

REVISED**Supporting Information:****Applications of Aziridinium Ions. Selective Syntheses of β -Aryl- α,β -diamino Esters.****Tsung-Hsun Chuang and K. Barry Sharpless****Department of Chemistry and the Skaggs Institute for Chemical Biology,
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Reactions were monitored by TLC using pre-coated plates with a 0.2 mm layer of silica containing a fluorescent indicator (Merck Art. 5714-3). ^1H and ^{13}C NMR spectra were recorded on Bruker AMX-400 or DRX-500 spectrometers. Chemical shifts are reported relative to CHCl_3 [δ_{H} 7.25, δ_{C} (central line of t) 77.0]. The X-ray diffraction data were collected on a Rigaku AFC6S diffractometer with graphite monochromated $\text{Mo-K}\alpha$ radiation.

(2*R,3*S**)-Ethyl 2-hydroxy-3-morpholino-3-phenylpropionate (2):** Solid (diethyl ether), mp 89-91 °C; TLC (EtOAc/hexane (1:2)) R_f = 0.1; ^1H NMR (400 MHz, CDCl_3) δ 1.14 (t, J = 7.2 Hz, 3 H), 2.40-2.45 (m, 2 H), 2.52-2.55 (m, 2 H), 3.09 (br s, 1 H), 3.54 (d, J = 4.4 Hz, 1 H), 3.67-3.69 (m, 4 H), 3.98-4.08 (m, 2 H), 4.72 (d, J = 4.4 Hz, 1 H), 7.24-7.29 (m, 5 H); ^{13}C NMR (100 MHz, CDCl_3) δ 14.0, 51.4 (2 C), 61.4, 66.8 (2 C), 69.9, 72.1, 128.1 (2 C), 128.2, 129.1 (2 C), 135.4, 172.6; FAB-MS m/z (rel intensity) 280 (M^+ + 1, 35), 176 (100).

(2*S,3*R**)-Ethyl 3-chloro-2-morpholino-3-phenylpropionate (4):** Solid (CH_2Cl_2 /hexane), mp 66-67 °C; TLC (EtOAc/hexane (1:2)) R_f = 0.4; ^1H NMR (400 MHz, CDCl_3) δ 1.34 (t, J = 7.2 Hz, 3 H), 2.36-2.41 (m, 2 H), 2.58-2.63 (m, 2 H), 3.28-3.40 (m, 4 H), 3.69 (d, J = 10.8 Hz, 1 H), 4.00-4.33 (m, 2 H), 5.14 (d, J = 10.8 Hz, 1 H), 7.30-7.39 (m, 5 H); ^{13}C NMR (100 MHz, CDCl_3) δ 14.5, 50.0 (2 C), 59.1, 60.8, 67.0 (2 C), 73.5, 127.7 (2 C), 128.3 (2 C), 128.5, 138.4, 168.5; FAB-MS m/z (rel intensity) 298 (M^+ + 1, 40), 262 (M^+ - Cl, 40), 172 (81).

(2*S,3*R**)-Ethyl 3-butylamino-2-morpholino-3-phenylpropionate (5a):** An oil; TLC (EtOAc/hexane (1:2)) R_f = 0.2; ^1H NMR (400 MHz, CDCl_3) δ 0.80 (t, J = 7.2 Hz, 3 H), 1.23-1.26 (m, 7 H), 2.33-2.44 (m, 4 H), 2.57-2.62 (m, 2 H), 3.27 (d, J = 9.7 Hz, 1 H), 3.37-3.43 (m, 4 H), 3.93 (d, J = 9.7 Hz, 1 H), 4.11-4.22 (m, 2 H), 7.20-7.31 (m, 5 H); ^{13}C NMR (100 MHz, CDCl_3)

δ 13.8, 14.4, 20.2, 32.0, 47.0, 50.3 (2 C), 60.1, 61.2, 67.1 (2 C), 73.5, 127.0, 127.5 (2 C), 128.0 (2 C), 141.3, 170.6; FAB-MS: m/z (rel intensity) 335 ($M^+ + 1$, 30), 162 (100).

