Supporting information

for

Synthesis of Heavily Substituted 1,2-Amino Alcohols in Enantiomerically Pure Form

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General Information. All reactions were carried out under an inert atmosphere. Dichlorometane was distilled under nitrogen from CaH_2 . Melting points have been determined by differential scanning calorimetry (DSC). Infrared spectra were recorded using NaCl film or KBr pellet techniques. ^1H chemical shifts are quoted relative to TMS and ^{13}C shifts relative to solvent signals. Carbons multiplicities have been assigned by distorsionless enhancement polarization transfer (DEPT) experiments. Commercial Jacobsen catalysts (*1R,2R*)-(-)-*N,N'*-Bis(3,5-di-*tert*-butylsalicylidene)-1,2-cyclohexanedi-aminomanganese (III) chloride was used throughout the present study.

General procedure for the olefin epoxidation (Scheme S-1)

Scheme S-1

A solution of NaClO (previously tritated and adjusted to pH = 11.3) was added dropwise to a solution of the olefin, (*R,R*)-Jacobsen's catalyst and 4-phenylpyridine N-oxide in anhydrous CH_2Cl_2 at 0 °C. When the reaction ceased to evolve, as determined by TLC, the solution was filtered with Celite[®]. The filtrate was washed with brine, the organic layer was dried (MgSO_4) and concentrated under vacuum. The residue was purified by column chromatography on silica gel/ NEt_3 2.5 % v/v (hexane and hexane/ethyl acetate 0.5 %).

(*S*)-3-(4-methoxyphenyl)-2,2-diphenyloxirane (11a). Prepared according to general procedure from a solution of 1-(2-(4-methoxyphenyl)-1-phenylvinyl)benzene (5.66 g, 19.77 mmol), (*R,R*)-Jacobsen's catalyst (0.61 g, 0.97 mmol), 4-phenylpyridine N-oxide (0.72 g, 4.21 mmol) in 20 mL of anhydrous CH_2Cl_2 and a solution of NaClO (0.57 M, pH = 11.3, 70 mL) for 3.5 hours. The desired product was

obtained as a yellow oil in 96 % yield (5.75 g, 19.01mmol). The product was recrystallized from diethyl ether to afford a crystalline solid of >99 % ee. Mp = 96 °C; $[\alpha]_D +69.7$ (c 1.04, CHCl₃); ¹H-NMR (400 MHz, CDCl₃) δ 7.37-7.19 (m, 10H), 6.93 (d, J = 9 Hz, 2H), 6.67 (d, J = 9 Hz, 2H), 4.26 (s, 1H), 3.73 (s, 3H) ppm; ¹³C-NMR (100 MHz, CDCl₃) δ 159.2 (C), 141.1 (C), 135.9 (C), 129.2 (CH), 128.3 (CH), 128.0 (CH), 127.9 (CH), 127.7 (CH), 127.5(3) (C), 127.5(1) (CH), 126.2 (CH), 113.2 (CH), 68.5 (C), 68.0 (CH), 55.1 (CH₃); IR (KBr) ν_{max} . 3028, 2860, 1516, 1447, 696 cm⁻¹; MS (ESI-TOF) m/z : 303 [(M⁺+1), 100%]; Anal. Cald for C₂₁H₁₈O₂: C 83.42, H 6.00 Found C 83.26, H 6.03; HPLC Daicel CHIRALCEL-ODR, MeOH, 0.5 mL/min, λ = 254 nm, t_R (S) = 12.6 min, t_R (R) = 15.6 min.

