Supplementary Information

Iridium and $B(C_6F_5)_3$ co-catalyzed chemoselective deoxygenative reduction of tertiary amides: application to the efficient synthesis and late-stage modification of pharmaceuticals

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1. General Information

General Methods. Melting points were determined on a Büchi M560 Automatic Melting Point apparatus and are uncorrected. Infrared spectra were measured with a Nicolet Avatar 360 FT-IR spectrometer using film KBr pellet techniques. ^{1}H NMR and ^{13}C NMR spectra were recorded on a Bruker spectrometer at 400 and 100 MHz, respectively. Chemical shifts (δ) are reported in ppm and respectively referenced to internal standard Me_4Si and solvent signals (Me_4Si, 0 ppm for ^{1}H NMR and $CDCl_3$, 77.0 ppm for ^{13}C NMR). Mass spectra were recorded on a Bruker Dalton ESquire 3000 plus LC-MS apparatus (ESI direct injection). HRMS spectra were recorded on a 7.0T FT-MS apparatus. Silica gel (300-400 mesh) was used for flash column chromatography, eluting (unless otherwise stated) with EtOAc/ *n*-hexane mixture. Toluene were distilled over sodium benzophenone ketyl under N_2.

2. General Procedure for the Reduction of *tert*-Amides by Ir and $B(C_6F_5)_3$ Co-catalysis

General Procedure A:

A 0.3 mL of a 0.1 M solution of $[IrCl(CO)(PPh_3)_2]$ in toluene {prepared by addition of $[IrCl(CO)(PPh_3)_2]$ (7.8 mg, 0.02 mmol) to toluene (10 mL)} and $B(C_6F_5)_3$ (12 mg, 0.02 mmol, 2 mol %) were added to a dried 10-mL round-bottom flask equipped with a magnetic stirring. A *tert*-amide (1.0 mmol, 1.0 equiv) in toluene (5 mL) and 1,1,3,3-tetramethyldisiloxane (0.36 mL, 2.0 mmol, 2.0 equiv) were successively added to the flask at room temperature. After been stirred for 10 min to 2 hours, the reaction mixture was concentrated under reduced pressure, and the residue was purified by flash column chromatography (FC) on silica gel to afford the desired amine.

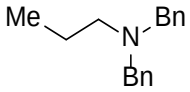
General Procedure B:

0.3 mL of a 0.1 M solution of $[IrCl(CO)(PPh_3)_2]$ in toluene was added to a dried 10-mL round-bottom flask equipped with a magnetic stirring. A *tert*-amide (1.0 mmol, 1.0 equiv) in toluene (4 mL) and 1,1,3,3-tetramethyldisiloxane (0.36 mL, 2.0 mmol, 2.0

equiv) were successively added to the flask at room temperature. After been stirred for 10 min to 30 min, $B(C_6F_5)_3$ (12 mg, 0.02 mmol, 2 mol %) in toluene (1 mL) was added, the reaction mixture was stirred for 20-60 min until all starting materials consumed. The reaction mixture was concentrated under reduced pressure, and the residue was purified by flash column chromatography (FC) on silica gel to afford the desired amine.

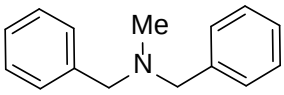
3. Characterization of Compounds

***N,N*-Dibenzylpropan-1-amine (2a)**



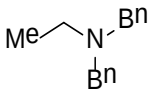
Following general procedure A, the reduction of *tert*-amide **1a** (253 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 100), amine **2a** (229 mg, yield: 96%) as a colorless oil; IR (film) ν_{max}: 3022, 2985, 2782, 1494, 1369, 1065 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 0.83 (t, J = 7.1 Hz, 3H), 1.44−1.55 (m, 2H), 2.36 (t, J = 7.2 Hz, 2H), 3.52 (s, 4H), 7.15-7.20 (m, 2H), 7.22-7.30 (m, 4H), 7.31-7.41 (m, 4H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 11.8, 20.2, 55.4, 58.3 (2C), 126.7 (2C), 128.1 (4C), 128.7 (4C), 140.0 (2C) ppm; MS (ESI, *m*/*z*): 240 ($M + H^+$). Analytical data match those reported in the literature. [1]

***N*-Benzyl-*N*-methyl-1-phenylmethanamine (2b)**



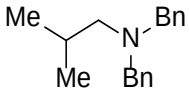
Following general procedure A, the reduction of *tert*-amide **1b** (225 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 100), amine **2b** (206 mg, yield: 98%) as a colorless oil; IR (film) ν_{max}: 3085, 3027, 2785, 1494, 1260, 1076, 1024, 803, 698 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 2.31 (s, 3H), 3.65 (s, 4H), 7.34-7.54 (m, 10H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 42.2, 61.8 (2C), 126.9 (2C), 128.2 (4C), 128.9 (4C), 139.2 (2C) ppm; MS (ESI, *m*/*z*): 211 ($M + H^+$). Analytical data match those reported in the literature. [2]

***N,N*-Dibenzylethanamine (2c)**



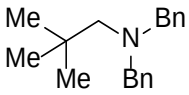
Following general procedure A, the reduction of *tert*-amide **1c** (239 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 80), amine **2c** (220 mg, yield: 98%) as a pale yellow oil; IR (film) ν_{max}: 3058, 3025, 2985, 2782, 1494, 1369, 1230 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.12 (t, J = 7.0 Hz, 3H), 2.55 (q, J = 7.0 Hz, 2H), 3.61 (s, 4H), 7.43-7.27 (m, 10H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 11.9, 47.0, 57.7 (2C), 126.7(2C), 128.1 (4C), 128.7 (4C), 140.0 (2C) ppm; MS (ESI, *m*/*z*): 226 ($M + H^+$). Analytical data match those reported in the literature. [3]

***N,N*-Dibenzyl-2-methylpropan-1-amine (2d)**



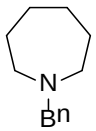
Following general procedure A, the reduction of *tert*-amide **1d** (267 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 90), amine **2d** (247 mg, yield: 98%) as a colorless oil; IR (film) ν_{max}: 3025, 2959, 2801, 1453, 1369, 1065 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 0.85 (d, J = 6.6 Hz, 6H), 1.80-1.90 (m, 1H); 2.15 (d, J = 7.4 Hz, 2H); 3.51 (s, 4H); 7.17-7.38 (m, 10H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 20.8 (2C), 26.2, 58.9 (2C), 62.2, 126.7 (2C), 128.1 (4C), 128.8 (4C), 140.1 (2C) ppm; MS (ESI, *m*/*z*): 254 ($M + H^+$). Analytical data match those reported in the literature. [4]

***N,N*-Dibenzyl-2,2-dimethylpropan-1-amine (2e)**



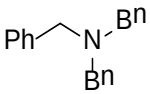
Following general procedure A, the reduction of *tert*-amide **1e** (268 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 50), amine **2e** (246 mg, yield: 97%) as a pale yellow oil; IR (film) ν_{max}: 3085, 3062, 2952, 2864, 2794, 1478, 1338, 1259, 1105, 1027, 744 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 0.67 (s, 9H), 1.80-1.90 (m, 1H), 2.20 (s, 2H), 3.47 (s, 4H), 7.07-7.28 (m, 10H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 28.4 (3C), 33.0, 60.8 (2C), 65.8, 126.7 (2C), 128.2 (4C), 129.1 (4C), 140.2 (2C) ppm; MS (ESI, *m*/*z*): 267 ($M + H^+$). Analytical data match those reported in the literature. [5]

1-Benzylazepane (2f)



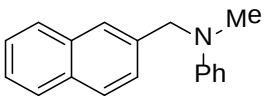
Following general procedure A, the reduction of lactam **1f** (203 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 10), 1-benzylazepane **2f** (168mg, yield: 89%) as a colorless oil; IR (film) ν_{max}: 3021, 2921, 2847, 2979, 1490, 1453, 1353 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.55-1.67 (m, 8H), 2.56-2.68 (m, 4H), 3.69 (s, 2H), 7.21-7.49 (m, 5H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 27.0 (2C), 28.2 (2C), 55.6 (2C), 62.7, 126.6, 128.0 (2C), 128.7 (2C), 140.0 ppm; MS (ESI, *m/z*): 190 ($M + H^+$). Analytical data match those reported in the literature. [3]

Tribenzylamine (2g)



Following general procedure A, the reduction of *tert*-amide **1g** (302 mg, 1.0 mmol) gave, after after FC (eluent: EtOAc/*n*-hexane = 1: 100), amine **2g** (282 mg, yield: 98%) as a white solid; M.p. 86.4-88.0 °C (Lit.[3] m.p. 90-94 °C); IR (film) ν_{max}: 3082, 3062, 3028, 2925, 2881, 2837, 2802, 1603, 1493, 1452, 1366, 1247, 1122, 1028 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.55 (s, 6H), 7.18-7.26 (m, 3H), 7.26-7.35 (m, 6H), 7.37-7.43 (m, 6H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 57.9 (3C), 126.9 (3C), 128.2 (6C), 128.8 (6C), 139.7 (3C) ppm; MS (ESI, *m/z*): 288 ($M + H^+$). Analytical data match those reported in the literature. [3]

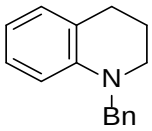
***N*-Methyl-*N*-(naphthalen-2-ylmethyl)aniline (2h)**



Following general procedure B, the reduction of *tert*-amide **1h** (261 mg, 1 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 20), amine **2h** (240 mg, yield: 97%) as a colorless oil; IR (film) ν_{max}: 3052, 2962, 2819, 1598, 1505, 1367, 1119, 939, 812, 747 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.02 (s, 3H), 4.63 (s, 2H), 6.66-6.83 (m, 3H), 7.17-7.28 (m, 2H), 7.30-7.50 (m, 3H), 7.60-7.69 (m, 1H), 7.71-7.85 (m, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 38.6, 57.1, 112.5, 112.6, 116.8, 125.2, 125.3, 125.6, 126.2, 127.7,

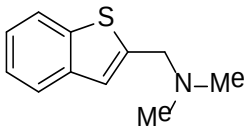
128.4, 129.3, 132.8, 133.6, 136.7, 149.9 ppm; MS (ESI, *m*/*z*): 247 (M + H^+). Analytical data match those reported in the literature. [5]

Benzyl-1,2,3,4-tetrahydroquinoline (2i)



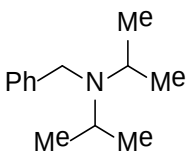
Following general procedure A, the reduction of dihydroquinolin-2-one **1i** (242 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 10), tetrahydroquinoline **2i** (218 mg, yield: 98%) as a red oil; IR (film) ν_{max}: 3061, 2926, 2840, 1601, 1505, 1451, 1039, 743, 695 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 1.93-2.06 (m, 2H), 2.80 (t, J = 6.3 Hz, 2H), 3.34 (t, J = 5.6 Hz, 2H), 4.46 (s, 2H), 6.45-6.58 (m, 2H), 6.90-6.99 (m, 2H), 7.20-7.34 (m, 5H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 22.4, 28.2, 49.8, 55.2, 110.9, 115.8, 122.2, 126.5, 126.7, 127.1, 128.5, 128.9, 138.9, 145.6 ppm; MS (ESI, *m*/*z*): 224 (M + H^+). Analytical data match those reported in the literature. [6]

1-(Benzo[b]thiophen-2-yl)-*N*,*N*-dimethylmethanamine (2j)



Following general procedure B, the reduction of *tert*-amide **1j** (205 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 3), amine **2j** (137 mg, yield: 72%) as a colorless oil; ^1H NMR (400 MHz, $CDCl_3$) δ 2.36 (s, 6H), 3,75 (s, 2H), 7.17 (s, 1H), 7.29-7.40 (m, 2H), 7.74 (d, J = 7.5 Hz, 2H), 7,84 (d, J = 7.5 Hz, 2H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 45.1 (2C), 59.0, 121.9, 122.2, 122.9, 123.8, 123.9, 139.5, 139.9, 143.7 ppm; MS (ESI, *m*/*z*): 191 (M + H^+). Analytical data match those reported in the literature. [7]

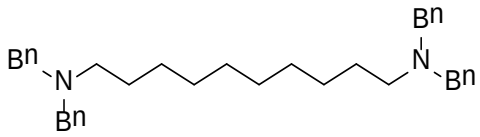
***N*-benzyl-*N*-isopropylpropan-2-amine (2k)**



Following general procedure A, the reduction of *tert*-amide **1k** (206 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 50), amine **2k** (192 mg, yield: 72%) as a

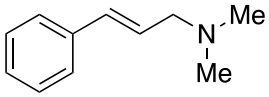
pale yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.02 (d, J = 6.6 Hz, 12H), 3.01 (sep, J = 6.6 Hz, 2H), 3.64 (s, 2H), 7.15-7.39 (m, 5H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 20.8 (4C), 47.8 (2C), 48.9, 126.1, 127.8 (2C), 127.9 (2C), 143.3 ppm; MS (ESI, m/z): 192 ($M+H^+$). Analytical data match those reported in the literature. [3]

***N*^{1},*N*^{1},*N*^{10},*N*^{10}-Tetrabenzyldecane-1,10-diamine (2m)**



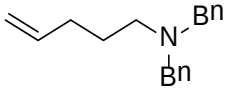
Following general procedure A except TMDS (4 equiv), the reduction of *tert*-amide **1m** (560 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 50), amine **2m** (500 mg, yield: 96%) as a winter soild; IR (film) ν_{max}: 3026, 2926, 2792, 1493, 1452, 1122, 1028, 746, 697 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.02-1.19 (m, 12H), 1.34-1.45 (m, 4H), 2.30 (t, J = 7.2 Hz, 4H), 3.45 (s, 8H), 7.10-7.15 (m, 4H), 7.17-7.24 (m, 8H), 7.25-7.30 (m, 8H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 27.0, 27.3, 29.5, 53.5, 58.3, 126.7 (4C), 128.1 (8C), 128.8, 140.1 ppm; MS (ESI, *m*/*z*): 532.4 ($M + H^+$). Analytical data match those reported in the literature. [3]

***N*,*N*-Dimethyl-3-phenylpropan-1-amine (2n)**



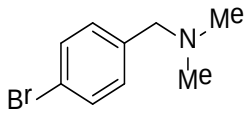
Following general procedure B, the reduction of *tert*-amide **1n** (175 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1:1), amine **2n** (132 mg, yield: 82%) as a pale yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.30 (s, 6H), 3.10 (d, J = 6.9 Hz, 2H), 6.22-6.36 (m, 1H), 6.47-6.60 (m, 1H), 7.21-7.28 (m, 1H), 7.30-7.37 (m, 2H), 7.38-7.44 (m, 2H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 45.2 (2C), 61.9, 126.2, 127.3 (2C), 128.4 (2C), 132.5, 136.9 ppm; MS (ESI, *m*/*z*): 161 ($M + H^+$). Analytical data match those reported in the literature. [8]

***N*,*N*-Dibenzylpent-4-en-1-amine (2o)**



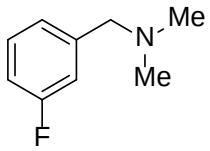
Following general procedure B, the reduction of *tert*-amide **1o** (279 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 20), amine **2o** (241 mg, yield: 91%) as a colorless oil; IR (film) ν_{max}: 3082, 2793, 2285, 1493, 1452, 1073, 1027, 697 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 1.69 (m, 2H), 2.13 (q, J = 7.1Hz, 2H), 2.52 (t, J = 7.6 Hz, 2H), 3.64 (s, 4H), 4.94-5.06 (m, 2H), 5.76-5.92 (m, 1H), 7.36-7.50 (m, 10H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 26.5, 31.5, 55.0, 58.4, 114.4, 126.8, 128.2, 128.8, 138.8, 140.0 ppm; HRMS (ESI) *m/z* calcd for $[C_{19}H_{23}N]^+$ (M + H) $^+$: 265.1830; found: 265.1827.

1-(4-Bromophenyl)-*N*,*N*-dimethylmethanamine (2p)



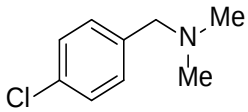
Following general procedure A, the reduction of *tert*-amide **1p** (227 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 10), amine **2p** (208 mg, yield: 98%) as a colorless oil; IR (film) ν_{max}: 3005, 2972, 2801, 1690, 1365, 1127, 1007, 735 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 2.24 (s, 6H), 3.37 (s, 2H), 7.14-7.23 (m, 2H), 7.40-7.50 (m, 2H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 45.2 (2C), 63.6, 120.8, 130.6 (2C), 131.3 (2C), 137.9 ppm; MS (ESI, *m*/*z*): 213 (M + H^+) and 215 (M + H^+). Analytical data match those reported in the literature. [9]

1-(3-Fluorophenyl)-*N*,*N*-dimethylmethanamine (2q)



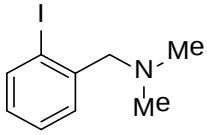
Following general procedure A, the reduction of *tert*-amide **1q** (167 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 10), amine **2q** (148 mg, yield: 97%) as a colorless oil; IR (film) ν_{max}: 2945, 2819, 2775, 1590, 1487, 1455, 1256, 783, 687 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 2.21(s, 6H), 3.38 (s, 2H), 6.88 (m, 1H), 7.03 (m, 2H), 7.24 (m, 1H) ppm; ^{13}C NMR δ 45.3 (2C), 63.8, (d, J = 21.0 Hz, 1C), 115.9 (d, J = 21.0 Hz, 1C), 124.8 (d, J = 2.5 Hz, 1C), 129.7 (d, J = 8.0 Hz, 1C), 141.8 (d, J = 7.0 Hz, 1C), 161.2 (1C), 163.0 (d, J = 245.5 Hz, 1C) ppm; MS (ESI, *m*/*z*): 153 (M + H^+). Analytical data match those reported in the literature. [10]

1-(3-Chlorophenyl)-*N*,*N*-dimethylmethanamine (2r)



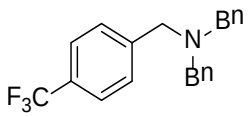
Following general procedure A, the reduction of *tert*-amide **1r**(183 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane/TEA = 1: 10: 0.001), amine **2r** (160 mg, yield: 95%) as a colorless oil; IR (film) ν_{max}: 3031, 2974, 2857, 2816, 1612, 1512, 1407, 1251, 1015, 905, 730 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 2.22 (s, 6H), 3.39 (s, 2H), 7.22-7.30 (m, 4H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 45.2 (2C), 63.5, 128.4 (2C), 130.4 (2C), 132.8, 137.2 ppm; MS (ESI, *m*/*z*): 169 ($M + H^+$). Analytical data match those reported in the literature. [11]

1-(2-Iodophenyl)-*N*,*N*-dimethylmethanamine (2s)



Following general procedure A, the reduction of *tert*-amide **1s** (275 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane/TEA = 1: 10: 0.001), amine **2s** (188 mg, yield: 72%) as a pale yellow oil; IR (film) ν_{max}: 3021, 2965, 2885, 2782, 1494, 1467, 1369, 1065 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 2.32 (s, 6H), 3.49 (s, 2H), 6.90-7.02 (m, 1H), 7.26-7.46 (m, 2H), 7.77-7.88 (m, 1H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 45.3, 67.8, 100.6, 127.9, 128.6, 130.3, 139.4, 140.9 ppm; MS (ESI, *m*/*z*): 261 ($M + H^+$). Analytical data match those reported in the literature. [12]

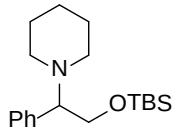
***N*,*N*-dibenzyl-1-(4-(trifluoromethyl)phenyl)methanamine (2t)**



Following general procedure A, the reduction of *tert*-amide **1t** (369 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 10), amine **2t** (347 mg, yield: 98%) as a colorless oil; IR (film) ν_{max}: 3063, 2799, 1494, 1325, 1123, 1103, 1066, 698 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 3.64 (s, 4H), 3.67 (s, 2H), 7.28-7.36 (m, 2H), 7.37-7.44 (m, 4H), 7.45-

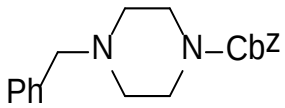
7.52 (m, 4H), 7.56-7.69 (m, 4H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 57.5 (2C), 58.1, 124.3 (d, J = 278 Hz), 125.2 (q, J = 4 Hz), 127.3 (2C), 128.3 (4C), 128.7 (4C), 128.8, 129.2 (d, J = 32 Hz), 139.2 (2C), 144.0 (2C) ppm; MS (ESI, *m*/*z*): 355 (M + H^+). Analytical data match those reported in the literature. [4]

1-(2-((*tert*-Butyldimethylsilyl)oxy)-1-phenylethyl)piperidine (2u)



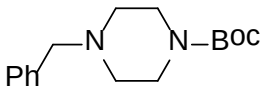
Following general procedure A, the reduction of lactam **1u** (333 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 30), piperidine **2u** (289 mg, yield: 86%) as a colorless oil; IR (film) ν_{max}: 2930, 2855, 2795, 1471, 1255, 1104, 835, 775 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ -0.92 (s, 3H), -0.93 (s, 3H), 0.86 (s, 9H), 1.38-1.48 (m, 2H), 1.54-1.63 (m, 4H), 2.42-2.56 (m, 4H), 3.42 (t, J = 5.8 Hz, 1H), 3.87 (dd, J = 10.5, 5.8 Hz, 1H), 4.06 (dd, J = 10.5, 5.8 Hz, 1H), 7.21-7.36 (m, 5H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ -5.5 (2C), 18.1, 24.7, 25.8 (3C), 26.3 (2C), 52.4 (2C), 65.3, 72.2, 126.7, 127.8 (2C), 128.7 (2C), 140.9 ppm; HRMS (ESI): *m/z* calcd for $[C_{19}H_{33}NONaSi]^+$ [(M + $Na)^+$]: 342.2229; found: 342.2228;

Benzyl 4-benzylpiperazine-1-carboxylate (2v)



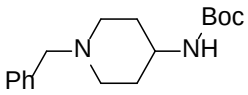
Following general procedure A, the reduction of piperazine **1v** (324 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 20), piperazine **2v** (269 mg, yield: 88%) as a colorless oil; IR (film) ν_{max}: 3062, 2973, 2809, 1704, 1545, 1361, 1260, 1001, 763, 698 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.35-2.40 (m, 4H), 3.42-3.56 (m, 6H), 5.11 (s, 2H), 7.21-7.31 (m, 2H), 7.27-7.31 (m, 4H), 7.32-7.35 (m, 4H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 43.7, 52.6 (2C), 53.3, 62.8 (2C), 66.9 (2C), 127.1, 127.7 (2C), 127.8 (2C), 128.1, 128.3 (2C), 128.9 (2C), 136.7, 137.6, 155.1 ppm; MS (ESI, *m*/*z*): 310 (M + H^+). Analytical data match those reported in the literature. [13]

***tert*-Butyl 4-benzylpiperazine-1-carboxylate (2w)**



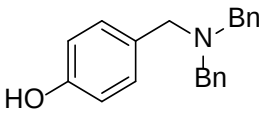
Following general procedure A, the reduction of piperazine **1w** (290 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 20), piperazine **2w** (242 mg, yield: 87%) as a colorless oil; IR (film) ν_{max}: 3062, 2873, 2709, 1704, 1545, 1461, 1160, 1001, 763 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 1.45 (s, 9H), 2.36 (t, J = 5.2 Hz, 4H), 4.17 (t, J = 5.2 Hz, 4H), 3.14 (s, 2H), 7.20-7.34 (m, 5H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 28.3 (3C), 52.7 (2C), 53.2 (2C), 62.9, 79.3, 127.0, 128.1 (2C), 128.9 (2C), 137.7, 154.6 ppm; MS (ESI, *m*/*z*): 277 ($M + H^+$). Analytical data match those reported in the literature. [14]

tert-Butyl (1-benzylpiperidin-4-yl)carbamate (2x)



Following general procedure A, the reduction of *N*-benzoyl piperidine derivative **1ad** (304 mg, 1 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 20), piperidine derivative **2ad** (272 mg, yield: 96%) as a white soild; M.p. 123-124 °C (lit.[15] m.p. 123-126 °C); IR (film) ν_{max}: 3349, 2975, 2801, 1695, 1579, 1365, 1172, 1045 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 1.16-1.45 (m, 2H), 1.43 (s, 9H), 1.87 (d, J = 12.1 Hz, 2H), 2.06 (t, J = 11.4 Hz, 2H), 2.77 (d, J = 11.4 Hz, 2H), 3.46 (s, 3H), 4.60 (s, 1H), 7.17-7.32 (m, 5H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 28.3 (3C), 32.3 (2C), 47.6, 52.1 (2C), 62.9, 78.8, 126.8, 127.9, 128.9 (2C), 138.2 (2C), 155.0 ppm; MS (ESI, *m*/*z*): 290 ($M + H^+$). [15]

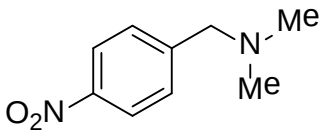
4– ((Dibenzylamino)methyl)phenol (**2y**)



Following general procedure A, except that after completion of the redution reaction, the mixture was treated with TBAF (1.0 M in THF, 1.0 mL) at room temperature for 20 min. In this manner, the reduction of *tert*-amide **1y** (158 mg, 0.5 mmol) gave, after FC (eluent: EtOAc/*n*–hexane = 1: 2), phenolic amine **2y** (140 mg, yield: 93%) as a colorless

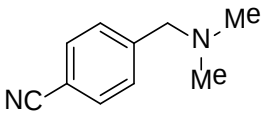
oil; IR (film) ν_{max}: 3439, 3026, 2924, 2795, 1613, 1512, 1452, 1365, 1240, 822, 745, 698 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 3.47 (s, 2H). 3.53 (s, 4H), 6.76 (m, 2H), 7.22 (m, 4H), 7.30 (m, 4H), 7.38 (m, 4H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 57.2, 57.7 (2C), 115.0 (2C), 126.8 (2C), 128.2 (4C), 128.7 (4C), 130.1 (2C), 139.6 (2C), 154.4 ppm; HRMS (ESI): *m/z* calcd for $[C_{21}H_{22}NO]^+$ [$(M + H)^+$]: 304.1696; found: 304.1692.

***N,N*-Dimethyl-1-(4-nitrophenyl)methanamine (2z)**



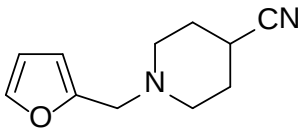
Following general procedure A, the reduction of *tert*-amide **1z** (194 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 5), amine **2z** (174 mg, yield: 97%) as a pale yellow oil; ^1H NMR (400 MHz, $CDCl_3$) δ 2.25 (s, 6H), 3.51 (s, 2H), 7.44-7.55 (m, 2H), 8.11-8.22 (m, 2H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 45.4 (2C), 63.5, 123.5, 129.4 (2C), 146.9 (2C), 147.1 ppm; MS (ESI, *m/z*): 180 ($M + H^+$). Othe spectral and analytical data match those reported in the literature. [5]

4-((Dimethylamino)methyl)benzonitrile (2aa)



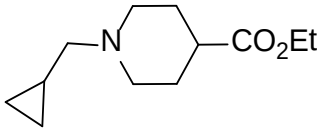
Following general procedure B, the reduction of *tert*-amide **1aa** (174 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 10), amine **2aa** (147 mg, yield: 92%) as a colorless oil; ^1H NMR (400 MHz, $CDCl_3$) δ 2.23 (s, 6H), 3.46 (s, 2H), 7.34-7.49 (m, 2H), 7.52-7.68 (m, 2H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 45.3 (2C), 63.7, 110.7, 118.8 (2C), 129.4 (2C), 131.9, 144.7 ppm; MS (ESI, *m/z*): 160 ($M + H^+$). Othe spectral and analytical other spectral and data match those reported in the literaure. [5]

1-(Furan-2-ylmethyl)piperidine-4-carbonitrile (2ab)



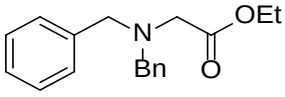
Following general procedure B, the reduction of *tert*-amide **1ab** (205 mg, 1 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 10), amine **2ab** (182 mg, yield: 96%) as a pale yellow oil; IR (film) ν_{max}: 3117, 2932, 2857, 2239, 1622, 1433, 7042, 781, 600 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 1.80-2.00 (m, 4H), 2.27-2.45 (m, 2H), 2.57-2.75 (m, 3H), 3.55 (s, 2H), 6.20 (m, 1H), 6.32 (m, 1H), 7.24-7.45 (m, 1H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 25.8 (2C), 28.6 (2C), 50.9, 54.8, 108.8, 109.9, 121.5, 142.2, 151.1 ppm; HRMS (ESI): *m/z* calcd for $[C_{11}H_{14}N_2ONa]^+$ $[(M + Na)^+]$: 213.1004; found: 213.1002.

Ethyl 1-(cyclopropylmethyl)piperidine-4-carboxylate (2ac)



Following general procedure A, the reduction of lactam **1ac** (225 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane/NH_3-H_2O = 1: 10 :0.05), piperidine **2ac** (196 mg, yield: 97%) as a pale yellow oil; IR (film) ν_{max}: 3076, 2943, 2771, 1732, 1466, 1286, 1176, 1048, 827 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ −0.01-0.05 (m, 2H), 0.31-0.45 (m, 2H), 0.62-0.82 (m, 1H), 1.12 (t, *J* = 7.1 Hz, 3H), 1.58-1.72 (m, 2H), 1.84-1.94 (m, 2H), 2.10 (d, *J* = 6.8 Hz, 2H), 2.12-2.19 (m, 3H), 2.76-2.97 (m, 2H), 4.00 (q, *J* = 6.8 Hz, 2H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 3.6 (2C), 8.1, 13.9, 27.9 (2C), 40.9, 52.7 (2C), 59.8, 63.7, 174.7 ppm; HRMS (ESI): *m/z* calcd for $[C_{12}H_{21}N_2ONa]^+$ $[(M + Na)^+]$: 234.1470; found: 234.1437;

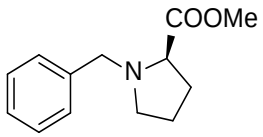
Ethyl dibenzylglycinate (2ad)



Following general procedure A, the reduction of *tert*– amide **1ae** (149 mg, 0.5 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 10), amino ester **2ae** (131 mg, yield: 93%) as a pale yellow oil; IR (film) ν_{max}: 3025, 2983, 1730, 1186, 1029, 745, 698 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 1.25 (t, *J* = 7.2 Hz, 3H), 3.28 (s, 2H), 3.80 (s, 3H), 4.14 (q, *J* = 7.2 Hz, 2H), 7.21-7.26 (m, 2H), 7.28-7.33 (m, 4H), 7.36-7.40 (m, 4H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 14.3, 53.5, 57.7 (2C), 60.2, 127.1 (2), 128.3 (4C), 128.9 (4C), 139.0 (2C), 171.4 ppm; HRMS (ESI): *m/z* calcd for $[C_{18}H_{22}NO_2]^+$ $[(M + H)^+]$:

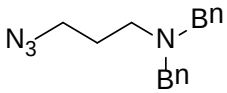
284.1645; found: 284.1647. Othe spectral and analytical data match those reported in the literature. [16]

Methyl benzyl– L– prolinate (2ae)



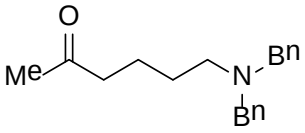
Following general procedure A, the reduction of *tert*-amide **1ad** (116 mg, 0.5 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 2), amino ester **2ad** (84 mg, yield: 78%) as a pale yellow oil; $[\alpha]_D^{20} = -62$ (*c* = 1.00, CH_2Cl_2); Lit.[16] $[\alpha]_D^{23} = -65.3$ (*c* = 3.6, CH_2Cl_2) IR (film) ν_{max}: 2943, 2795, 1735, 1466, 1207, 1168, 694 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 1.72-1.83 (m, 1H), 1.84-2.00 (m, 2H), 2.05-2.17 (m, 1H), 2.38 (dd, *J* = 16.8, 8.5 Hz, 1H), 3.01-3.09 (m, 1H), 3.24 (dd, *J* = 8.6, 6.1 Hz, 1H), 3.56 (d, *J* = 12.8 Hz, 1H), 3.63 (s, 3H), 3.88 (d, *J* = 12.8 Hz, 1H), 7.20-7.35 (m, 5H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 22.9, 29.3, 51.6, 53.2, 58.7, 65.2, 127.1, 128.1 (2C), 129.2 (2C), 138.2, 174.5 ppm; MS(ESI, *m/z*): 220.1 ($M+H^+$); Othe spectral and analytical data match those reported in the literature. [17] Chiral HPLC (Chiralpak OJ-H, hexane/ alcohol = 98:2, 1.0 mL/min., λ = 254 nm), t_R (R) = 7.04 min., t_R (S) = 7.47 min., 98% *ee*.

3-Azido-*N*,*N*-dibenzylpropan-1-amine (1af)



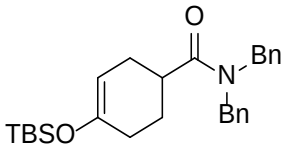
Following general procedure A, the reduction of *tert*-amide **1af** (294 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 50), azido amine **2af** (176 mg, yield: 63%) as a colorless oil; IR (film) ν_{max}: 2933, 2477, 2093, 1493, 1126, 1079, 745 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 1.38-1.47 (m, 2H), 2.49 (t, *J* = 7.0 Hz, 2H), 3.30 (t, *J* = 7.0 Hz, 2H), 3.62 (s, 4H), 7.25-7.33 (m, 2H), 7.35-7.40 (m, 4H), 7.41-7.47 (m, 4H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 26.6, 49.5, 50.9, 58.4 (2C), 126.7 (2C), 128.1 (4C), 128.7 (4C), 139.9 (2C) ppm; MS (ESI, *m/z*): 280 ($M + H^+$). Othe spectral and analytical data match those reported in the literature. [18]

6-(Bibenzylamino)hexan-2-one (2ag)



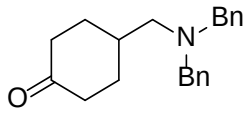
Following general procedure, the reduction of *tert*-amide **1ag** (305 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 10), amine **2ag** (177 mg, yield: 60%) as a colorless oil; IR (film) ν_{max}: 3061, 2957, 1715, 1452, 1239, 1076, 1027, 803, 698 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 1.43-1.59 (m, 4H), 2.03 (s, 3H), 2.24 (t, J = 6.7 Hz, 2H) , 2.39 (t, J = 6.7 Hz, 2H), 3.52 (s, 4H), 7.17-7.24 (m, 2H), 7.25-7.31 (m, 4H), 7.32-7.37 (m, 4H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 21.2, 26.3, 29.7, 43.1, 52.6, 58.3 (2C), 126.7 (2C), 128.1 (4C), 128.7 (4C), 129.8 (2C), 209.0 ppm; HRMS (ESI): *m/z* calcd for $[C_{20}H_{25}NONa]^+$ $[(M + Na)^+]$: 318.1834; found: 318.1842.

***N,N*-Dibenzyl-4-((*tert*-butyldimethylsilyl)oxy)cyclohex-3-ene-1-carboxamide (1ah-2)**



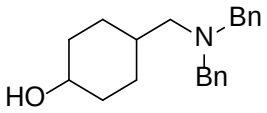
To an oven dried 2 neck round bottom flask under nitrogen was added amide **1ah-1** (1605 mg, 5 mmol) in dry DCM (10 mL) and triethylamine (0.84 mL,1.2 equiv). The reaction mixture was stirred for 10 min at 0 ^oC and TBSOTf (1.15 mL, 1.1 equiv) was added dropwise. The reaction was allowed to stir for 8 h and quenched with a cold aqueous NH_4Cl solution. The mixture was extracted with diethyl ether and dried over $MgSO_4$. After evaporation of solvents, the residue was purified by flash column chromatography (eluent: EtOAc/*n*-hexane = 1: 80) to afford amide derivative **1ah-2** (2088 mg, 96%) as a colorless oil; IR (film) ν_{max}: 2954, 2928, 1670, 1645, 1471, 887, 839, 759 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 0.10 (s, 3H). 0.11 (s, 3H), 0.89 (s, 9H), 1.83-1.89 (m, 2H), 1.94-2.14 (m, 4H), 2.44-2.54 (m, 1H), 2.67-2.75 (m, 1H), 4.47 (s, 2H), 4.60 (s, 2H), 4.84 (d, J = 5.0 Hz, 1H), 7.13-7.19 (m, 4H), 7.26-7.37 (m, 6H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ -4.5, 17.9, 25.6, 26.4, 27.2, 29.2, 36.8, 48.0, 49.8, 102.4, 126.3 (2C), 127.3, 127.6, 128.0 (2C), 128.5 (2C), 128.9 (2C), 136.8, 137.5, 149.9, 176.4 ppm; HRMS (ESI): *m/z* calcd for $[C_{27}H_{38}NO_2Si]^+$ $[(M + H)^+]$: 436.2666; found: 436.2675.

