J=17.1, 7.6 Hz), 2.37 (ddd, 1H, J=17.1, 7.6, 6.1 Hz), 3.59 (dd, 1H, J=7.9, 6.7 Hz), 4.08 (dd, 1H, J=7.9, 6.1 Hz), 4.15–4.20 (m, 1H); ^{13}C NMR (67.8 MHz, $CDCl_3$): δ=0.06 (3C), 16.4, 25.6, 26.9, 32.7, 69.2, 75.0, 85.1, 106.2, 108.7; IR (KBr): ν=2175 cm^{-1}; MS (EI): m/z (%): 226 (5.9) $[M]^+$, 211 (100); elemental analysis calcd (%) for $C_{12}H_{22}O_2Si$: C 63.66, H 9.80; found: C 63.49, H 9.51.

(*R*)-6-(Trimethylsilyl)-5-hexyne-1,2-diol (24). A solution of **23** (590 mg, 2.61 mmol) in AcOH–water (16:9, 25 mL) was stirred at rt for 10 h. The reaction was quenched with $NaHCO_3$, and the mixture was extracted with $CHCl_3$. The extract was washed with brine prior to drying and solvent evaporation. The residue was chromatographed on silica gel with hexane–EtOAc (1:1) to give **24** (423 mg, 87%) as a colorless powder. m.p. 54.0–54.5 °C (*n*-hexane); $[\alpha]^{27}_{D}$=+16.1 (*c*=1.00, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$): δ=0.15 (s, 9H), 1.67 (q, 2H, *J*=6.9 Hz), 1.90 (t, 1H, *J*=5.8 Hz), 2.37 (d, 1H, *J*=4.9 Hz), 2.40 (t, 2H, *J*=7.0 Hz), 3.51 (ddd, 1H, *J*=11.0, 6.9, 5.0 Hz), 3.68 (ddd, 1H, *J*=11.0, 6.4, 3.4 Hz), 3.85–3.91 (m, 1H); ^{13}C NMR (67.8 MHz, $CDCl_3$): δ=0.04 (3C), 16.3, 31.7, 66.4, 71.3, 85.5, 106.6; IR (KBr): ν=3358, 2175 cm^{-1}; MS (FAB): *m/z*: 187 $[M+H]^+$; elemental analysis calcd (%) for $C_9H_{18}O_2Si$: C 58.02, H 9.74; found: C 58.16, H 9.48.

(*R*)-5-Hexyne-1,2-diol (25). TBAF (1.0 M in THF, 4.46 mL, 4.46 mmol) was added to a solution of **24** (415 mg, 2.23 mmol) in THF (22 mL) with sttiring at rt. After 5 min, water was added to the mixture, and the mixture was extracted with EtOAc. The extract was washed water and brine prior to drying and solvent evaporation. The residue was chromatographed on silica gel with EtOAc to give **25** (232 mg, 91%) as a colorless waxy solid. $[\alpha]^{25}_{D}$=+44.0 (*c*=0.48, MeOH); ^{1}H NMR (500 MHz, CD_3OD): δ=1.51–1.59 (m, 1H), 1.71 (dtd, 1H, *J*=13.7, 7.9, 4.0 Hz), 2.18 (m, 1H), 2.24–2.36 (m, 2H), 3.42–3.49 (m, 2H), 3.68–3.72 (m, 1H); ^{13}C NMR (67.8 MHz, CD_3OD): δ=15.4, 33.4, 67.1, 69.6, 71.8, 84.7; IR (KBr): ν=3296, 2116 cm^{-1}; MS (FAB): *m/z*: 137 $[M+Na]^+$; HRMS-FAB: $[M+Na]^+$ calcd for $C_6H_{10}O_2Na$ 137.0578; found 137.0582.