(S)-3-(4-fluorophenyl)-2,2-diphenyloxirane (11b). Prepared according to general procedure from a solution of 1-(2-(4-fluorophenyl)-1-phenylvinyl)benzene (4.44 g, 16.20 mmol), (*R,R*)-Jacobsen's catalyst (0.50 g, 0.79 mmol), 4-phenylpyridine N-oxide (0.59 g, 3.48 mmol) in 15 mL of anhydrous CH₂Cl₂ and a solution of NaClO (0.57 M, pH = 11.3, 57 mL) for 6 hours. The desired product was obtained as a yellow solid in 92 % yield (4.31 g, 14.84 mmol). The product was recrystallized from hexane to afford a crystalline solid of >99 % ee. Mp = 125 °C; $[\alpha]_D +66.8$ (c 1.07, CHCl₃); ¹H-NMR (400 MHz, CDCl₃) δ 7.37-7.17 (m, 10H), 7.05-6.95 (m, 2H), 6.83 (t, J =8 Hz, 2H), 4.30 (s, 1H), ppm; ¹³C-NMR (100 MHz, CDCl₃) δ 162.6 (C, J_F = 245 Hz), 141.0 (C), 135.9 (C), 131.6 (C, J_F = 3 Hz), 129.5 (CH), 128.7 (CH), 128.7 (CH, J_F = 8 Hz), 128.3 (CH), 128.2 (CH), 128.0 (CH), 126.6 (CH), 115.1 (CH, J_F = 21 Hz), 68.9 (C), 67.8 (CH) ppm; IR (KBr) ν_{max} . 3085, 1509, 1447, 762, 702 cm⁻¹; HRMS (ESI-TOF) calcd for C₂₀H₁₆FO: 291.1185, found 291.1198; Anal. Cald for C₂₀H₁₆FO: C 82.74, H 5.21 Found C 82.71, H 5.22; HPLC Daicel CHIRALCEL-ODR, MeOH/solution NaClO₄ 0.5M 90:10, 0.5 mL/min, λ = 254 nm, t_R (R) = 17.1 min, t_R (S) = 18.5 min.

(S)-3-biphenyl-2,2-diphenyloxirane (11c). Prepared according to general procedure from a solution of 2-biphenyl-4-yl-1,1-diphenyl-ethene (1.00 g, 3.01 mmol), (*R,R*)-Jacobsen's catalyst (93 mg, 0.15 mmol), 4-phenylpyridine N-oxide (109 mg, 0.64 mmol) in 2.5 mL of anhydrous CH₂Cl₂ and a solution

of NaClO (0.57 M, pH = 11.3, 10.6 mL) for 2.5 hours. The desired product was obtained as a pale-yellow solid in 86 % yield (0.91 g, 2.61 mmol), 86 % ee. The product was recrystallized from hexane to afford a crystalline solid of >99 % ee. Mp = 146 °C; $[\alpha]_D +62.33$ (c 1.00, CHCl₃); ¹H-NMR (400 MHz, CDCl₃) δ 7.52 (d, *J* = 8 Hz, 2H), 7.40-7.20 (m, 14H), 7.10 (d, *J* = 8 Hz, 3H), 4.35 (s, 1H) ppm; ¹³C-NMR (100 MHz, CDCl₃) δ 140.9 (C), 140.5 (C), 140.3 (C), 135.7 (C), 134.5 (C), 129.2 (CH), 128.7 (CH), 128.3 (CH), 127.9 (CH), 127.8 (CH), 127.6 (CH), 127.3 (CH), 127.2 (CH), 126.9 (CH), 126.4 (CH), 126.3 (CH), 68.7 (C), 68.0 (CH) ppm; IR (KBr) ν_{max} . 3424, 3027, 1488, 1448, 700 cm⁻¹; MS (CI-NH₃) *m/z*: 348 [(M⁺+1), 100%]; Anal. Calcd for C₂₆H₂₀O: C 89.62, H 5.79 Found C 89.46, H 5.73; HPLC Daicel CHIRALCEL-ODR. MeOH, 0.5 mL/min, λ = 254 nm, *t_R* (*R*) = 16.9 min, *t_R* (*S*) = 24.7 min.