4-((Dibenzylamino)methyl)cyclohexan-1-one (**2ah-1**)



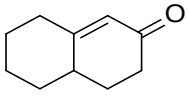
Following general procedure B, except that after completion of the redution reaction, the mixture was treated with TBAF (1.0 M in THF, 2.0 mL) at room temperature for 20 min. In this manner, the reduction of **1ah-2** (421 mg, 1 mmol) gave, after FC (eluent: EtOAc/n-hexane = 1: 2), keto amine **2ah-1** (282 mg, yield: 92%) as a colorless oil; IR (film) ν_{max}: 3027, 2928, 2855, 1713, 1494, 1450, 1374, 746, 699 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 1.26 (m, 2H), 1.97 (m, 1H), 2.17 (m, 3H), 2.28 (m, 5H), 3.56 (s, 4H), 7.23 (t, J = 7.2 Hz, 2H), 7.33 (m, 8H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 30.8 (2C) 34.0, 40.5 (2C), 58.7, 59.2 (2C), 127.0, 128.3, 128.8, 139.7, 212.5 ppm; HRMS (ESI): *m/z* calcd for $[C_{21}H_{26}NO]^+$ $[(M + H)^+]$: 308.2009; found: 308.2012.

4-((Dibenzylamino)methyl)cyclohexan-1-ol (2ah-2)



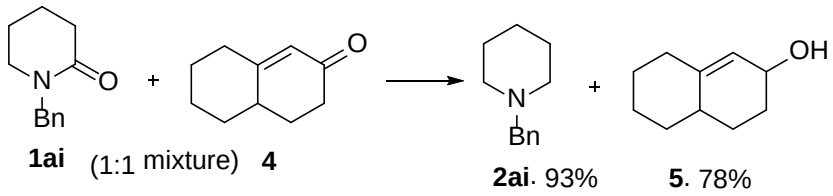
Following general procedure B, except that after completion of the redution reaction, the mixture was treated with TBAF (1.0 M in THF, 2.0 mL) at room temperature for 20 min. In this manner, the reduction of *tert*-amide **1ah-1** (321 mg, 1 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 2), hydroxy amine **2ah-2** (241 mg, yield: 78%) as a colorless oil; IR (film) ν_{max}: 3367, 3026, 2926, 1494, 1364, 1257, 735, 697 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 1.23-1.33 (m, 2H); 1.44-1.65 (m, 7H), 2.30 (d, J = 6.8 Hz, 2H), 3.56 (s, 4H), 3.95 (h, J = 3.3 Hz, 1H), 7.27 (m, 2H), 7.34 (t, J = 7.5 Hz, 4H), δ 7.41 (d, J = 7.0 Hz, 4H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 25.3. 32.1, 34.1, 58.9, 59.3, 67.4, 126.7, 128.1 (2C), 128.7 (2C), 140.0 ppm; HRMS (ESI): *m/z* calcd for $[C_{21}H_{28}NO]^+$ $[(M + H)^+]$: 310.2165; found: 310.2172.

4,4a,5,6,7,8-Hexahydronaphthalen-2(3*H*)-one (4)



This compound was prepared according to a reported protocol [19]. Spectral and analytical data match those reported in the literature. [19]

_N_-Benzylpiperidine (2ai) and 2,3,4,4a,5,6,7,8-Octahydronaphthalen-2-ol (5)



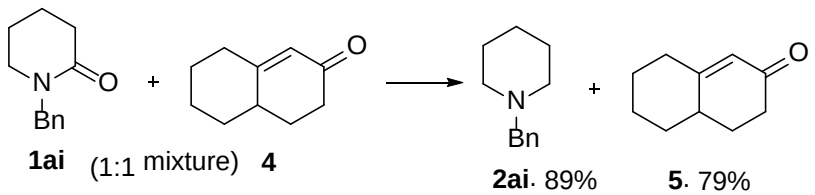
1ai (1:1 mixture) **4** **2ai**. 93% **5**. 78%

Following general procedure A, except that 3.0 equivalents of TMDS was used, and after completion of the redution reaction, the reduction reaction mixture was treated with TBAF (1.0 M in THF, 2.0 mL) at room temperature for 20 min. In this manner, the reduction of a 1: 1 mixture of 1-benzylpiperidin-2-one (**1ai**, 189.1 mg, 1.0 mmol) and cyclic enone **4** (150 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 20), *N*-benzylpiperidine (**2ai**, 163.2 mg, 93%) as a pale yellow oil and allylic alcohol **5** (120.1 mg, 78%) as a colorless oil.

Compound **2ai**: IR (film) ν_{max}: 3021, 2934, 2851, 2793, 2751, 1449, 1436, 1345, 1109 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 1.37-1.47 (m, 2H), 1.52-1.60 (m, 4H), 2.32-2.41 (m, 4H), 3.47 (s, 2H), 7.20-7.33 (m, 5H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 24.4, 26.0 (2C), 54.5 (2C), 63.9, 126.8, 128.0 (2C), 129.2 (2C), 138.6 ppm; MS (ESI, *m/z*): 176 ($M+H^+$). Othe spectral and analytical data match those reported in the literature. [3]

Compound **5**: IR (film) ν_{max}: 3333, 2923, 2852, 1447, 1068, 1037 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 0.98 (ddd, J = 25.2, 12.9, 3.6, 1H), 1.14-1.29 (m, 3H), 1.32-1.41 (m, 2H), 1.68-1.81 (m, 3H), 1.82-1.89 (m, 1H), 1.92-2.01 (m, 3H), 2.17-2.23 (m, 1H), 4.16-4.22 (m, 1H), 5.38 (s, 1H) ppm; 26.3, 27.8, 27.9, 31.6, 35.2, 37.4, 67.3, 123.2, 144.2 ppm; HRMS(ESI) calcd for $[C_{10}H_{17}O]^+$ $[(M + H)^+]$: 153.1274, found 153.1279.

_N_-Benzylpiperidine (2ai) and 4,4a,5,6,7,8-Hexahydronaphthalen-2(3*H*)-one (4)

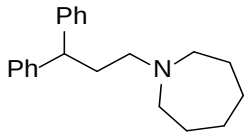


1ai (1:1 mixture) **4** **2ai**. 89% **5**. 79%

Following general procedure B (except that 0.5 mol% of $B(C_6F_5)_3$ was used and reaction time was 4 hours), the reaction of a 1: 1 mixture of 1-benzylpiperidin-2-one

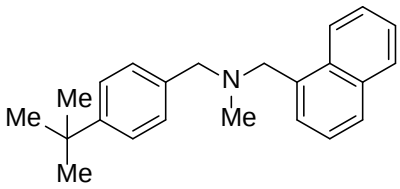
(**1ai**, 189.1 mg, 1.0 mmol) and cyclic enone **4** (150 mg, 1.0 mmol) gave, after FC (eluent: EtOAc/n-hexane = 1: 20 to EtOAc/ *n*-hexane/ TEA = 1: 20: 0.01), *N*-benzylpiperidine **2ai** (155.2 mg, 89%) and enone **4** (118.2 mg, 79%).

Prozapine (2aj)



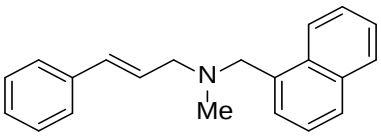
Following general procedure, the reduction of *tert*-amide **1aj** gave, after FC (eluent: EtOAc/*n*-hexane = 1: 50), prozapine (**2aj**, 236 mg, yield: 97%) as a pale yellow oil; IR (film) ν_{max}: 3083, 3025, 2924, 2852, 1599, 1494, 1369, 1065, 700 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 1.55-1.61 (m, 8H), 2.21 (m, 2H), 2.39 (t, J = 6.8 Hz, 2H), 2.57 (t, J = 6.8 Hz, 4H), 4.01 (t, J = 7.2 Hz, 1H), 7.13-7.18 (m, 2H), 7.23-7.28 (m, 8H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 27.0 (2C), 28.1 (2C), 33.5, 49.1, 55.6 (2C), 56.4, 126.1 (2C), 127.9 (4C), 128.4 (4C), 145.1 (2C) ppm; MS (ESI, *m*/*z*): 294 ($M + H^+$). Othe spectral and analytical data match those reported in the literaure. [20]

Butenafine (2ak)



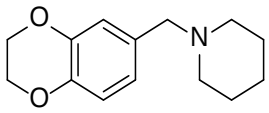
Following general procedure, the reduction of *tert*-amide **1ak** gave, after FC (eluent: EtOAc/*n*-hexane = 1: 80), butenafine (**2ak**, 282 mg, yield: 89%) as a colorless oil; IR (film) ν_{max}: 3047, 2961, 2903, 2837, 2786, 1510, 1460, 1369, 1250, 1065, 797 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 1.39 (s, 9H), 2.28 (s, 3H), 3.65 (s, 2H), 4.00 (s, 2H), 7.28-7.63 (m, 8H), 7.80-7.96 (m, 2H), 8.23-8.38 (m, 1H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 31.5 (3C), 34.5, 42.4, 60.5, 62.1, 124.9, 125.11, 125.13, 125.6, 125.7, 127.4, 127.9, 128.4, 128.8, 132.6, 134.0, 135.2, 136.4, 150.9 ppm; MS (ESI, *m*/*z*): 317 ($M + H^+$). Othe spectral and analytical data match those reported in the literaure. [21]

Naftifine (2al)



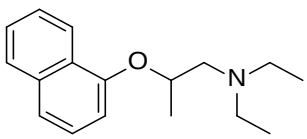
Following general procedure B, the reduction of *tert*-amide **1al** gave, after FC (eluent: EtOAc/*n*-hexane = 1: 10), naftifine (**2al**, 178 mg, yield: 62%) as a pale yellow oil; IR (film) ν_{max}: 3028, 2927, 2785, 1597, 1494, 1369, 1015, 775 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 2.27 (s, 3H), 3.27 (dd, J = 6.6, 1.1 Hz, 2H), 3.94 (s, 2H), 6.36 (dt, J = 15.9, 6.6 Hz, 1H), 6.56 (d, J = 15.9 Hz, 1H), 7.24-7.17 (m, 1H), 7.33-7.27 (m, 2H), 7.55-7.35 (m, 6H), 7.76 (d, J = 8.0 Hz, 1H), 7.83 (dd, J = 8.3, 1.0 Hz, 1H), 8.30 (d, J = 8.3 Hz, 1H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 42.4, 60.0, 60.4, 124.6, 125.1, 125.5, 125.9, 126.3 (2C), 127.3, 127.4, 127.5, 127.9, 128.4, 128.5 (2C), 132.4, 132.6, 133.8, 134.8, 137.1 ppm; MS (ESI, *m*/*z*): 287 ($M + H^+$). Othe spectral and analytical data match those reported in the literaure. [22]

1-((Octahydrobenzo[*b*][1,4]dioxin-6-yl)methyl)piperidine (2am)



Following general procedure A, the reduction of *tert*–amide **1am** (247 mg, 1 mmol) gave, after FC (eluent: EtOAc/n-hexane/TEA = 1/10/0.001), compound **2am** (214 mg, yield: 92%) as a colorless oil; IR (film) ν_{max}: 2932, 2874, 2972, 2720, 1590, 1507, 1457, 1298, 920, 901, 886, 781 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 1.37-1.44 (m, 2H), 1.52-1.59 (m, 4H), 2.34 (br, 4H), 3.35 (s, 2H), 4.23 (s, 4H), 6.74-6.79 (m, 3H), 6.82-6.83 (m, 2H), ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 24.4, 25.9, 54.3, 63.2, 64.3, 116.7, 117.9, 122.2, 131.8, 142.4, 143.1 ppm; HRMS (ESI): *m/z* calcd for $[C_{14}H_{20}NO_{22}]^+$ $[(M + H)^+]$: 234.1489; found: 234.1487.

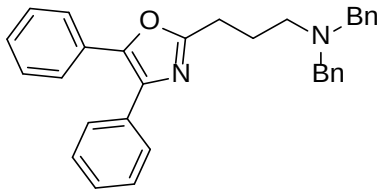
***N,N*-Diethyl-2-(naphthalen-1-yloxy)propan-1-amine (2an)**



Following general procedure A (except the reaction was run at 55 ^oC), the reduction of *tert*-amide **1an** (136 mg, 0.5 mmol) gave, after FC (eluent: EtOAc/*n*–hexane = 1: 2),

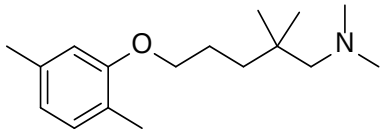
compound **2an** (110 mg, yield: 85%) as a pale yellow oil; IR (film) ν_{max}: 3051, 2970, 2931, 2871, 1594, 1579, 1462, 1400, 1266, 1016, 937, 789, 770 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 1.05 (t, J = 7.2 Hz, 6H), 1.40 (d, J = 6.2 Hz, 3H), 2.58-2.69 (m, 5H), 2.94 (dd, J = 13.6, 6.2 Hz, 1H), 4.67-4.73 (m, 1H), 6.88 (d, J = 7.4 Hz, 1H), 7.34-7.40 (m, 2H), 7.41-7.48 (m, 2H), 7.76-7.78 (m, 1H), 8.25-8.28 (m, 1H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 12.0, 18.4, 48.0, 58.4, 73.3, 106.1, 119.9, 122.3, 124.9, 125.9, 126.2, 126.5, 127.4, 134.7, 153.6 ppm; HRMS (ESI): *m/z* calcd for $[C_{17}H_{24}NO]^+$ $[(M + H)^+]$: 258.1852; found: 258.1859.

_N,N_-Dibenzyl-3-(4,5-diphenyloxazol-2-yl)propan-1-amine (1aq)



Following general procedure A, the reduction of *tert*-amide **1aq** (236 mg, 0.5 mmol) gave, after FC (eluent: EtOAc/*n*-hexane = 1: 5), compound **2aq** (190 mg, yield: 83%) as a pale yellow oil; IR (film) ν_{max}: 3083, 3060, 3026, 1926, 1604, 1494, 1260, 962, 763, 745, 695, 674 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 2.02-2.10 (m, 2H), 2.57 (t, J = 6.7 Hz, 2H), 2.84 (t, J = 6.7 Hz. 2H), 3.58 (s, 4H), 7.16-7.20 (m, 2H), 7.24-7.36 (m, 14H), 7.52-7.54 (m, 2H), 7.58-7.60 (m, 2H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 24.3, 25.8, 52.3, 58.2, 126.3 (2C), 126.8 (2C), 127.9 (3C), 128.1 (4C), 128.2, 128.4 (2C), 128.5 (2C), 128.7 (4C), 129.1, 132.6, 134.9, 139.5, 144.9, 163.5 ppm; HRMS (ESI): *m/z* calcd for $[C_{32}H_{31}N_2O]^+$ $[(M + H)^+]$: 459.2431; found: 459.2442.

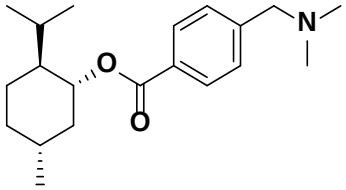
5-(2,5-Dimethylphenoxy)-_N,N_,2,2-tetramethylpentan-1-amine (2ap)



Following general procedure A, except TMDS (3 equiv) the reduction of amide **1ap** (277 mg, 1.0 mmol) afforded, after flash column chromatography on silica gel (gradient elution with 0-10% EtOAc in hexane), compound **2ap** (205 mg, yield: 78%) as a colorless oil; IR (film) ν_{max}: 2947, 2854, 2817, 2765, 1059, 1264, 1130, 1040, 802 cm^{-}

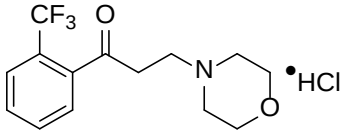
[1]; ^{1}H NMR (400 MHz, $CDCl_3$) δ 0.91 (s, 6H), 1.44-1.36 (m, 2H), 1.81-1.70 (m, 2H), 2.12 (s, 2H), 2.18 (s, 3H), 2.30 (s, 3H), 2.31 (s, 6H), 3.92 (t, J = 6.5 Hz, 2H), 6.62 (s, 1H), 6.65 (d, J = 7.6 Hz, 1H), 7.00 (d, J = 7.6 Hz, 1H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 15.8, 21.4, 24.3, 25.6 (2C), 35.1, 36.5, 48.9 (2C), 68.7, 70.8, 112.0, 120.6, 123.6, 130.2, 136.4, 157.1, ppm; HRMS (ESI) *m/z* calcd for $[C_{17}H_{30}NO]^+$ ($M + H^+$): 264.2322; found: 264.2316.

(*1R,2S,5R*)-2-Isopropyl-5-methylcyclohexyl-4-((dimethylamino)methyl)benzoate (2aq)



Following general procedure A, the reduction of *tert*-amide **1aq** (166 mg, 0.5 mmol) gave, after FC (eluent: MeOH/ DCM = 1: 20), compound **2aq** (145 mg, yield: 92%) as a pale yellow oil; [α_D^{25}] = –52.3 ($CHCl_3$, c = 1.0); IR (film) ν_{max}: 2954, 2869, 1714, 1456, 1308, 1285, 1274, 1112, 1037, 805, 756 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 0.80 (d, J = 6.7 Hz, 3H), 0.90-0.97 (m, 7H), 1.06-1.19 (m, 2H), 1.56 (t, J = 11.0 Hz, 2H), 1.73 (d, J = 11.3 Hz, 2H), 1.91-2.02 (m, 1H), 2.09-2.17 (m, 1H), 2.25 (s, 6H), 3.48 (s, 2H), 4.93 (dt, J = 11.0, 3.8 Hz, 1H), 7.39 (d, J = 7.8 Hz, 2H), 8.00 (d, J = 7.8 Hz, 2H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 16.5, 20.7, 22.0, 23.6, 26.4, 31.4, 34.3, 40.9, 45.3, 47.2, 63.9, 74.7, 128.8 (2C), 129.5 (2C), 129.7, 143.8, 165.9 ppm; HRMS (ESI): *m/z* calcd for $[C_{20}H_{32}NO_2]^+$ [$(M + H)^+$]: 318.2428; found: 318.2429.

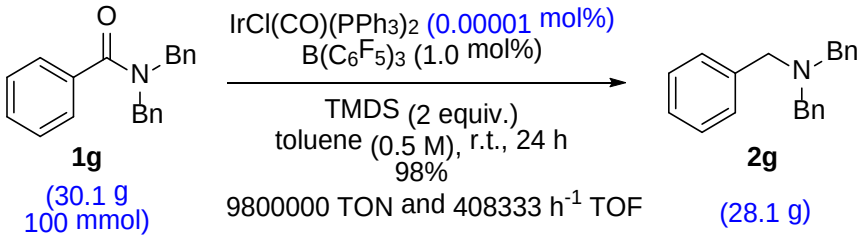
3-Morpholino-1-(2-(trifluoromethyl)phenyl)propan-1-one hydrochloride salt (2ar)[23]



Following general procedure B, the reduction of *tert*-amide **1ar** (300 mg, 1 mmol) gave, after FC (eluent: MeOH/ DCM = 1: 10) and treating the product with 0.5 mL of HCl (2 M in 1,4 dioxane) at r.t. for 20 min, amine hydrochloride salt **2ar** (278 mg, yield: 86%)

as a white solid, Mp 162–165 °C; IR (film) ν_{max}: 3436, 2916, 1643, 1516, 1466, 1318, 749, 677 cm^{-1}; ^1H NMR (400 MHz, DMSO-d_6) δ 3.09-3.19 (m, 2H), 3.41-3.54 (m, 4H), 3.63-3.71 (m, 2H), 3.78-3.89 (m, 2H), 3.92-4.01 (m, 2H), 7.75-7.80 (m, 1H), 7.83-7.90 (m, 2H), 7.93-7.98 (m, 1H), 11.63 (s, 1H) ppm; ^{13}C NMR (100 MHz, DMSO-d_6) δ 36.3, 50.5, 51.1, 63.1, 123.5 (d, J_{C-F} = 271.5 Hz), 125.6 (d, J_{C-F} = 31.1 Hz), 126.9 (t, J_{C-F} = 5.2 Hz), 128.2, 131.4, 132.7, 138.2, 200.0 ppm; HRMS (ESI) *m/z:* calcd for $(C_{14}H_{17}F_3NO_2)^+$ [$(M + H)^+$]: 288.1206, found: 288.1196. Othe spectral and analytical data match those reported in the literaure. [23]

4. Reduction of 1g at S/C = 10000000

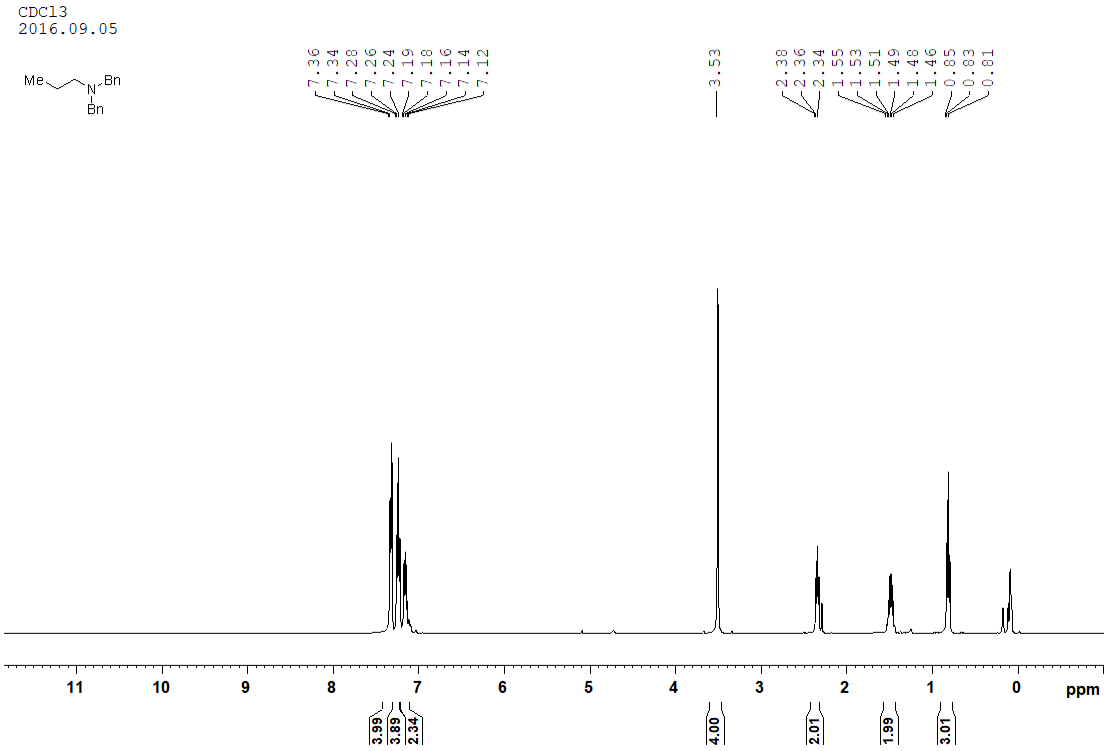


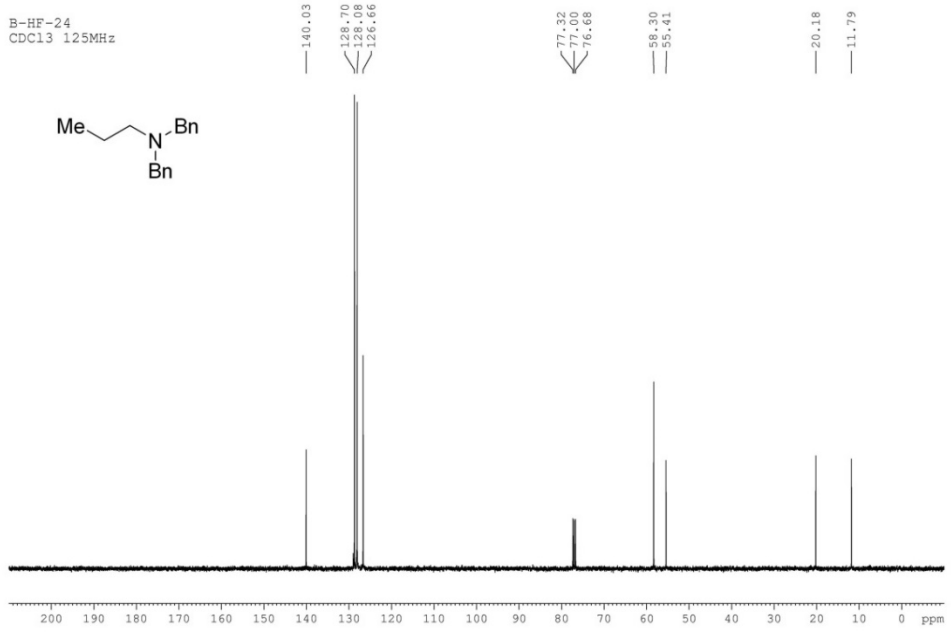
$[IrCl(CO)(PPh_3)_2]$ (7.8 mg, 0.01 mmol) was added to toluene (100 mL) and heated to reflux for 30 min. The resultant solution was cooled and diluted to 0.000001 mmol/ mL. 10 mL of the diluted $[IrCl(CO)(PPh_3)_2]$/toluene solution and $B(C_6F_5)_3$ (512 mg, 1% mmol) were added to a dried 500-mL round-bottom flask equipped with a magnetic stirring bar. A solution of *N*,*N*-dibenzylbenzamide (**1g**, 30.1 g, 100.0 mmol, 1.0 equiv) in toluene (200 mL) and 1,1,3,3-tetramethyldisiloxane (36.3 mL, 2.0 equiv) were successively added to the flask. After being stirred at room temperature for 24 hours, the reaction mixture was concentrated under reduced pressure, and the residue was purified by flash column chromatography (FC) on silica gel to afford tribenzylamine (**2g**, 28.1 g, 98%).

These results have been confirmed by Dr. Lei-Tao Huan (Xiamen University) who used 28 hours instead of 24 hours for the last step.

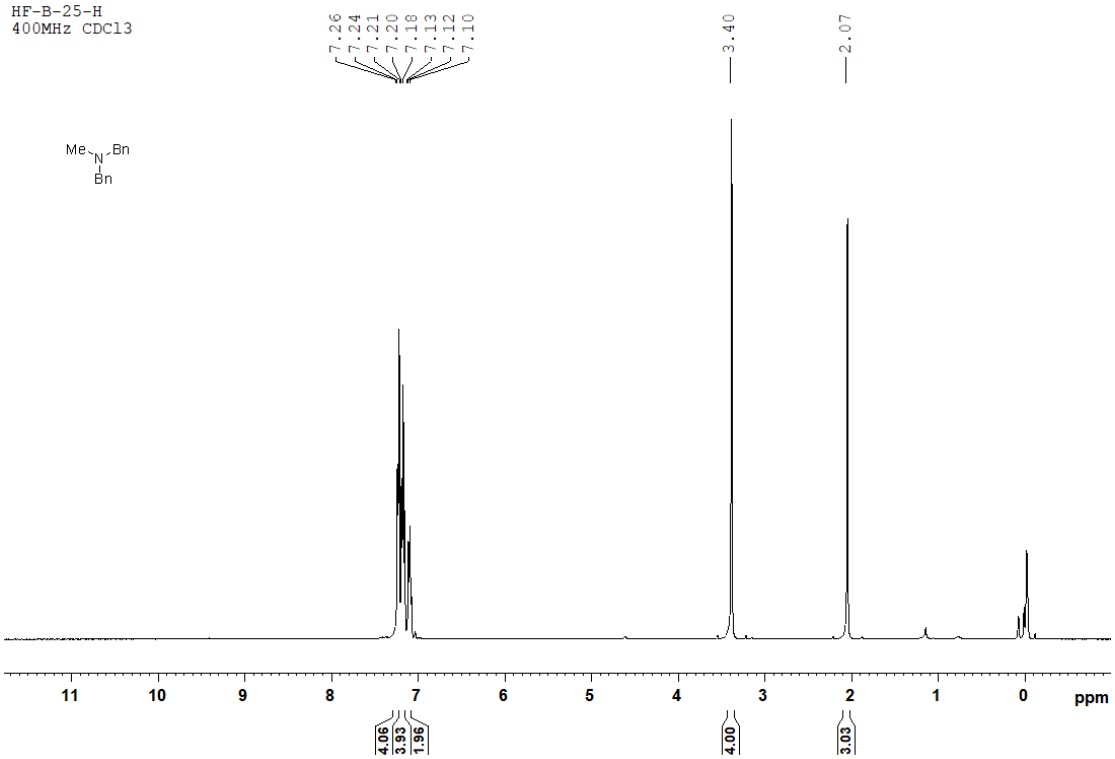
5. NMR Spectra

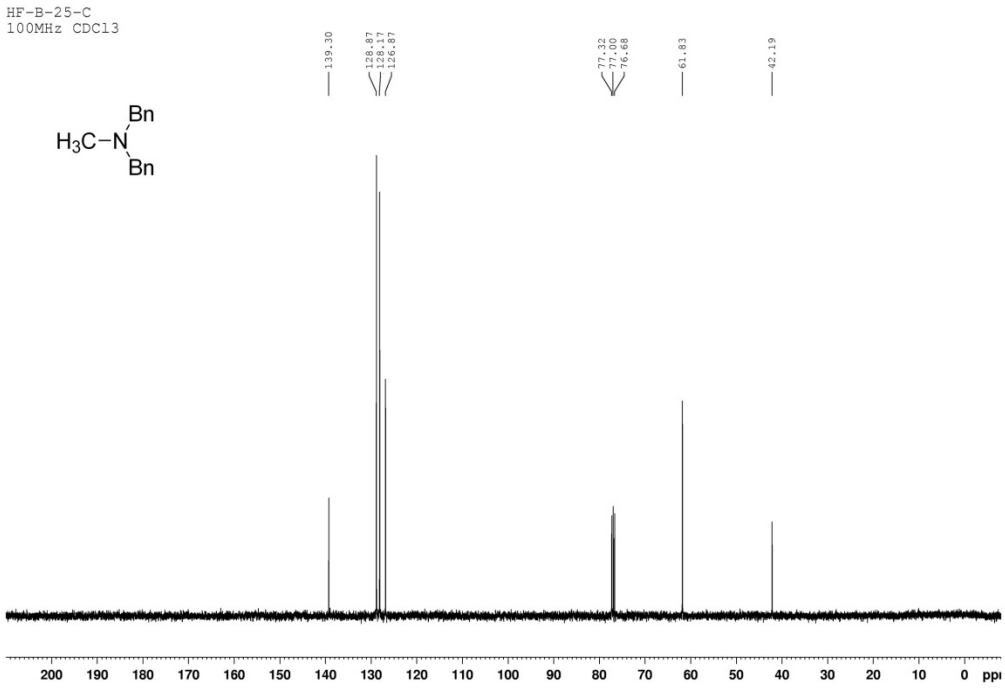
^{1}H NMR and ^{13}C NMR spectra of compound **2a**



