Supporting Information

Palladium-Catalyzed Oxidative Amination of Homoallylic Alcohols: Sequential Installing Carbonyl and Amino Groups along an Alkyl Chain

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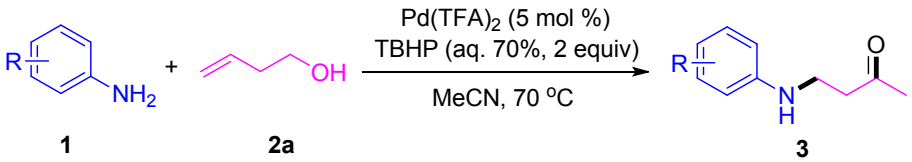
A. General Methods

^{1}H and ^{13}C NMR spectra were recorded by using a Bruker DRX-400 spectrometer (400 MHz for ^{1}H; 100 MHz for ^{13}C), using $CDCl_3$ as solvent and TMS as an internal standard. The chemical shifts are referenced to signals at 7.26 and 77.0 ppm, respectively. Chemical shifts (δ) are reported in ppm and quoted to the nearest 0.01 ppm relative to the residual protons in $CDCl_3$ (7.26 ppm for 1H) or TMS (0 ppm for 1H) and $CDCl_3$ (77.0 ppm for ^{13}C). Data are reported as follows: Chemical shift (number of protons, multiplicity, coupling constants). Coupling constants were quoted to the nearest 0.1 Hz and multiplicity reported according to the following convention: s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet, br = broad. GC analyses were performed on a GC-7900 chromatograph with an FID and equipped with an AT.SE-30 capillary column (internal diameter: 0.32 mm, length: 30 m). Mass spectra were recorded on a Thermo Scientific ISQ gas chromatograph-mass spectrometer at an ionization voltage of 70 eV and equipped with a DB-WAX capillary column (internal diameter: 0.25 mm, length: 30 m). The data of HRMS was carried out on a high-resolution mass spectrometer (LCMS-IT-TOF). IR spectra were obtained either as potassium bromide pellets or as liquid films between two potassium bromide pellets with a TENSOR 27 spectrometer. Melting points were determined with a Büchi Melting Point B-545 instrument. All compounds were commercially purchased and used without further purification.

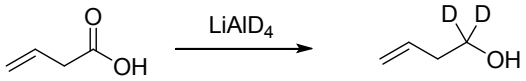
B. Procedure for the Preparation of 3



1 2a 3

To a 25 mL dried tube was added the mixture of anilines **1** (0.25 mmol), homoallylic alcohol **2a** (0.5 mmol), 70% aq. TBHP (2 equiv), $Pd(TFA)_2$ (5 mol %) in MeCN (1.0 mL) successively. The mixture was stirred at 70 °C for 12 h under an air atmosphere. After the reaction was completed, the mixture was cooled to room temperature and diluted with H_2O (15 mL), neutralized with NH_4Cl, and extracted with EtOAc (10 mL × 3). The organic extract was washed with H_2O (10 mL × 3) and dried over anhydrous $MgSO_4$. After removal of the EtOAc in vacuum, the crude product was purified by column chromatography on silica gel with hexanes or petroleum ether/ethyl acetate (5:1 to 20:1) to give the desired products **3**.

C. Procedure for the Preparation of 2a-d2[1, 2]

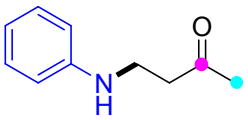


Lithium aluminum deuteride (6 mmol) was suspended in anhydrous THF (10 mL) and cooled to 0 °C under nitrogen. 3-Butenoic acid (5 mmol) was added dropwise. The mixture was stirred for 20 min and heated to reflux. After 2 h the mixture was cooled to room temperature and stirred for another 4 h. Then, water (0.12 mL) and 15% aq. NaOH (0.35 mL) were added dropwise. After stirring for 15 min, the mixture was extracted with Et_2O (10 mL × 3) and filtered. The filtrate was dried ($MgSO_4$) and evaporated to afford the title compound (0.33 g, 90% accounting for 1.1 equiv. Et_2O) as a clear oil.