(*R*)-2-(*tert*-Butyldimethylsilyloxy)-5-hexynyl *p*-Toluenesulfonate (26). *p*-TsCl (387 mg, 2.03 mmol) was added to a solution of **25** (232 mg, 2.03 mmol) in pyridine (2 mL) with stirring at rt. After 1h, satureted NH_4Cl was added to the mixture, and the mixture was extracted with EtOAc. The extract was washed satureted NH_4Cl, water and brine prior to drying and solvent evaporation. The residue was dissoleved in DMF (2 mL), and imidazole (276 mg, 4.06 mmol) and TBSCl (612 mg, 4.06 mmol) was added to the mixture with stirring at rt. After 14 h, water was added to the mixture, and the mixture was extracted with EtOAc. The extract was washed with water and brine prior to drying and solvent evaporation. The residue was chromatogaraphed on silica gel with hexane–EtOAc (10:1) to give **26** (536 mg, 69% in two steps) as a colorless oil. $[\alpha]^{28}_{D}$=+18.2 (*c*=1.21, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$): δ=0.02 (s, 3H), 0.05 (s, 3H), 0.84 (s, 9H), 1.57–1.62 (m, 1H), 1.65–1.71 (m, 1H), 1.93 (t, 1H, *J*=2.7 Hz), 2.21 (td, 2H, *J*=7.3, 2.4 Hz), 2.45 (s, 3H), 3.87 (dd, 1H, *J*=9.8, 4.9 Hz), 3.89 (dd, 1H, *J*=9.8, 5.5 Hz), 3.96–4.01 (m, 1H), 7.35 (d, 2H, *J*=8.5 Hz), 7.79 (d, 2H, *J*=8.5 Hz); ^{13}C NMR ($CDCl_3$, 67.8 MHz): δ=–5.0, –4.6, 14.1, 17.9, 21.6, 25.7 (3C), 32.6, 68.4, 69.0, 72.7, 83.4, 127.9 (2C), 129.7 (2C), 132.8, 144.8; IR (KBr): ν=3309, 2119 cm^{-1}; MS (FAB): *m/z*: 383 $[M+H]^+$; elemental analysis calcd (%) for $C_{19}H_{30}O_4SSi$: C 59.65, H 7.90, S 8.38; found: C 59.50, H 7.79, S 8.28.

(*R*)-5-(*tert*-Butyldimethylsilyloxy)-6-iodo-1-hexyne (27). A mixture of **26** (510 mg, 1.33 mmol), $NaHCO_3$ (894 mg, 10.6 mmol), and NaI (598 mg, 3.99 mol) in acetone (13 mL) was refluxed for 41 h. Water was added to the mixture, and the mixture was extracted with EtOAc. The extract was washed with brine prior to drying and solvent evaporation. The residue was chromatographed on slica gel with hexane–EtOAc (20:1) to give **27** (398 mg, 88%) as a colorless oil. $[\alpha]^{26}_{D}$=+28.0 (*c*=1.16, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$): δ=0.10 (s, 3H), 0.11 (s, 3H), 0.91 (s, 9H), 1.75 (m, 1H), 1.82–1.88 (m, 1H), 1.96 (t, 1H, *J*=2.7 Hz), 2.25 (td, 2H, *J*=7.3, 2.6 Hz), 3.19 (dd, 1H, *J*=10.4, 6.1 Hz), 3.23 (dd, 1H, *J*=10.4, 3.7 Hz), 3.66–3.70 (m, 1H); ^{13}C NMR ($CDCl_3$, 67.8 MHz): δ=–4.7, –4.4, 13.5, 14.3, 18.0, 25.8 (3C), 35.6, 66.9, 69.5, 83.7; IR (KBr): ν=3309, 2119 cm^{-1}; MS (FAB) *m/z*:176 $[M+Na–C_4H_9–I]^+$; elemental analysis calcd (%) for $C_{12}H_{23}IOSi$: C 42.60, H 6.85, I 37.51; found: C 42.42, H 6.55, I 37.23.