(2S*,3R*)-Ethyl 3-(1-methylethylamino)-2-morpholino-3-phenylpropionate (5b): Solid ($\text{CH}_2\text{Cl}_2/\text{hexane}$), mp 64-66 °C; TLC (EtOAc/hexane (1:2)) R_f = 0.2; ^1H NMR (400 MHz, CDCl_3) δ 0.87 (d, J = 6.2 Hz, 3 H), 0.94 (d, J = 6.2 Hz, 3 H), 1.26 (t, J = 7.2 Hz, 3 H), 2.40-2.45 (m, 2 H), 2.53-2.63 (m, 3 H), 3.25 (d, J = 9.7 Hz, 1 H), 3.34-3.45 (m, 4 H), 4.05 (d, J = 9.7 Hz, 1 H), 4.15-4.20 (m, 2 H), 7.20-7.32 (m, 5 H); ^{13}C NMR (100 MHz, CDCl_3) δ 14.4, 21.6, 24.3, 45.5, 50.3 (2 C), 58.5, 60.1, 67.1 (2 C), 73.9, 126.9, 127.4 (2 C), 128.0 (2 C), 141.7, 170.6; FAB-MS: m/z (rel intensity) 321 ($M^+ + 1$, 36), 148 (100).

(2S*,3R*)-Ethyl 3-(1,1-dimethylethylamino)-2-morpholino-3-phenylpropionate (5c): Solid ($\text{CH}_2\text{Cl}_2/\text{hexane}$), mp 69-70 °C; TLC (EtOAc/hexane (1:2)) R_f = 0.3; ^1H NMR (400 MHz, CDCl_3) δ 0.87 (s, 9 H), 1.27 (t, J = 7.0 Hz, 3 H), 2.37-2.42 (m, 2 H), 2.59-2.64 (m, 2 H), 3.26-3.29 (m, 2 H), 3.12 (d, J = 10.5 Hz, 1 H), 3.27-3.39 (m, 4 H), 4.09-4.20 (m, 3 H), 7.16-7.27 (m, 5 H); ^{13}C NMR (100 MHz, CDCl_3) δ 14.5, 30.4 (3 C), 50.3 (2 C), 51.0, 55.9, 59.9, 67.2 (2 C), 75.3, 126.5, 127.1 (2 C), 128.0 (2 C), 145.1, 170.5; FAB-MS m/z (rel intensity) 335 ($M^+ + 1$, 23), 162 (100); HRMS $[M + H]^+$ for $\text{C}_{19}\text{H}_{31}\text{N}_2\text{O}_3$: 335.2335, found 335.2330.

(2S*,3R*)-Ethyl 2-morpholino-3-phenyl-3-piperidinypropionate (5d): Solid ($\text{CH}_2\text{Cl}_2/\text{hexane}$), mp 106-108 °C; TLC (EtOAc/hexane (1:2)) R_f = 0.3; ^1H NMR (500 MHz, CDCl_3) δ 1.20-1.45 (m, 9 H), 2.00-2.15 (m, 2 H), 2.47-2.50 (m, 4 H), 2.58-2.61 (m, 2 H), 3.26-3.29 (m, 2 H), 3.86 (d, J = 11.8 Hz, 1 H), 4.01 (d, J = 11.8 Hz, 1 H), 4.21-4.24 (m, 2 H), 7.10-7.32 (m, 5 H); ^{13}C NMR (125 MHz, CDCl_3) δ 14.6, 24.4, 26.6 (2 C), 49.6 (2 C), 50.8, 50.9, 59.8, 67.2 (2 C), 68.0, 68.1, 127.0, 127.3 (2 C), 129.3 (2 C), 134.0, 171.1; FAB-MS m/z (rel intensity) 347 ($M^+ + 1$, 13), 174 (100); HRMS $[M + H]^+$ for $\text{C}_{20}\text{H}_{31}\text{N}_2\text{O}_3$: 347.2335, found 347.2339.