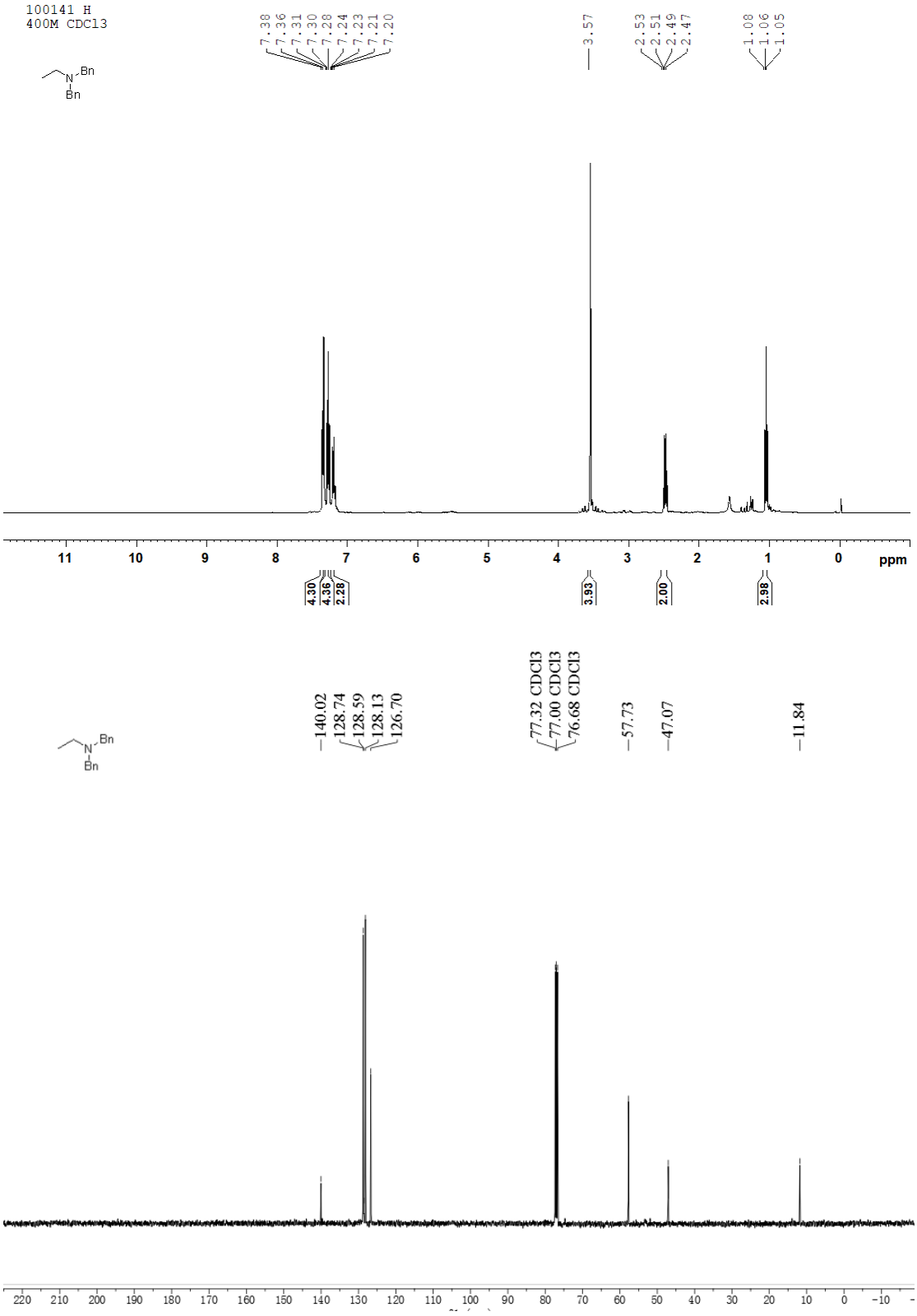


^{1}H NMR and ^{13}C NMR spectra of compound **2b**

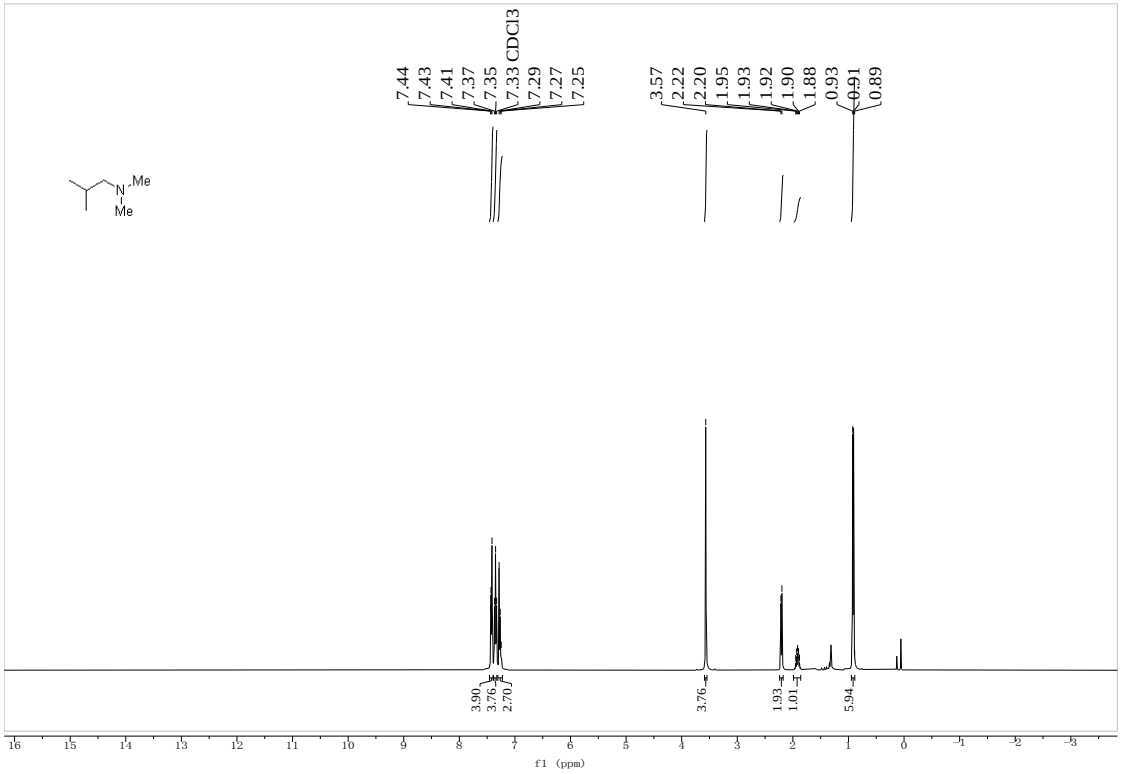


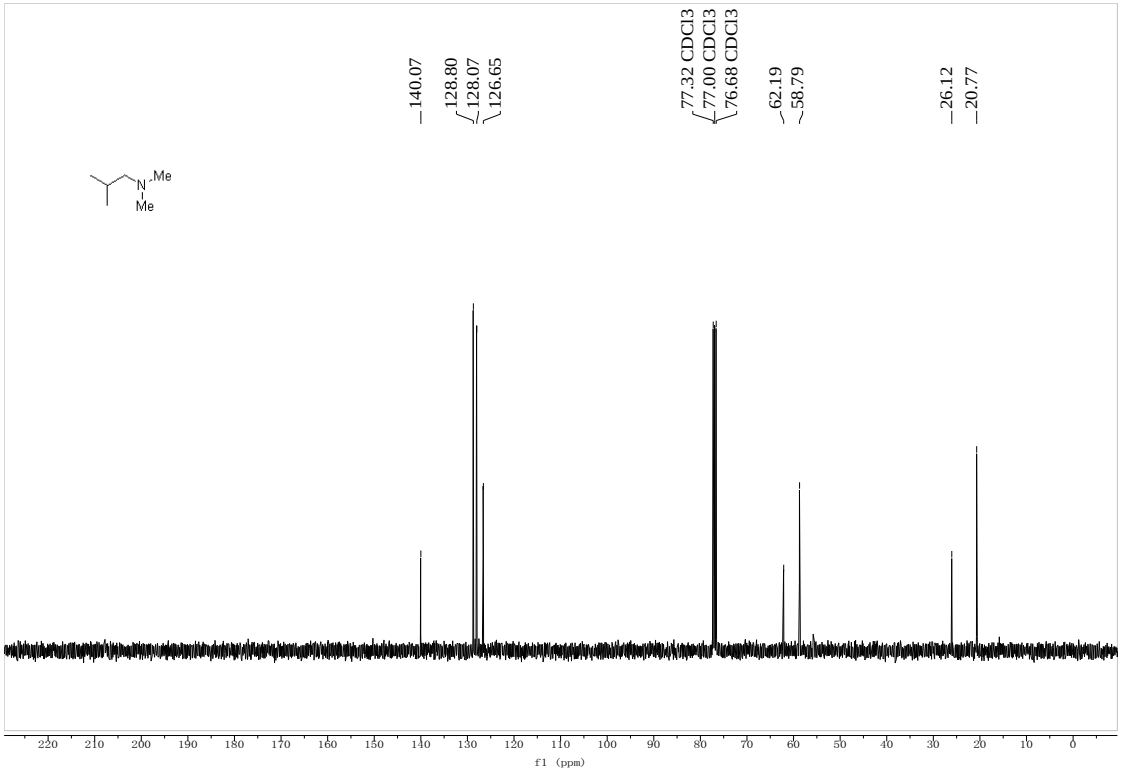


^{1}H NMR and ^{13}C NMR spectra of compound **2c**

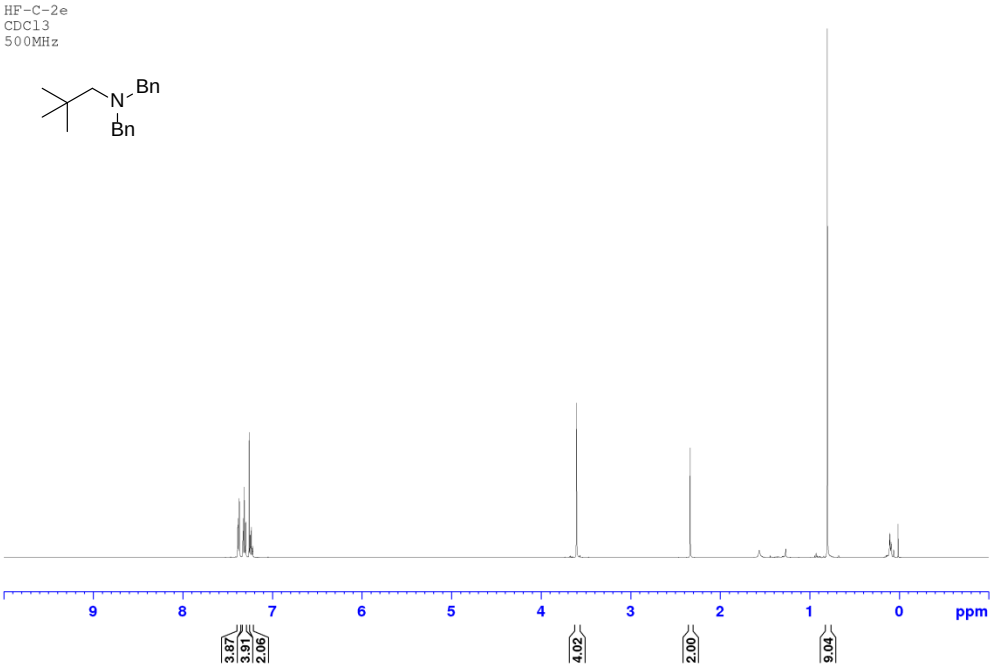


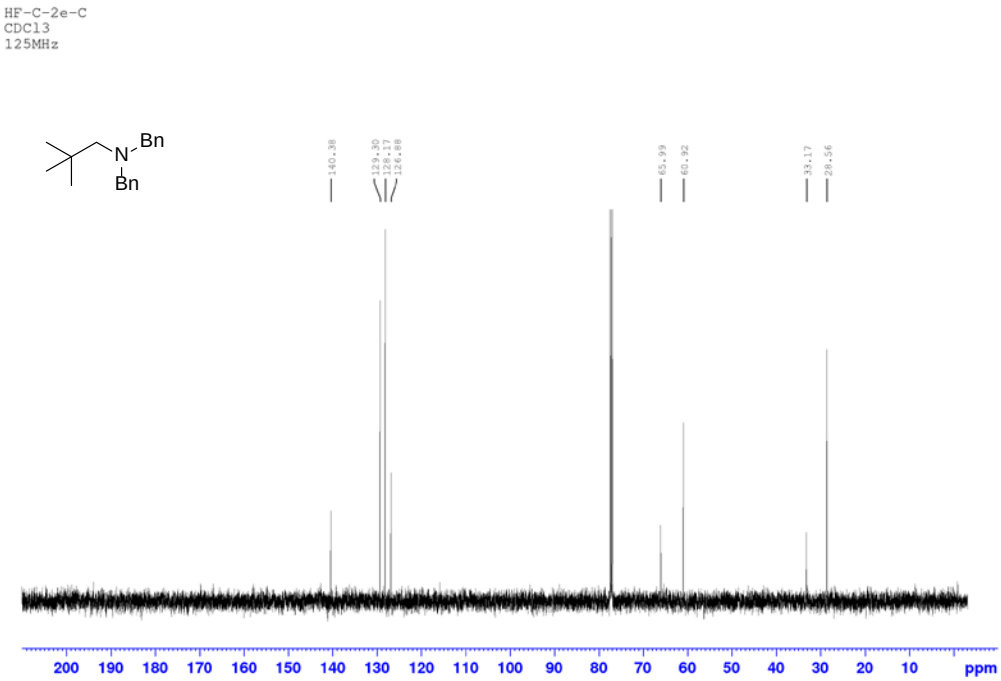
^{1}H NMR and ^{13}C NMR spectra of compound **2d**



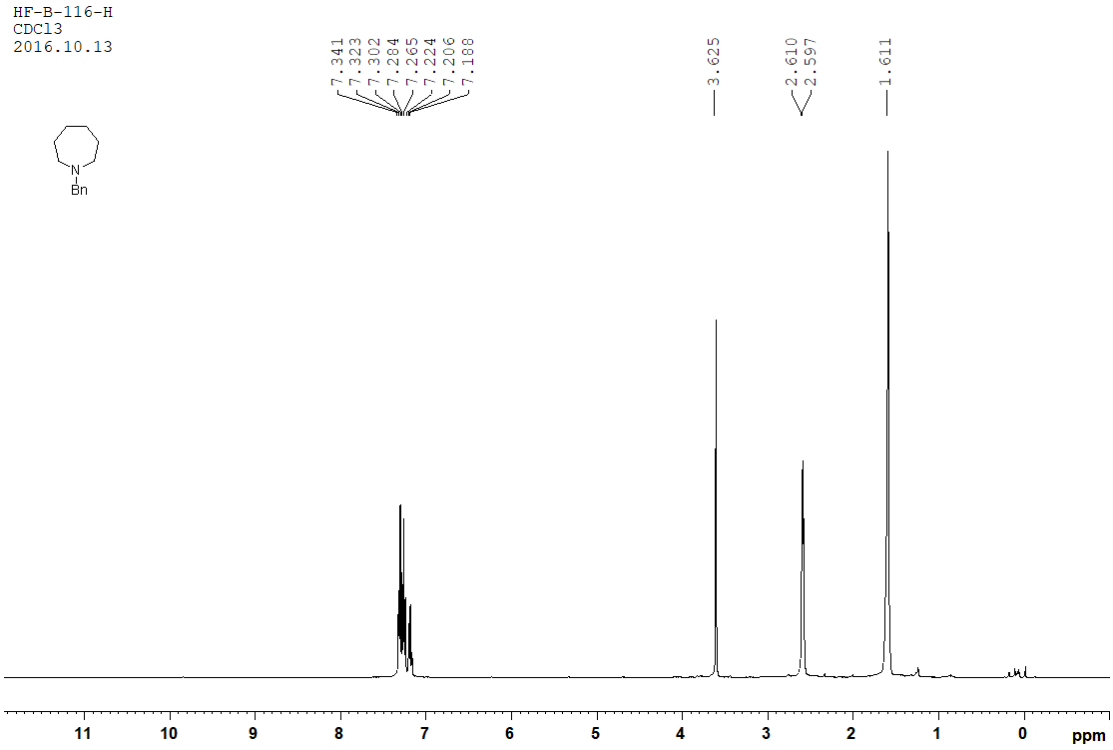


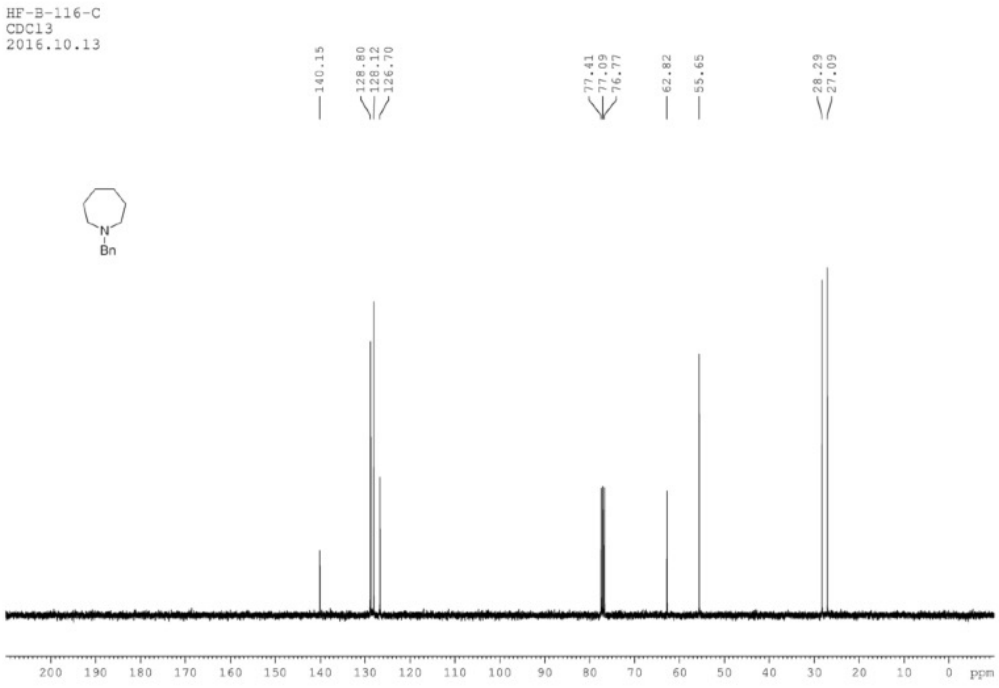
^{1}H NMR and ^{13}C NMR spectra of compound **2e**



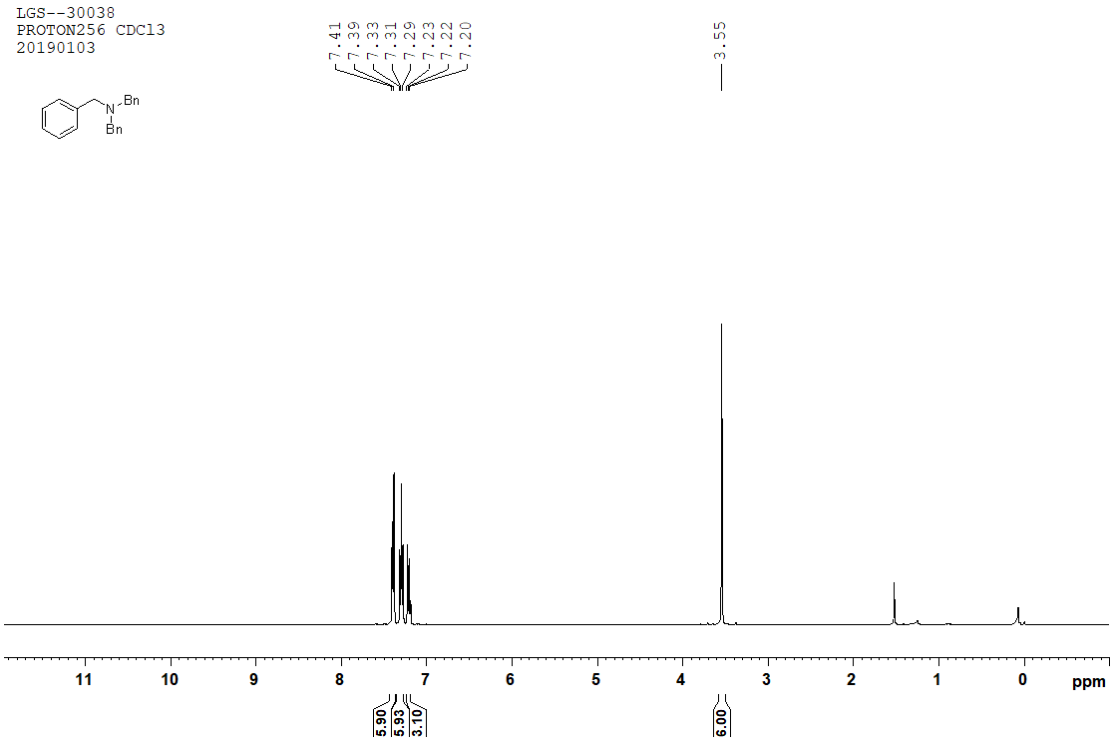


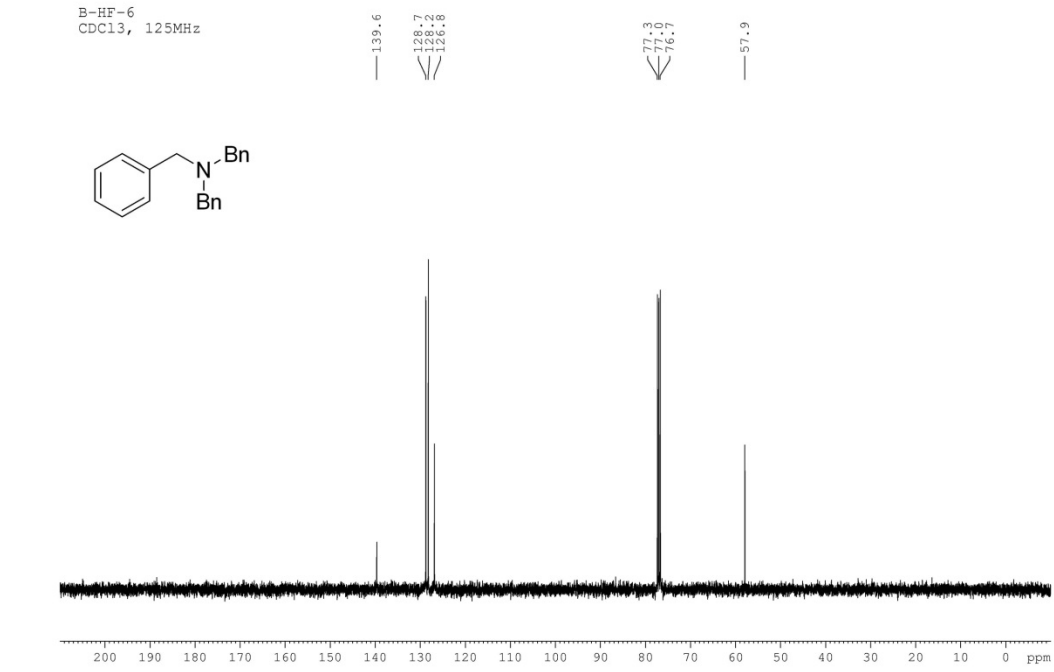
^{1}H NMR and ^{13}C NMR spectra of compound **2f**



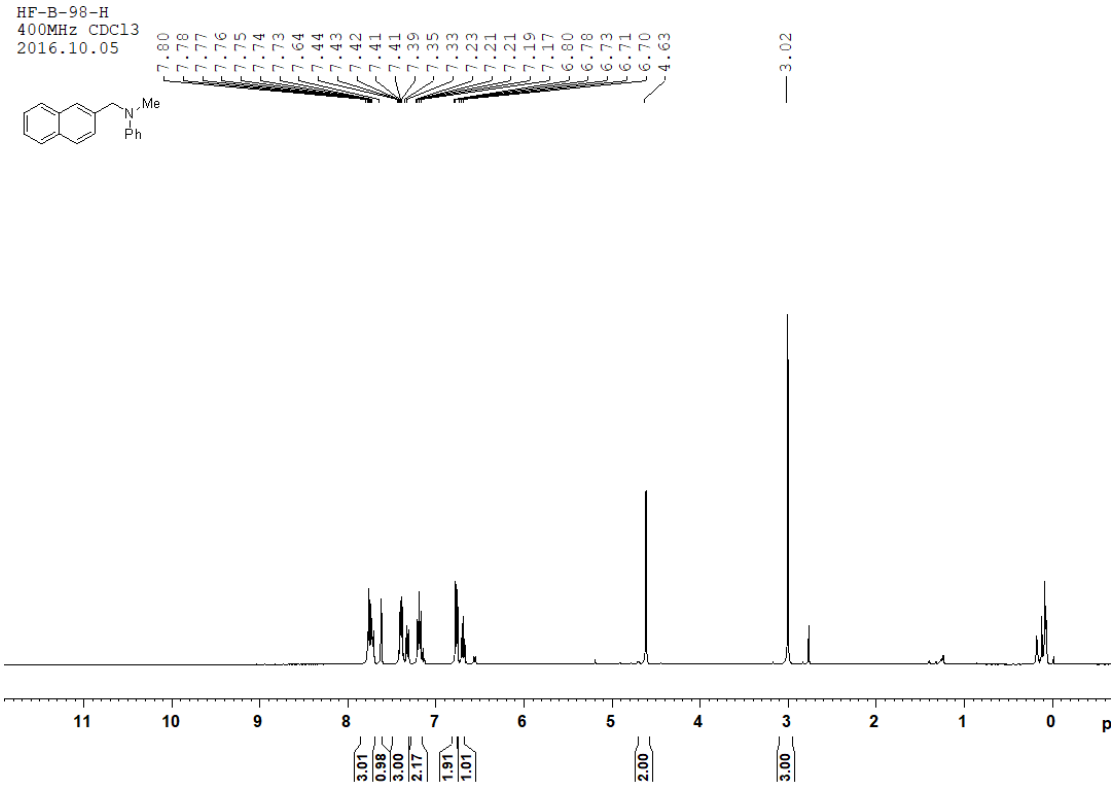


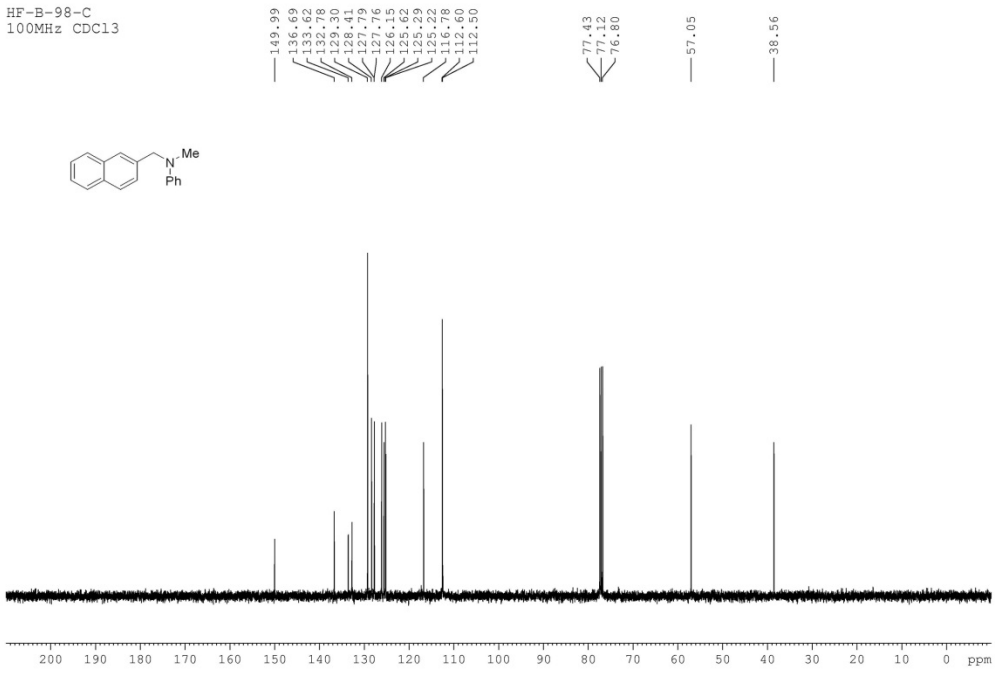
^{1}H NMR and ^{13}C NMR spectra of compound **2g**



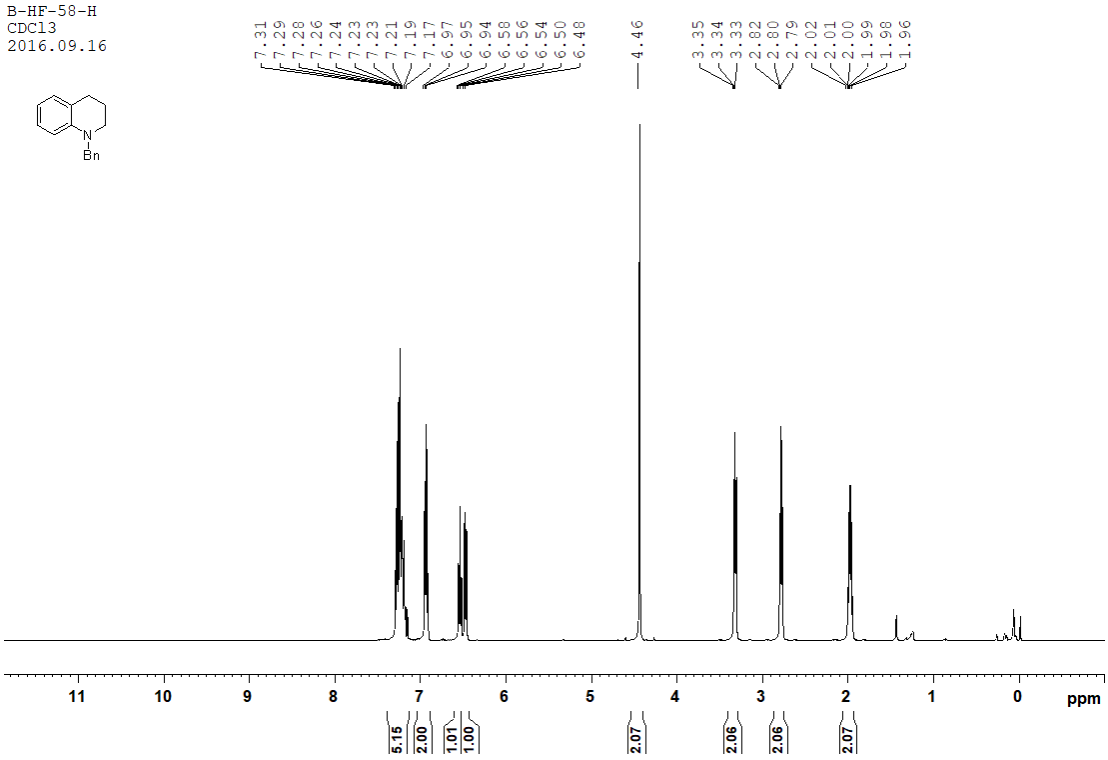


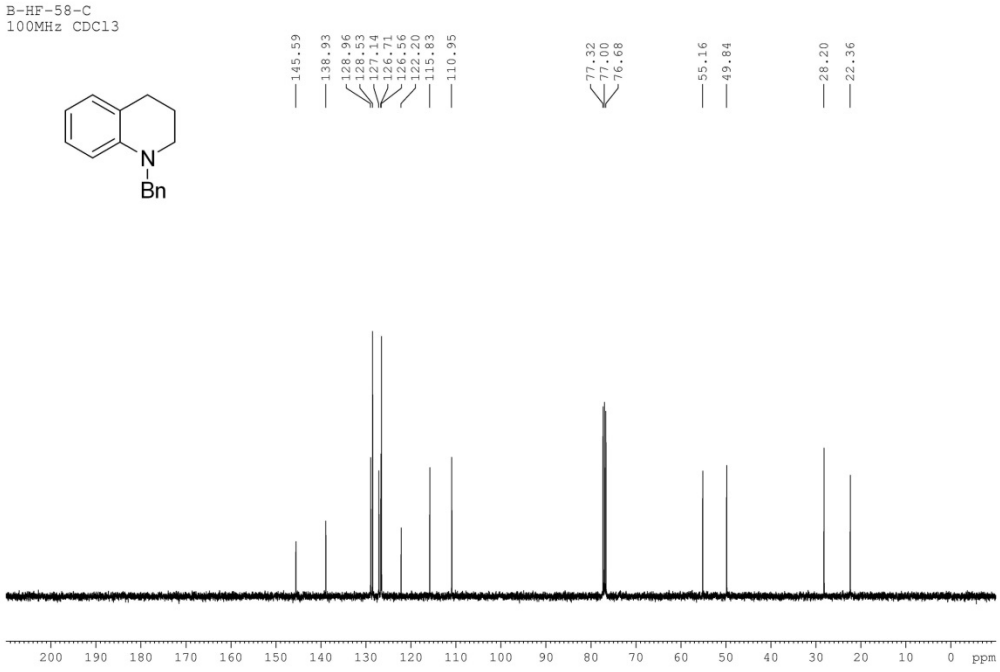
^{1}H NMR and ^{13}C NMR spectra of compound **2h**



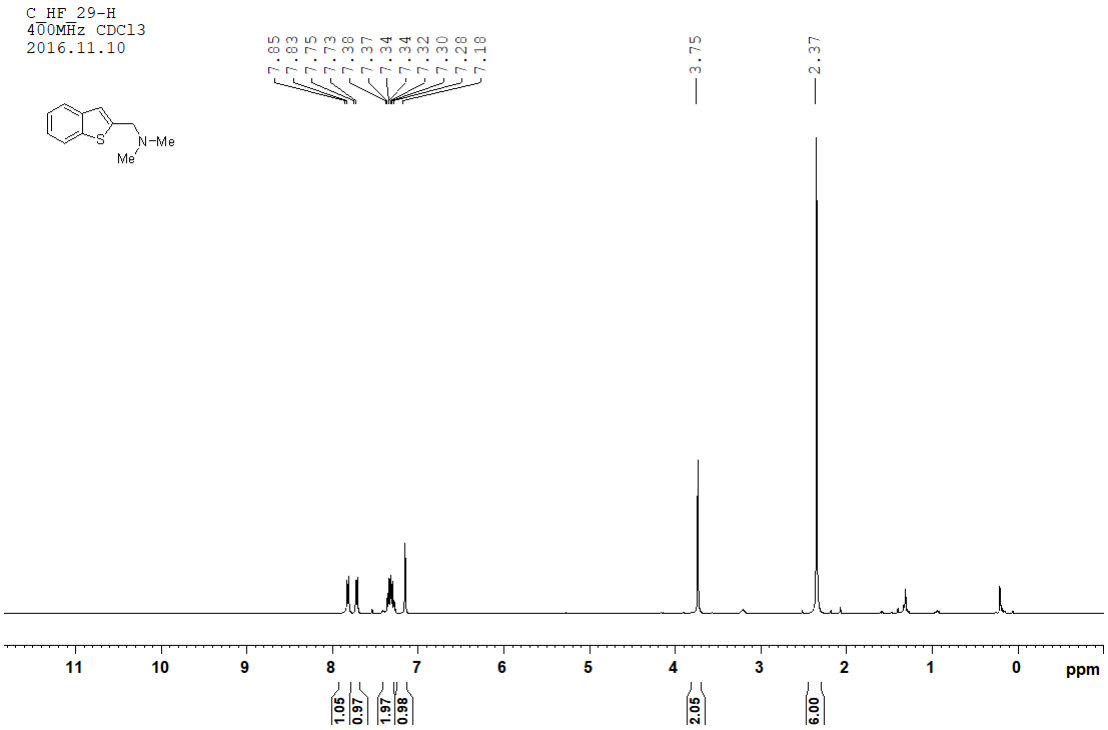


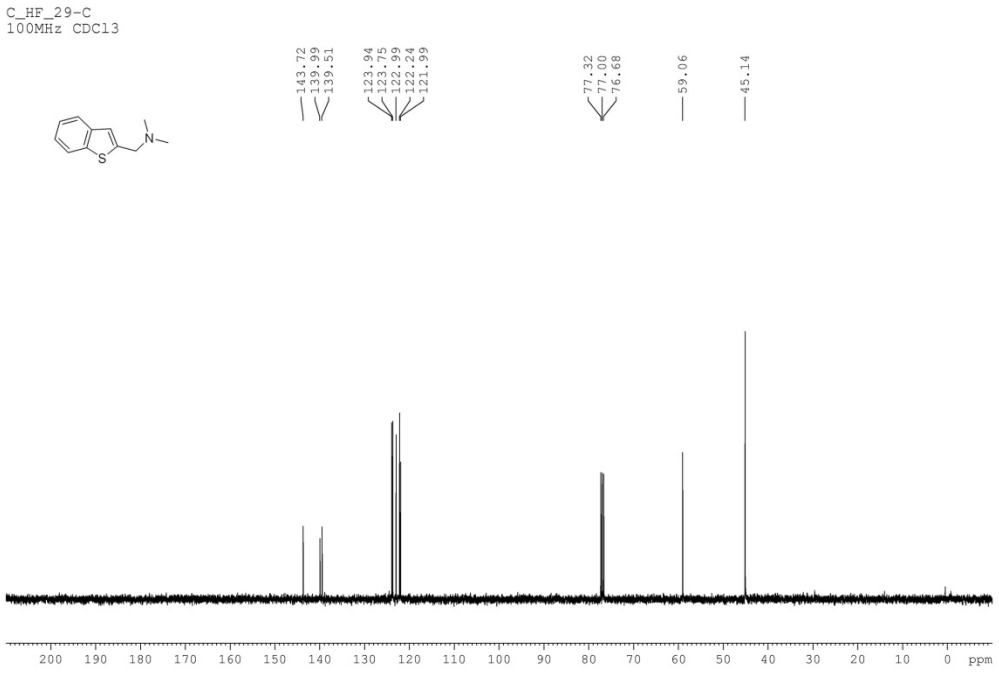
^{1}H NMR and ^{13}C NMR spectra of compound **2i**



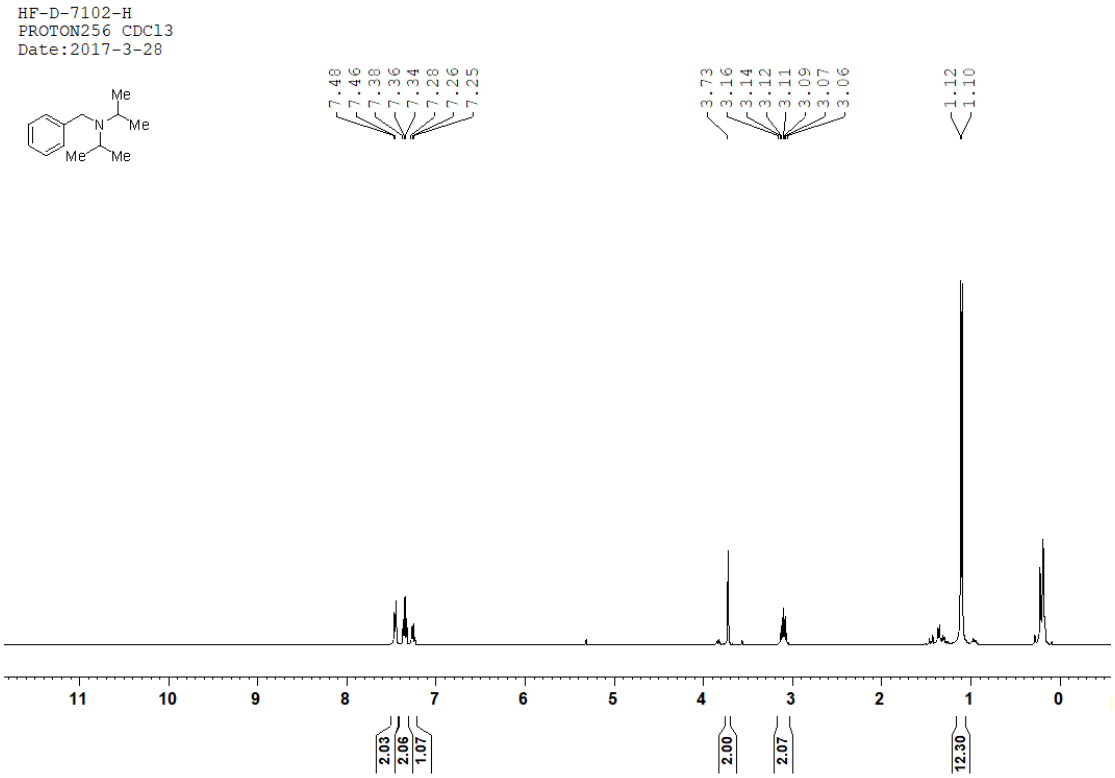


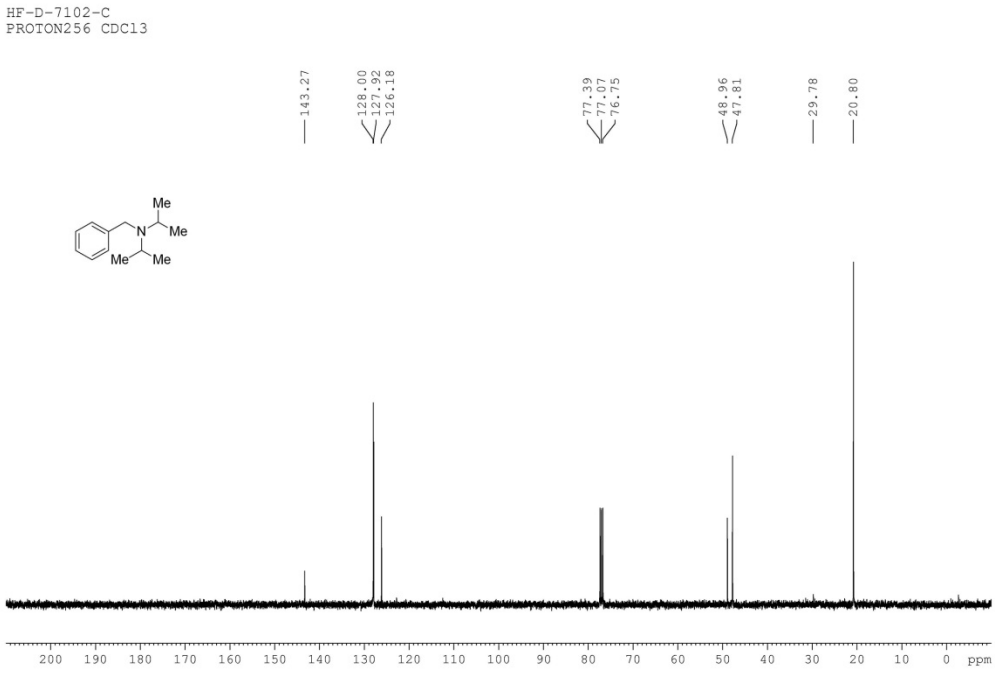
^{1}H NMR and ^{13}C NMR spectra of compound **2j**