(*S*)-3-(3,5-dimethylphenyl)-2,2-diphenyloxirane (11d). Prepared according to general procedure from a solution of 1-(2-(3,5-dimethylphenyl)-1-phenylvinyl)benzene (600 mg, 2.11 mmol), (*R,R*)-Jacobsen's catalyst (66 mg, 0.10 mmol), 4-phenylpyridine N-oxide (77 mg, 0.45 mmol) in 3 mL of anhydrous CH₂Cl₂ and a solution of NaClO (0.50 M, pH = 11.3, 8.5 mL) for 16 hours. The desired product was obtained as a colorless oil in 44 % yield (277 mg, 0.92 mmol), 70 % ee. $[\alpha]_D +28.05$ (c 0.98, CHCl₃); ¹H-NMR (400 MHz, CDCl₃) δ 7.39-7.18 (m, 10H), 6.78 (s, 1H), 6.63 (s, 1H), 4.24 (s, 1H), 2.14 (s, 6H) ppm; ¹³C-NMR (100 MHz, CDCl₃) δ 141.3 (C), 137.3 (C), 136.1 (C), 135.4 (C), 129.4 (CH), 129.3 (CH), 128.4 (CH), 127.9 (CH), 127.8 (CH), 127.6 (CH), 127.5 (CH), 124.8 (CH), 68.7 (C), 68.2 (CH), 21.2 (CH₃) ppm; IR (film) ν_{max} . 3028, 2917, 1605, 1493, 1447 cm⁻¹; MS (EI) *m/z*: 300 [(M⁺), 9.12%]; HRMS (EI) calcd for C₂₂H₂₀O: 300.1514, found 300.1505; HPLC Daicel CHIRALCEL-OD, Hexane/*i*-PrOH 95:5, 0.5 mL/min, λ = 254 nm, *t_R* (*S*) = 8.4 min, *t_R* (*R*) = 10.6 min.

General procedure for the epoxide ring opening (Scheme S-2)

Scheme S-2

A pressure tube equipped with a magnetic stir bar was charged with the appropriate epoxide, allylamine and LiClO₄. The suspension was heated to 120 °C until the epoxide was consumed as determined by TLC. The resulting solution solidified when cooled to room temperature. The crude was dissolved with CH₂Cl₂ and the organic layer was washed successively with brine. The organics were then dried (MgSO₄) and removed together with the amine under vacuum. The desired β -aminoalcohol was obtained in a quantitative yield and purified by silica gel chromatography (hexane/ethyl acetate) if necessary.

(*R*)-2-(allylamino)-2-(4-methoxyphenyl)-1,1-diphenylethanol (12a). Prepared according to general procedure from (*S*)-3-(4-methoxyphenyl)-2,2-diphenyloxirane **11a** (0.250 g, 0.83 mmol), LiClO₄ (0.176 g, 1.65 mmol) and allylamine (0.62 mL, 8.27 mmol) in a 15 mL pressure tube. The suspension was then stirred at 120 °C overnight. The pure product was obtained as a white solid in 99 % yield (0.290 g, 0.81 mmol). Mp = 129 °C; [α]_D +159.9 (*c* 1.00, CHCl₃); ¹H-NMR (400 MHz, CDCl₃) δ 7.69 (d, *J* = 7 Hz, 2H), 7.40-6.97 (m, 10H), 6.65 (d, *J* = 9 Hz, 2H), 5.78 (m, 1H), 5.04 (d, *J* = 9 Hz, 1H), 4.98 (dd, *J* = 17 Hz, *J'* = 1 Hz, 1H), 4.63 (s, 1H), 4.30 (broad s, 1H), 3.73 (s, 3H), 3.09 (dd, *J* = 14 Hz, *J'* = 5 Hz, 1H), 2.95 (dd, *J* = 14 Hz, *J'* = 7 Hz, 1H), 1.56 (broad s, 1H) ppm; ¹³C-NMR (100 MHz, CDCl₃) δ 158.6 (C), 145.9 (C), 144.0 (C), 136.2 (CH), 130.5 (CH), 129.4 (CH), 128.4 (CH), 127.3 (CH), 127.1 (CH), 126.6 (CH), 126.1 (CH), 126.1 (CH), 116.3 (C), 112.8 (CH), 79.9 (C), 67.5 (CH), 55.1 (CH₃), 49.3 (CH₂) ppm; IR (KBr) ν_{max} . 3443, 2927, 1611, 1513 cm⁻¹; MS (CI-NH₃) *m/z*: 360.1 [(M+1)⁺, 8.7 %], 175.8 [(C₁₁H₁₄NO)⁺, 100 %]; Anal. Calcd for C₂₄H₂₅NO₂: C 80.19, H 7.01, N 3.90 Found C 80.40, H 6.93, N 3.74.