(3*RS*,5*S*)-3-[(2*R*)-2-(*tert*-Butyldimethylsilyloxy)-5-hexynyl]-5-methyl-3-(phenylsulfenyl)tetrahydrofuran-2-one (28). KHMDS (0.5 M in toluene, 0.358 mL, 0.179 mmol) was added to a solution of **9** (37.3 mg, 0.179 mmol) in THF (0.6 mL) with stirring at 0 °C. After 10 min, a solution of **27** (40.4 mg, 0.119 mmol) in HMPA (0.3 mL) was added to the mixture, and the whole was stirred at the same temperature. After the mixture was refluxed for 5 h, the reaction was quenched with saturated NH_4Cl, and the mixture was extracted with EtOAc. The extract was washed with saturated NH_4Cl, water, and brine prior to drying and solvent evaporation. The residue was chromatographed on silica gel with hexane–EtOAc (10:1) to give **28** (7.9 mg, 16%) as a colorless oil. $[\alpha]^{25}_{D}$=–41.9 (*c* 0.58, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$): δ=0.03 (s, 3/4H), 0.07 (s, 3/4H), 0.15 (s, 9/4H), 0.17 (s, 9/4H), 0.87 (s, 9/4H), 0.90 (s, 27/4H), 1.27 (d, 9/4H, *J*=6.1 Hz), 1.39 (d, 3/4H, *J*=6.1 Hz), 1.59–1.64 (m, 1/4H), 1.68–1.78 (m, 7/4H), 1.86–1.94 (m, 2H), 1.96 (t, 3/4H, *J*=2.7 Hz), 2.00 (dd, 3/4H, *J*=15.0, 2.7 Hz), 2.04–2.11 (m, 3/4H), 2.15–2.26 (m, 3/2H), 2.32 (dd, 1/4H, *J*=14.0, 9.8 Hz), 2.37 (dd, 1/4H, *J*=14.0, 5.5 Hz), 3.00 (dd, 3/4H, *J*=14.0, 7.9 Hz), 4.02 (tt, 1/4H, *J*=6.1, 5.5 Hz), 4.35–4.40 (m, 3/4H), 4.55 (dq, 3/4H, *J*=14.0, 6.1 Hz), 4.61 (dq, 1/4H, *J*=16.5, 6.1 Hz), 7.33–7.43 (m, 3H), 7.54–7.59 (m, 2H); ^{13}C NMR (67.8 MHz, $CDCl_3$): (major) δ=–4.1, –3.9, 13.8, 17.9, 21.4, 25.9, 36.7, 39.5, 41.1, 54.6, 68.2, 68.8, 73.2, 83.7, 129.0 (2C), 129.7 (2C), 130.1, 136.8, 177.0; (minor) δ=–4.3, –4.2, 14.0, 17.9, 20.4, 25.8 (3C), 36.0, 41.7, 42.4, 54.4, 68.5, 68.5, 73.6, 84.1, 129.0 (2C), 129.3, 130.0, 136.9 (2C), 175.0; IR (KBr): ν=3309, 2119, 1767 cm^{-1}; MS (FAB) *m/z*: 419 [M+H]$^+$; elemental analysis calcd (%) for $C_{23}H_{34}O_3SSi$: C 65.98, H 8.19, S 7.66; found: C 65.97, H 8.15, S 7.46.

(*R*)-2-(Methoxymethoxy)-5-hexynyl *p*-Toluenesulfonate (29). *p*-TsCl (167 mg, 0.876 mmol) was added to a solution of **25** (100 mg, 0.876 mmol) in pyridine (0.9 mL) with stirring at rt. After 1.5h, saturated NH_4Cl was added to the mixture, and the mixture was extracted with EtOAc. The extract was washed saturated NH_4Cl, water and brine prior to drying and solvent evaporation. The residue was dissolved in CH_2Cl_2 (9 mL) and *i*Pr_2NEt (0.759 mL, 4.38 mmol) was added at rt. After 5 min, MOMCl (0.330 mL, 4.38 mmol) was added to the mixture with stirring at 0 °C. After stirred at rt for 20 h, saturated NH_4Cl was added to the mixture, and the mixture was extracted with EtOAc. The extract was washed with saturated $NaHCO_3$, water and brine prior to drying and solvent evaporation. The residue was chromatogaraphed on silica gel with hexane–EtOAc (5:1) to give **29** (184 mg, 67% in two steps) as a colorless oil. $[\alpha]^{23}_{D}$=+27.6 (*c*=1.38, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$): δ=1.67–1.77 (m, 2H), 1.94 (t, 1H, *J*=2.4 Hz), 2.25–2.29 (m, 2H), 2.45 (s, 3H), 3.32 (s, 3H), 3.86–3.91 (m, 1H), 4.05 (dd, 1H, *J*=10.4, 4.9 Hz), 4.09 (dd, 1H, *J*=10.4, 4.3 Hz), 4.61 (d, 1H, *J*=6.7 Hz), 4.63 (dd, 1H, *J*=7.9 Hz), 7.35 (d, 2H, *J*=7.9 Hz), 7.80 (d, 2H, *J*=7.9 Hz); ^{13}C NMR (75 MHz, $CDCl_3$): δ=14.2, 21.5, 30.2, 55.6, 69.1, 71.0, 73.5, 83.0, 96.3, 127.9 (2C), 129.8 (2C), 132.7, 144.9; IR (KBr): ν=3292, 2118 cm^{-1}; MS (FAB) *m/z*: 335 [M+Na]$^+$; HRMS-FAB: [M+Na]$^+$ calcd for $C_{15}H_{20}NaO_5S$ 335.0929; found: 335.0927.