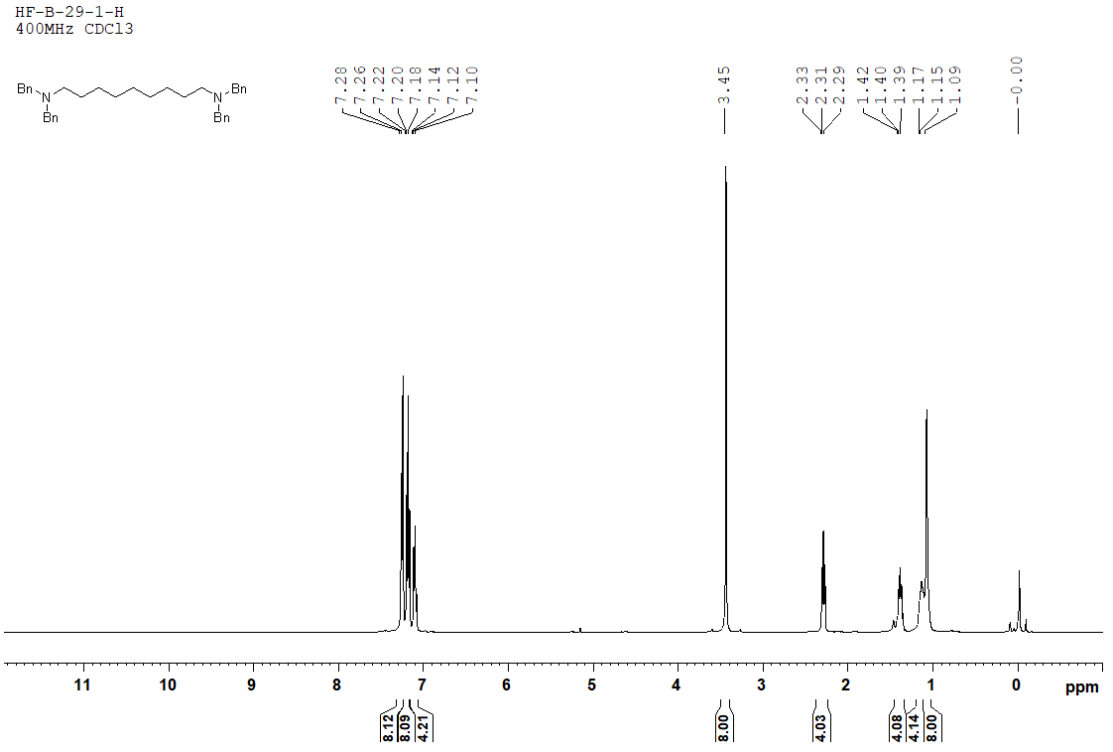


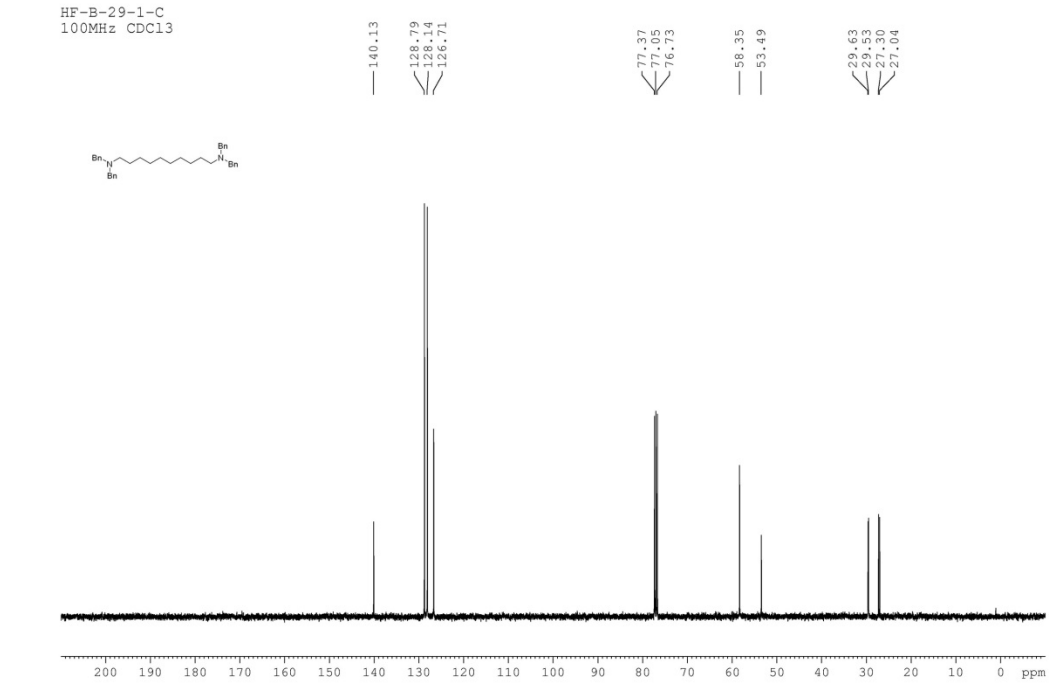
^{1}H NMR and ^{13}C NMR spectra of compound **2k**



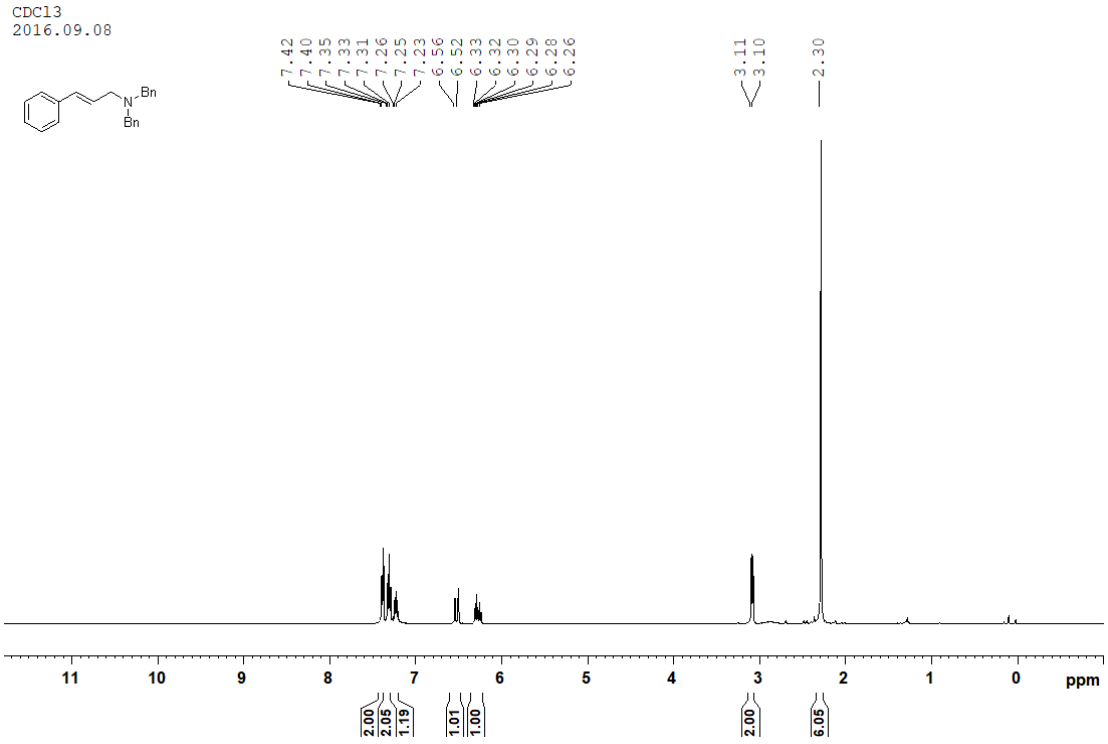


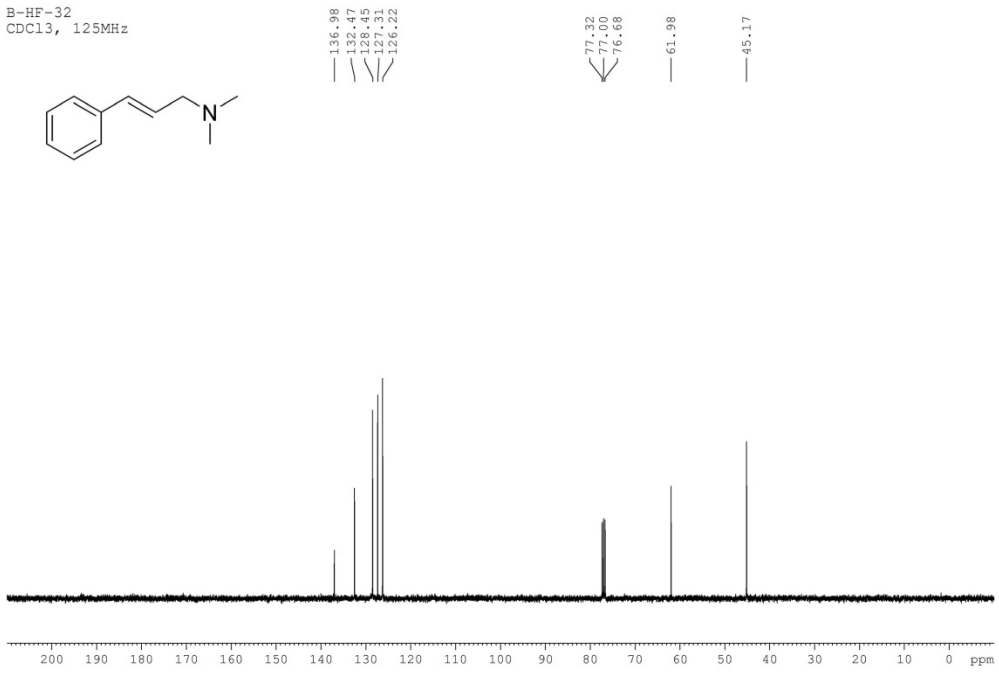
^{1}H NMR and ^{13}C NMR spectra of compound **2m**



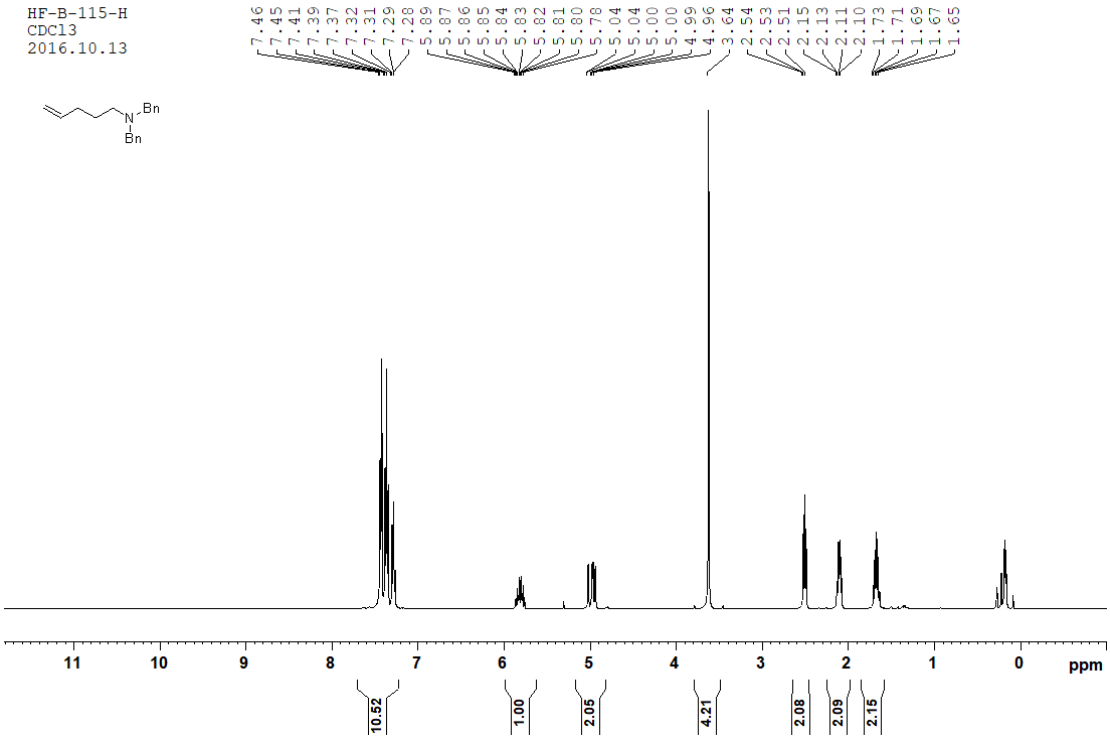


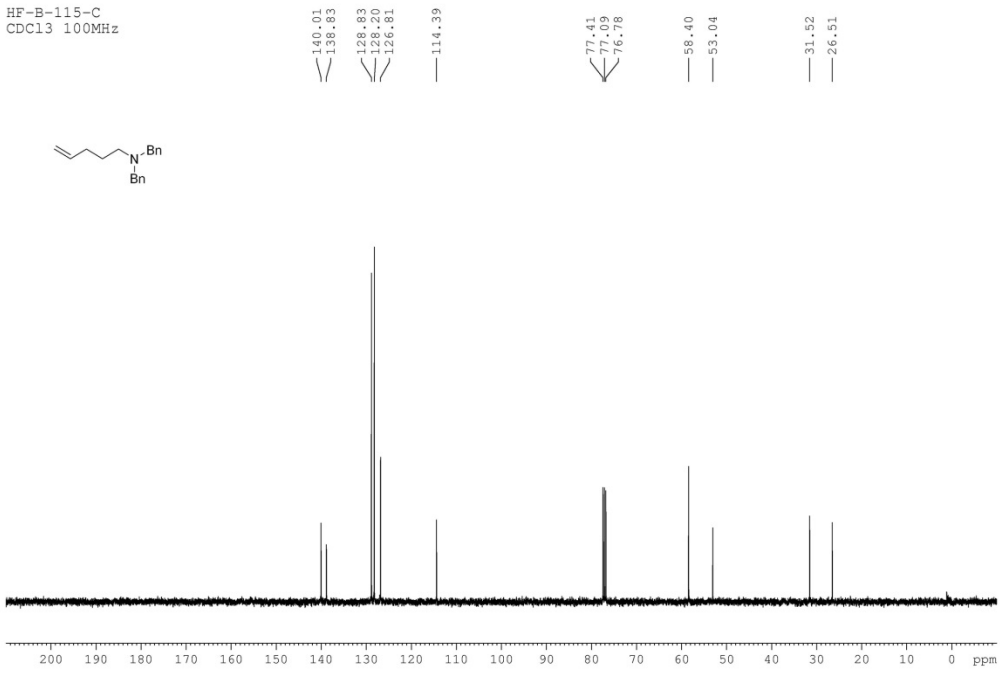
^{1}H NMR and ^{13}C NMR spectra of compound **2n**



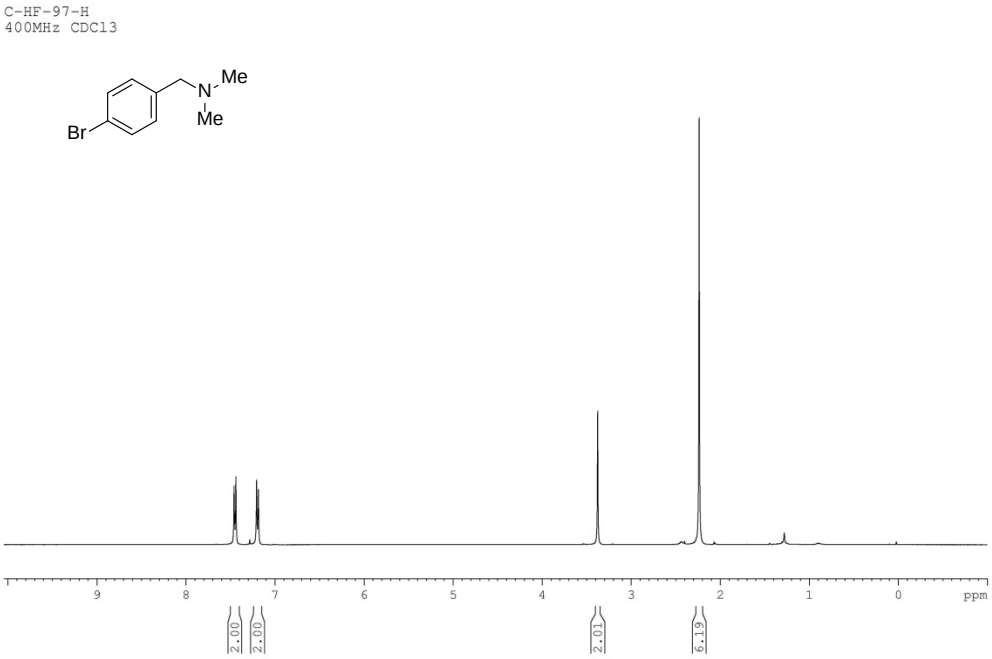


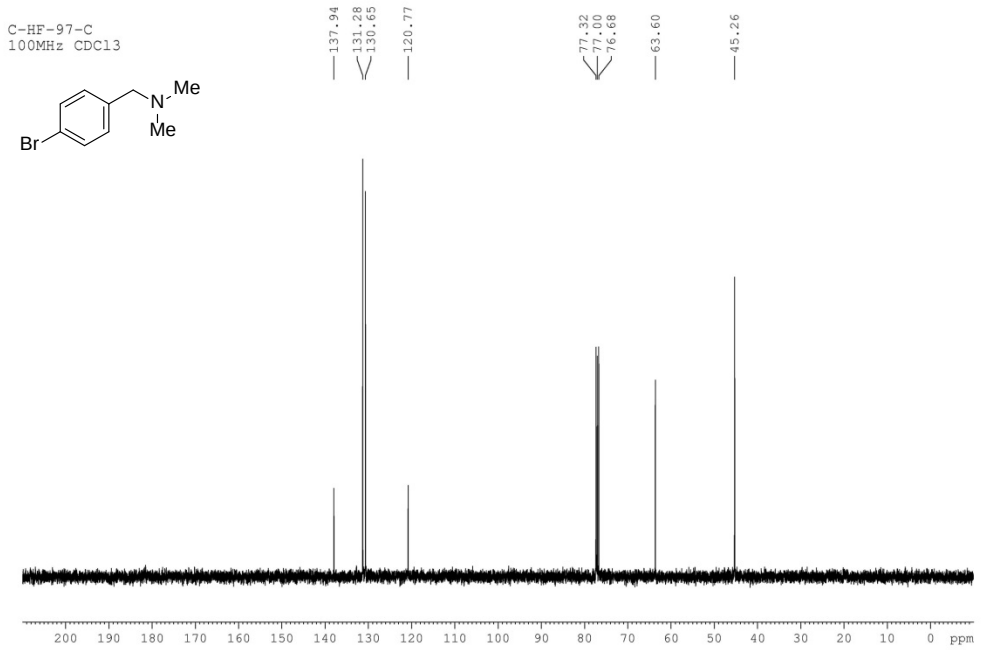
^{1}H NMR and ^{13}C NMR spectra of compound **2o**



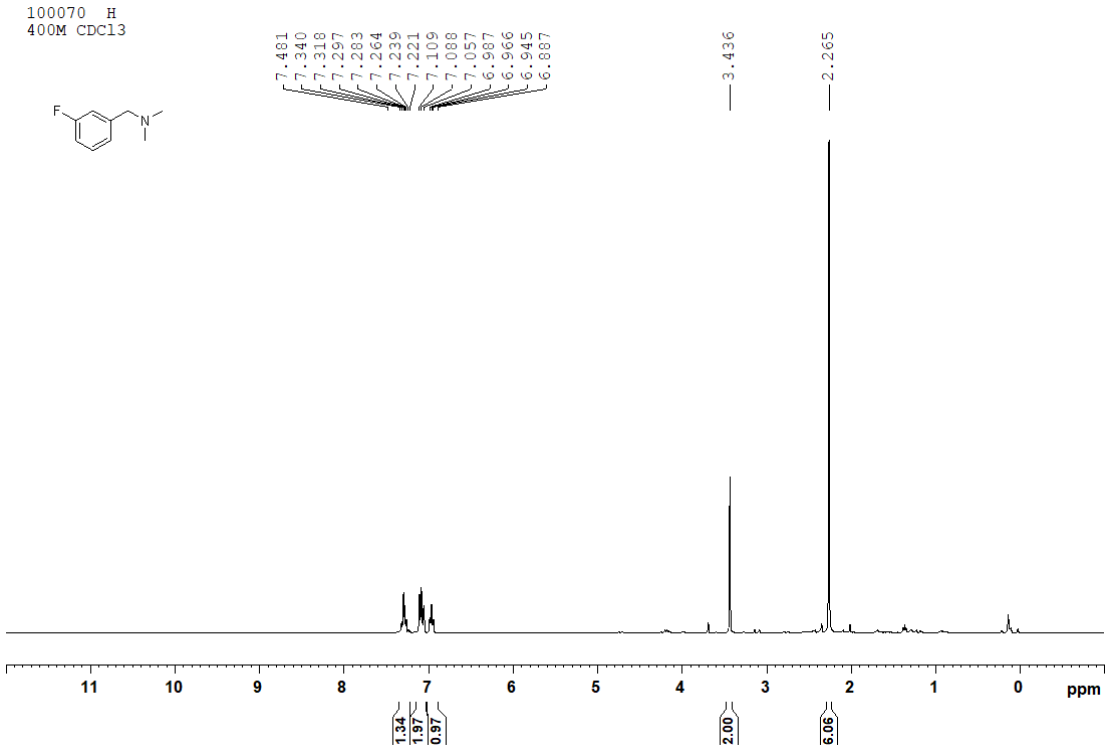


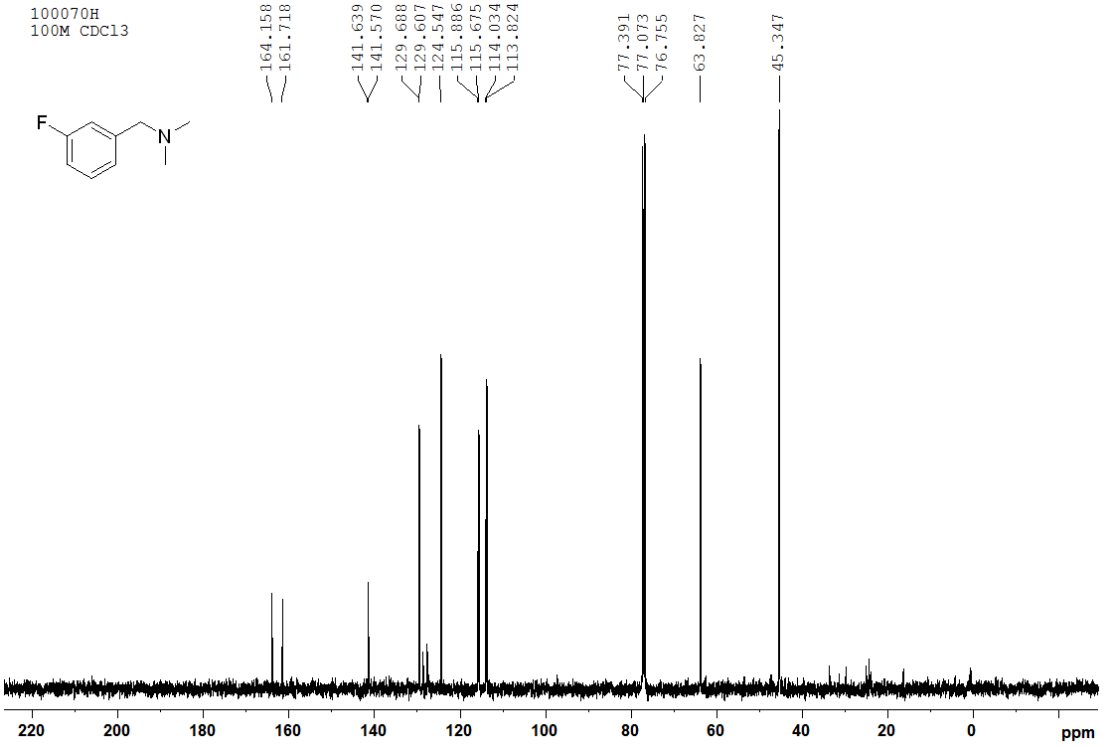
^{1}H NMR and ^{13}C NMR spectra of compound **2p**



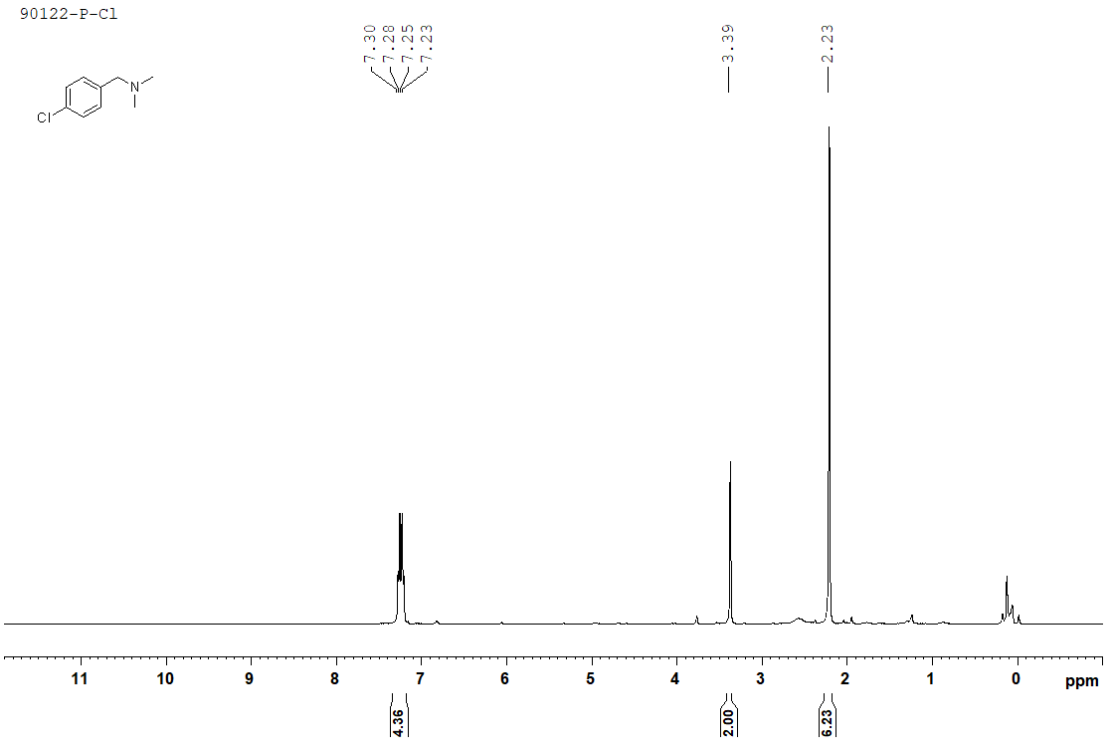


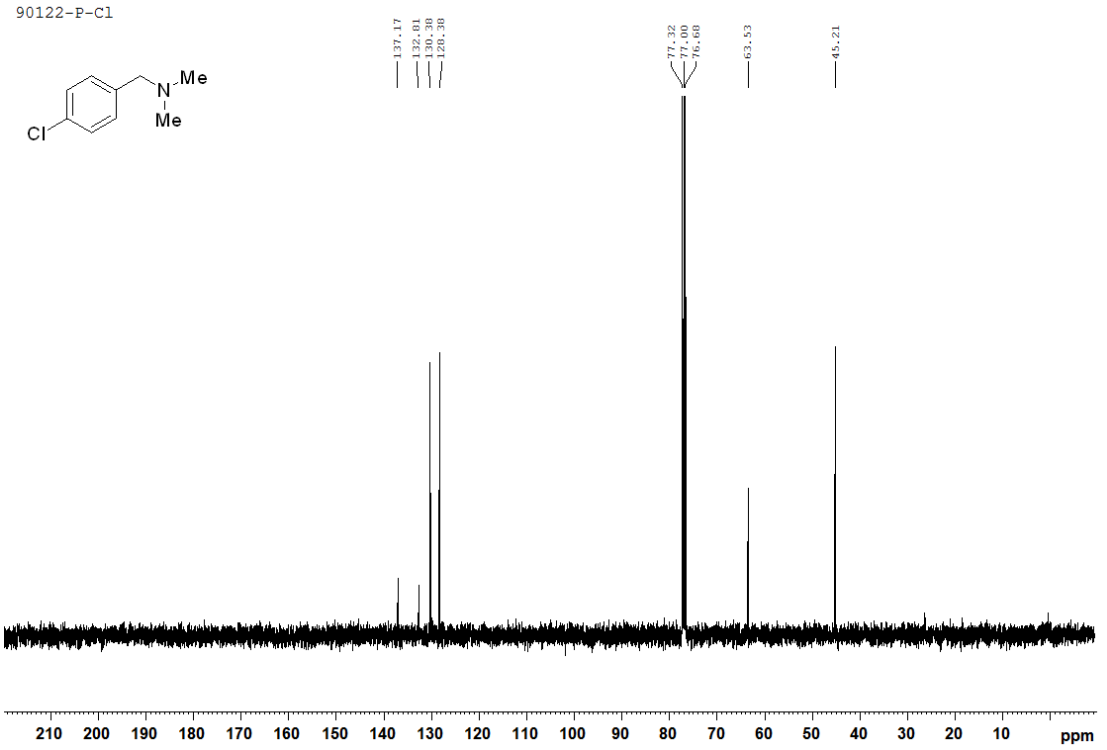
^{1}H NMR and ^{13}C NMR spectra of compound **2q**



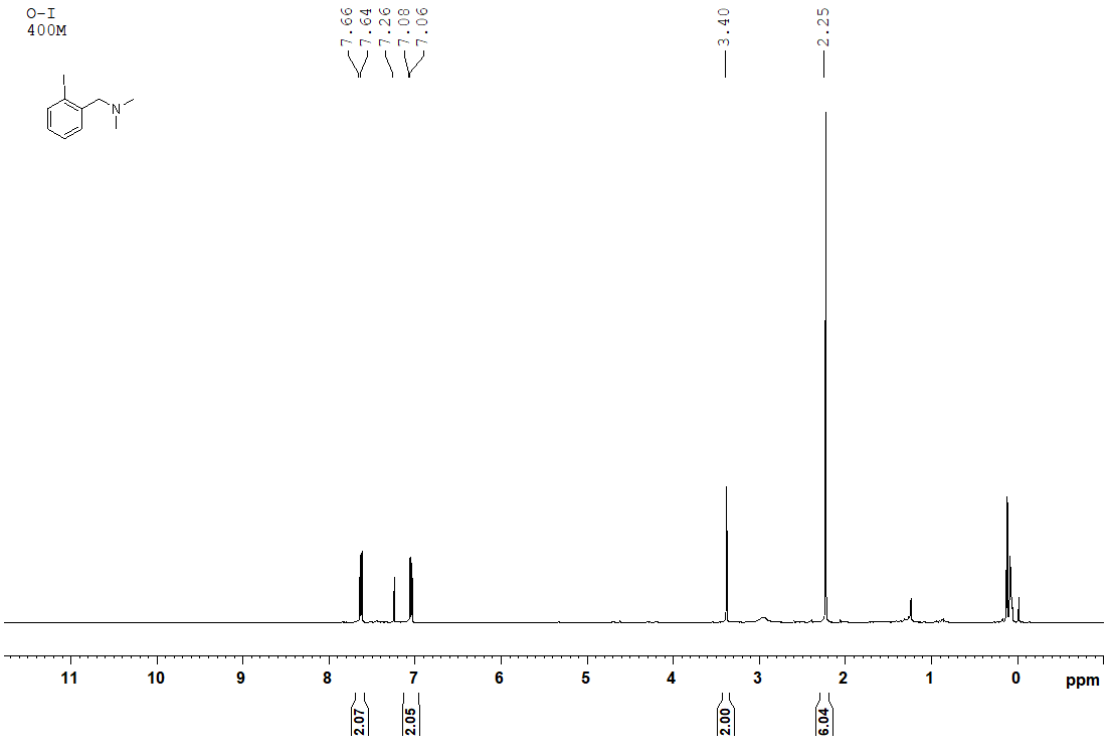


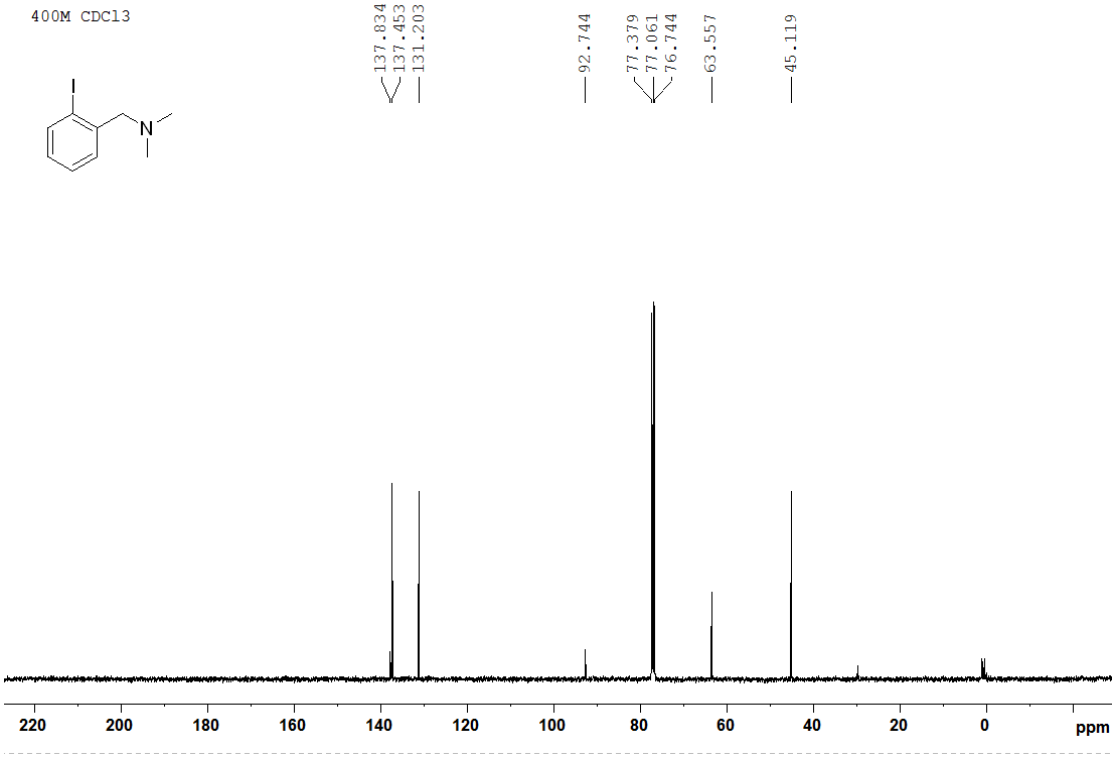
^{1}H NMR and ^{13}C NMR spectra of compound **2r**