(*R*)-2-(allylamino)-2-(4-fluorophenyl)-1,1-diphenylethanol (12b). Prepared according to general procedure from (*S*)-3-(4-fluorophenyl)-2,2-diphenyloxirane **11b** (250 mg, 0.86 mmol), LiClO₄ (183 mg, 1.72 mmol) and allylamine (0.65 mL, 8.61 mmol) in a 15 mL pressure tube. The suspension was then stirred at 120 °C overnight. The product was obtained as a yellow solid in 95% yield (285 mg, 0.8 mmol). Mp = 133 °C; [α]_D +194.4 (*c* 1.04, CHCl₃); ¹H-NMR (400 MHz, CDCl₃) δ 7.69 (dd, *J* = 9 Hz, *J'* = 1 Hz, 2H), 7.40-6.80 (m, 12H), 5.77 (m, 1H), 5.05 (d, *J* = 10 Hz, 1H), 4.97 (d, *J* = 17 Hz, 1H), 4.17 (s, 1H), 3.09 (dd, *J* = 14 Hz, *J'* = 5 Hz, 1H), 2.94 (dd, *J* = 15 Hz, *J'* = 7 Hz, 1H), 1.60 (broad s, 2H) ppm; ¹³C-NMR (100 MHz, CDCl₃) δ 162.0 (C, *J_F* = 244 Hz), 145.7 (C), 143.7 (C), 135.9 (CH), 133.1 (C, *J_F* = 3 Hz), 131.0 (CH, *J_F* = 8 Hz), 128.6 (CH), 127.4 (CH), 127.3 (CH), 126.6 (CH), 126.3 (CH), 125.9 (CH), 116.6 (CH₂), 114.2 (CH, *J_F* = 21 Hz), 79.9 (C), 67.3 (CH), 49.3 (CH₂) ppm; IR (KBr) ν_{max} . 3432, 3058, 2920, 1602, 1508 cm⁻¹. MS (CI-NH₃) *m/z*: 348.3 [(M⁺+1), 65%], 163.9 [(C₁₀H₁₁NF⁺), 100%]; Anal. Calcd for C₂₃H₂₂FNO: C 79.51, H 6.38, N 4.03 Found C 79.24, H 6.29, N 3.91.