(*R*)-5-(Methoxymethoxy)-6-iodo-1-hexyne (30). A mixture of **29** (180 mg, 0.577 mmol), $NaHCO_3$ (388 mg, 4.62 mmol), and NaI (259 mg, 1.73 mmol) in acetone (6 mL) was refluxed for 26 h. Water was added to the mixture, and the mixture was extracted with EtOAc. The extract was washed with brine prior to drying and solvent evaporation. The residue was chromatographed on slica gel with hexane–EtOAc (10:1) to give **30** (121 mg, 79%) as a colorless oil. $[\alpha]^{24}_{D}$=+27.8 (*c*=0.73, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$): δ=1.83–1.87 (m, 2H), 1.96 (t, 1H, *J*=2.7 Hz), 2.30–2.34 (m, 2H), 3.33 (dd, 1H, *J*=10.4, 3.7 Hz), 3.38 (dd, 1H, *J*=10.4, 5.8 Hz), 3.43 (s, 3H), 3.57 (dt, 1H, *J*=9.8, 6.1 Hz), 4.70–4.72 (m, 2H); ^{13}C NMR (75 MHz, $CDCl_3$): δ=10.7, 14.3, 33.9, 56.1, 69.1, 74.8, 83.3, 96.2; IR (KBr): ν=3292, 2118 cm^{-1}.

(*R*)-2-Hydroxy-5-hexynyl Pivaloate (31). Pivaloyl chloride (0.214 mL, 1.75 mmol) was added to a solution of **25** (200 mg, 1.75 mmol) in pyridine (1.8 mL) and CH_2Cl_2 (1.8 mL) with stirring at 0 °C.

After 5 min, the whole was stirred at rt for 4h. After solvent evaporation, azeotropic removal of pyridine with toluene was repeated three times. The residue was chromatographed on slica gel with hexane–EtOAc (5:1) to give **31** (288 mg, 83%) as a colorless oil. $[\alpha]^{25}_{D}$=+8.7 (*c*=1.14, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$): δ=1.23 (s, 9H), 1.68–1.72 (m, 2H), 1.98 (t, 1H, *J*=2.7 Hz), 2.16 (d, 1H, *J*=4.3 Hz), 2.38 (td, 2H, *J*=7.0, 2.6 Hz), 4.01–4.05 (m, 2H), 4.15 (dd, 1H, *J*=14.0, 6.1 Hz); ^{13}C NMR (75 MHz, $CDCl_3$,): δ=14.5, 27.0 (3C), 31.9, 38.7, 68.0, 68.4, 68.9, 83.5, 178.6; IR (KBr): ν=3485, 3300, 2118, 1728 cm^{-1}; MS (FAB): *m/z*: 199 $[M+H]^+$; HRMS-FAB: $[M+H]^+$ calcd for $C_{11}H_{19}O_3$ 199.1334; found 199.1380.