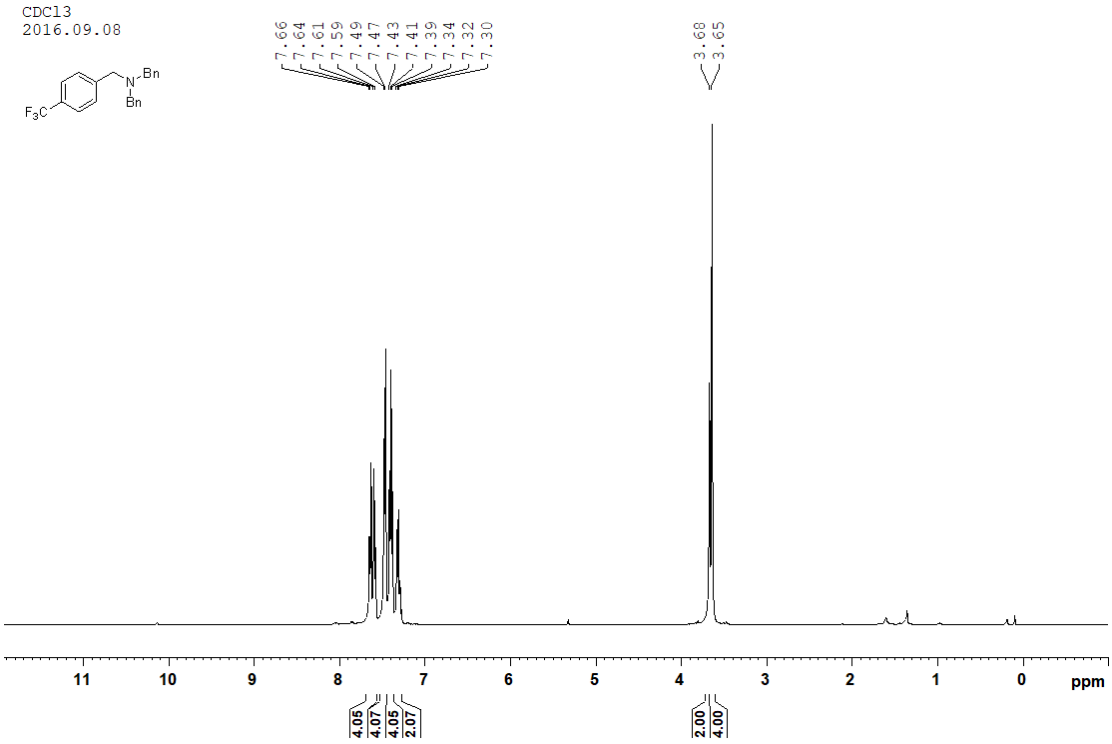


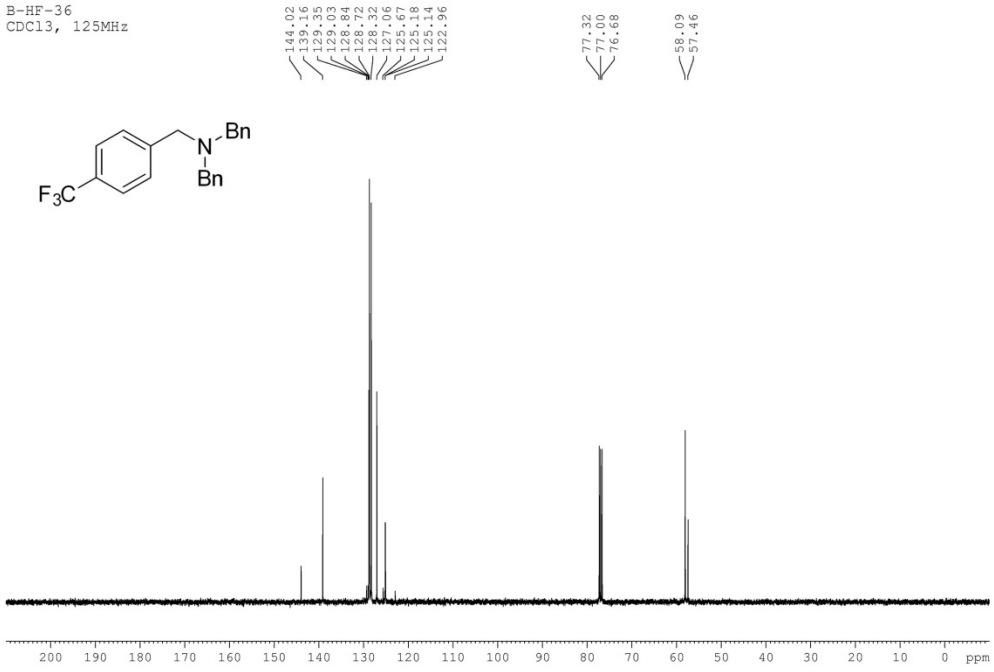
^{1}H NMR and ^{13}C NMR spectra of compound **2s**



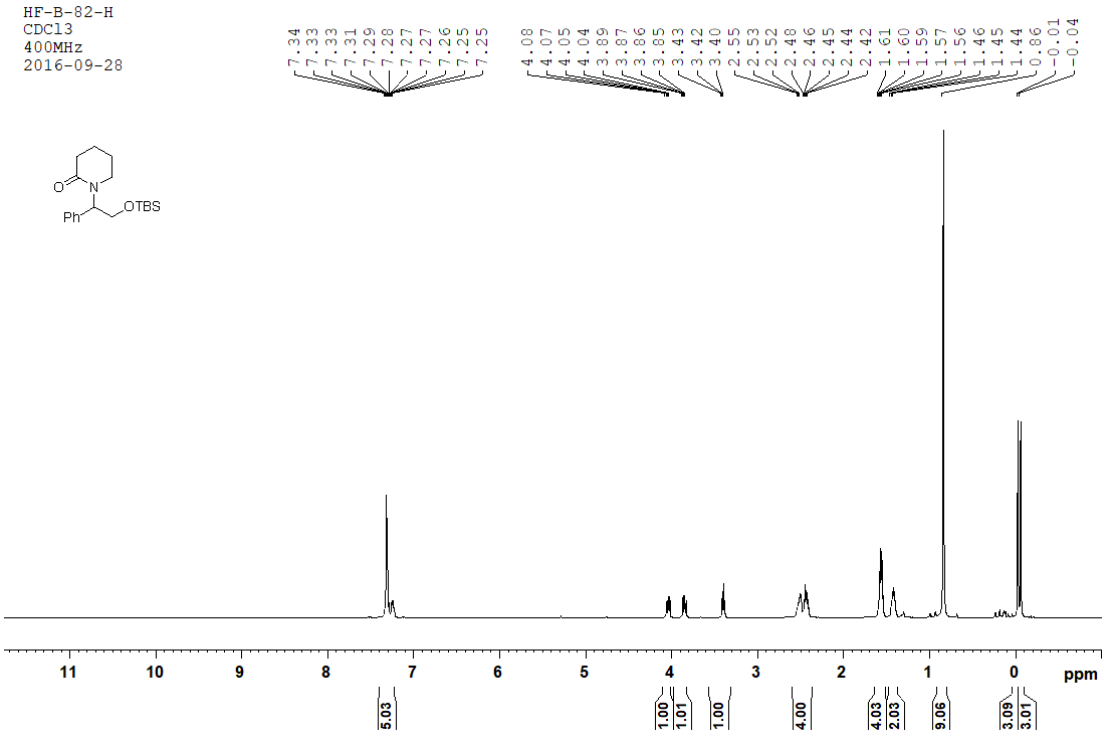


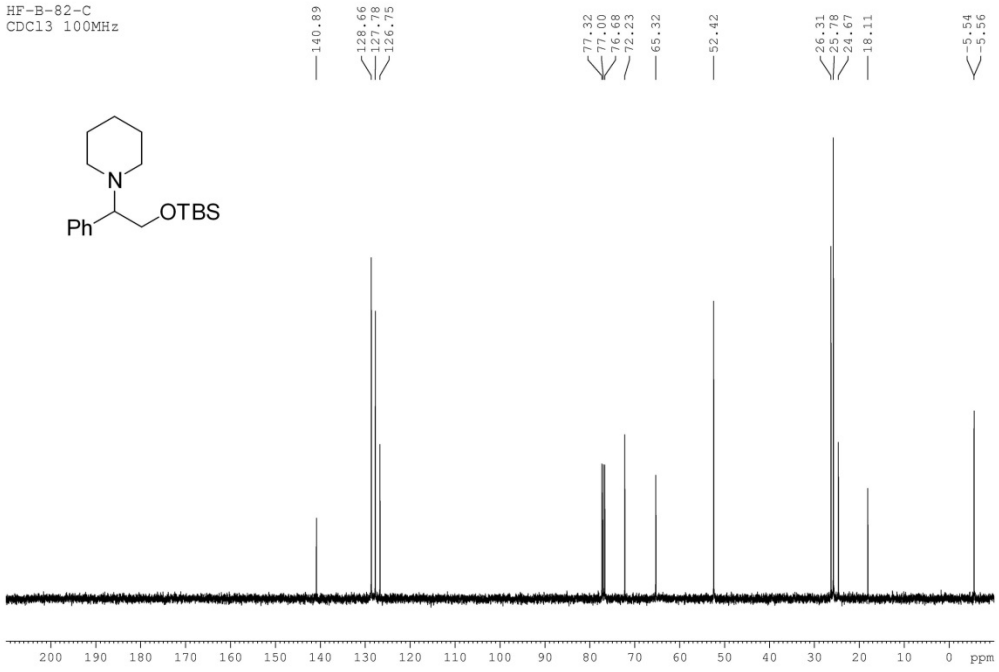
^{1}H NMR and ^{13}C NMR spectra of compound **2t**



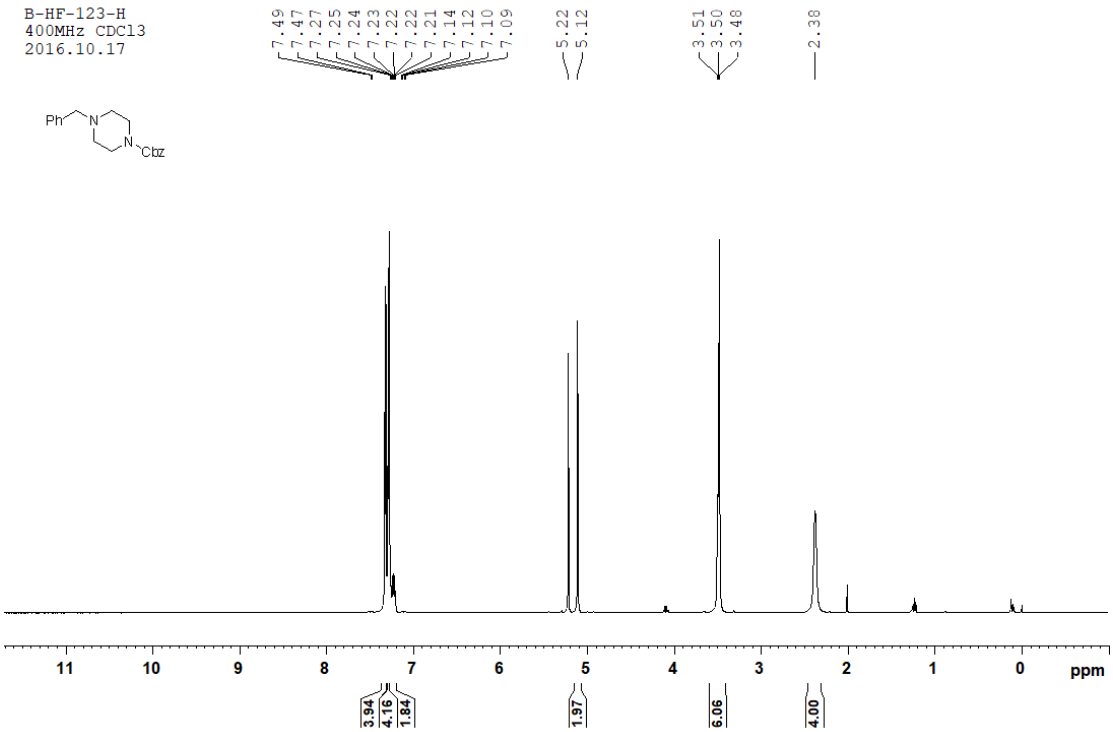


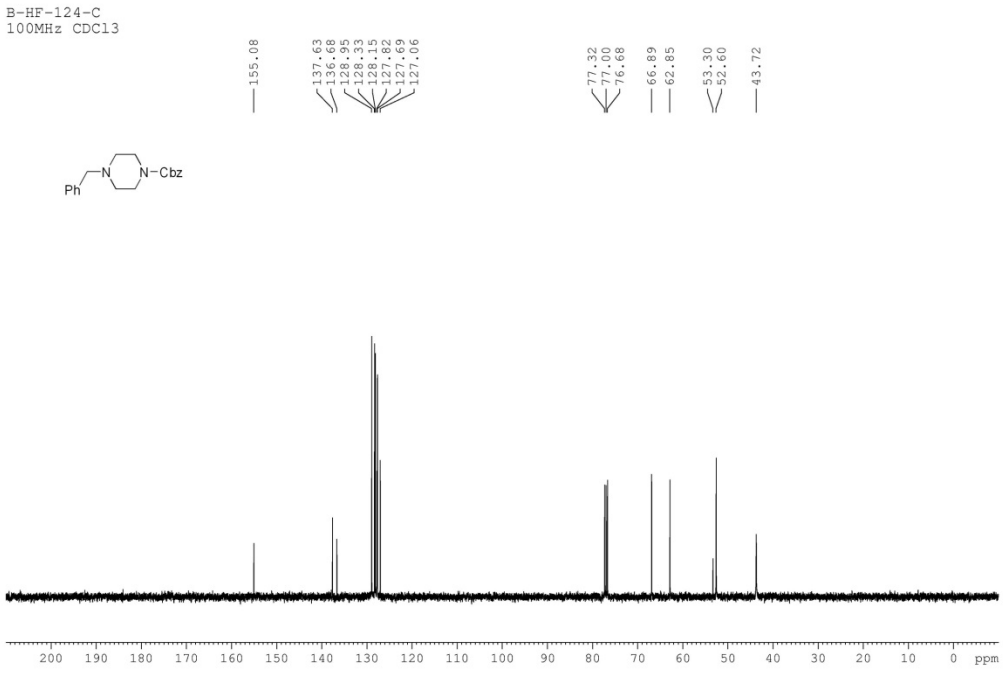
^{1}H NMR and ^{13}C NMR spectra of compound **2u**



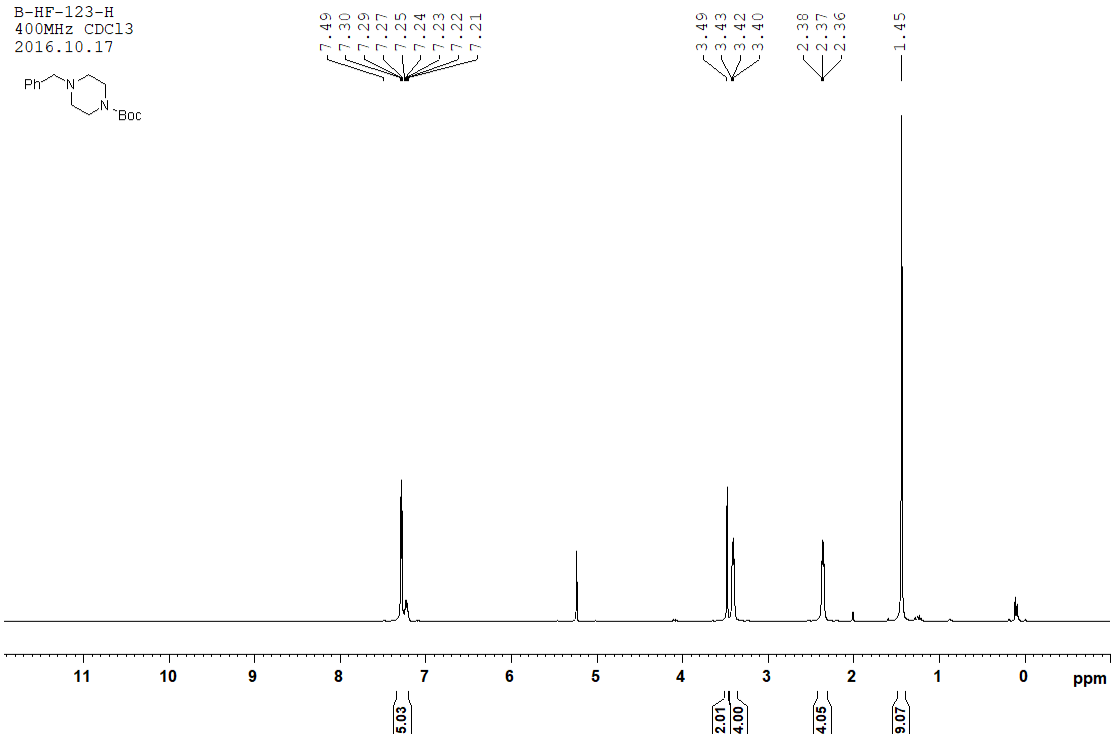


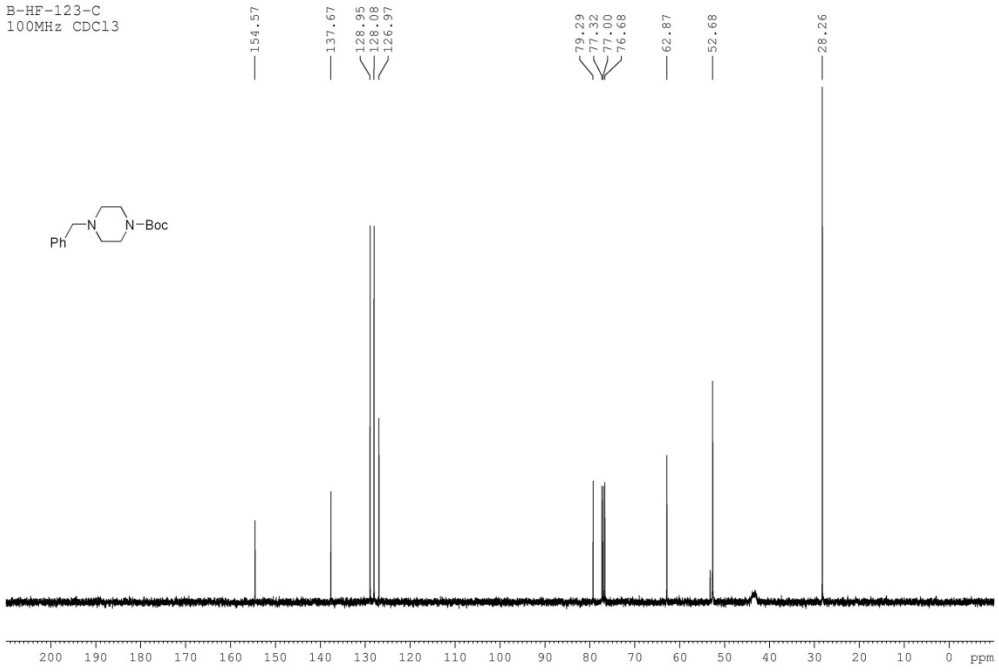
^{1}H NMR and ^{13}C NMR spectra of compound **2v**



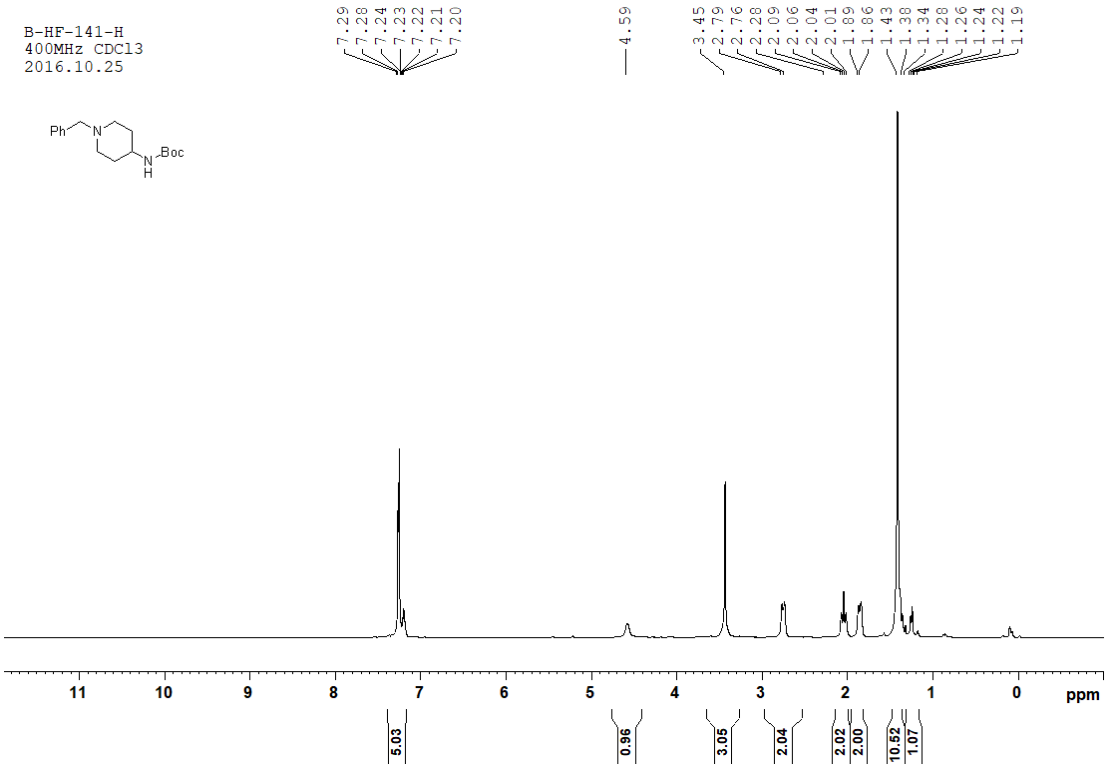


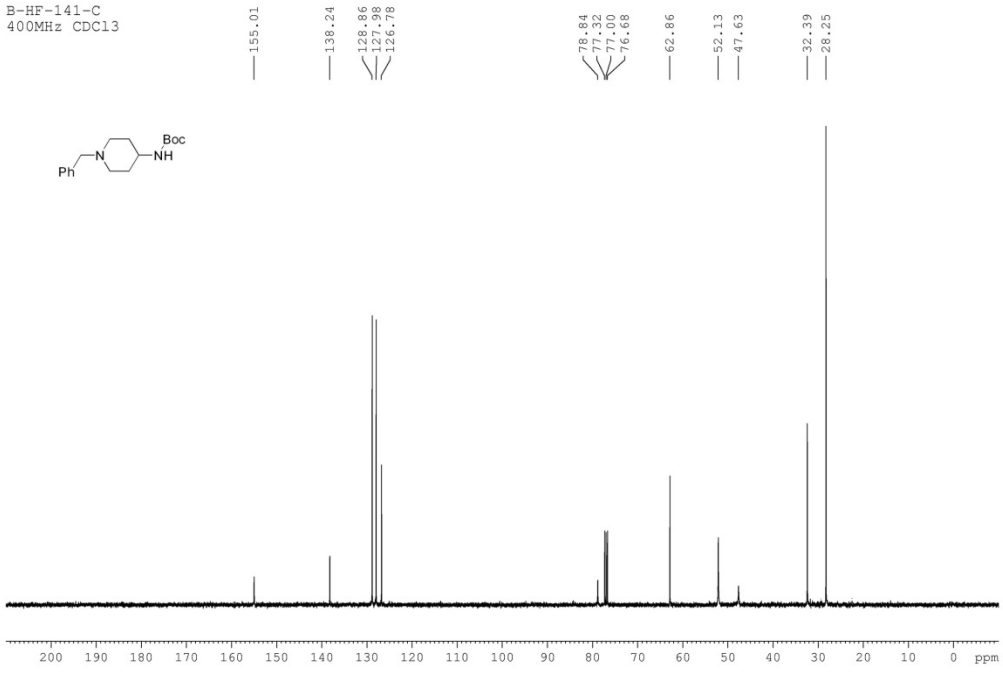
^{1}H NMR and ^{13}C NMR spectra of compound **2w**



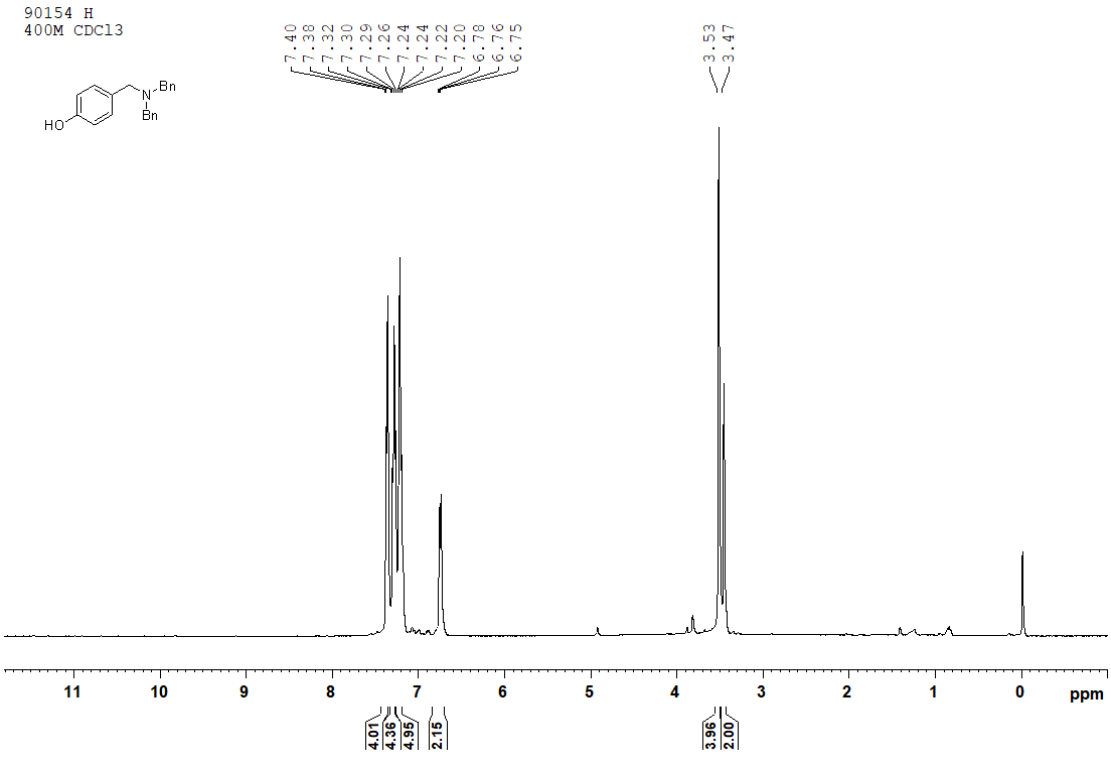


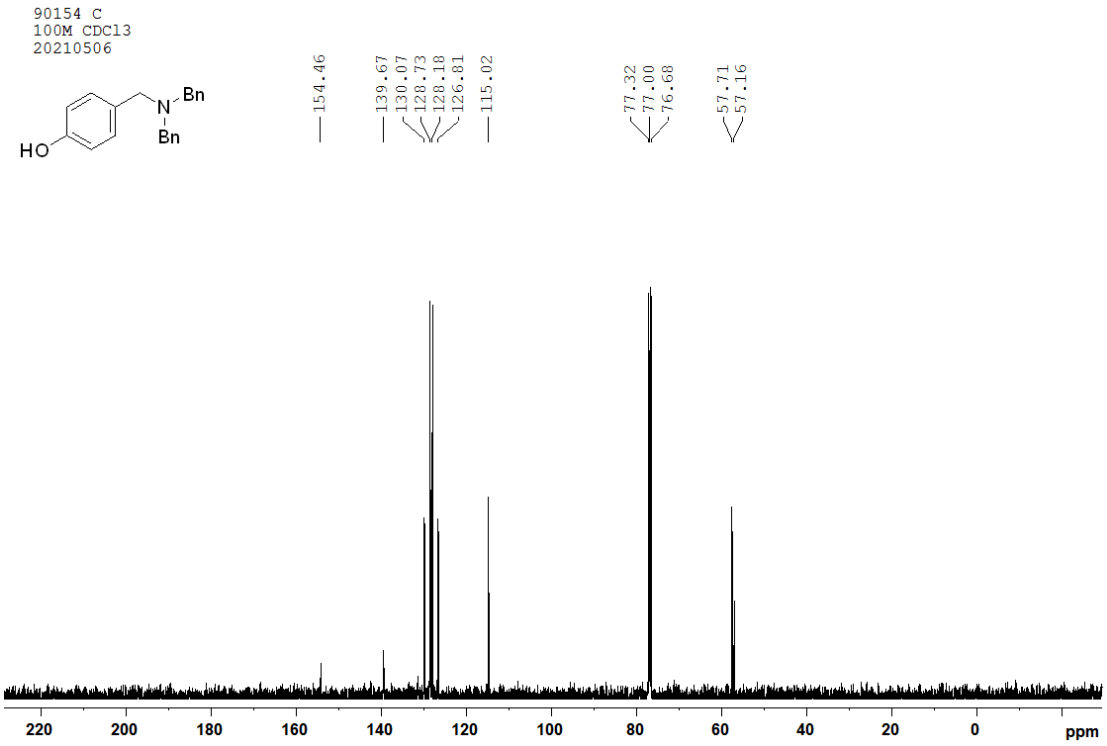
^{1}H NMR and ^{13}C NMR spectra of compound **2x**



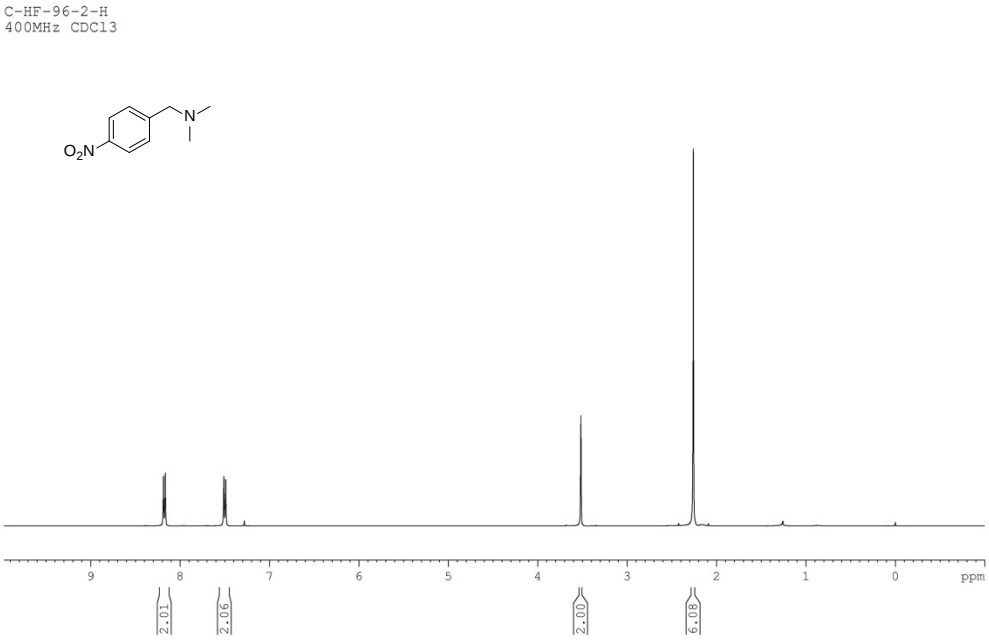


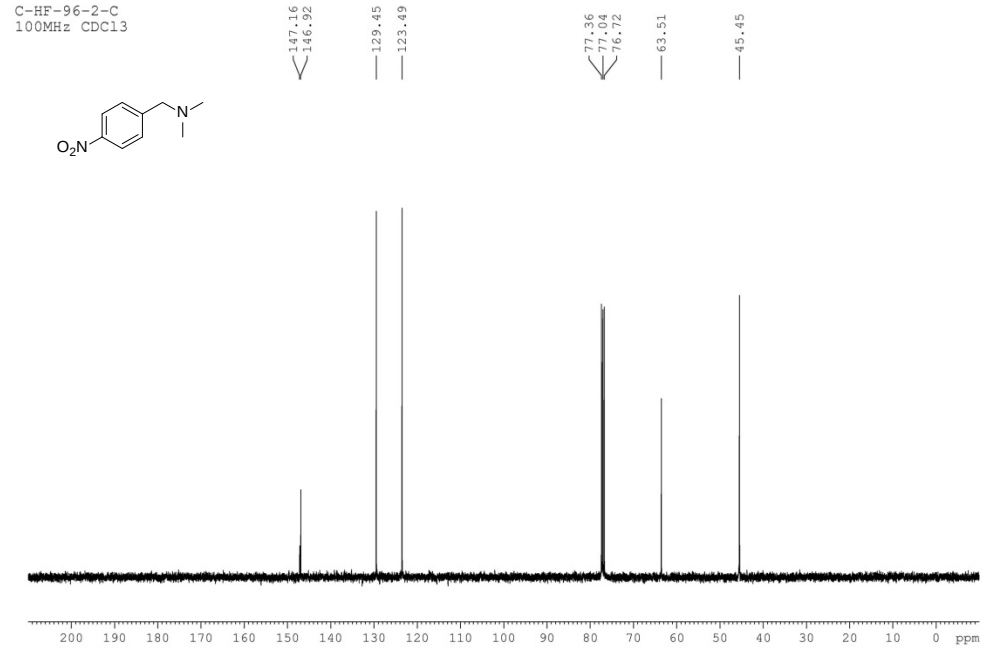
^{1}H NMR and ^{13}C NMR spectra of compound **2y**



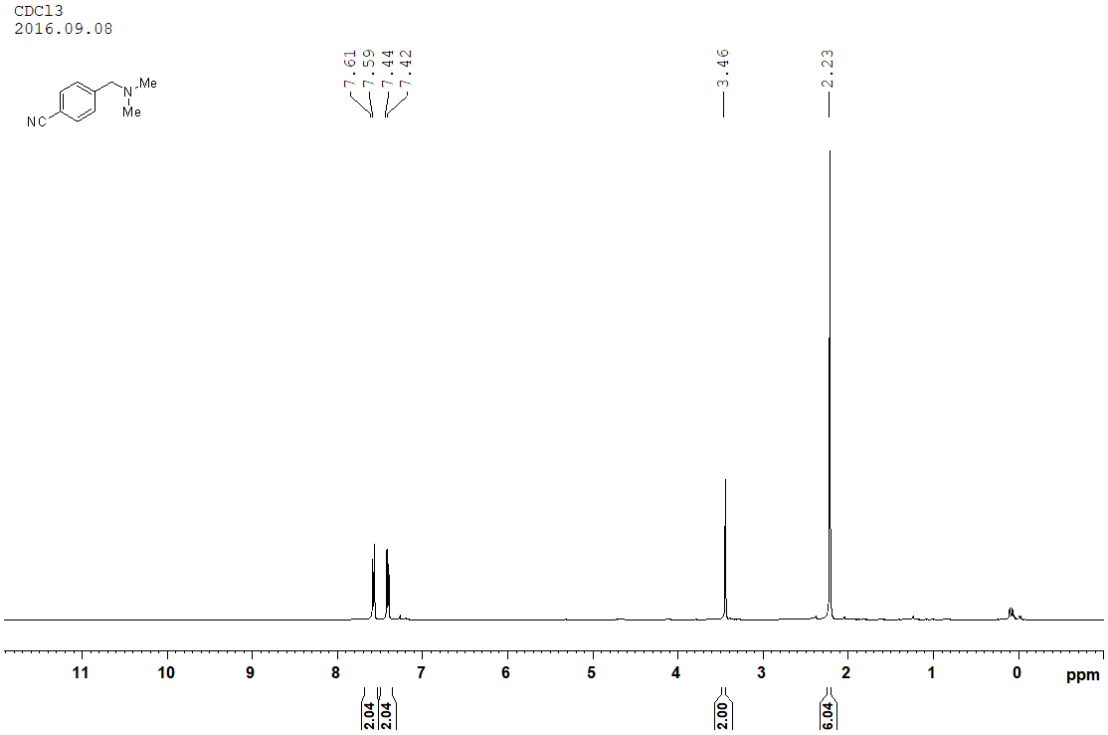


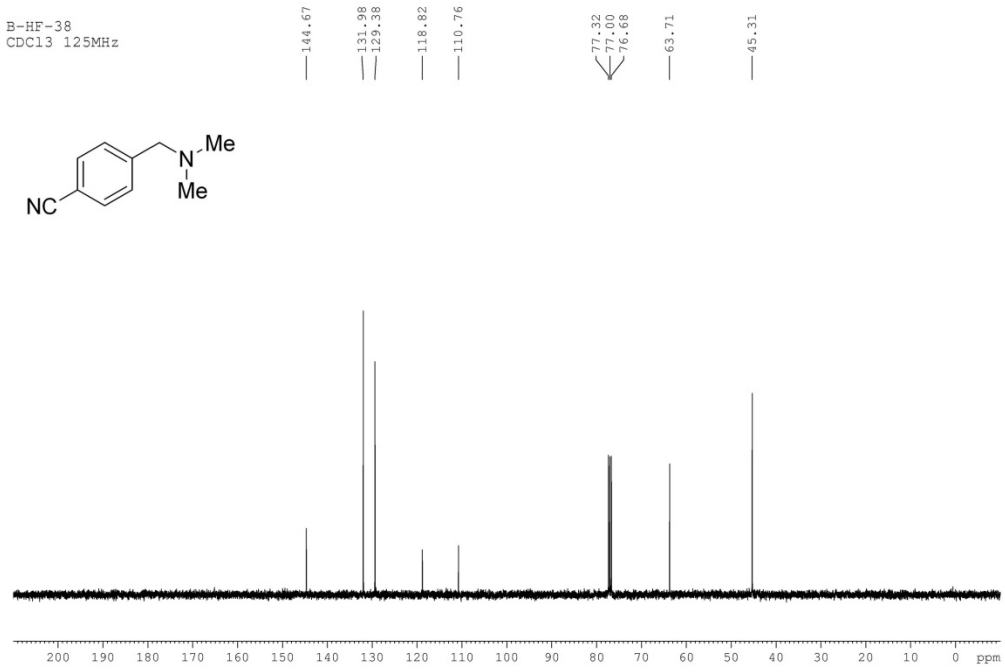
^{1}H NMR and ^{13}C NMR spectra of compound **2z**