(*R*)-2-(allylamino)-2-biphenyl-1,1-diphenylethanol (12c). Prepared according to general procedure from (*S*)-3-biphenyl-2,2-diphenyloxirane **11c** (150 mg, 0.45 mmol), LiClO₄ (96 mg, 0.90 mmol) and allylamine (0.34 mL, 4.51 mmol) in a 15 mL pressure tube. The suspension was then stirred at 120 °C for 3.5 days. The pure product was obtained as a white solid in 75% yield (137 mg, 0.3 mmol) after purification by silica gel. Mp = 142 °C; [α]_D +196.2 (*c* 1.02, CHCl₃); ¹H-NMR (400 MHz, CDCl₃) δ 7.72 (d, *J* = 7 Hz, 2H), 7.54 (d, *J* = 7 Hz, 2H), 7.42-7.25 (m, 8H), 7.13 (m, 4H), 7.03 (m, 3H), 5.81 (m, 1H), 5.08 (d, *J* = 10 Hz, 1H), 5.02 (d, *J* = 18 Hz, 1H), 4.72 (s, 1H), 4.32 (broad s, 1H), 3.15 (dd, *J* = 15 Hz, *J'* = 5 Hz, 1H), 3.01 (dd, *J* = 14 Hz, *J'* = 7 Hz, 1H), 1.56 (broad s, 1H) ppm; ¹³C-NMR (100 MHz, CDCl₃) δ 146.2 (C), 144.2 (C), 141.1 (C), 140.2 (C), 137.0 (C), 136.5 (CH), 130.2 (CH), 129.0 (CH), 128.9 (CH), 127.7 (CH), 127.6 (CH), 127.5 (CH), 127.3 (CH); 127.0 (CH), 126.6 (CH), 126.5 (CH), 126.4 (CH), 116.8 (CH₂), 79.9 (C), 68.3 (CH), 49.8 (CH₂) ppm; IR (KBr) ν_{max} . 3394, 3029, 1597, 1411 cm⁻¹; MS (CI-NH₃) *m/z*: 406.2 [(M+1)⁺, 93.9 %], 222.1 [(C₁₆H₁₆N)⁺, 100 %]; Anal. Calcd for C₂₉H₂₇NO: C 85.89, H 6.71, N 3.45 Found C 86.20, H 6.37, N 3.35.

(R)-2-(allylamino)-2-(3,5-dimethylphenyl)-1,1-diphenylethanol (12d). Prepared according to general procedure from (S)-3-(3,5-dimethylphenyl)-2,2-diphenyloxirane **11d** (162 mg, 0.54 mmol), LiClO₄ (114 mg, 1.08 mmol) and allylamine (0.4 mL, 5.39 mmol) in a 15 mL pressure tube. The suspension was then stirred at 120 °C for 40 hours. The product was obtained as a white solid in 90% yield (172 mg, 0.48 mmol) after purification by silica gel. Mp = 81-82 °C; [α]_D +119.3 (*c* 1.00, CHCl₃); ¹H-NMR (400 MHz, CDCl₃) δ 7.68 (d, *J* = 8 Hz, 2H), 7.38 (t, *J* = 8 Hz), 7.27 (t, *J* = 8 Hz, 1H), 7.13-6.98 (m, 5H), 6.76 (s, 1H), 6.63 (s, 2H), 5.80 (m, 1H), 5.03 (m, 2H), 4.57 (s, 1H), 4.31 (broad s, 1H), 3.12 (dd, *J*₁ = 14 Hz, *J*₂ = 5 Hz, 1H), 2.99 (dd, *J*₁ = 14 Hz, *J*₂ = 7 Hz, 1H), 2.14 (s, 6H) ppm; ¹³C-NMR (100 MHz, CDCl₃) δ 145.9 (C), 144.2 (C), 137.5 (C), 136.8 (CH), 136.5 (C), 128.9 (CH), 128.5 (CH), 127.5 (CH), 127.3 (CH), 127.2 (CH), 126.9 (CH), 126.5 (CH), 126.3 (CH), 116.4 (CH₂), 80.0 (C), 68.4 (CH), 49.8 (CH₂), 21.3 (CH₃) ppm; IR (KBr) ν_{max} . 3471, 2917, 1602, 1448, 669 cm⁻¹; MS (CI-CH₄) *m/z*: 358.5 [(M+1)⁺, 80.5 %], 340.5 [(C₂₅H₂₆N)⁺, 61.0 %]; HRMS (CI-CH₄): calcd for C₂₅H₂₇NO (M + H⁺) 358.2171, found 358.2166.

General procedure for the amine deprotection (Scheme S-3)

Scheme S-3

The appropriate β -aminoalcohol, methanesulfonic acid, palladium on charcoal 10 % and water were added to a two-necked roundbottomed-flask. The mixture was heated under reflux overnight. A slow flow of argon passed through the solution to aid removal of propionaldehyde. The solution was then basified with NaOH to pH 10 and a white solid appears. Celite[®] was used to filter off the Pd/C and was washed with CH₂Cl₂. The organic layer was extracted with brine, dried (MgSO₄) and concentrated under vacuum. The residue was purified by column chromatography on silica gel (hexane/ethyl acetate).