(2S*,3R*)-Ethyl 3-(4-phenylpiperazino)-2-morpholino-3-phenylpropionate (5e): Solid ($\text{CH}_2\text{Cl}_2/\text{hexane}$), mp 137-138 °C; TLC (EtOAc/hexane (1:4)) R_f = 0.28; ^1H NMR (400 MHz, CDCl_3) δ 1.31 (t, J = 7.0 Hz, 3 H), 2.35-2.37 (m, 2 H), 2.50-2.55 (m, 2 H), 2.60-2.65 (m, 2 H), 2.69-2.74 (m, 2 H), 3.00-3.10 (m, 4 H), 3.28-3.33 (m, 2 H), 3.42-3.47 (m, 2 H), 3.90 (d, J = 11.8 Hz, 1 H), 4.14 (d, J = 11.8 Hz, 1 H), 4.20-4.22 (m, 2 H), 6.80-6.82 (m, 3 H), 7.13-7.28 (m, 7 H); ^{13}C NMR (100 MHz, CDCl_3) δ 14.7, 49.4 (2 C), 49.6 (2 C), 49.7 (2 C), 59.9, 67.2 (2 C), 67.4, 67.9, 115.9 (2 C), 119.5, 127.3, 127.6 (2 C), 128.9 (2 C), 129.3 (2 C), 133.2, 151.3, 170.9;

FAB-MS m/z (rel intensity) 424 ($M^+ + 1$, 7), 251 (100); HRMS $[M + H]^+$ for $C_{25}H_{34}N_3O_3$: 424.2600, found 424.2612.

(2S*,3R*)-Ethyl 3-anilino-2-morpholino-3-phenylpropionate (5f): An oil; TLC (EtOAc/hexane (1:2)) R_f = 0.3; 1H NMR (400 MHz, $CDCl_3$) δ 0.94 (t, J = 7.2 Hz, 3 H), 2.53-2.60 (m, 4 H), 3.30 (d, J = 5.9 Hz, 1 H), 3.66-3.69 (m, 4 H), 3.81-3.95 (m, 2 H), 4.74 (d, J = 5.9 Hz, 1 H), 6.50-7.09 (m, 10 H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 13.7, 51.0 (2 C), 56.2, 60.5, 66.7 (2 C), 73.9, 113.2 (2 C), 117.3, 126.7 (2 C), 127.4, 128.4 (2 C), 129.0 (2 C), 139.4, 146.9, 170.3; FAB-MS m/z (rel intensity) 355 ($M^+ + 1$, 16), 182 (100); HRMS $[M + H]^+$ for $C_{21}H_{27}N_2O_3$: 355.2022, found 355.2024.

(2S*,3R*)-Ethyl 3-amino-2-morpholino-3-phenylpropionate (5g): An oil; TLC (EtOAc/hexane (4:1)) R_f = 0.1; 1H NMR (400 MHz, $CDCl_3$) δ 1.24 (t, J = 7.0 Hz, 3 H), 1.89 (br s, 2 H), 2.37-2.42 (m, 2 H), 2.62-2.67 (m, 2 H), 3.25 (d, J = 9.4 Hz, 1 H), 3.44-3.47 (m, 4 H), 4.13-4.22 (m, 2 H), 4.24 (d, J = 9.4 Hz, 1 H), 7.25-7.32 (m, 5 H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 14.5, 50.6, 54.0 (2 C), 60.3, 67.1 (2 C), 74.5, 126.9 (2 C), 127.2, 128.2 (2 C), 142.9, 170.8; FAB-MS m/z (rel intensity) 279 ($M^+ + 1$, 100), 262 (30), 107 (38); HRMS $[M + H]^+$ for $C_{15}H_{23}N_2O_5$: 279.1709, found 279.1706.