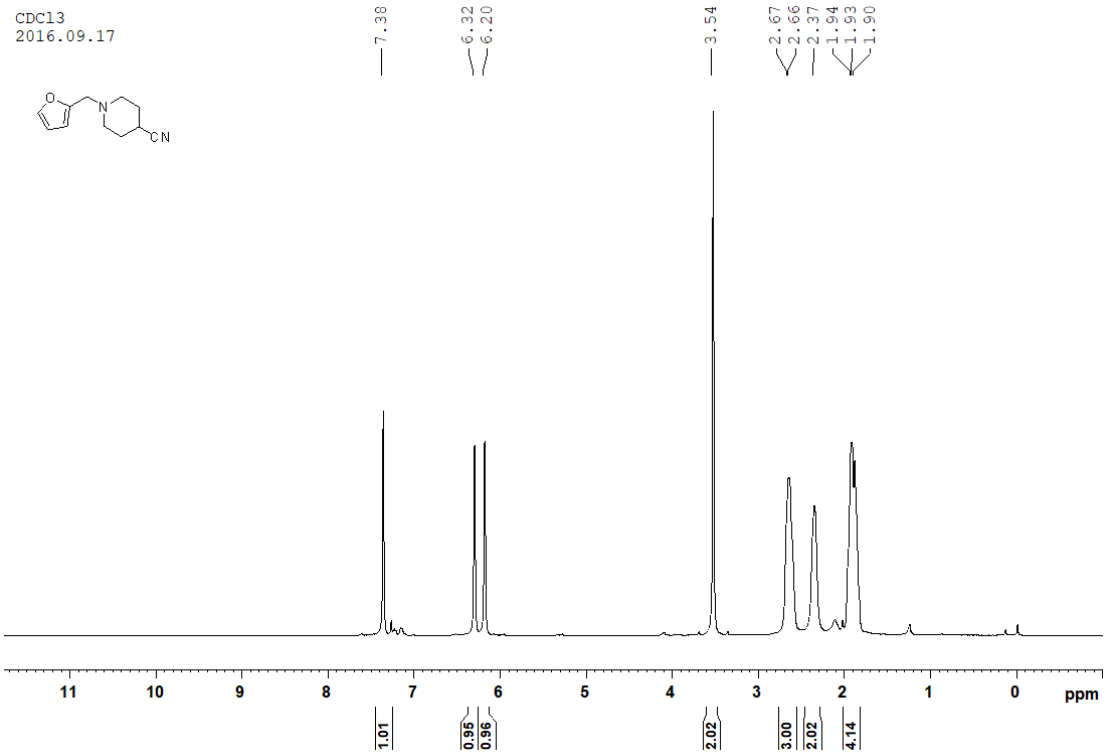


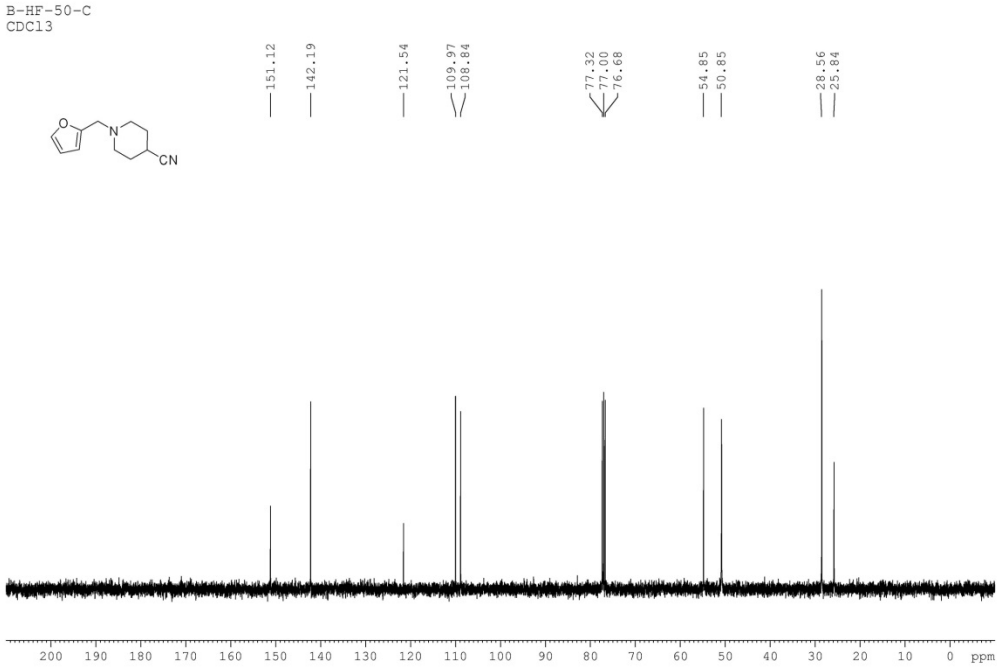
^{1}H NMR and ^{13}C NMR spectra of compound **2aa**



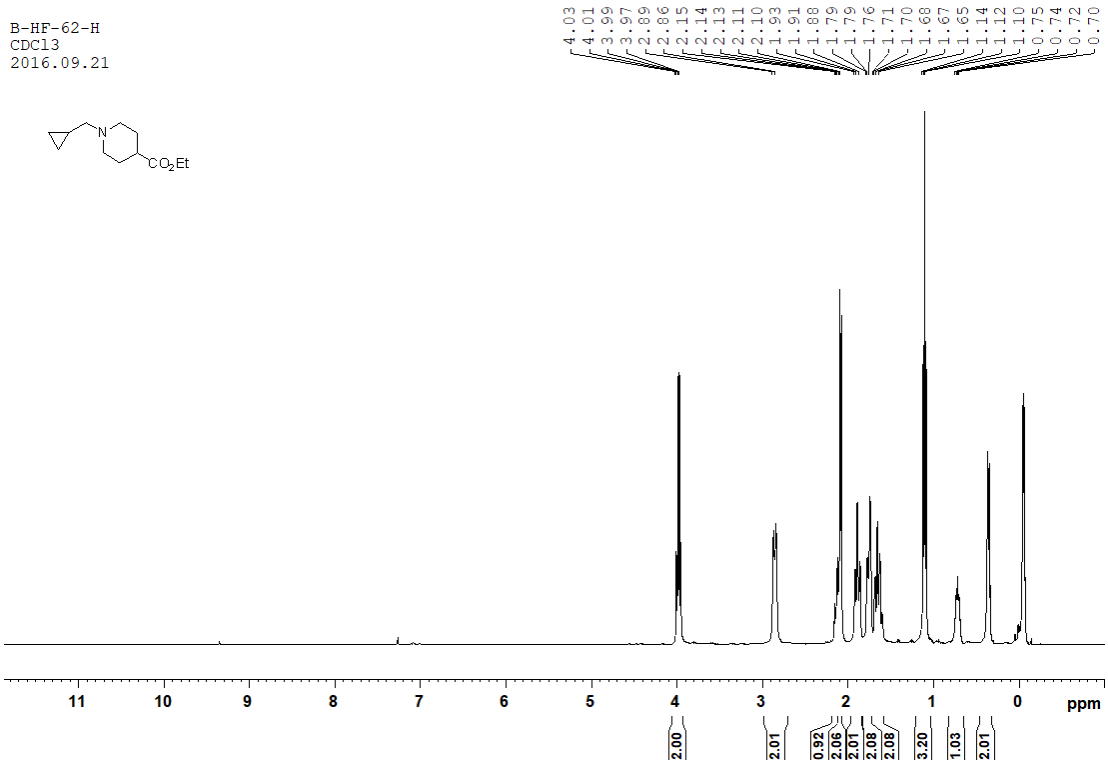


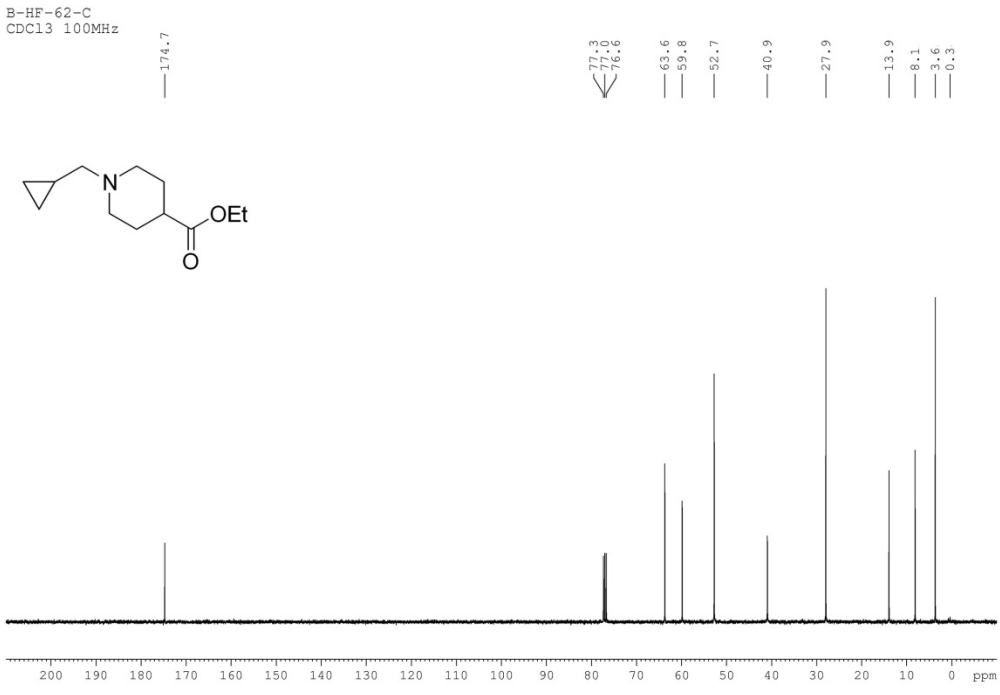
^{1}H NMR and ^{13}C NMR spectra of compound **2ab**



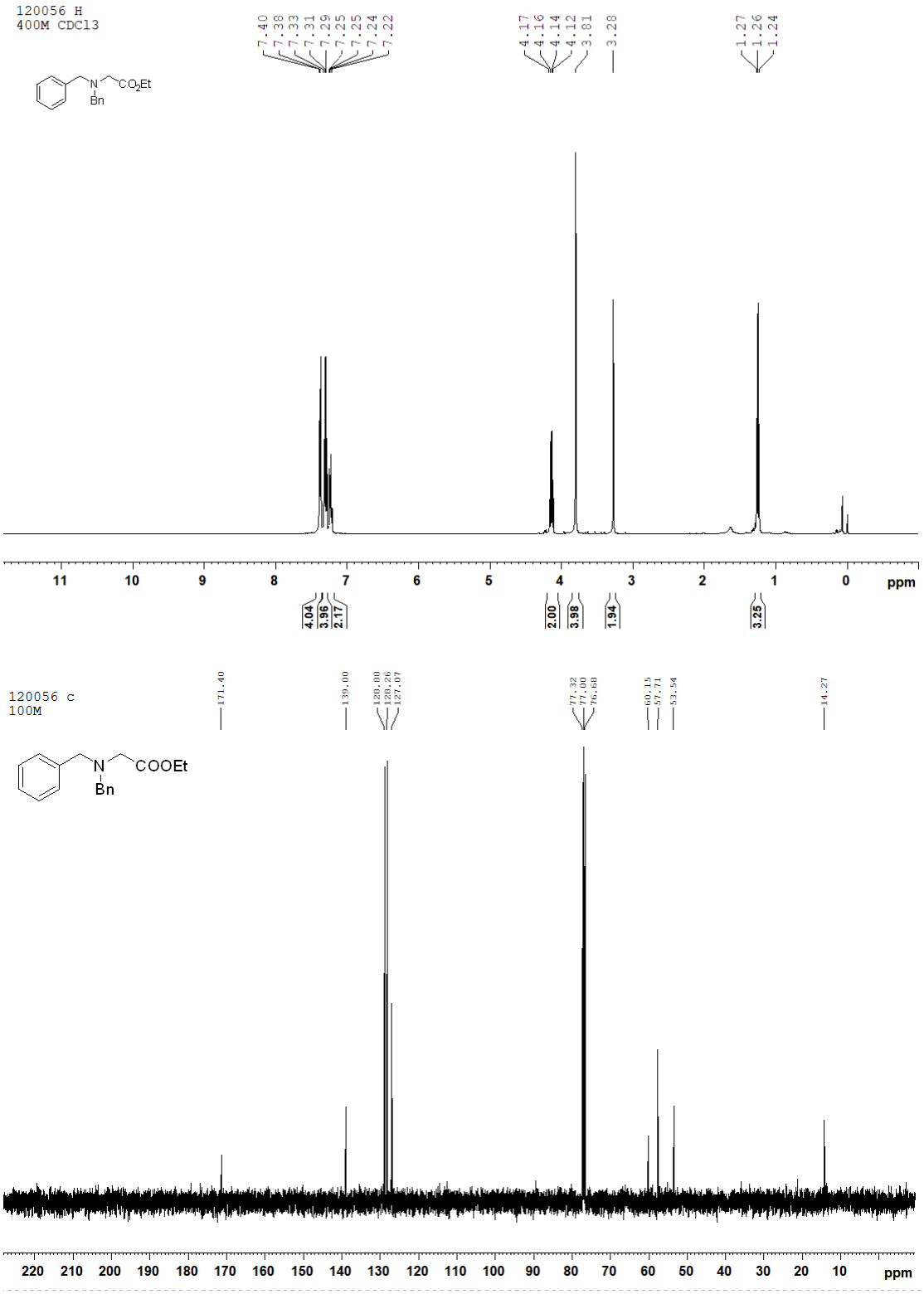


^{1}H NMR and ^{13}C NMR spectra of compound **2ac**

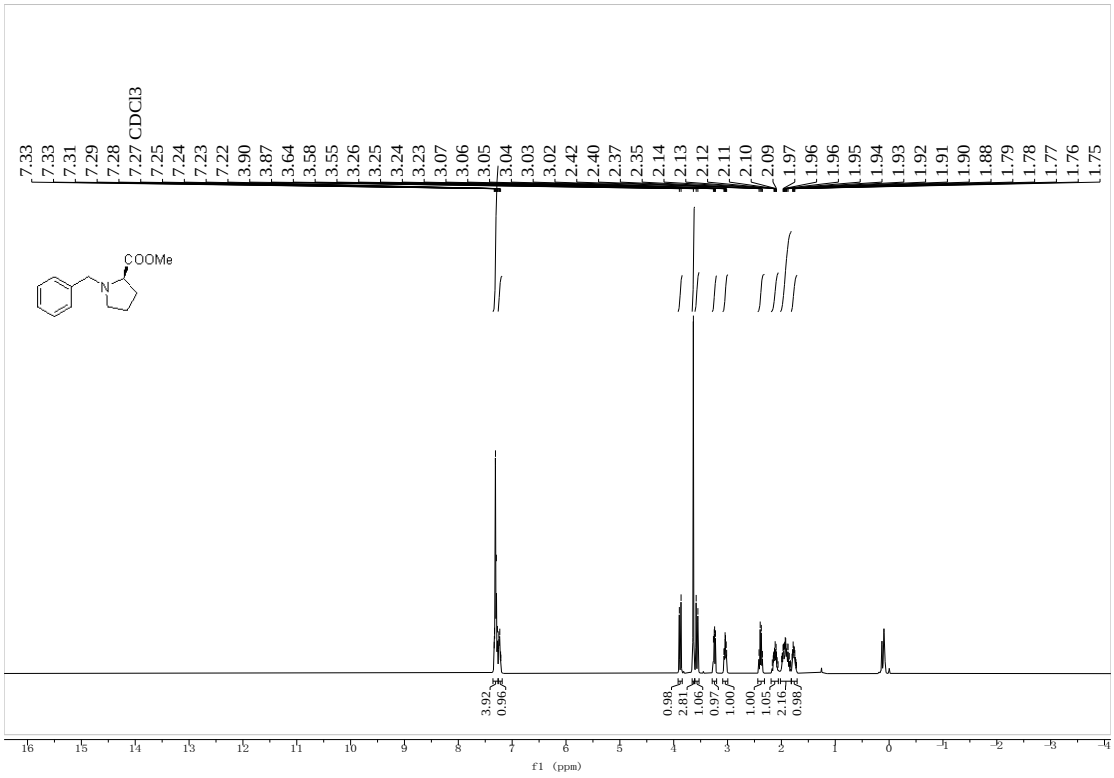


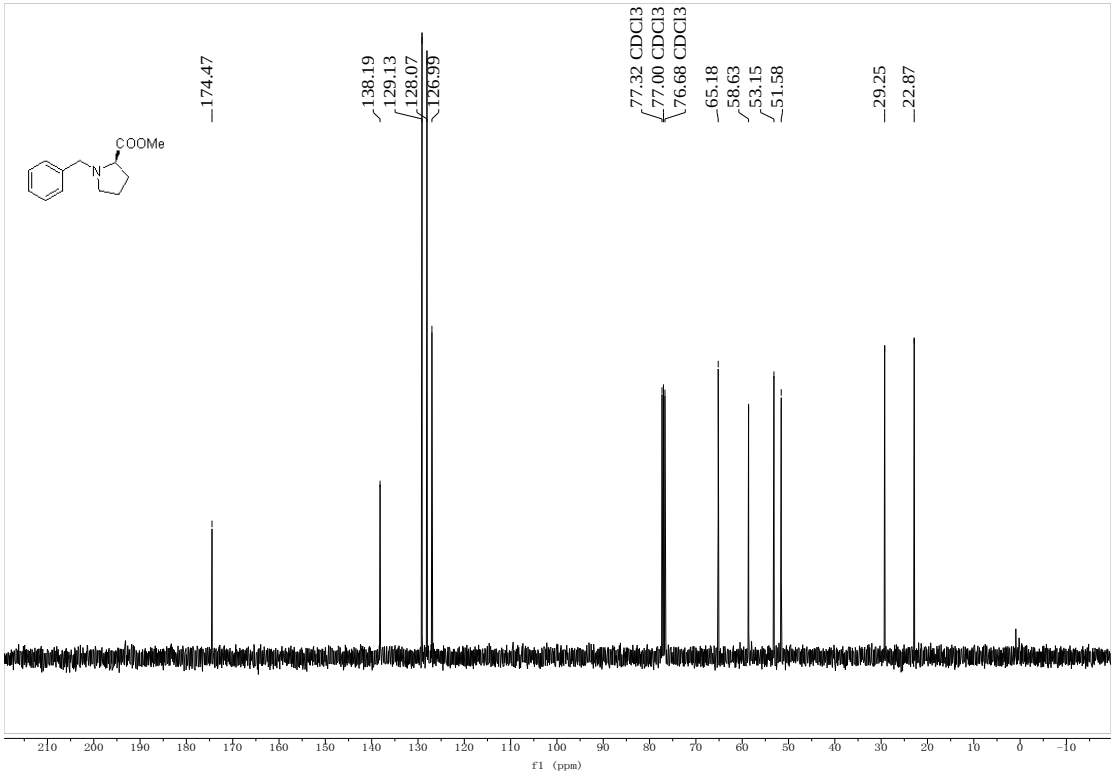


^{1}H NMR and ^{13}C NMR spectra of compound **2ad**

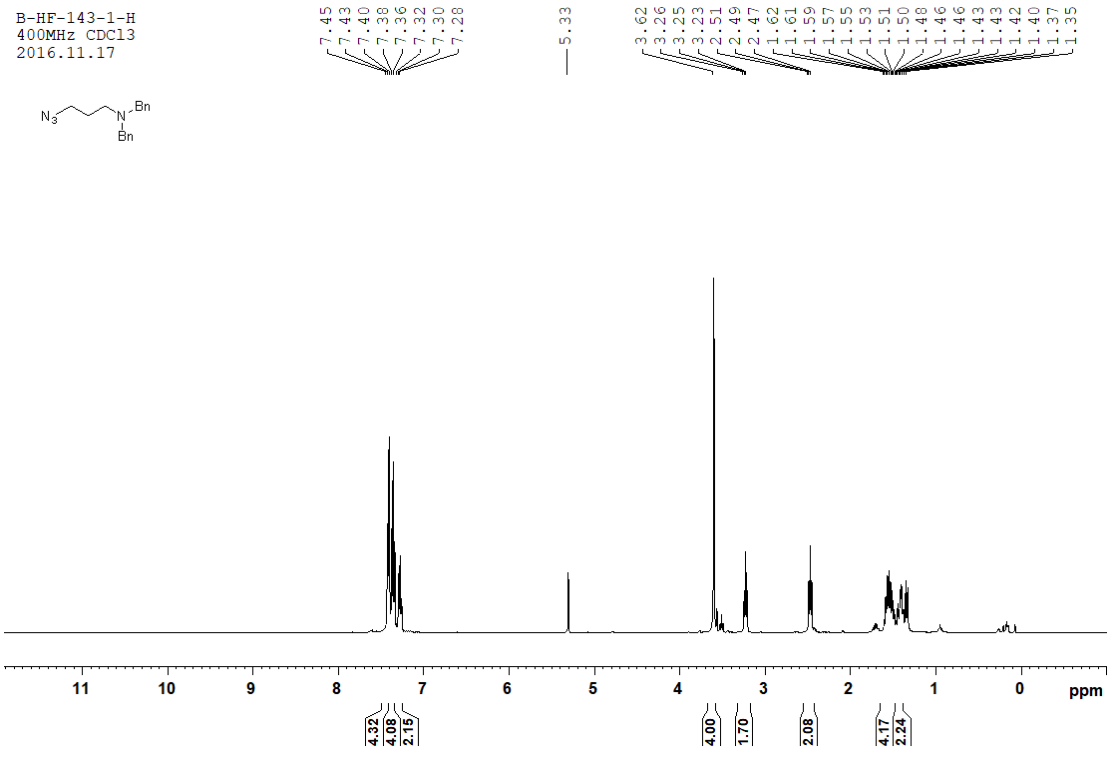


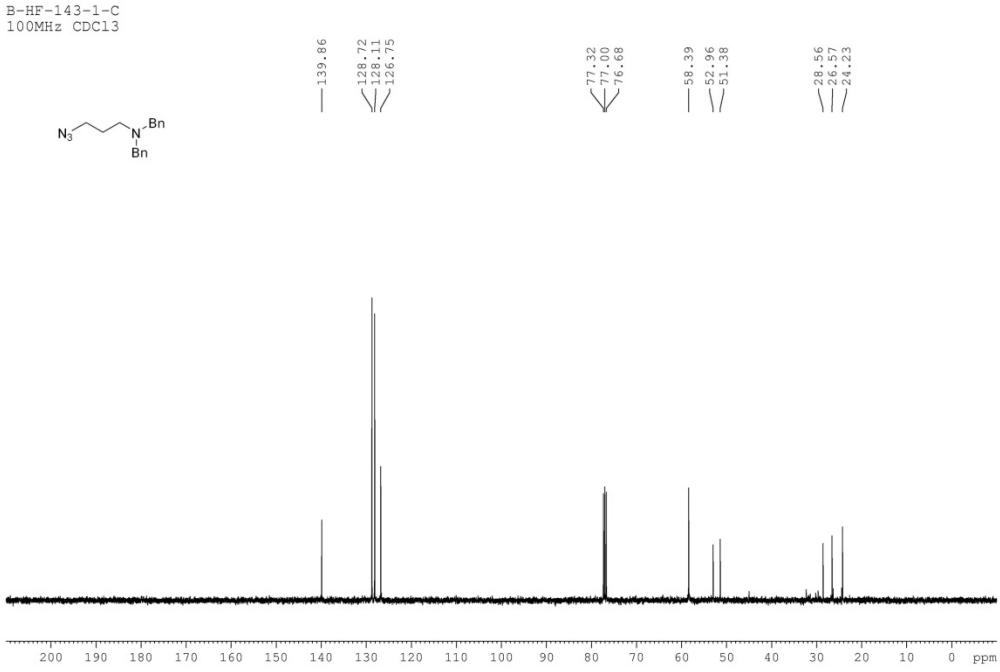
^{1}H NMR and ^{13}C NMR spectra of compound **2ae**



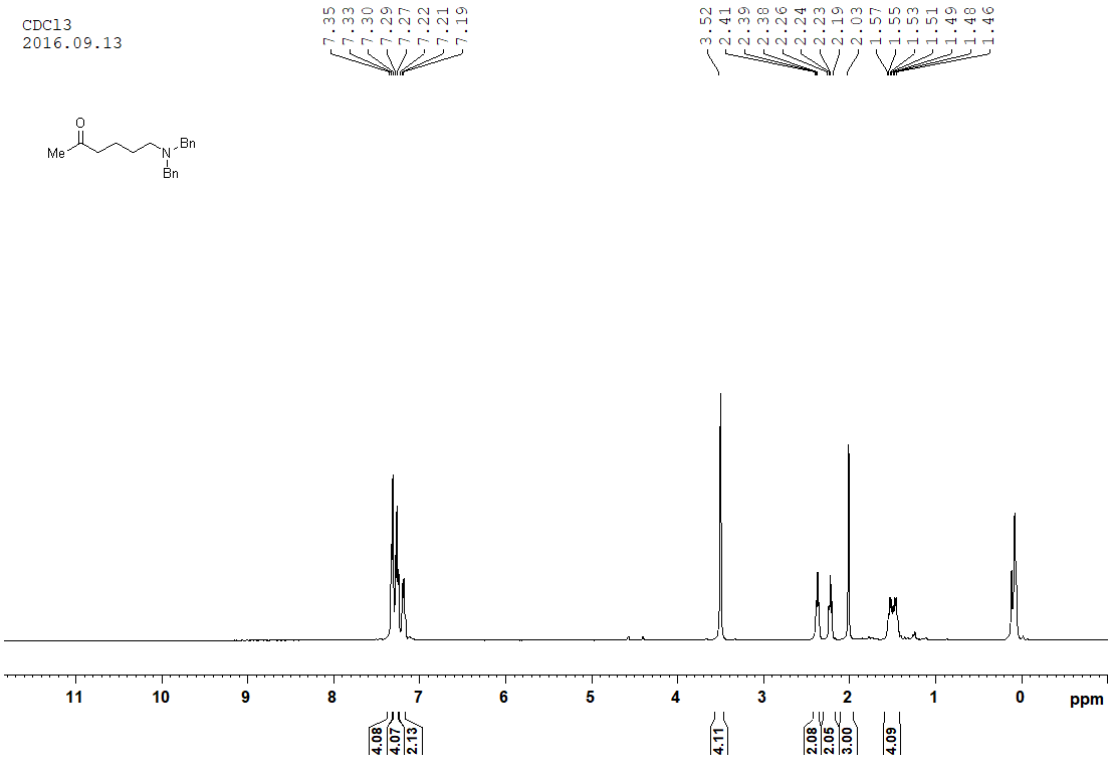


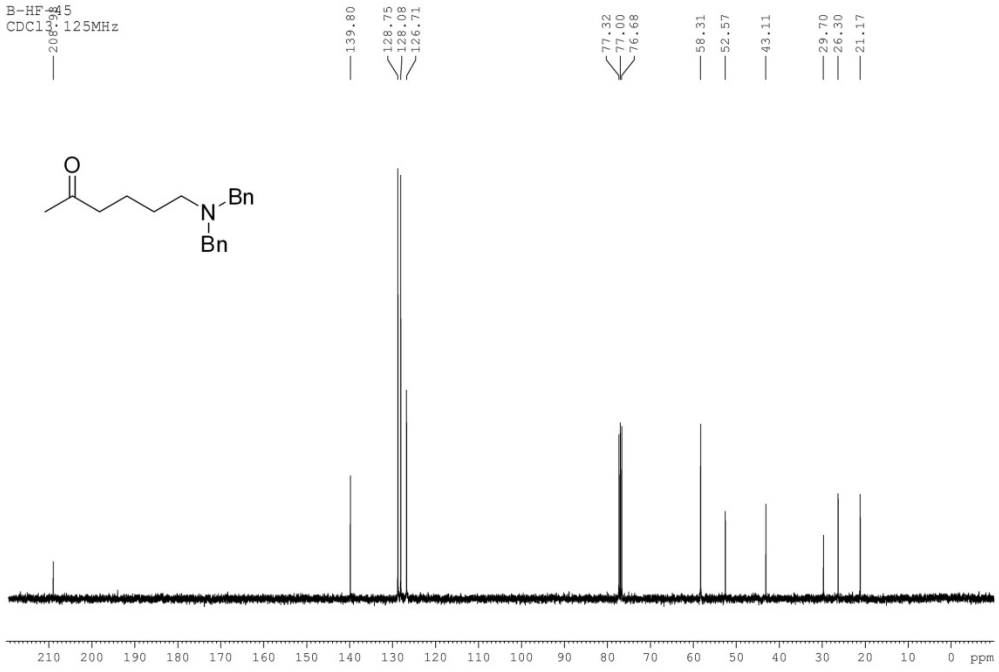
^{1}H NMR and ^{13}C NMR spectra of compound **2af**



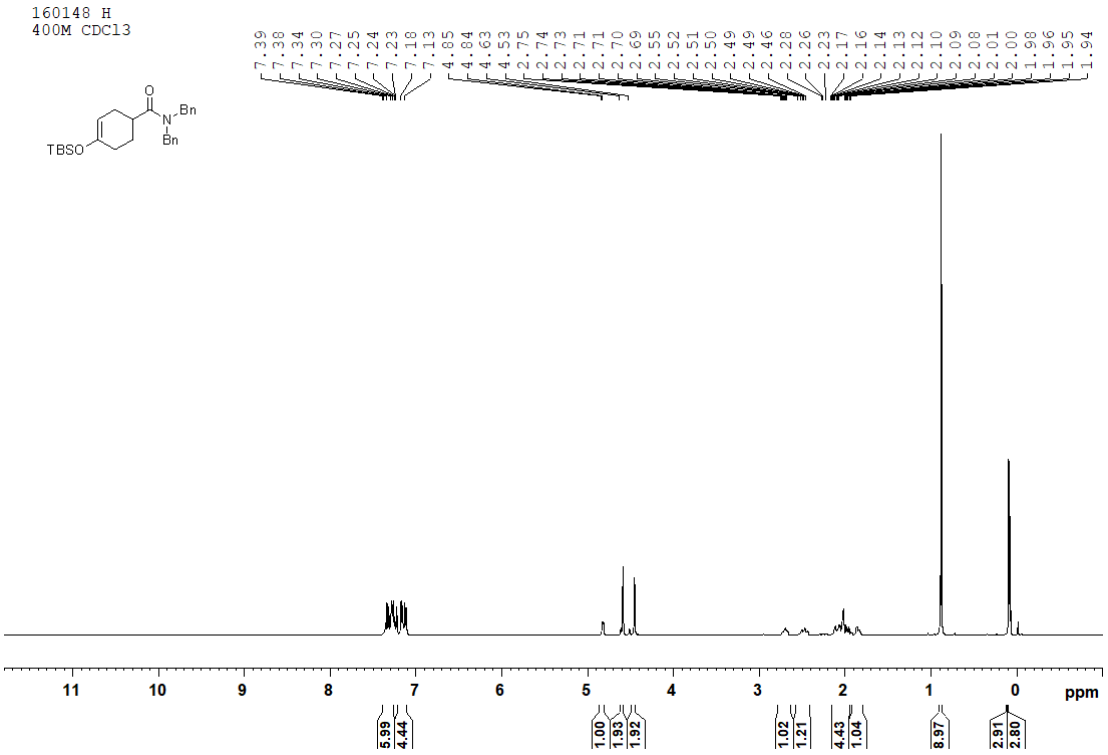


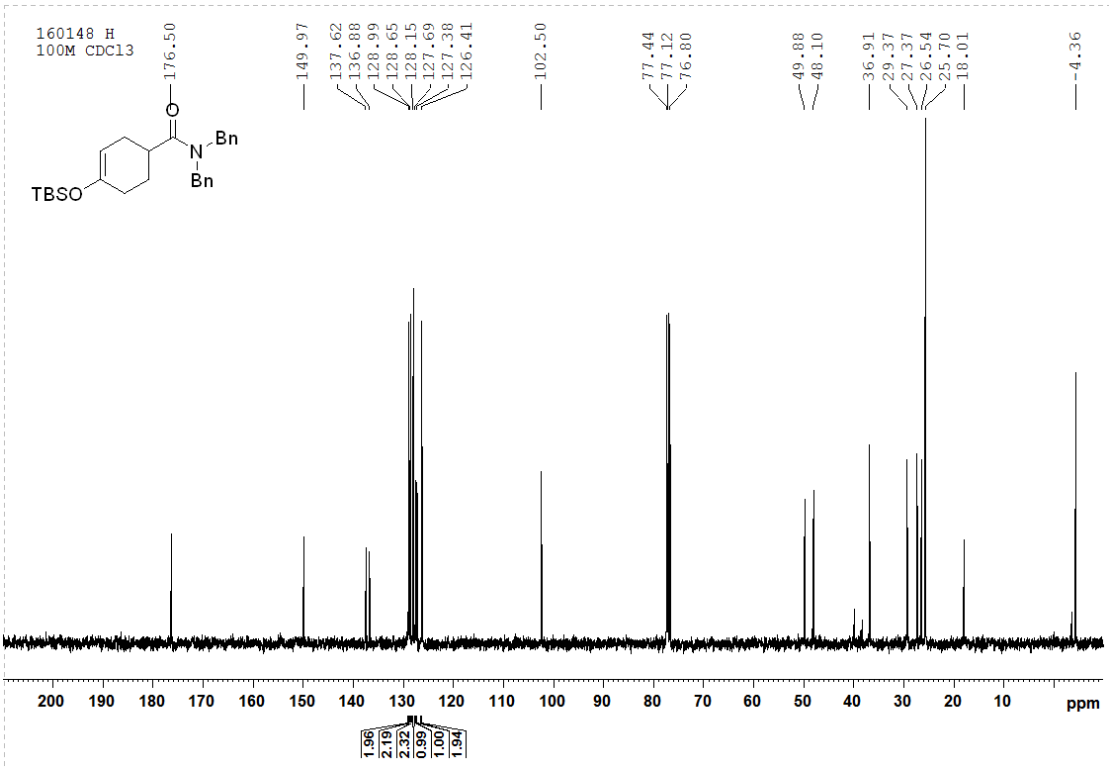
^{1}H NMR and ^{13}C NMR spectra of compound **2ag**