(*R*)-2-amino-2-(4-methoxyphenyl)-1,1-diphenylethanol (13a). Prepared according to general procedure from (*R*)-2-(allylamino)-2-(4-methoxyphenyl)-1,1-diphenylethanol **12a** (200 mg, 0.57 mmol), methanesulfonic acid (75 μ L, 1.15 mmol), 10 % Pd/C (79 mg) and water (7 mL) to provide the pure product as a white solid in 61 % yield (110 mg, 0.34 mmol). Mp = 166 °C; $[\alpha]_D^{25} +240.8$ (*c* 1.04, CHCl₃); ¹H-NMR (400 MHz, CDCl₃) δ 7.74 (d, *J* = 9 Hz, 2H), 7.40-7.00 (m, 10H), 6.65 (d, *J* = 9 Hz, 2H), 4.97 (s, 1H), 3.72 (s, 3H), 1.55 (broad s, 2H) ppm; ¹³C-NMR (100 MHz, CDCl₃) δ 158.6 (C), 146.6 (C), 144.0 (C), 132.2 (C), 129.6 (CH), 128.5 (CH), 127.4 (CH), 126.9 (CH), 126.5 (CH), 126.2 (CH), 126.0 (CH), 112.8 (CH), 79.5 (C), 61.1 (CH), 55.1 (CH₃) ppm; IR (KBr) ν_{max} . 3375, 2904, 2830, 1610, 1514 cm⁻¹. MS (CI-NH₃) *m/z*: 320.1 [(M⁺+1), 11%], 135.8 [(C₈H₁₀NO⁺), 100%]; Anal. Calcd for C₂₁H₂₁NO₂: C 78.97, H 6.63, N 4.39 Found C 78.98, H 6.43, N 4.25.

(*R*)-2-amino-2-(4-fluorophenyl)-1,1-diphenylethanol (13b). Prepared according to general procedure from (*R*)-2-(allylamino)-2-(4-fluorophenyl)-1,1-diphenylethanol **12b** (100 mg, 0.29 mmol), methanesulfonic acid (37 μ L, 0.57 mmol), 10 % Pd/C (39 mg) and water (4 mL) to provide the pure

product as a white solid in 74 % yield (65 mg, 0.21mmol). Mp = 69-71 °C; $[\alpha]_D +190.3.6$ (*c* 1.00, CHCl₃); ¹H-NMR (400 MHz, CDCl₃) δ 7.74 (d, *J* = 7 Hz, 2H), 7.40 (t, *J* = 8 Hz, 2H), 7.28 (t, *J* = 8 Hz, 2H), 7.13-6.98 (m, 6H), 5.00 (s, 1H), 1.58 (broad s, 2H) ppm; ¹³C-NMR (100 MHz, CDCl₃) δ 161.9 (C, *J_F* = 244 Hz), 146.2 (C), 143.7 (C), 135.7 (C), 130.1 (CH, *J_F* = 8 Hz), 128.6 (CH), 127.4 (CH), 127.1 (CH), 126.4 (CH), 126.3 (CH), 125.9 (CH), 114.2 (CH, *J_F* = 21 Hz), 79.5 (C), 61.0 (CH) ppm; IR (KBr) ν_{max} . 3370, 3058, 2361, 1652, 1509 cm⁻¹; MS (CI-NH₃) *m/z*: 308.1 [(M⁺+1, 5.6%), 123.8 (C₇H₇FN⁺, 100%)]]; HRMS (CI-CH₄); calcd for C₂₀H₁₈FNO (M + H⁺) 308.1451, found 308.1443.