Reference

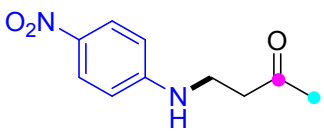
[1] E. Negishi, L. D. Boardman, H. Sawada, V. Bagheri, A. T. Stoll, J. M. Tour, Cynthia L. Rand, *J. Am.Chem. Soc.*, **1988**, *110*, 5383.
[2] J. P. Knowles, K. I. Booker-Milburn, *Chem. Eur. J.*, **2016**, *22*, 11429.

D. Analytical Data



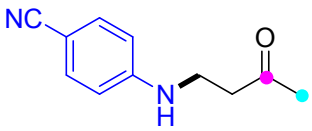
4-(Phenylamino)butan-2-one (3aa)

Yield: 65% (26.5 mg) as a yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.17 (t, *J* = 7.6 Hz, 2H), 6.71 (t, *J* = 7.2 Hz, 1H), 6.61 (d, *J* = 8.4 Hz, 2H), 3.42 (t, *J* = 6.1 Hz, 2H), 2.74 (t, *J* = 6.2 Hz, 2H), 2.16 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 208.0, 147.7, 129.3, 117.7, 113.1, 42.6, 38.4, 30.3. ν_{max}(KBr)/cm^{-1} 3393, 2926, 1709, 1601, 1504, 1364, 1169, 752, 694, 509. HRMS-ESI (m/z): calcd for $C_{10}H_{14}NO$, $[M+H]^+$: 164.1070, found 164.1068.



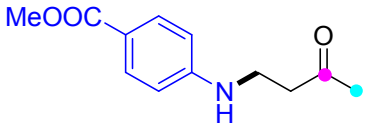
4-((4-Nitrophenyl)amino)butan-2-one (3ab)

Yield: 81% (42.1 mg) as a yellow solid; mp = 88.9 – 92.3 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.06 (d, *J* = 9.0 Hz, 2H), 6.52 (d, *J* = 9.0 Hz, 2H), 3.51 (t, *J* = 5.9 Hz, 2H), 2.81 (t, *J* = 5.9 Hz, 2H), 2.20 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 207.5, 153.0, 137.9, 126.5, 111.0, 42.1, 37.6, 30.3. ν_{max}(KBr)/cm^{-1} 3373, 2918, 1598, 1467, 1305, 1109, 833, 751, 539, 488. HRMS-ESI (m/z): calcd for $C_{10}H_{12}N_2NaO_3$, $[M+Na]^+$: 231.0740, found 231.0744.



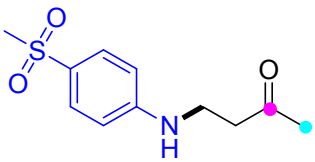
4-((3-Oxobutyl)amino)benzonitrile (3ac)

Yield: 74% (34.9 mg) as a yellow solid; mp = 90.4 – 92.2 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.41 (d, *J* = 8.6 Hz, 2H), 6.55 (d, *J* = 8.4 Hz, 2H), 3.45 (t, *J* = 5.9 Hz, 2H), 2.76 (t, *J* = 5.9 Hz, 2H), 2.19 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 207.5, 150.9, 133.8, 120.4, 112.2, 98.8, 42.1, 37.5, 30.3. ν_{max}(KBr)/cm^{-1} 3374, 2854, 2212, 1712, 1607, 1527, 1459, 1375, 1169, 949, 825, 546. HRMS-ESI (m/z): calcd for $C_{11}H_{12}N_2NaO$, $[M+Na]^+$: 211.0842, found 211.0845.



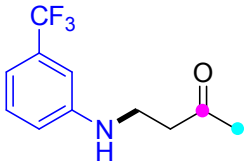
Methyl 4-((3-oxobutyl)amino)benzoate (3ad)

Yield: 73% (40.3 mg) as a canary yellow solid; mp =108.3 – 111.6 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.85 (d, *J* = 8.5 Hz, 2H), 6.54 (d, *J* = 8.5 Hz, 2H), 3.84 (s, 3H), 3.46 (t, *J* = 6.0 Hz, 2H), 2.75 (t, *J* = 6.0 Hz, 2H), 2.17 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 207.7, 167.3, 151.4, 131.6, 118.5, 111.5, 51.6, 42.3, 37.7, 30.3. ν_{max}(KBr)/cm^{-1} 3381, 2900, 1708, 1612, 1281, 1181, 1111, 835, 767, 502. HRMS-ESI (m/z): calcd for $C_{12}H_{15}NNaO_3$, $[M+Na]^+$: 244.0944, found 244.0947.



