Stereodivergent and Regioselective Synthesis of 3,4-*cis* and 3,4-*trans*- Pyrrolidinediols from α -Amino acids

Jin Hyo Kim, Marcus J. C. Long[†], Jun Young Kim, Ki Hun Park*

Department of Agricultural Chemistry, Division of Applied Life Science (BK21 programs), Gyeongsang National University, Jinju, 660-701, South Korea.

[†] *Chemistry Research Laboratory, University of Oxford, 12 Mansfield Road, Oxford, OX1 3TA, UK.*

Supporting Information

1.	General Procedures	S2
2.	Synthesis and Spectroscopic Data	S3
3.	References	S5
4.	NMR Spectra	S6

General Procedures

All non-aqueous reaction was carried out under an inert nitrogen atmosphere. THF was distilled from Na/benzophenone; triethylamine (Et₃N), 2,2-dimethoxypropane, DMF, and methylene chloride were distilled from CaH₂. All reactions were monitored by TLC which using commercially available glass-backed plates. Column chromatography was carried out using 230-400 mesh silica gel. Final solution before evaporation was washed with brine and dried over anhydrous Na₂SO₄. Infrared spectra were recorded on a Bruker IFS 66. Proton and carbon magnetic resonance spectra were measured downfield relative to tetramethylsilane in CDCl₃ unless otherwise noted (values in ppm). All ¹H-NMR and ¹³C-NMR experiments were conducted on Avance-300 spectrometer and 2D NMR experiments were conducted on Bruker DRX-500. Elemental analyses were performed on Leco CHNS-932. Optical rotations were measured on a Perkin-Elmer polarimeter 343 and [α]_D-values are given in units of 10⁻¹ deg cm²g⁻¹.

Typical Procedure for Synthesis of 3-Acetyl-4-iodo-*N*-(9-phenylfluoren-9-yl) pyrrolidine.¹

Allyl acetate (0.8 mmol) and iodine (0.4 g, 3.2 mmol) in Et₂O/THF/sat. NaHCO₃ (2/1/1, 6 mL) were stirred for 18 h at room temperature. The reaction mixture was quenched with 0.05 M Na₂S₂O₃ (15 mL) and the organic layer was dried and evaporated. The product was isolated by chromatography using hexane-ethyl acetate as eluent.

Typical Procedure for Synthesis of 3, 4- *trans*-dihydroxy-*N*-(9-phenylfluoren-9-yl) pyrrolidine

3-Acetyl-4-iodopyrrolidine (0.4 mmol) and silver acetate (0.133 g, 0.8 mmol) were refluxed in dried toluene (4 mL) for 3 h. The reaction mixture was filtered and evaporated. The residue was reduced with LiAlH₄ (0.030 g, 0.8 mmol) in THF (4 mL) at 0 °C. The reaction mixture was filtered and concentrated. The product was isolated by chromatography using hexane-ethyl acetate as eluent.

Typical Procedure for Synthesis of 3, 4- *cis*-dihydroxy-*N*-(9-phenylfluoren-9-yl) pyrrolidine

3-Acetyl-4-iodopyrrolidine (0.4 mmol), silver tetrafluoroborate (0.155 g, 0.8 mmol) were stirred in toluene/water (9/1, 4 mL) for 12 h. The reaction mixture was evaporated and filtered with EtOAc. The residue was reduced with LiAlH₄ (0.030g, 0.8 mmol) in THF (4 mL) at 0 °C. The reaction mixture was filtered and concentrated. The product isolated by chromatography using hexane-ethyl acetate as eluent.

(2S, 3S, 4S)-2-Benzyl-3,4-dihydroxy-N-(9-phenylfluoren-9-yl) pyrrolidine (3a)

$[\alpha]_D - 93.2$ (*c* 1.0, CHCl₃); IR (KBr): 3409, 3058, 2926 cm⁻¹; ¹H NMR (300 MHz; CDCl₃) δ 2.01 (1H, bs), 2.34 (1H, dd, *J* = 11.8, 2.5 Hz), 2.51 (2H, m), 3.27 (1H, dd, *J* = 11.2, 3.8 Hz), 3.46 (1H, dd, *J* = 11.2, 5.7 Hz), 3.76 (1H, m), 4.03 (1H, m), 6.63 (2H, m), 7.80 ~ 7.12 (16H, m); ¹³C NMR (75 MHz; CDCl₃) δ 40.7, 54.8, 68.7, 76.1, 76.5, 81.0, 120.0, 120.2, 125.9, 126.3, 127.1, 127.3, 127.5, 127.8, 128.4, 128.5, 128.8, 129.1, 139.2, 139.6, 141.4, 143.0, 146.9, and 148.7 (Found; C, 83.12; H, 6.28; N, 3.22. C₃₀H₂₇NO₂ requires C, 83.11; H, 6.28; N, 3.23 %).