(*R*)-2-amino-2-biphenyl-1,1-diphenylethanol (13c). Prepared according to general procedure from (*R*)-2-(allylamino)-2-biphenyl-1,1-diphenylethanol **12c** (75 mg, 0.18 mmol), methanesulfonic acid (24 μ L, 0.37 mmol), 10 % Pd/C (25 mg) and water (5 mL) to provide the pure product as a white solid in 64 % yield (39 mg, 0.11 mmol). Mp = 168 °C; $[\alpha]_D +241.6$ (*c* 1.01, CHCl₃); ¹H-NMR (400 MHz, CDCl₃) δ 7.76 (d, *J* = 8 Hz, 2H), 7.53 (d, *J* = 8 Hz, 2H), 7.44-6.95 (m, 15H), 5.06 (s, 1H), 4.66 (broad s, 1H), 1.55 (broad s, 2H) ppm; ¹³C-NMR (100 MHz, CDCl₃) δ 146.4 (C), 143.8 (C), 140.7 (C), 139.9 (C), 139.2 (C), 129.0 (CH), 128.6 (CH), 128.5 (CH), 127.4 (CH), 127.1 (CH), 127.0 (CH), 126.9 (CH), 126.5 (CH), 126.3 (CH), 126.0 (CH) ppm; IR (KBr) ν_{max} 3379, 3031, 1489, 1448, 746 cm⁻¹; MS (CI-NH₃) *m/z*: 366.2 [(M⁺+1), 57%, 182.0 (C₁₃H₁₂N⁺), 100%]; Anal. Cald for C₂₆H₂₃NO: C 85.89, H 6.71, N 3.45 Found C 86.20, H 6.37, N 3.35.

(*R*)-2-amino-2-(3,5-dimethylphenyl)-1,1-diphenylethanol (13d). Prepared according to general procedure from (*R*)-2-(allylamino)-2-(3,5-dimethylphenyl)-1,1-diphenylethanol **12d** (71 mg, 0.20 mmol), methanesulfonic acid (26 μ L, 0.40 mmol), 10 % Pd/C (30 mg) and water (3 mL) to provide the pure product as a white solid in 66 % yield (38 mg, 0.12mmol). Mp = 132-135 °C; $[\alpha]_D +141.4$ (*c* 1.00, CHCl₃); ¹H-NMR (400 MHz, CDCl₃) δ 7.73 (d, *J* = 8 Hz, 2H), 7.39 (t, *J* = 8 Hz, 2H), 7.27 (t, *J* = 7 Hz, 2H), 7.13-6.98 (m, 4H), 6.76 (s, 1H), 6.69 (s, 2H), 4.92 (s, 1H), 2.14 (s, 6H); ¹³C-NMR (100 MHz,

CDCl₃) δ 146.6 (C), 144.1 (C), 140.0 (C), 136.9 (C), 128.8 (CH), 128.6 (CH), 127.4 (CH), 127.1 (CH), 126.7 (CH), 126.6 (CH), 126.4 (CH), 126.3 (CH), 79.7 (C), 61.8 (CH), 21.3 (CH₃) ppm; IR (KBr) ν_{max} 3389, 3024, 2916, 1602, 1448 cm⁻¹; MS (CI-CH₄) m/z : 318.4 [(M⁺+1), 100%]; HRMS (CI-CH₄): calcd for C₂₂H₂₃NO (M + H⁺) 318.1858, found 318.1857.

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$^1\text{H-NMR}$ (400 MHz, CDCl_3)

$^{13}\text{C-NMR}$ (100 MHz, CDCl_3)

$^1\text{H-NMR}$ (400 MHz, CDCl_3)

$^{13}\text{C-NMR}$ (100 MHz, CDCl_3)

12d

$^1\text{H-NMR}$ (400 MHz, CDCl_3)

$^{13}\text{C-NMR}$ (100 MHz, CDCl_3)

13b

$^1\text{H-NMR}$ (400 MHz, CDCl_3)

$^{13}\text{C-NMR}$ (100 MHz, CDCl_3)

13d

$^1\text{H-NMR}$ (400 MHz, CDCl_3)

$^{13}\text{C-NMR}$ (100 MHz, CDCl_3)