4-((4-(Methylsulfonyl)phenyl)amino)butan-2-one (3ae)

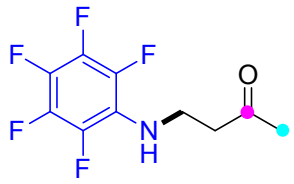
Yield: 72% (43.4 mg) as a canary yellow solid; mp =78.9 – 80.6 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.68 (d, *J* = 8.5 Hz, 2H), 6.61 (d, *J* = 8.5 Hz, 2H), 3.47 (t, *J* = 6.0 Hz, 2H), 3.00 (s, 3H), 2.77 (t, *J* = 6.0 Hz, 2H), 2.19 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 207.6, 151.9, 129.4, 127.3, 111.8, 45.0, 42.1, 37.6, 30.3. ν_{max}(KBr)/cm^{-1} 3380, 3011, 2925, 1710, 1598, 1523, 1348, 1289, 1137, 958, 828, 767. HRMS-ESI (m/z): calcd for $C_{11}H_{15}NNaO_3S$, $[M+Na]^+$: 264.0665, found 264.0669.



4-((3-(Trifluoromethyl)phenyl)amino)butan-2-one (3af)

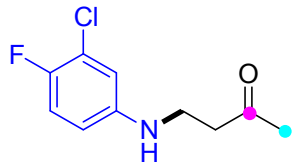
Yield: 68% (39.1 mg) as a yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.26 – 7.22 (m, 1H), 6.93 (d, *J* = 7.6 Hz, 1H), 6.78 (s, 1H), 6.73 (d, *J* = 8.0 Hz, 1H), 4.23 (d, *J* = 5.5 Hz, 1H), 3.43 (t, *J* = 6.0 Hz, 2H), 2.75 (t, *J* = 6.0 Hz, 2H),

2.18 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 207.8, 147.9, 131.6 (q, J = 31.6 MHz, 1C), 129.7, 124.3 (q, J = 271.0 MHz, 1C), 116.04, 113.9 (q, J = 3.6 MHz, 1C), 108.9 (q, J = 4.0 MHz, 1C), 42.30, 38.10, 30.28. ν_{max}(KBr)/cm^{-1} 3395, 2925, 1713, 1613, 1498, 1343, 1167, 1121, 992, 862, 766, 699. HRMS-ESI (m/z): calcd for $C_{11}H_{13}F_3NO$, $[M+H]^+$: 232.0944, found 232.0945.



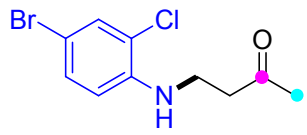
4-((Perfluorophenyl)amino)butan-2-one (3ag)

Yield: 58% (36.7 mg) as a yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 4.10 (s, 1H), 3.55 (t, J = 5.9 Hz, 2H), 2.75 (t, J = 5.8 Hz, 2H), 2.19 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 207.56, 139.5 - 139.2 (M, 1C), 137.1 - 136.7 (M, 2C), 135.0 - 134.8 (m, 1C), 132.6 - 132.3 (m, 1C), 123.6 - 123.4 (m, 1C), 43.38, 40.88 (t, J = 40MHz, 1C), 30.09. ν_{max}(KBr)/cm^{-1} 3382, 2926, 1713, 1522, 1370, 1258, 1168, 988, 794, 746. HRMS-ESI (m/z): calcd for $C_{10}H_8F_5NNaO$, $[M+Na]^+$: 276.0418, found 276.0414.