(2S, 3S, 4R)-2-Benzyl-3,4-dihydroxy-N-(9-phenylfluoren-9-yl) pyrrolidine (4a)

$[\alpha]_D - 143.2$ (*c* 0.7, CHCl₃); IR (KBr): 3409, 3022, 2926 cm⁻¹; ¹H NMR (300 MHz; CDCl₃) δ 2.03 (1H, bs), 2.31 (1H, dd, *J* = 12.8, 3.3 Hz), 2.45 (1H, m), 2.53 (1H, m), 3.23 (1H, dd, *J* = 11.2, 3.9 Hz), 3.42 (1H, dd, *J* = 11.2, 5.8 Hz), 3.72 (1H, m), 3.98 (1H, m), 7.94 ~ 6.45 (18H, m); ¹³C NMR (75 MHz; CDCl₃) δ 40.7, 54.8, 68.6, 76.1, 76.5, 81.0, 120.0, 120.1, 125.9, 126.4, 127.2, 127.3, 127.5, 127.8, 128.4, 128.5, 128.8, 129.2, 139.2, 139.6, 141.4, 143.0, 146.9 and 148.7 (Found; C, 83.12; H, 6.27; N, 3.22. C₃₀H₂₇NO₂ requires C, 83.11; H, 6.28; N, 3.23 %).

(2S, 3S, 4S)-3,4-Dihydroxy-2-(*p*-methoxybenzyl)-N-(9-phenylfluoren-9-yl) pyrrolidine (3b)

$[\alpha]_D + 122.8$ (*c* 2.0, CHCl₃); IR (KBr): 3446, 3031, 2924 cm⁻¹; ¹H NMR (300 MHz; CDCl₃) δ 2.08 (1H, bs), 2.28 (1H, dd, *J* = 12.4, 5.2 Hz), 2.46 (2H, m), 3.25 (1H, dd, *J* = 11.2, 3.9 Hz), 3.44 (1H, dd, *J* = 11.2, 5.7 Hz), 3.72 (3H, s), 3.75 (1H, m), 4.01 (1H, m), 7.59 ~ 6.54 (17H, m); ¹³C NMR (75 MHz; CDCl₃) δ 39.8, 54.9, 55.2, 68.8, 76.1, 76.4, 81.1, 113.8, 119.9, 120.1, 126.3, 127.2, 127.3, 127.5, 127.8, 128.4, 128.5, 128.8, 130.0, 131.2, 139.6, 141.4, 143.1, 146.9, 148.7, and 157.8 (Found; C, 80.33; H, 6.31; N, 3.01. C₃₁H₂₉NO₃ requires C, 80.32; H, 6.31; N, 3.02 %).

(2S, 3S, 4R)-3,4-Dihydroxy-2-(*p*-methoxybenzyl)-N-(9-phenylfluoren-9-yl) pyrrolidine (4b)

$[\alpha]_D + 90.6$ (*c* 0.9, CHCl₃); IR (KBr): 3430, 3064, 2986 cm⁻¹; ¹H NMR (300 MHz; CDCl₃) δ 0.74 (1H, OH), 1.96 (1H, OH), 2.27 (1H, dd, *J* = 11.9, 2.2 Hz), 2.43 (2H, m), 3.28 (1H, dd, *J* = 11.1, 2.6 Hz), 3.44 (1H, dd, *J* = 11.3, 5.9 Hz), 3.72 (3H, s), 3.75 (1H, m), 4.02 (1H, m), 7.74 ~ 6.54 (17H, m); ¹³C NMR (75 MHz; CDCl₃) δ 39.8, 54.9, 55.2, 62.8, 76.2, 76.4, 81.1, 113.8, 119.9, 120.1, 126.4, 127.1, 127.2, 127.3, 127.5, 127.8, 128.4, 128.5, 128.8, 130.1, 131.1, 139.6, 141.4, and 157.8 (Found; C, 80.33; H, 6.30; N, 3.01. C₃₁H₂₉NO₃ requires C, 80.32; H, 6.31; N, 3.02 %).