(*R*)-2-(*tert*-Butyldimethylsilyloxy)-5-hexynyl Pivaloate (32). Imidazole (196 mg, 2.88 mmol) and TBSCl (435 mg, 2.88 mmol) was added to a solution of **31** (286 mg, 1.44 mmol) in DMF (1.4 ml) with stirring at rt. After 12 h, water was added to the mixture, and the mixture was extracted with EtOAc. The extract was washed with water and brine prior to drying and solvent evaporation. The residue was chromatographed on silica gel with hexane–EtOAc (10:1) to give **32** (449 mg, 100%) as a colorless oil. $[\alpha]^{26}_{D}$=+19.3 (*c*=0.52, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$): δ=0.10 (s, 6H), 0.89 (s, 9H), 1.21 (s, 9H), 1.67–1.77 (m, 2H), 1.95 (t, 1H, *J*=2.7 Hz), 2.27 (td, 1H, *J*=3.4, 2.4 Hz), 2.29 (td, 1H, *J*=4.9, 2.4 Hz), 3.94–4.04 (m, 3H); ^{13}C NMR (67.8 MHz, $CDCl_3$): δ=–4.8, –4.6, 14.3, 18.0, 25.7 (3C), 27.2 (3C), 33.3, 38.8, 67.6, 68.5, 68.7, 84.0, 178.4; IR (KBr): ν=3315, 2119, 1732 cm^{-1}; MS (FAB): *m/z*: 313 $[M+H]^+$; HRMS-FAB: $[M+H]^+$ calcd for $C_{17}H_{33}O_3Si$ 313.2199; found 313.2208.

(*R*)-2-(Methoxymethoxy)-5-hexynyl Pivaloate (33). MOMCl (0.587 mL, 7.81 mmol) was added to a mixture of **31** (310 mg, 1.56 mmol) and *i*Pr_2NEt (1.35 mL, 7.81 mmol) in CH_2Cl_2 (16 mL) with stirring at 0 °C. After 5 min, the whole was stirred at rt for 19 h. Saturated NH_4Cl was added to the mixture, and the mixture was extracted with EtOAc. The extract was washed with saturated $NaHCO_3$, water and brine prior to drying and solvent evaporation. The residue was chromatogaraphed on silica gel with hexane–EtOAc (5:1) to give **33** (351 mg, 93%) as a colorless oil. $[\alpha]^{26}_{D}$=+33.1 (*c*=0.98, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$): δ=1.22 (s, 9H), 1.72–1.83 (m, 2H), 1.97 (t, 1H, *J*=2.7 Hz), 2.34 (td, 2H, *J*= 7.0, 2.4 Hz), 3.40 (s, 3H), 3.92 (tdd, 1H, *J*=7.9, 4.9, 4.9 Hz), 4.09 (dd, 1H, *J*=11.6, 5.5 Hz), 4.17 (dd, 1H, *J*=11.6, 4.3 Hz), 4.68 (d, 1H, *J*=6.7 Hz), 4.76 (d, 1H, *J*=6.7 Hz); ^{13}C NMR (75 MHz, $CDCl_3$): δ=14.3, 26.9 (3C), 30.8, 38.5, 55.4, 65.6, 68.8, 73.8, 83.3, 96.0, 177.9; IR (KBr): ν=3273, 2119, 1732 cm^{-1}; MS (FAB): *m/z*: 243 $[M+H]^+$; HRMS-FAB: $[M+H]^+$ calcd for $C_{13}H_{23}O_4$ 243.1596; found 243.1586

(*R*)-2-(*tert*-Butyldimethylsilyloxy)-5-hexyn-1-ol (34). DIBALH (1.0 M in toluene, 1.28 mL, 1.28 mmol) was added to a solution of **32** (200 mg, 0.641 mmol) in CH_2Cl_2 (6 mL) with stirring at –78 °C. After 5 min, saturated Rochelle salt was gradually added to the mixture, and the whole was stirred at rt for 1 h. The mixture was extracted with EtOAc, and the extract was washed with water and brine prior to drying and solvent evaporation. The residue was chromatographed on silica gel with hexane–EtOAc (5:1) to give **34** (144 mg, 98%) as a colorless oil. $[\alpha]^{22}_{D}$=+19.3 (*c*=0.79, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$): δ=0.10 (s, 3H), 0.12 (s, 3H), 0.91 (s, 9H), 1.68–1.78 (m, 2H), 1.81 (dd, 1H, *J*=7.3, 5.5 Hz), 1.96 (t, 1H, *J*=2.4 Hz), 2.25 (td, 2H, *J*=7.0, 2.6 Hz), 3.49 (ddd, 1H, *J*=11.6, 7.0, 4.0 Hz), 3.61 (ddd, 1H, *J*=11.6, 5.2, 3.8 Hz), 3.89–3.93 (m, 1H); ^{13}C NMR (67.8 MHz, $CDCl_3$): δ=–4.7, –4.6, 14.5, 18.0, 25.8 (3C), 32.4, 66.0, 68.7, 71.2, 84.0; IR (KBr): ν=3573, 3313, 2119 cm^{-1}. MS (FAB): *m/z*: 229 $[M+H]^+$. HRMS-FAB: $[M+H]^+$ calcd for $C_{12}H_{25}O_2Si$ 229.1624; found 229.1621.