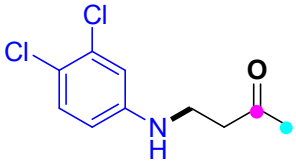
4-((3-Chloro-4-fluorophenyl)amino)butan-2-one (3ah)

Yield: 71% (38.2 mg) as a reddish black oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.93 (t, J = 8.8 Hz, 1H), 6.61 – 6.58 (m, 1H), 6.45 – 6.40 (m, 1H), 3.34 (t, J = 6.0 Hz, 2H), 2.74 (t, J = 6.0 Hz, 2H), 2.18 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 207.9, 151.1 (d, J = 236 Hz), 144.6 (d, J = 3 Hz), 121.1 (d, J = 18 Hz), 116.9 (d, J = 22 Hz), 113.9, 112.5 (d, J = 6 Hz), 42.2, 38.8, 30.3. ν_{max}(KBr)/cm^{-1} 3400, 2922, 1717, 1594, 1501, 1467, 1325, 1168, 1018, 765. HRMS-ESI (m/z): calcd for $C_{10}H_{12}ClFNO$, $[M+H]^+$: 216.0586, found 216.0587.



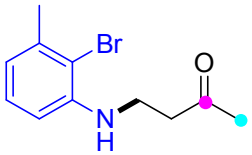
4-((4-Bromo-2-chlorophenyl)amino)butan-2-one (3ai)

Yield: 62% (42.6 mg) as a yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.36 (d, J = 2.3 Hz, 1H), 7.22 (dd, J = 8.7, 2.3 Hz, 1H), 6.53 (d, J = 8.7 Hz, 1H), 3.43 (t, J = 6.3 Hz, 2H), 2.77 (t, J = 6.3 Hz, 2H), 2.18 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 207.3, 142.8, 131.5, 130.6, 120.1, 112.1, 107.8, 42.4, 38.1, 30.4. ν_{max}(KBr)/cm^{-1} 3402, 2921, 1711, 1590, 1500, 1373, 1241, 1165, 1099, 1044, 799. HRMS-ESI (m/z): calcd for $C_{10}H_{11}BrClNaNO$, $[M+Na]^+$: 297.9605, found 297.9605.



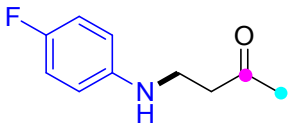
4-((3,4-Dichlorophenyl)amino)butan-2-one (3aj)

Yield: 68% (39.3 mg) as a yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.16 (d, *J* = 2.4 Hz, 1H), 7.01 (dd, *J* = 8.8, 2.4 Hz, 1H), 6.50 (d, *J* = 8.7 Hz, 1H), 4.47 (s, 1H), 3.36 (t, *J* = 6.4 Hz, 2H), 2.69 (t, *J* = 6.3 Hz, 2H), 2.10 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 207.3, 142.4, 128.9, 127.7, 121.3, 119.8, 111.6, 42.4, 38.6, 30.3. ν_{max}(KBr)/cm^{-1} 3403, 2925, 1712, 1596, 1505, 1366, 1321, 1167, 1105, 867, 803, 710. HRMS-ESI (m/z): calcd for $C_{10}H_{11}Cl_2NNaO$, $[M+Na]^+$: 254.0110, found 254.0111.



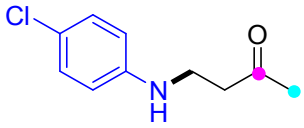
4-((2-Bromo-3-methylphenyl)amino)butan-2-one (3ak)

Yield: 58% (40.0 mg) as a red oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.99 (t, *J* = 7.8 Hz, 1H), 6.53 (d, *J* = 7.5 Hz, 1H), 6.42 (d, *J* = 8.1 Hz, 1H), 3.39 (t, *J* = 6.4 Hz, 2H), 2.70 (t, *J* = 6.4 Hz, 2H), 2.28 (s, 3H), 2.10 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 207.5, 144.7, 138.7, 127.6, 119.2, 112.8, 108.6, 42.6, 38.5, 30.4, 23.8. ν_{max}(KBr)/cm^{-1} 3400, 2922, 1713, 1594, 1501, 1467, 1325, 1168, 1123, 1018, 765, 509. HRMS-ESI (m/z): calcd for $C_{11}H_{14}BrNNaO$, $[M+Na]^+$: 278.0151, found 278.0153.