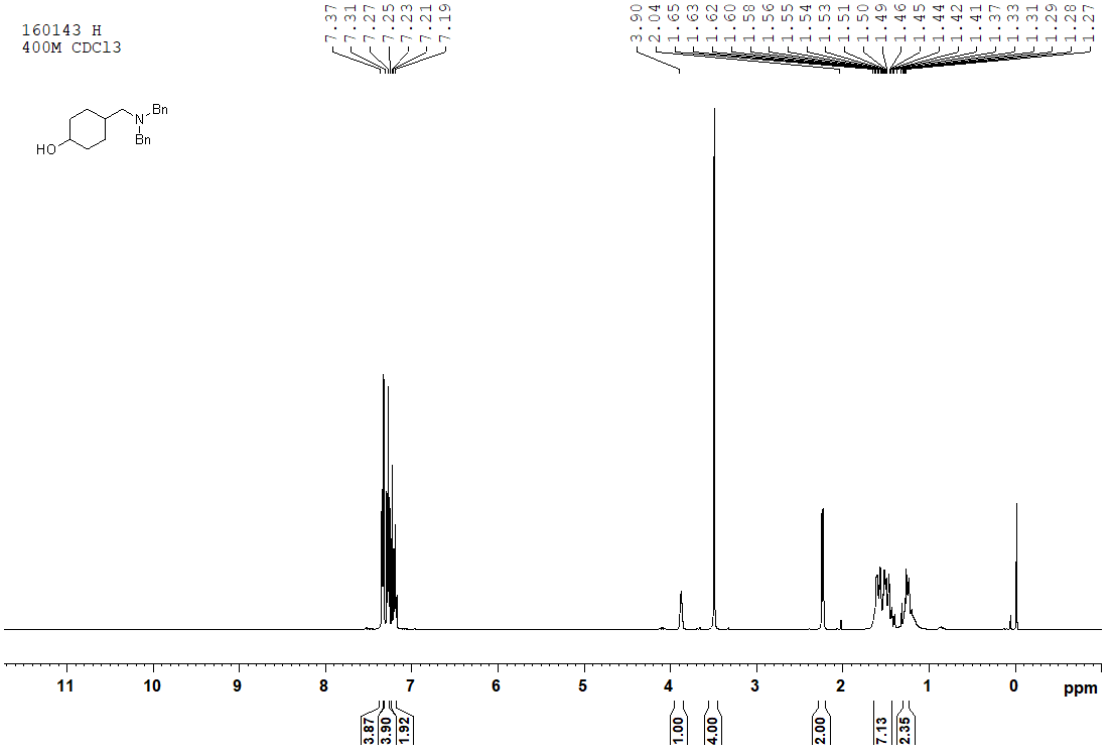


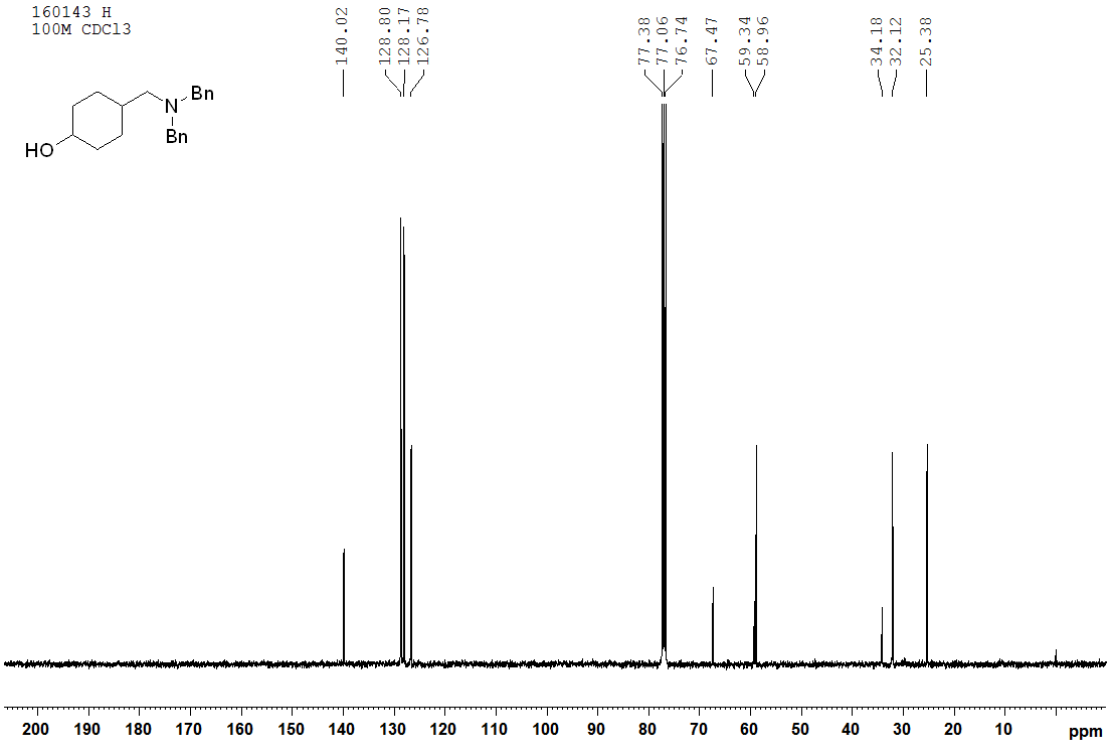
^{1}H NMR and ^{13}C NMR spectra of compound **1ah-1**



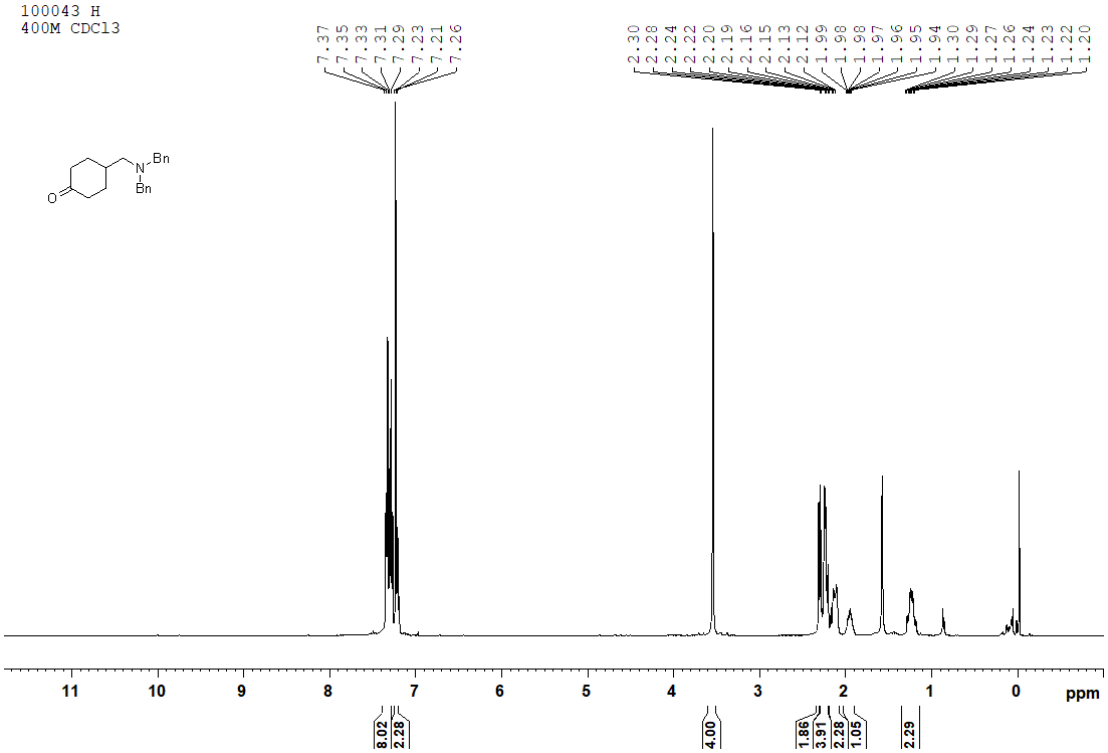


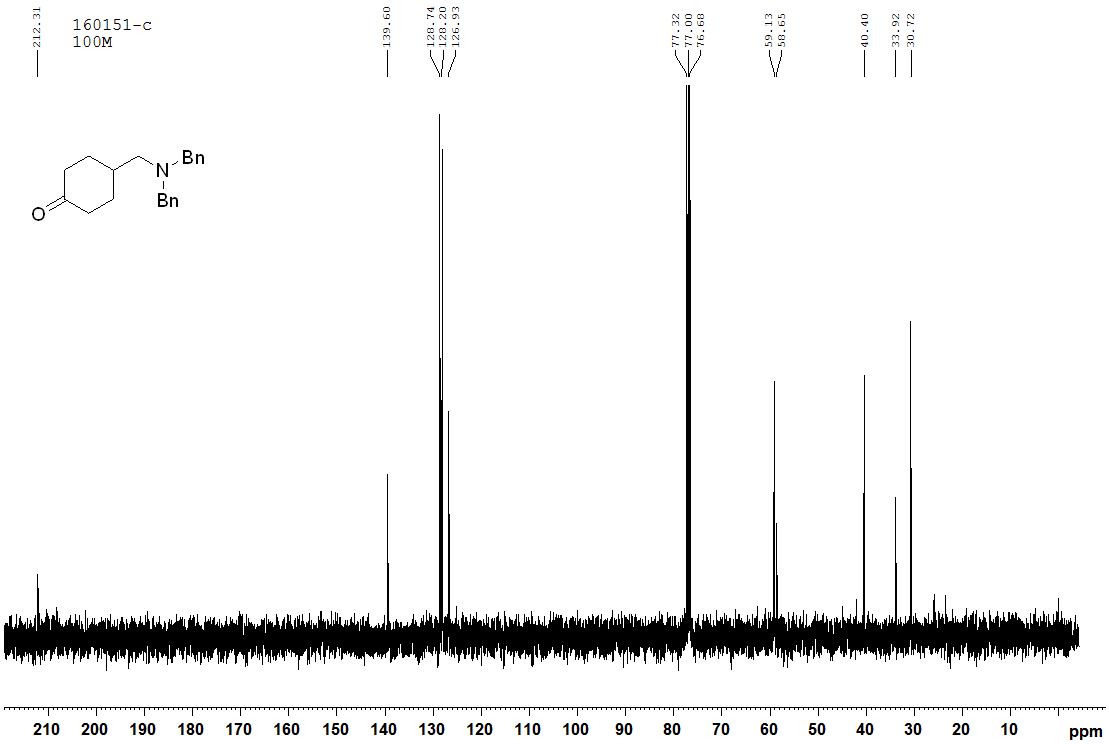
^{1}H NMR and ^{13}C NMR spectra of compound **2ah-2**



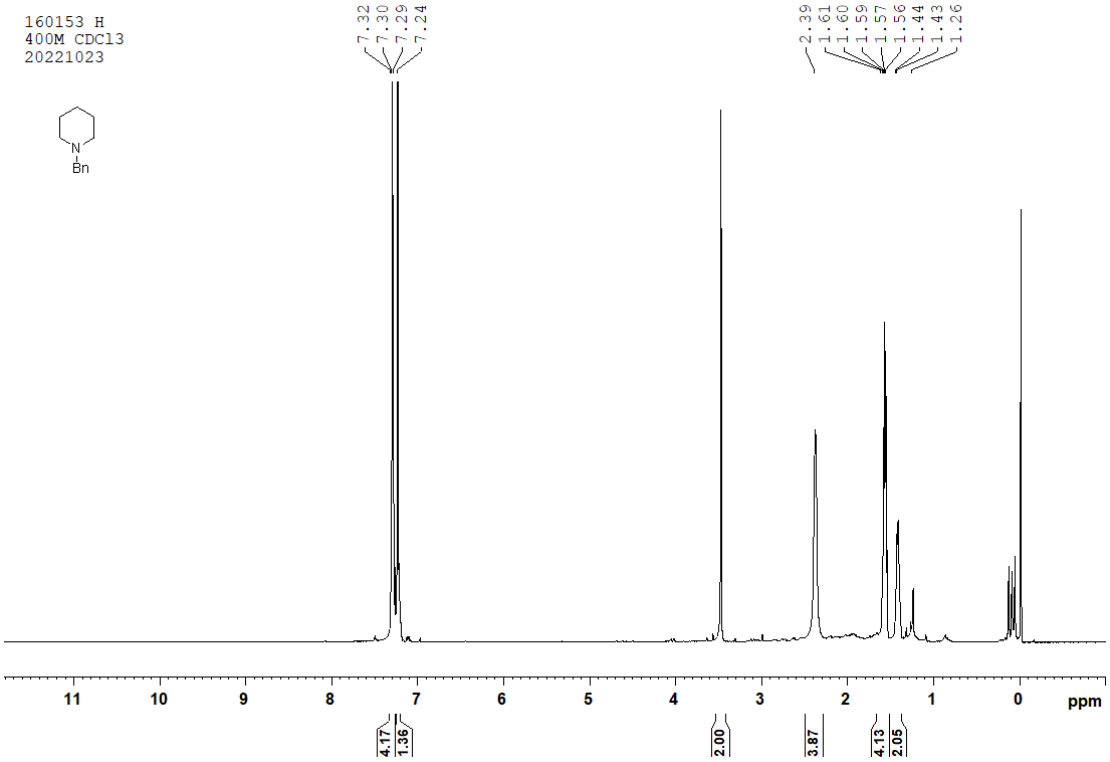


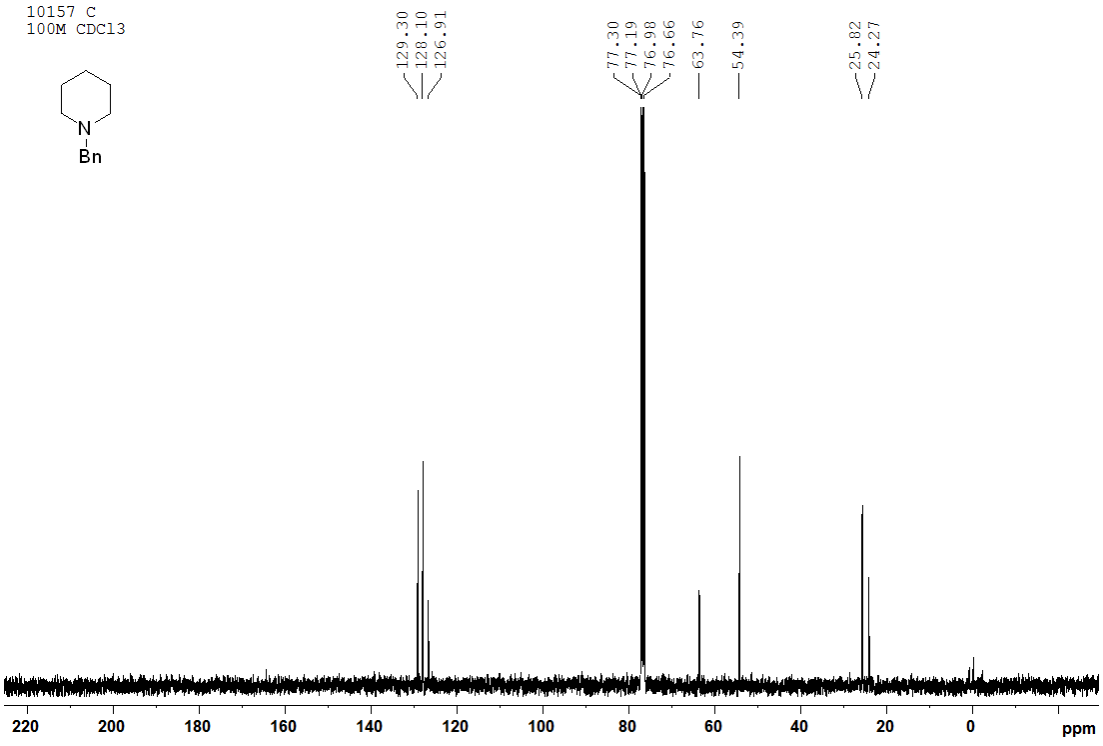
^{1}H NMR and ^{13}C NMR spectra of compound **2ah-1**



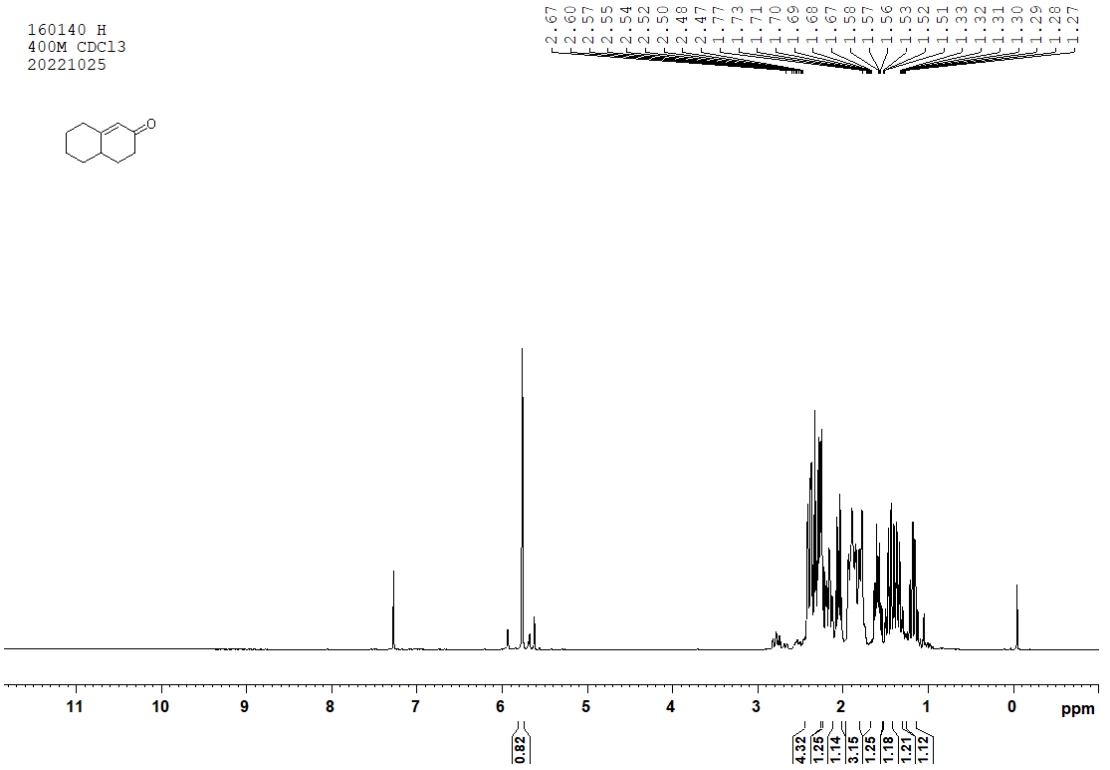


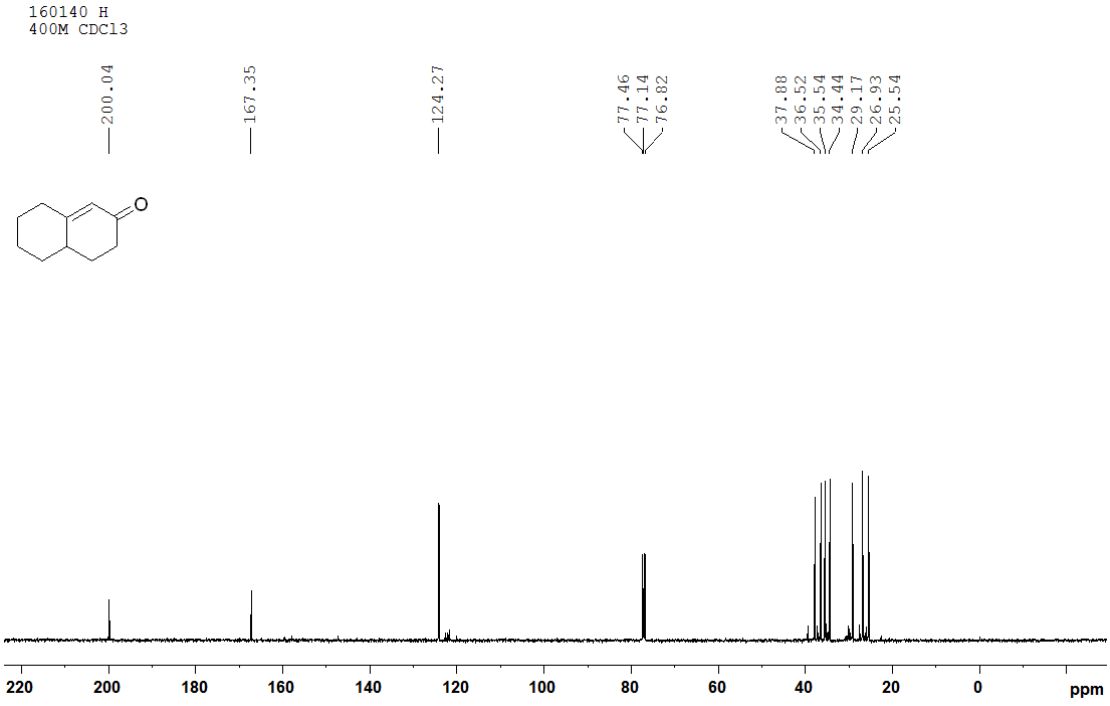
^{1}H NMR and ^{13}C NMR spectra of compound **2ai**



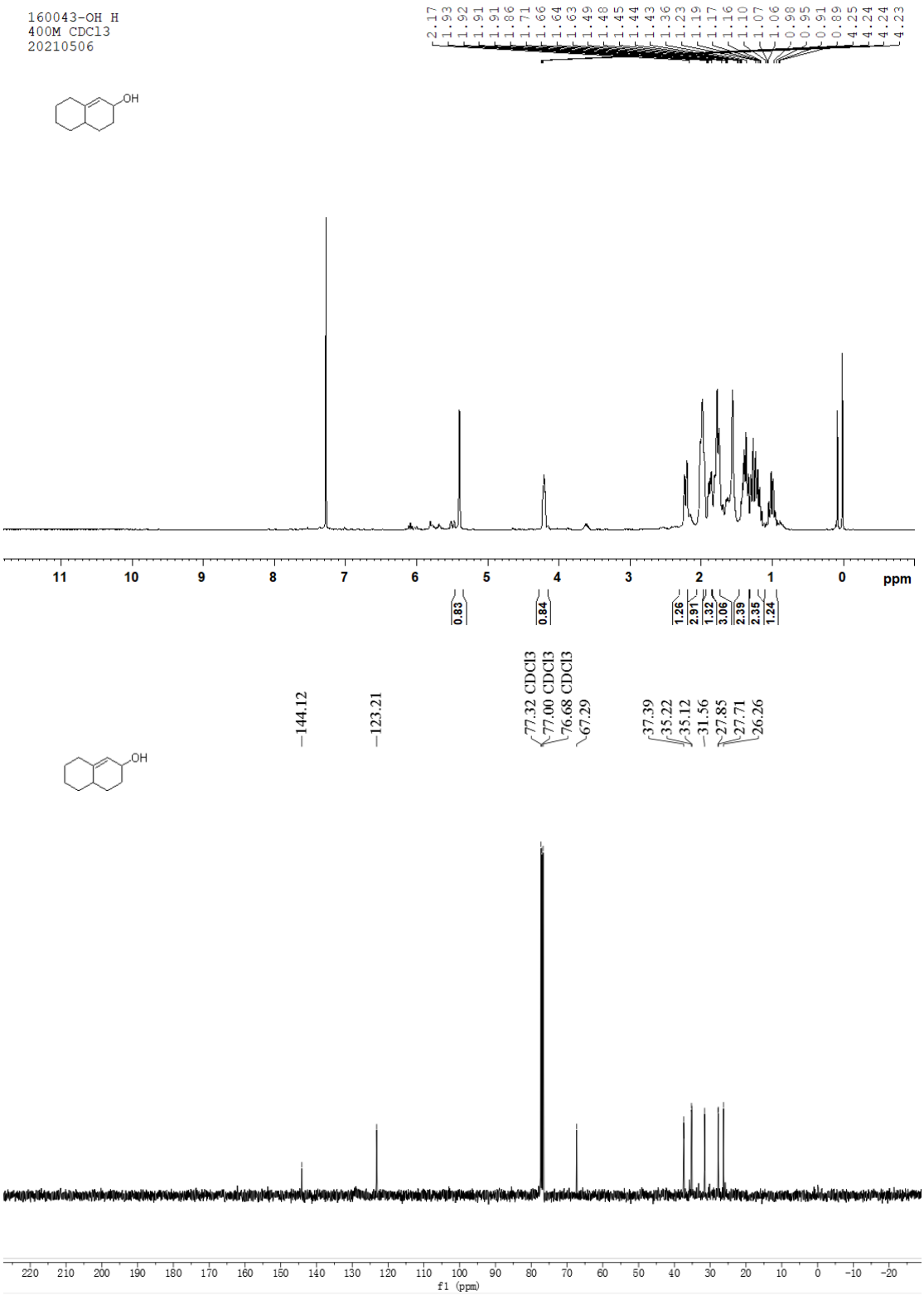


^{1}H NMR and ^{13}C NMR spectra of compound **4**

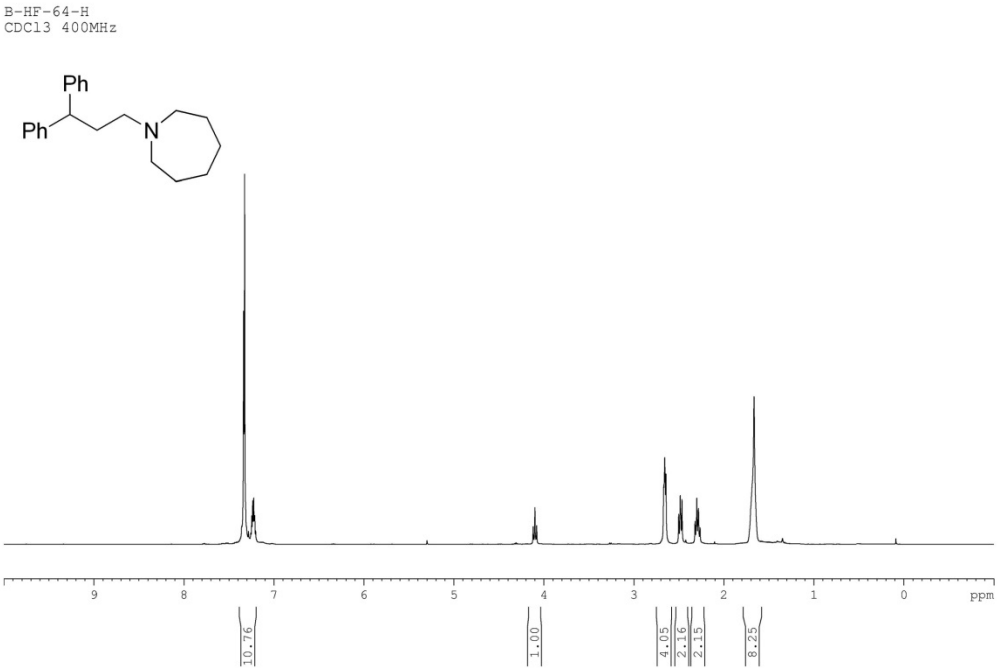


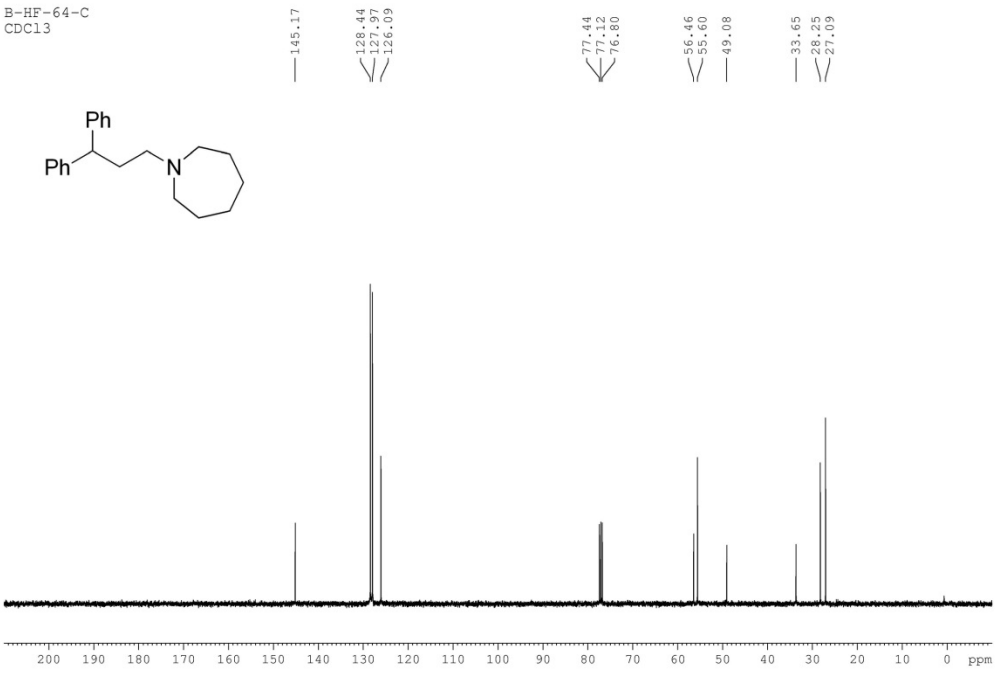


^{1}H NMR and ^{13}C NMR spectra of compound **5**

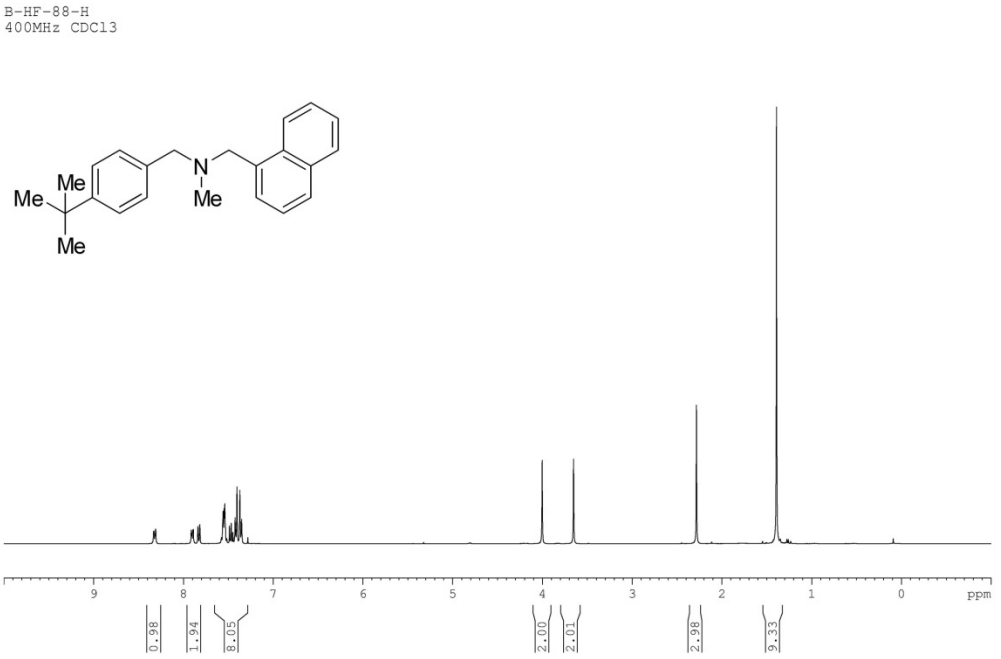


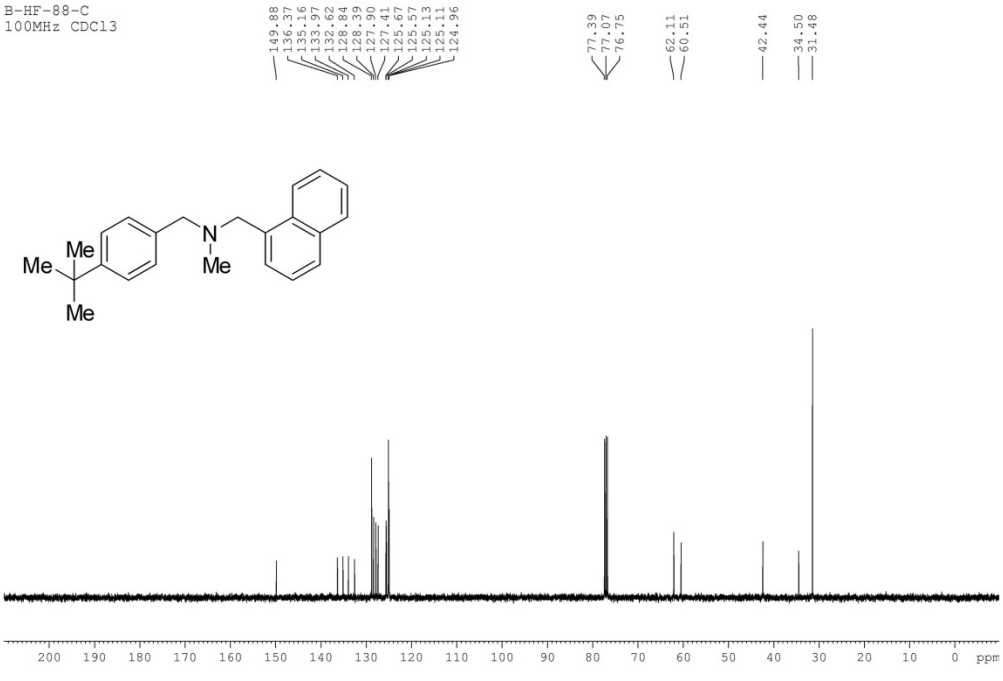
^{1}H NMR and ^{13}C NMR spectra of compound **2aj**



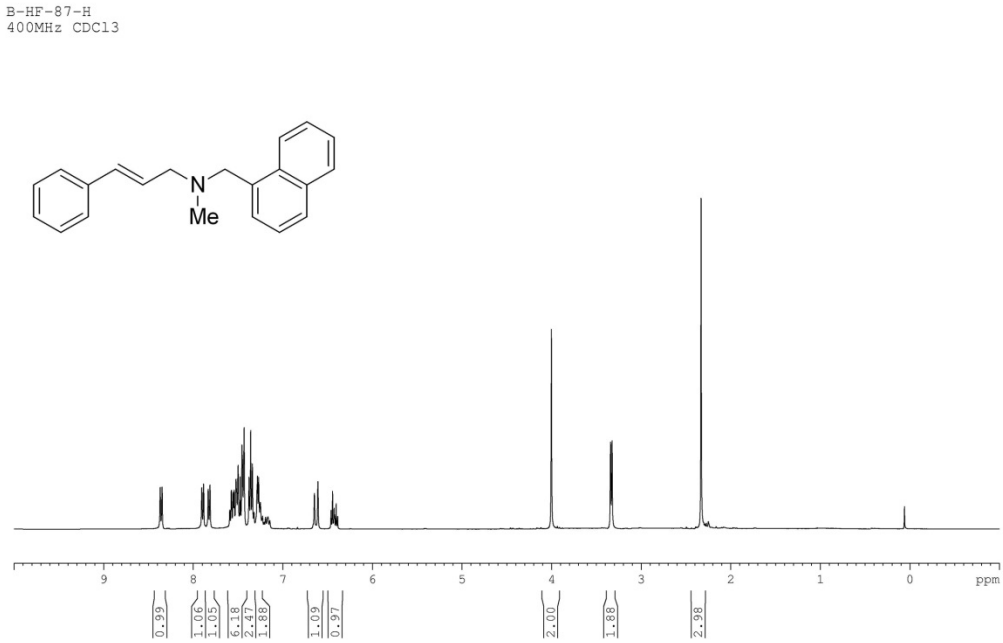


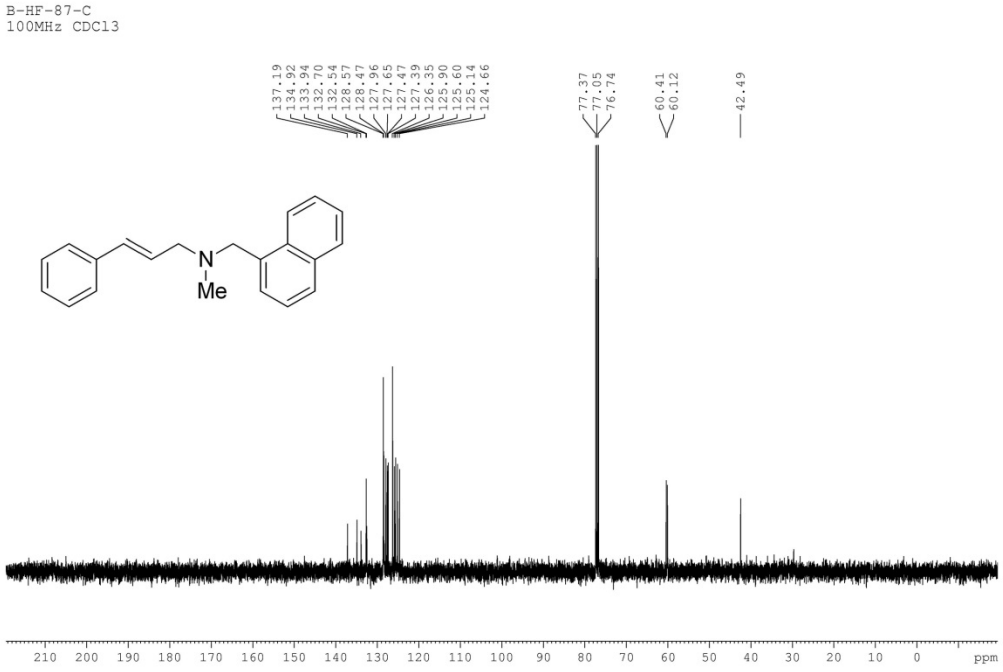
^{1}H NMR and ^{13}C NMR spectra of compound **2ak**