(*R*)-2-(Methoxymethoxy)-5-hexyn-1-ol (35). DIBALH (1.0 M in toluene, 1.91 mL, 1.91 mmol) was added to a solution of **33** (231 mg, 0.955 mmol) in CH_2Cl_2 (10 mL) with stirring at –78 °C. After 5 min, saturated Rochelle salt was gradually added to the mixture, and the whole was stirred at rt for 1h. The mixture was extracted with EtOAc, and the extract was washed with water and brine prior to drying and solvent evaporation. The residue was chromatographed on silica gel with hexane–EtOAc (1:1) to give **35** (140 mg, 92%) as a colorless oil. $[\alpha]^{25}{}_{D}$=+24.5 (*c*=0.65, MeOH); ^{1}H NMR (500 MHz, $CDCl_3$): δ=1.68 (dtd, 1H, *J*=9.8, 7.9, 6.1 Hz), 1.71–1.78 (m, 1H), 1.97 (t, 1H, *J*=2.7 Hz), 2.30–2.33 (m, 2H), 3.08–3.11 (m, 1H), 3.44 (s, 3H), 3.53 (ddd, 1H, *J*=12.2, 6.7, 4.3 Hz), 3.63 (ddd, 1H, *J*=11.6, 8.8, 2.4 Hz), 3.74 (dtd, 1H, *J*=11.0, 4.3, 2.4 Hz), 4.72 (d, 1H, *J*=6.7 Hz), 4.76 (d, 1H, *J*=6.7 Hz); ^{13}C NMR (67.8 MHz, $CDCl_3$): δ=14.4, 30.1, 55.5, 65.1, 68.8, 80.0, 83.4, 96.9; IR (KBr): ν=3425, 3300, 2116 cm^{-1}.

(*R*)-2-(*tert*-Butyldimethylsilyloxy)-5-hexynyl Trifluoromethanesulfonate (36). Tf_2O (42.4 μL, 0.257 mmol) was added to a mixture of **34** (48.9 mg, 0.214 mmol) and 2,6-lutidine (29.8 μL, 0.257 mmol) in CH_2Cl_2 (2 mL) with stirring at 0 °C. The whole was stirred at the same temperature for 5 min. The reaction was quenched with saturated NH_4Cl, and the mixture was extracted with Et_2O. The extract was washed with saturated NH_4Cl, water, and brine prior to drying and solvent evaporation. The residue was chromatographed on silica gel with hexane–EtOAc (20:1) to give **36** (70.1 mg, 91%) as a colorless oil. The triflate was unstable and was used immediately in the next step.

(*R*)-2-(*tert*-Butyldimethylsilyloxy)-5-hexynyl Chloromethanesulfonate (37). Chloromethanesulfonyl chloride (29.4 μL, 0.329 mmol) was added to a solution of **34** (50.0 mg, 0.219 mmol) and 2,6-lutidine (38.3 μL, 0.329 mmol in CH_2Cl_2 (2 mL) with stirring at 0 °C. The whole was stirred at the same temperature for 1h. The reaction was quenched with saturated NH_4Cl, and the mixture was extracted with EtOAc. The extract was washed with saturated NH_4Cl, water, and brine prior to drying and solvent evaporation. The residue was chromatographed on silica gel with hexane–EtOAc (20:1) to give **37** (67.5 mg, 90%) as a colorless oil. The chloromethanesulfonate was unstable and was used immediately in the next step.

(*R*)-2-(Methoxymethoxy)-5-hexynyl Trifluoromethanesulfonate (38). Tf_2O (62.0 μL, 0.379 mmol) was added to a mixture of **35** (50.0 mg, 0.316 mmol) and 2,6-lutidine (44.0 μL, 0.379 mmol) in CH_2Cl_2 (3 mL). The whole was stirred at the same temperature for 15 min. The reaction was quenched with saturated NH_4Cl, and the mixture was extracted with Et_2O. The extract was washed with saturated NH_4Cl, water, and brine prior to drying and solvent evaporation. The triflate was unstable and used in the next step without futher pufirication.