(2S, 3S, 4S)-2-Benzyl-3,4-dihydroxy-N-(9-phenylfluoren-9-yl)pyrrolidine (3c)

$[\alpha]_D - 161.7$ (*c* 0.85, CHCl₃); IR (KBr): 3350, 3028, 2992 cm⁻¹; ¹H NMR (300 MHz; CDCl₃) δ 1.33 (1H, d, *J* = 4.6 Hz, OH), 2.45 (1H, m), 2.75 (1H, dd, *J* = 9.4, 4.7 Hz), 2.96 (1H, dd, *J* = 9.4, 2.4 Hz), 3.31 (2H, m), 3.83 (1H, m), 3.93 (1H, t, *J* = 2.1 Hz), 4.05 (1H, d, *J* = 9.8 Hz, OH), 4.33 (2H, s), 7.74 ~ 6.54 (18H, m); ¹³C NMR (75 MHz; CDCl₃) δ 56.2, 65.8, 72.2, 73.2, 75.1, 75.9, 82.2, 119.8, 120.1, 126.5, 126.6,

127.3, 127.5, 127.8, 127.9, 128.3, 128.4, 128.5, 128.8, 137.5, 139.0, 141.6, 142.6, 146.2, and 148.7 (Found; C, 80.33; H, 6.31; N, 3.01. C₃₁H₂₉NO₃ requires C, 80.32; H, 6.31; N, 3.02 %).

(2S, 3S, 4R)-2-Benzoyloxy methyl-3,4-dihydroxy-N-(9-phenylfluoren-9-yl) pyrrolidine (4c)

[α]_D – 190.3 (*c* 2.0, CHCl₃); IR (KBr): 3348, 3024, 2992 cm⁻¹; ¹H NMR (300 MHz; CDCl₃) δ 1.43 (1H, d, *J* = 4.3 Hz, OH), 2.46 (1H, m), 2.75 (1H, dd, *J* = 9.4, 4.7 Hz), 2.95 (1H, dd, *J* = 9.4, 2.4 Hz), 3.31 (2H, m), 3.83 (1H, m), 3.93 (1H, m), 4.07 (1H, d, *J* = 9.7 Hz, OH), 4.32 (2H, s), 7.61 ~ 7.07 (18H, m); ¹³C NMR (75 MHz; CDCl₃) δ 56.1, 65.8, 72.2, 73.2, 75.1, 75.9, 82.2, 119.8, 120.1, 126.5, 126.7, 127.3, 127.5, 127.8, 128.0, 128.3, 128.4, 128.5, 128.7, 137.5, 139.0, 141.6, 142.6, 146.3, and 148.8 (Found; C, 80.32; H, 6.31; N, 3.02. C₃₁H₂₉NO₃ requires C, 80.32; H, 6.31; N, 3.02 %).

(2S, 3S, 4S)-2-Isopropyl-3,4-dihydroxy-N-(9-phenylfluoren-9-yl)pyrrolidine (3d)

[α]_D – 389.8 (*c* 1.2, CHCl₃); IR (KBr): 3428, 3062, 2959 cm⁻¹; ¹H NMR (300 MHz; CDCl₃) δ 0.58 (3H, d, *J* = 6.6 Hz), 0.91 (3H, d, *J* = 6.0 Hz), 0.99 (1H, m), 1.31 (1H, m, OH), 2.12 (1H, m, OH), 2.22 (1H, m), 3.12 (1H, dd, *J* = 11.7, 6.3 Hz), 3.32 (1H, dd, *J* = 11.7, 6.0 Hz), 3.84 (2H, m), 7.75 ~ 7.15 (13H, m); ¹³C NMR (75 MHz; CDCl₃) δ 16.2, 19.7, 29.7, 55.6, 70.6, 76.1, 77.2, 79.0, 119.7, 120.1, 126.3, 126.7, 127.2, 127.7, 128.3, 128.4, 128.8, 139.0, 141.8, and 146.9 (Found; C, 81.02; H, 7.07; N, 3.62 C₂₆H₂₇NO₂ requires C, 81.01; H, 7.06; N, 3.63 %).