4-((4-Fluorophenyl)amino)butan-2-one (3al)

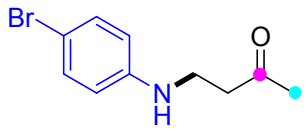
Yield: 72% (32.6 mg) as a reddish blackoil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.91 – 6.85 (m, 2H), 6.56 – 6.53 (m, 2H), 3.36 (t, *J* = 6.1 Hz, 2H), 2.73 (t, *J* = 6.1 Hz, 2H), 2.17 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 208.1, 156.0 (d, *J* = 234 Hz), 144.0 (d, *J* = 2 Hz), 115.7 (d, *J* = 22 Hz), 114.1 (d, *J* = 8 Hz), 42.5, 39.2, 30.3. ν_{max}(KBr)/cm^{-1} 3393, 2923, 1709, 1596, 1510, 1363, 1218, 1166, 823. ν_{max}(KBr)/cm^{-1} 3394, 2922, 1709, 1599, 1501, 1318, 1169, 1088, 816, 505. HRMS-ESI (m/z): calcd for $C_{10}H_{13}FNO$, $[M+H]^+$: 182.0976, found 182.0979.



4-((4-Chlorophenyl)amino)butan-2-one (3am)

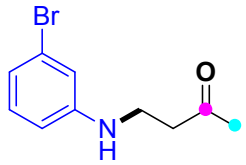
Yield: 75% (36.9 mg) as a red solid; mp = 70.2 – 72.5 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.11 (d, *J* = 8.5 Hz, 2H), 6.52 (d, *J* = 8.5 Hz, 2H), 3.37 (t, *J* = 6.0 Hz, 2H), 2.73 (t, *J* = 6.0 Hz, 2H), 2.16 (s, 3H). ^{13}C NMR (100 MHz,

$CDCl_3$) δ 208.0, 146.3, 129.1, 122.2, 114.1, 42.4, 38.5, 30.3. HRMS-ESI (m/z): calcd for $C_{10}H_{13}ClNO$, $[M+H]^+$: 198.0680, found 198.0681.



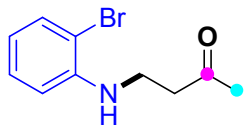
4-((4-Bromophenyl)amino)butan-2-one (3an)

Yield: 68% (41.0 mg) as a red solid; mp = 68.2 – 72.5 °C. ^1H NMR (400 MHz, $CDCl_3$) δ 7.24 (d, J = 8.8 Hz, 2H), 6.47 (d, J = 8.8 Hz, 2H), 3.37 (t, J = 6.0 Hz, 2H), 2.72 (t, J = 6.1 Hz, 2H), 2.16 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 207.9, 146.7, 132.0, 114.6, 109.2, 42.3, 38.4, 30.3. ν_{max}(KBr)/cm^{-1} 3396, 2922, 1708, 1593, 1497, 1317, 1169, 1070, 1000, 812, 501. HRMS-ESI (m/z): calcd for $C_{10}H_{12}BrNNaO$, $[M+Na]^+$: 263.9994, found 263.9996.



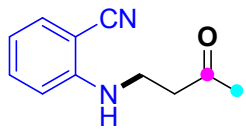
4-((3-Bromophenyl)amino)butan-2-one (3ao)

Yield: 70% (42.2 mg) as a yellow oil; ^1H NMR (400 MHz, $CDCl_3$) δ 7.00 (t, J = 8.0 Hz, 1H), 6.80 (ddd, J = 7.8, 1.8, 0.9 Hz, 1H), 6.72 (t, J = 2.1 Hz, 1H), 6.49 (ddd, J = 8.2, 2.3, 0.9 Hz, 1H), 3.38 (t, J = 6.0 Hz, 2H), 2.73 (t, J = 6.0 Hz, 2H), 2.17 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 207.8, 149.0, 130.5, 123.3, 120.3, 115.3, 111.8, 42.3, 38.1, 30.3. ν_{max}(KBr)/cm^{-1} 3392, 2921, 1708, 1592, 1478, 1365, 1166, 1071, 983, 841, 762, 630. HRMS-ESI (m/z): calcd for $C_{10}H_{12}BrNNaO$, $[M+Na]^+$: 263.9994, found 263.9995.