(*R*)-2-(Methoxymethoxy)-5-hexynyl Chloromethanesulfonate (39). Chloromethanesulfonyl chloride (56.4 μL, 0.632 mmol) was added to a mixture of **35** (50.0 mg, 0.316 mmol) and 2,6-lutidine (73.5 μL, 0.632 mmol) in CH_2Cl_2 (3 mL). The whole was stirred at the same temperature for 1 h. The reaction was quenched with saturated NH_4Cl, and the mixture was extracted with EtOAc. The extract was washed with saturated NH_4Cl, water, and brine prior to drying and solvent evaporation. The residue was chromatographed on silica gel with hexane–EtOAc (5:1) to give **39** (71.4 mg, 84%) as a colorless oil. The chloromethanesulfonate was unstable and was used immediately in the next step.

General Procedure for Coupling Reaction of Lactone 9 and Alkylating Agent. (Table 2, Entry 3). KHMDS (0.5 M in toluene, 0.752 mL, 0.376 mmol) was added to a solution of **9** (78.3 mg, 0.376 mmol) in THF (0.6 mL) with stirring at 0 °C. After 10 min, a solution of **36** (135 mg, 0.376 mmol) in HMPA (0.327 mL, 1.88 mmol) was added to the mixture. The whole was stirred at the same temperature for 10 min. The reaction was quenched with saturated NH_4Cl, and the mixture was extracted with EtOAc. The extract was washed with saturated NH_4Cl, water, and brine prior to drying and solvent evaporation. The residue was chromatographed on silica gel with hexane–EtOAc (10:1) to give **28** (109 mg, 69%) as a colorless oil.

General Procedure for Coupling Reaction of Alkyne 28 to 1-Pentanal. (Table 3, Entry 1). *n*BuLi (1.5 M in hexane, 20.9 μL, 0.031 mmol) was added to a solution of **28** (13.1 mg, 0.031 mmol) in THF (0.3 mL) with stirring at –78 °C. After 5 min, **40** (3.3 μL, 0.031 mmol) was added to the mixture. The whole was stirred at the same temperature for 1h. The reaction was quenched with saturated NH_4Cl, and the mixture was extracted with EtOAc. The extract was washed with brine prior to drying and solvent evaporation. The residue was chromatographed on silica gel with hexane–EtOAc (10:1) to give **41** (3.2 mg, 20 %) as a colorless oil. ^{1}H NMR (300 MHz, $CDCl_3$): δ=0.03 (s, 3/4H), 0.07 (s, 3/4H), 0.15 (s, 9/4H H), 0.17 (s, 9/4H), 0.87–0.92 (m, 12H), 1.24 (d, 3H, *J*=6.7 Hz), 1.28–1.44 (m, 5H), 1.61–1.72 (m, 4H), 1.85–1.95 (m, 3/2H), 1.99–2.09 (m, 5/4H), 2.10–2.18 (m, 1H), 2.21–2.29 (m, 1H), 2.36 (dd, 1/2H, *J*=7.9, 4.3 Hz), 2.98 (dd, 5/4H, *J*=7.9, 4.9 Hz), 3.01 (dd, 5/4H, *J*=7.9, 4.9 Hz), 4.29 (m, 2H), 4.54 (dq, 3/4H, *J*=12.5, 6.1 Hz), 4.58–4.62 (m, 1/4H), 7.34–7.42 (m, 3H), 7.54–7.57 (m, 2H); ^{13}C NMR (75 MHz, $CDCl_3$): (major) δ=–4.0, –3.9, 14.0, 14.3, 17.9, 21.3, 22.4, 25.9 (3C), 27.4, 36.9, 37.7, 39.6, 41.4, 55.0, 62.6, 68.4, 73.3, 82.3, 84.4, 129.0 (2C), 129.8, 130.2, 136.8 (2C), 177.3; IR (KBr): ν=3477, 1765 cm^{-1}; MS (FAB): *m/z*: 527 $[M+Na]^+$. HRMS-FAB: $[M+Na]^+$ calcd for $C_{28}H_{44}NaO_4SSi$ 527.2627; found 527.2629.