(2S, 3S, 4R)-2-Isopropyl-3,4-dihydroxy-N-(9-phenylfluoren-9-yl) pyrrolidine (4d)

[α]_D – 254.4 (*c* 1.0, CHCl₃); IR (KBr): 3428, 3062, 2959 cm⁻¹; ¹H NMR (300 MHz; CDCl₃) δ 0.58 (3H, d, *J* = 6.6 Hz), 0.96 (4H, m), 1.31 (1H, bs), 2.21 (2H, m), 3.12 (1H, dd, *J* = 11.7, 6.2 Hz), 3.32 (1H, dd, *J* = 11.6, 5.9 Hz), 3.86 (2H, m), 7.75 ~ 6.62 (13H, m); ¹³C NMR (75 MHz; CDCl₃) δ 16.2, 19.7, 29.6, 55.6, 70.7, 76.1, 77.2, 79.1, 119.7, 120.1, 126.3, 126.7, 127.2, 127.6, 128.2, 128.4, 128.7, 139.0, 141.9, 143.9, 147.0, and 148.7 (Found; C, 81.03; H, 7.07; N, 3.62 C₂₆H₂₇NO₂ requires C, 81.01; H, 7.06; N, 3.63 %).

(2S, 3S, 4S)-2-Methyl-3,4-dihydroxy-N-(9-phenylfluoren-9-yl) pyrrolidine (3e)

[α]_D – 76.3 (*c* 1.0, CHCl₃); IR (KBr): 3455, 3031, 2956 cm⁻¹; ¹H NMR (300 MHz; CDCl₃) δ 0.68 (3H, d, *J* = 6.4 Hz), 1.57 (1H, bs), 2.06 (1H, bs), 2.49 (1H, m), 3.08 (2H, m), 3.62 (1H, m), 3.89 (1H, m), 7.74 ~ 7.24 (13H, m); ¹³C NMR (75 MHz; CDCl₃) δ 19.9, 55.0, 62.1, 75.8, 77.2, 84.9, 119.9, 120.1, 126.0, 127.1, 127.3, 127.8, 128.3, 128.4, 128.5, 139.9, and 140.8 (Found; C, 80.66; H, 6.50; N, 3.91 C₂₄H₂₃NO₂ requires C, 80.64; H, 6.49; N, 3.92 %).

(2S, 3S, 4R)-2-Methyl-3,4-dihydroxy-N-(9-phenylfluoren-9-yl) pyrrolidine (4e)

[α]_D – 73.3 (*c* 1.0, CHCl₃); IR (KBr): 3425, 3014, 2984 cm⁻¹; ¹H NMR (300 MHz; CDCl₃) δ 0.66 (3H, d, *J* = 18.7 Hz), 1.93 (2H, bs), 2.48 (1H, m), 3.05 (2H, m), 3.60 (1H, t, *J* = 4.2 Hz), 3.87 (1H, m), 7.71 ~ 6.92 (13H, m); ¹³C NMR (75 MHz; CDCl₃) δ 20.0, 55.0, 61.9, 75.8, 77.2, 84.9, 119.9, 120.0, 126.0, 127.1,

127.1, 127.7, 128.2, 128.3, 128.4, 139.9, and 140.7 (Found; C, 80.65; H, 6.49; N, 3.91 C₂₄H₂₃NO₂ requires C, 80.64; H, 6.49; N, 3.92 %).

(2S, 3S, 4R)-2-Benzyl-3,4-diacetoxy-N-(9-phenylfluoren-9-yl) pyrrolidine (5)

[α]_D – 74.4 (*c* 2.1, CHCl₃); IR (KBr): 3028, 2984, 1741 cm⁻¹; ¹H NMR (300 MHz; CDCl₃) δ 1.59 (3H, s), 2.16 (3H, s), 2.58 ~ 2.43 (2H, m), 2.82 (1H, m), 3.28 (1H, dd, *J* = 11.9, 3.9 Hz), 3.66 (1H, dd, *J* = 11.9, 6.4 Hz), 4.82 (1H, m), 5.05 (1H, m), 7.56 ~ 6.63 (18H, m); ¹³C NMR (75 MHz; CDCl₃) δ 20.6, 21.1, 39.9, 53.3, 65.7, 75.9, 77.1, 79.6, 120.0, 120.1, 125.9, 126.6, 126.9, 127.2, 127.3, 127.4, 127.7, 128.1, 128.4, 128.5, 129.3, 138.5, 139.8, 141.1, 143.0, 147.2, 148.4, 169.5, and 170.1 (Found; C, 78.91; H, 6.05; N, 2.70 C₃₄H₃₁NO₄ requires C, 78.89; H, 6.04; N, 2.71 %).