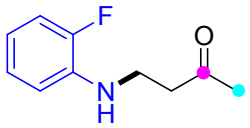
4-((2-Bromophenyl)amino)butan-2-one (3ap)

Yield: 61% (36.7 mg) as a yellow oil; ^1H NMR (400 MHz, $CDCl_3$) δ 7.33 (d, J = 7.9 Hz, 1H), 7.09 (t, J = 7.7 Hz, 1H), 6.56 (d, J = 8.2 Hz, 1H), 6.49 (t, J = 7.9 Hz, 1H), 3.38 (t, J = 6.4 Hz, 2H), 2.69 (t, J = 6.4 Hz, 2H), 2.10 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 207.4, 144.6, 132.6, 128.5, 118.0, 111.2, 110.1, 42.6, 38.3, 30.4. ν_{max}(KBr)/cm^{-1} 3399, 2922, 1712, 1594, 1507, 1365, 1320, 1166, 1090, 1016, 740. HRMS-ESI (m/z): calcd for $C_{10}H_{12}BrNNaO$, $[M+Na]^+$: 263.9994, found 263.9997.



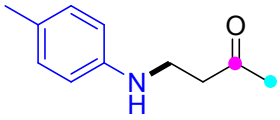
2-((3-Oxobutyl)amino)benzonitrile (3aq)

Yield: 60% (28.2 mg) as a yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.39 – 7.35 (m, 2H), 6.68 –6.65 (m, 2H), 3.49 (t, *J* = 6.5 Hz, 2H), 2.78 (t, *J* = 6.5 Hz, 2H), 2.18 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 206.8, 149.9, 134.3, 132.9, 117.7, 116.8, 110.6, 96.2, 42.5, 37.8, 30.3. ν_{max}(KBr)/cm^{-1} 3381, 2924, 2212, 172, 1603, 1516, 1459, 1169, 1074, 752, 501. HRMS-ESI (m/z): calcd for $C_{11}H_{12}N_2NaO$, $[M+Na]^+$: 211.0842, found 211.0846.



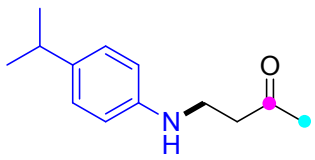
4-((2-Fluorophenyl)amino)butan-2-one (3ar)

Yield: 58% (26.2 mg) as a yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.02 – 6.92 (m, 2H), 6.72 – 6.68 (m, 1H), 6.65 – 6.60 (m, 1.6 Hz, 1H), 3.45 (t, *J* = 6.3 Hz, 2H), 2.76 (t, *J* = 6.3 Hz, 2H), 2.17 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 207.5, 151.8 (d, *J* = 238 Hz), 136.2 (d, *J* = 11 Hz), 124.6 (d, *J* = 3 Hz), 116.9 (d, *J* = 7 Hz), 114.6 (d, *J* = 19 Hz), 112.1 (d, *J* = 3 Hz), 42.7, 38.1, 30.3. ν_{max}(KBr)/cm^{-1} 3404, 2922, 1712, 1620, 1518, 1455, 1338, 1251, 1187, 1117, 744. HRMS-ESI (m/z): calcd for $C_{10}H_{13}FNO$, $[M+H]^+$: 182.0976, found 182.0981.



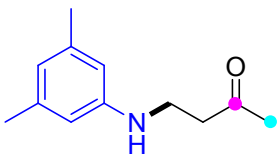
4-(*p*-Tolylamino)butan-2-one (3as)

Yield: 64% (28.3 mg) as a yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.98 (d, *J* = 8.0 Hz, 2H), 6.53 (d, *J* = 8.0 Hz, 2H), 3.39 (t, *J* = 6.1 Hz, 2H), 2.73 (t, *J* = 6.1 Hz, 2H), 2.23 (s, 3H), 2.15 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 208.2, 145.4, 129.8, 127.0, 113.3, 42.6, 38.8, 30.3, 20.4. ν_{max}(KBr)/cm^{-1} 3392, 2921, 1701, 1615, 1516, 1382, 1168, 1120, 809. HRMS-ESI (m/z): calcd for $C_{11}H_{16}NO$, $[M+H]^+$: 178.1226, found 178.1227.