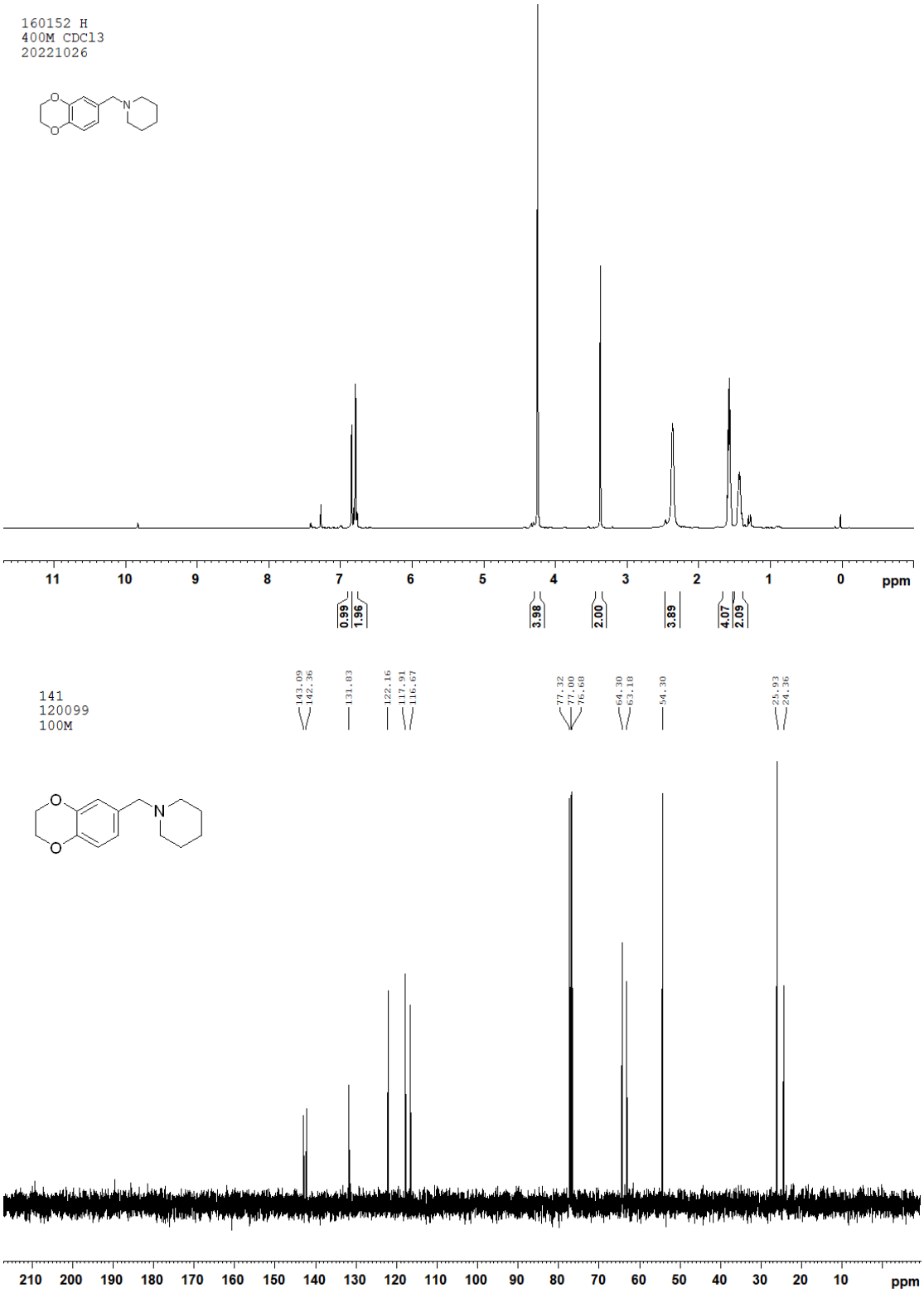


^{1}H NMR and ^{13}C NMR spectra of compound **2al**

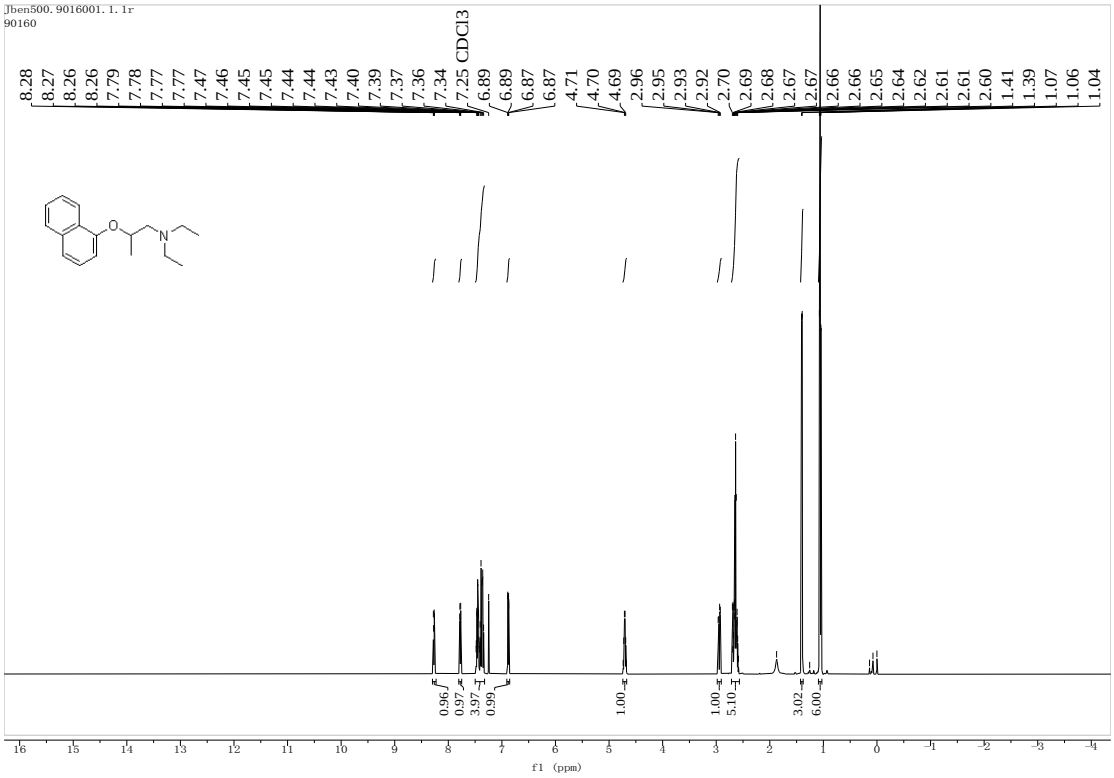


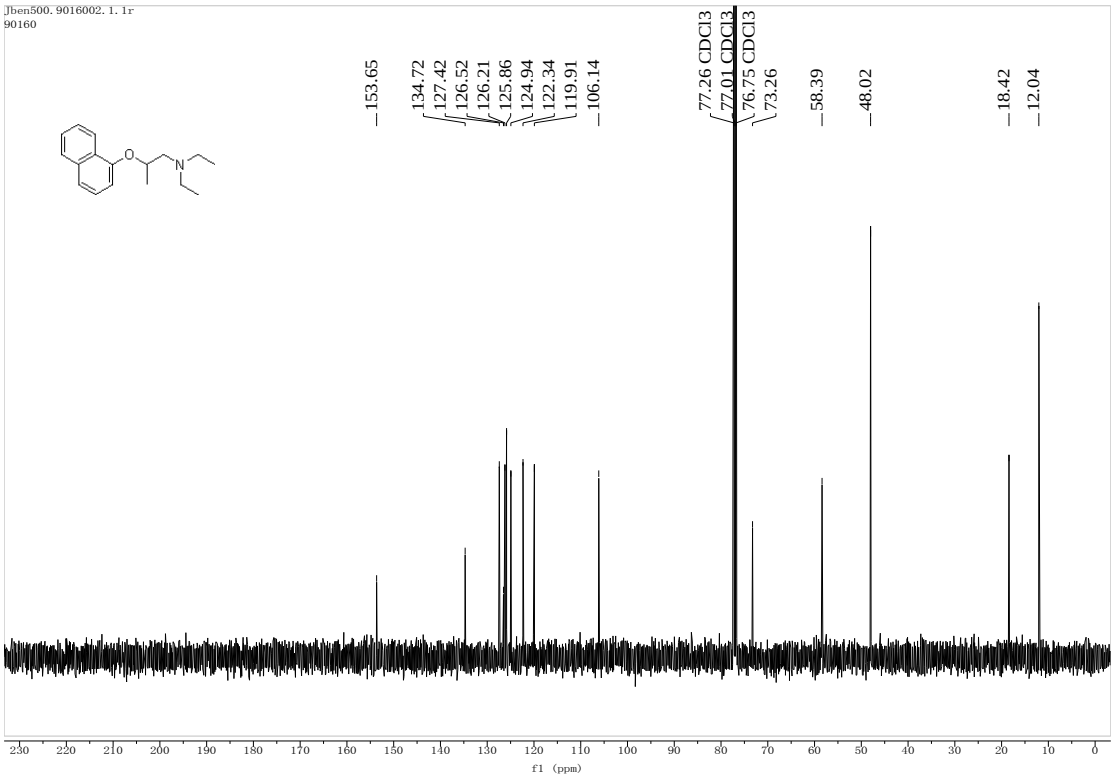


^{1}H NMR and ^{13}C NMR spectra of compound **2am**

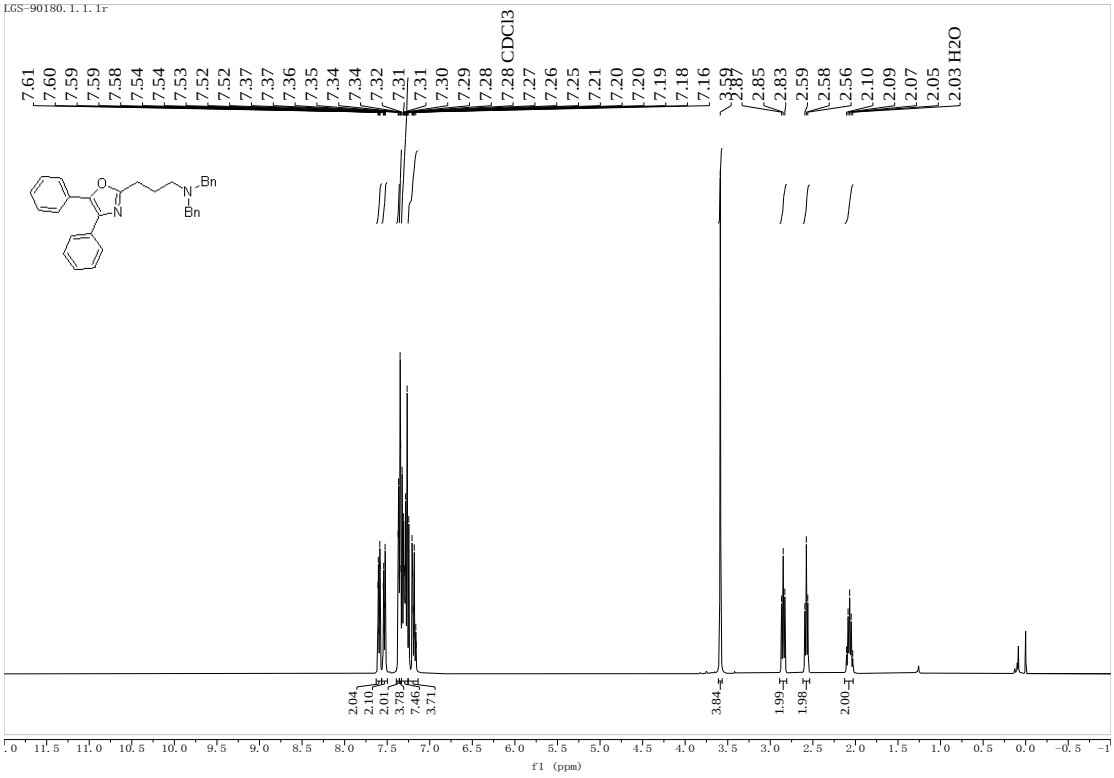


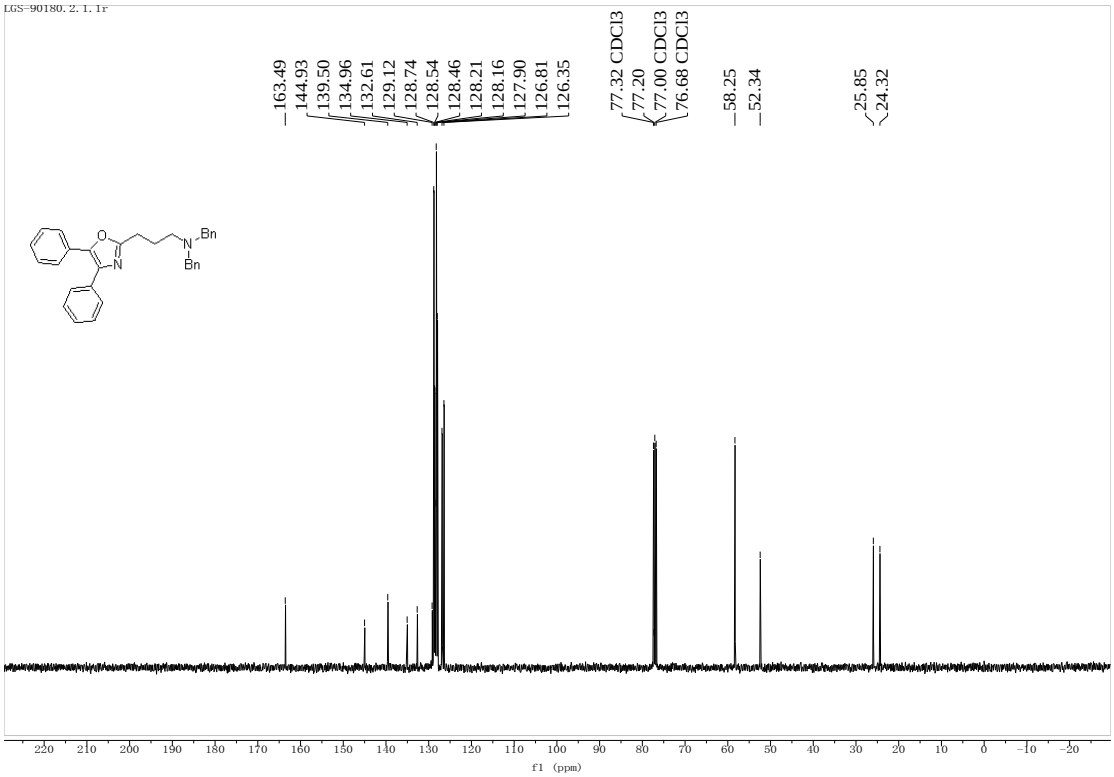
^{1}H NMR and ^{13}C NMR spectra of compound **2an**



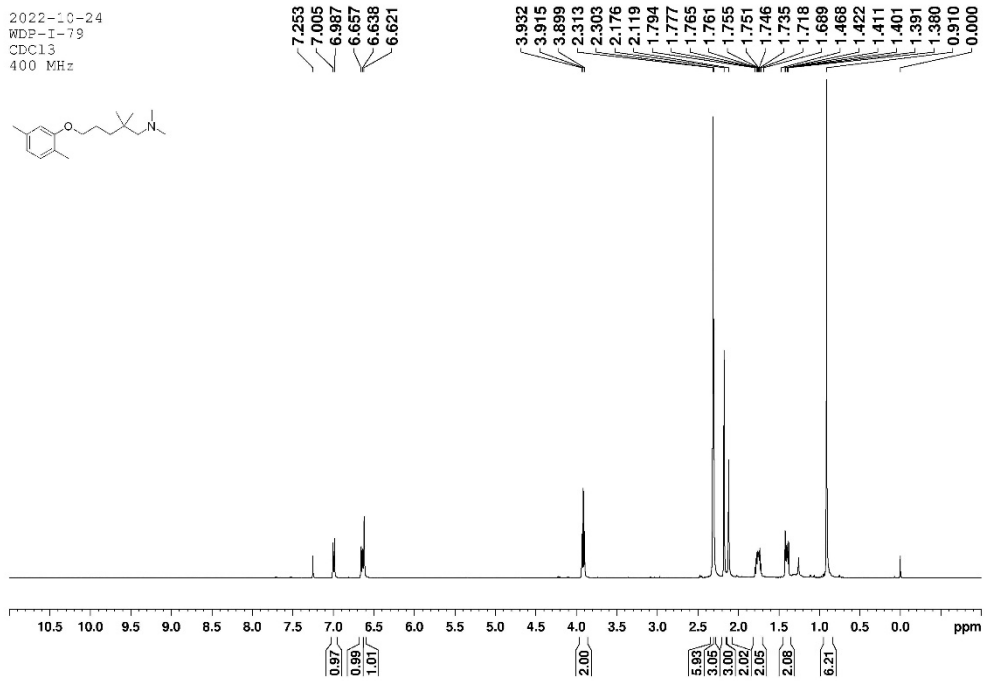


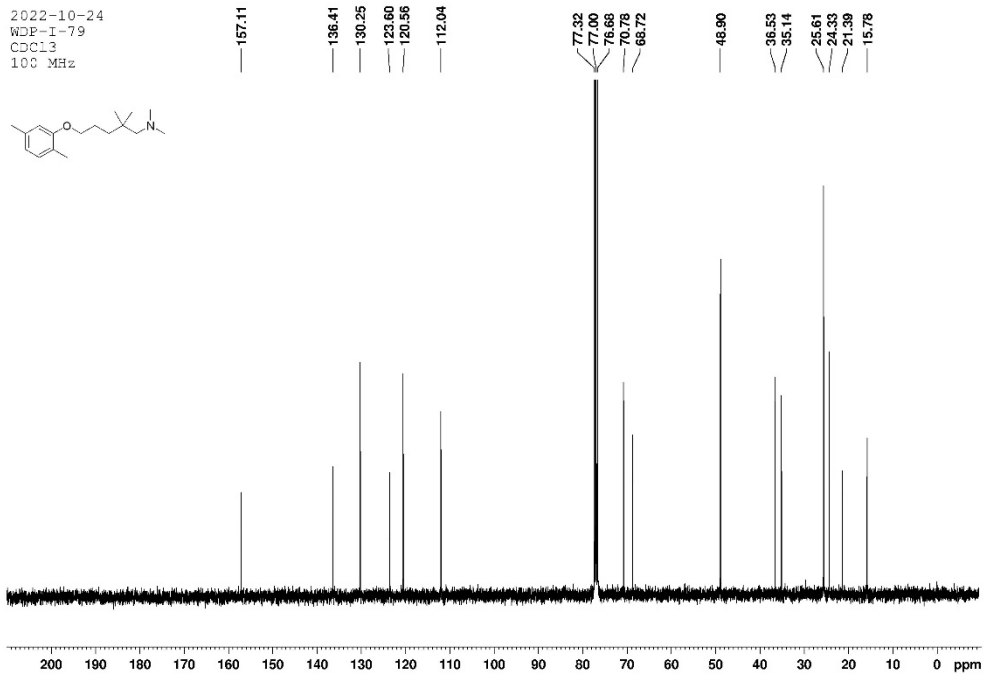
^{1}H NMR and ^{13}C NMR spectra of compound **2ao**



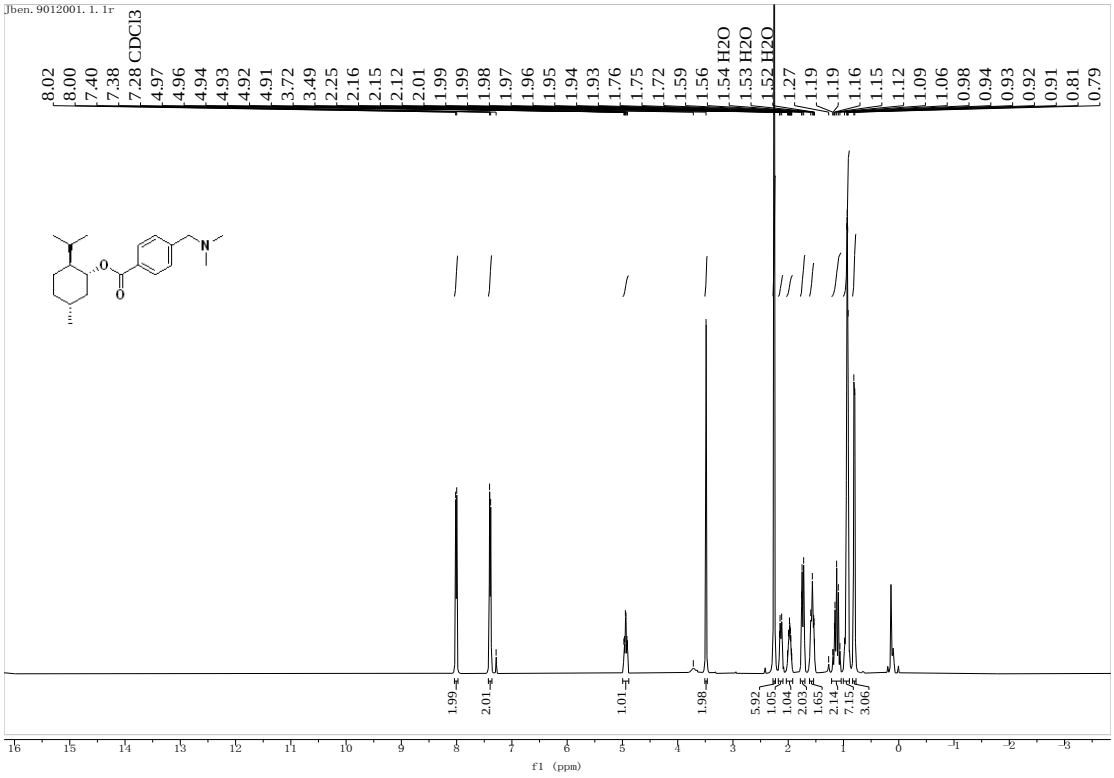


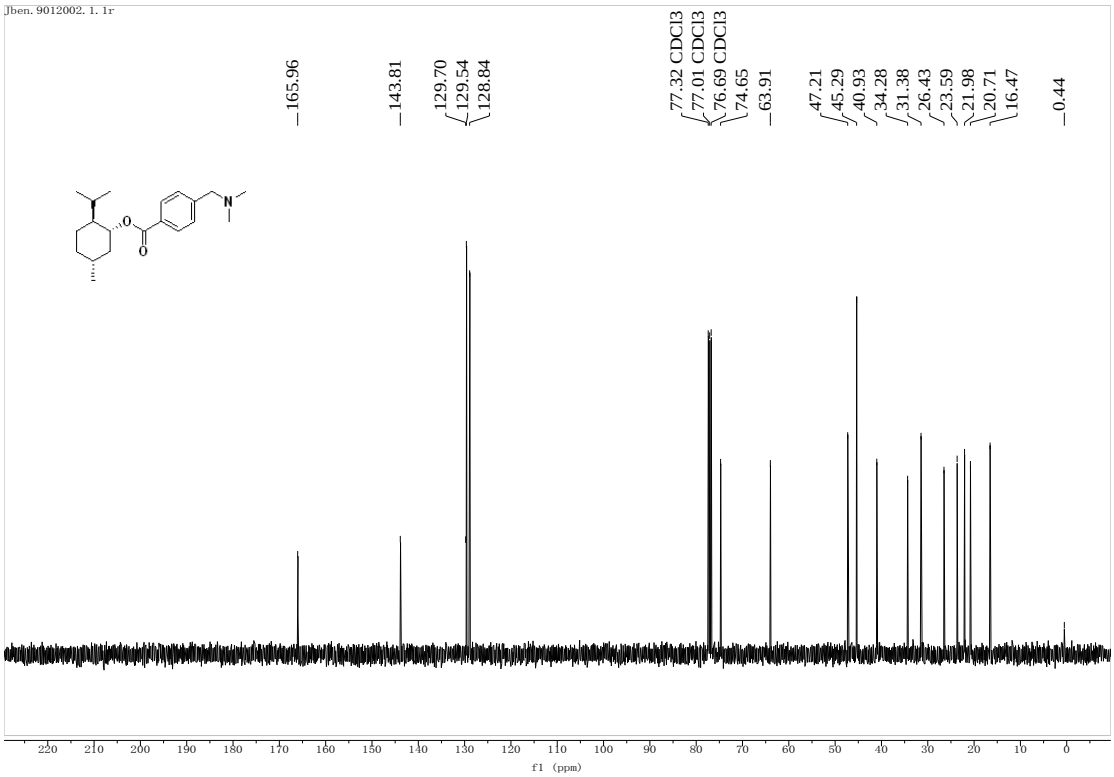
^{1}H NMR and ^{13}C NMR spectra of compound **2ap**



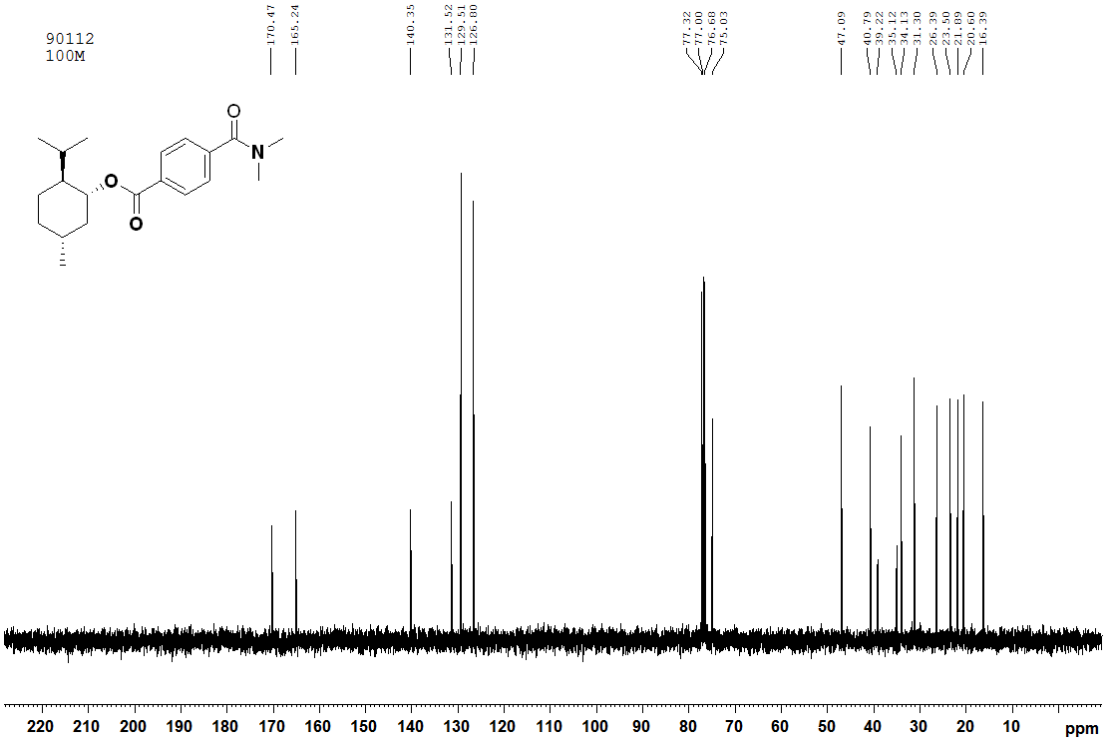


^{1}H NMR and ^{13}C NMR spectra of compound **2aq**

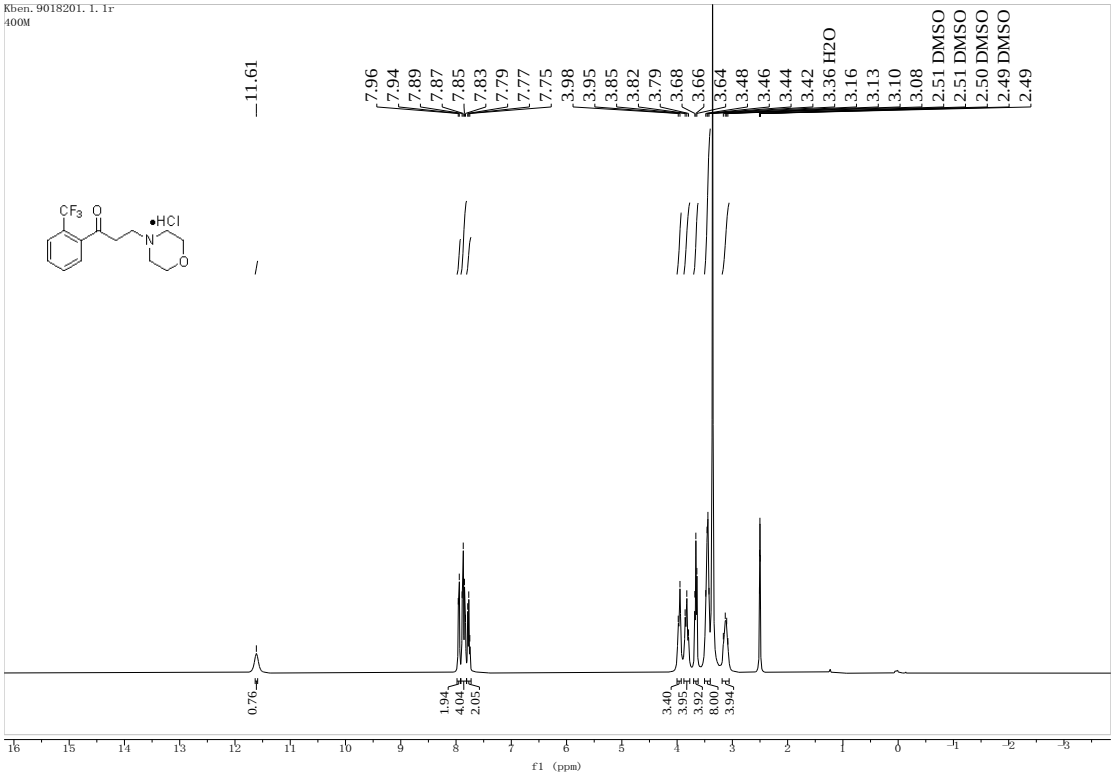


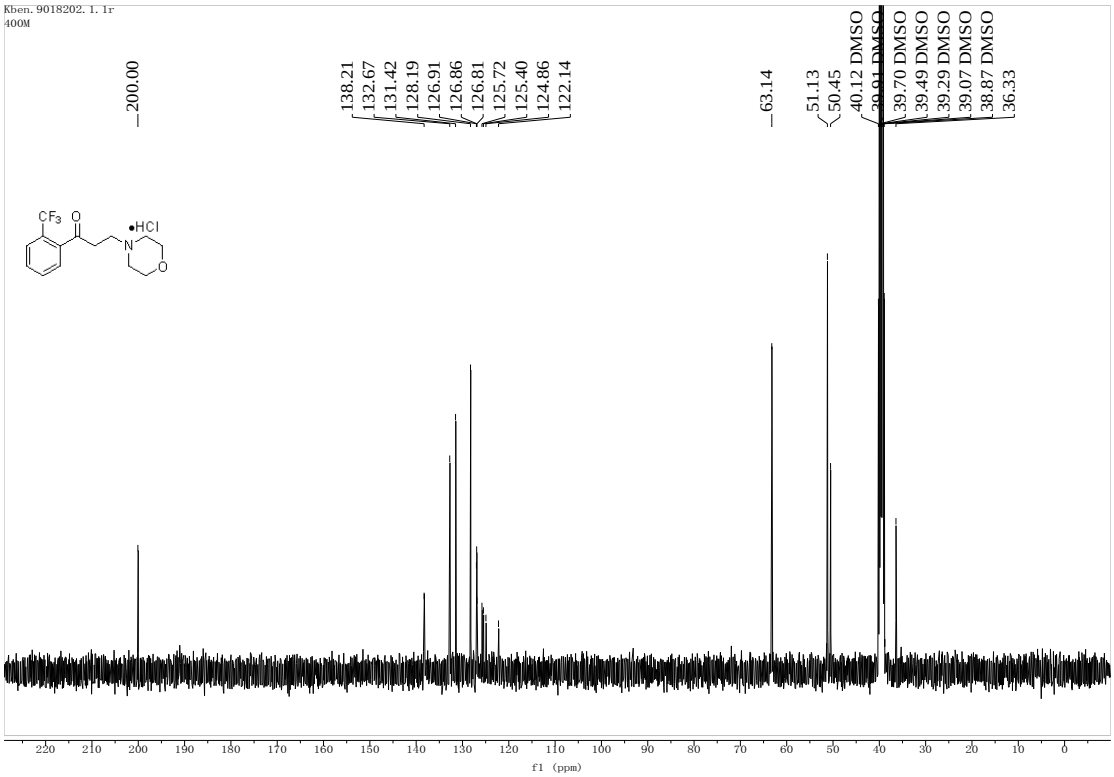


^{13}C NMR spectrum of compound **1aq**

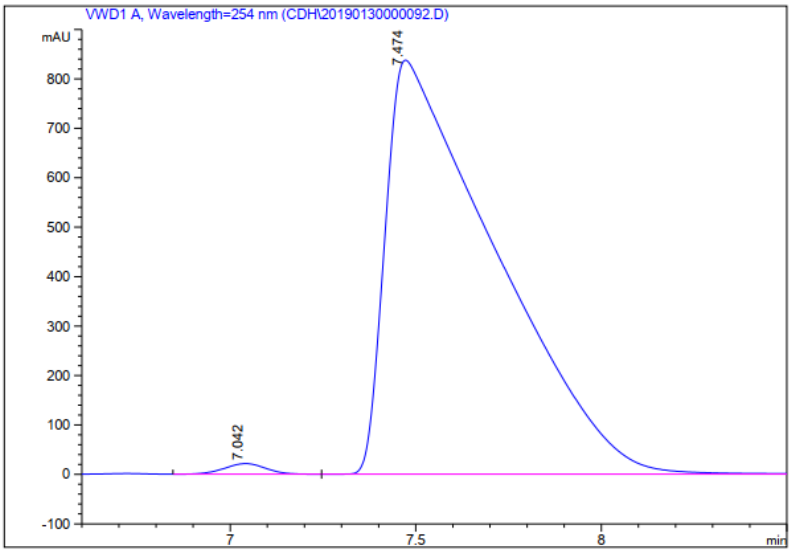


^{1}H NMR and ^{13}C NMR spectra of compound **1ar**



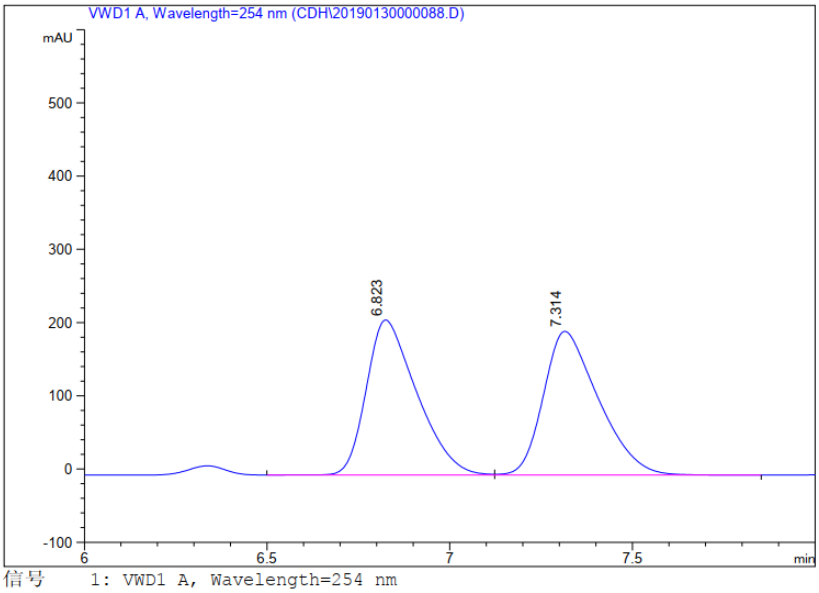


6. Chiral HPLC Traces of 2ae



信号　　1: VWD1 A, Wavelength=254 nm

峰 编号	保留时间 [min]	峰面积	峰面积 %
1	7.042	167.136	0.955
2	7.474	1.733e4	99.045



信号　　1: VWD1 A, Wavelength=254 nm

峰 编号	保留时间 [min]	峰面积	峰面积 %
1	6.823	2.037e3	49.773
2	7.314	2.056e3	50.227

7. References

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