(2S,3S,4S)-3-Acetoxy-4-benzoyl-2-(*p*-methoxybenzyl)-N-(9-phenylfluoren-9-yl) pyrrolidine (8)

[α]_D + 38.0 (*c* 1.7, CHCl₃); IR (KBr): 3063, 2924, 1737, 1722 cm⁻¹; ¹H NMR (300 MHz; CDCl₃) δ 1.62 (3H, s), 2.47 (1H, dd, *J* = 13.4, 3.4 Hz), 2.65 (1H, dd, *J* = 13.4, 10.7 Hz), 2.81 (1H, m), 3.41 (1H, dd, *J* = 12.0, 3.7 Hz), 3.73 (3H, s), 3.80 (1H, dd, *J* = 12.0, 6.3 Hz), 5.00 (1H, t, *J* = 1.8 Hz), 5.29 (1H, m), 8.13 ~ 6.54 (22H, m); ¹³C NMR (75 MHz; CDCl₃) δ 20.7, 39.4, 53.5, 55.1, 65.7, 76.1, 77.7, 79.6, 113.6, 119.9, 120.1, 126.7, 127.0, 127.3, 127.4, 127.7, 128.4, 128.5, 129.7, 129.8, 130.2, 130.6, 133.3, 139.7, 141.3, 143.0, 147.1, 148.6, 157.8, 165.7, and 169.5 (Found; C, 80.82; H, 5.74; N, 2.42 C₃₉H₃₃NO₄ requires C, 80.81; H, 5.74; N, 2.42 %).

(2S,3S,4R)-3-Acetoxy-2-benzyl-4-hydroxy-N-(9-phenylfluoren-9-yl) pyrrolidine (10)

[α]_D – 42.5 (*c* 0.45, CHCl₃); IR (KBr): 3046, 2956, 1742 cm⁻¹; ¹H NMR (300 MHz; CDCl₃) δ 1.68 (3H, s), 2.43 (2H, m), 2.97 (1H, m), 3.29 (1H, dd, *J* = 11.1, 5.4 Hz), 3.50 (1H, dd, *J* = 11.0, 6.6 Hz), 4.12 (1H, m), 4.53 (1H, t, *J* = 2.3 Hz), 7.78 ~ 6.62 (18H, m); ¹³C NMR (75 MHz; CDCl₃) δ 20.8, 39.4, 54.2, 65.3, 75.7, 76.1, 85.4, 120.1, 125.9, 126.5, 127.0, 127.1, 127.3, 127.5, 127.6, 128.2, 128.4, 128.5, 129.2, 138.7, 140.2, 140.8, 143.5, 147.5, 148.4, and 171.7 (Found; C, 80.83; H, 6.14; N, 2.94 C₃₂H₂₉NO₃ requires C, 80.82; H, 6.15; N, 2.95 %).

(2S,3S,4R)-3-Acetoxy-2-benzyl-4-hydroxy pyrrolidine (11)

[α]_D + 26.7 (*c* 1.0, MeOH); IR (KBr): 3046, 2956, 1764 cm⁻¹; ¹H NMR (300 MHz; CDCl₃) δ 2.03 (3H, s), 2.45 (2H, bs), 2.87 (1H, dd, *J* = 13.6, 8.3 Hz), 2.99 (2H, m), 3.12 (1H, dd, *J* = 12.0, 5.8 Hz), 3.29 (1H, m), 4.12 (1H, m), 4.52 (1H, dd, *J* = 5.9, 2.2 Hz), 7.25 (5H, m); ¹³C NMR (75 MHz; CDCl₃) δ 20.8, 39.4, 52.5, 64.2, 77.7, 86.9, 126.5, 128.5, 129.1, 138.2, and 172.1 (Found; C, 66.38; H, 7.27; N, 5.94 C₁₃H₁₇NO₃ requires C, 66.36; H, 7.28; N, 5.95 %).

References

1. Lee, W. S., Jang, K. C., Kim, J. H., Park, K. H. *Chem. Commun.* **1999**, 251.

Spectra 1. ¹H NMR of (2*S*, 3*S*, 4*S*)-3-Acetoxy-2-benzyl-4-iodo-*N*-(9-phenylfluoren-9-yl) pyrrolidine (2a).

Spectra 2. ¹³C NMR of (2*S*, 3*S*, 4*S*)-3-Acetoxy-2-benzyl-4-iodo-*N*-(9-phenylfluoren-9-yl) pyrrolidine (2a).

Spectra 3. ¹H NMR of (2S, 3S, 4S)-2-Benzyl-3,4-dihydroxy-N-(9-phenylfluoren-9-yl) pyrrolidine (3a)

Spectra 4. NOESY of (2S, 3S, 4S)-2-Benzyl-3,4-dihydroxy-N-(9-phenylfluoren-9-yl) pyrrolidine (3a)

Spectra 5. ¹H NMR of (2S, 3S, 4R)-2-Benzyl-3,4-dihydroxy-N-(9-phenylfluoren-9-yl) pyrrolidine (4a)

Spectra 6. NOESY of (2S, 3S, 4R)-2-Benzyl-3,4-dihydroxy-N-(9-phenylfluoren-9-yl) pyrrolidine (4a)

Spectra 7. ¹H NMR of (2S, 3S, 4S)-3,4-Dihydroxy-2-(p-methoxybenzyl)-N-(9-phenylfluoren-9-yl) pyrrolidine (3b).

Spectra 8. ¹H NMR of (2S, 3S, 4R)-3,4-Dihydroxy-2-(p-methoxybenzyl)-N-(9-phenylfluoren-9-yl) pyrrolidine (4b)

Spectra 9. ¹H NMR of (2S, 3S, 4S)-2-Benzyloxy methyl-3,4-dihydroxy-N-(9-phenylfluoren-9-yl) pyrrolidine (3c)

Spectra 10. ¹H NMR of (2S, 3S, 4R)-2-Benzyloxy methyl-3,4-dihydroxy-N-(9-phenylfluoren-9-yl) pyrrolidine (4c)

Spectra 11. ¹H NMR of (2*S*, 3*S*, 4*S*)-3,4-Dihydroxy-2-isopropyl-*N*-(9-phenylfluoren-9-yl) pyrrolidine (3d)

Spectra 12. ¹H NMR of (2*S*, 3*S*, 4*R*)-3,4-Dihydroxy-2-isopropyl-*N*-(9-phenylfluoren-9-yl) pyrrolidine (4d)

Spectra 13. ¹H NMR of (2*S*, 3*S*, 4*S*)-3,4-Dihydroxy-2-methyl-*N*-(9-phenylfluoren-9-yl) pyrrolidine (3e)

Spectra 14. ¹H NMR of (2*S*, 3*S*, 4*R*)-3,4-Dihydroxy-2-methyl-*N*-(9-phenylfluoren-9-yl) pyrrolidine (4e)

Spectra 15. ¹H NMR of (2S, 3S, 4R)-2-Benzyl-3,4-diacetoxy-N-(9-phenylfluoren-9-yl) pyrrolidine (5)

Spectra 16. ¹³C NMR of (2S, 3S, 4R)-2-Benzyl-3,4-diacetoxy-N-(9-phenylfluoren-9-yl) pyrrolidine (5)

Spectra 17. ¹H NMR of (2S,3S,4S)-3-Acetoxy-4-benzoxy-2-(*p*-methoxybenzyl)-*N*-(9-phenylfluoren-9-yl) pyrrolidine (8)

Spectra 18. ¹³C NMR of (2S,3S,4S)-3-Acetoxy-4-benzoxy-2-(*p*-methoxybenzyl)-*N*-(9-phenylfluoren-9-yl) pyrrolidine(8)

Spectra 19. HMBC of (2*S*,3*S*,4*S*)-3-Acetoxy-4-benzyloxy-2-(*p*-methoxy benzyl)-*N*-(9-phenylfluoren-9-yl) pyrrolidine (8)

Spectra 20. ^1H NMR of (2*S*,3*S*,4*S*)-3-Acetoxy-2-benzyl-4-hydroxy-*N*-(9-phenylfluoren-9-yl) pyrrolidine (10)

Spectra 21. ^1H NMR of (2*S*,3*S*,4*R*)-3-Acetoxy-2-benzyl-4-hydroxy pyrrolidine (11)