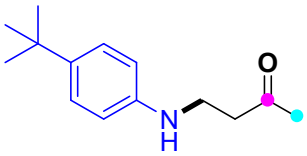
4-((4-Isopropylphenyl)amino)butan-2-one (3at)

Yield: 58% (29.7 mg) as a reddish black oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.05 (d, *J* = 8.5 Hz, 2H), 6.56 (d, *J* = 8.5 Hz, 2H), 3.40 (t, *J* = 6.2 Hz, 2H), 2.83 – 2.77 (m, 1H), 2.74 (t, *J* = 6.1 Hz, 2H), 2.16 (s, 3H), 1.21 (d, *J* = 6.9 Hz, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 208.1, 145.6, 138.3, 127.1, 113.1, 42.7, 38.7, 33.1, 30.2, 24.2. ν_{max}(KBr)/cm^{-1} 3376, 2959, 1709, 1615, 1516, 1461, 1363, 1170, 823, 550. HRMS-ESI (m/z): calcd for $C_{13}H_{20}NO$, $[M+H]^+$: 206.1539, found 206.1543.



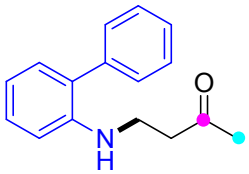
4-((3,5-Dimethylphenyl)amino)butan-2-one (3au)

Yield: 54% (25.8mg) as a red oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.37 (s, 1H), 6.24 (s, 2H), 3.39 (t, *J* = 6.1 Hz, 2H), 2.72 (t, *J* = 6.2 Hz, 2H), 2.23 (s, 6H), 2.15 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 208.1, 147.8, 139.0, 119.7, 111.0, 42.8, 38.5, 30.3, 21.5. ν_{max}(KBr)/cm^{-1} 3393, 2919, 1711, 1601, 1471, 1341, 1167, 824, 692. HRMS-ESI (m/z): calcd for $C_{12}H_{18}NO$, $[M+H]^+$: 192.1383, found 192.1385.



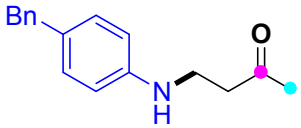
4-((4-(*tert*-Butyl)phenyl)amino)butan-2-one (3av)

Yield: 51% (27.9 mg) as a reddish black oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.20 (d, *J* = 8.6 Hz, 2H), 6.57 (d, *J* = 8.5 Hz, 2H), 3.40 (t, *J* = 6.1 Hz, 2H), 2.74 (t, *J* = 6.1 Hz, 2H), 2.15 (s, 3H), 1.27 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 208.1, 145.2, 140.6, 126.1, 112.9, 42.8, 38.8, 33.9, 31.5, 30.3. ν_{max}(KBr)/cm^{-1} 3392, 3398, 2957, 1710, 1614, 1518, 1362, 1261, 1166, 821. HRMS-ESI (m/z): calcd for $C_{14}H_{22}NO$, $[M+H]^+$: 220.1696, found 220.1699.



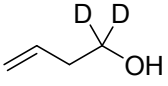
4-([1,1'-Biphenyl]-2-ylamino)butan-2-one (3aw)

Yield: 54% (32.3 mg) as a yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.26 (d, *J* = 7.1 Hz, 2H), 7.00 (t, *J* = 7.4 Hz, 1H), 6.91 (t, *J* = 8.5 Hz, 4H), 6.60 (d, *J* = 8.3 Hz, 2H), 3.39 (t, *J* = 6.2 Hz, 2H), 2.76 (t, *J* = 6.2 Hz, 2H), 2.18 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 208.1, 159.0, 148.0, 144.3, 129.5, 122.0, 121.2, 117.2, 114.2, 42.6, 39.1, 30.3. ν_{max}(KBr)/cm^{-1} 3397, 2920, 2852, 1764, 1709, 1578, 1508, 1375, 1243, 739, 699. HRMS-ESI (m/z): calcd for $C_{16}H_{18}NO$, $[M+H]^+$: 240.1383, found 240.1387.



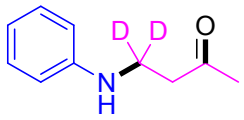
4-((4-Benzylphenyl)amino)butan-2-one (3ax)

Yield: 50% (31.6 mg) as a yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.29 – 7.25 (m, 2H), 7.20 – 7.16 (m, 3H), 7.08 (t, *J* = 7.8 Hz, 1H), 6.55 (d, *J* = 7.5 Hz, 1H), 6.46 – 6.40 (m, 2H), 3.88 (s, 2H), 3.37 (t, *J* = 6.1 Hz, 2H), 2.70 (t, *J* = 6.1 Hz, 2H), 2.14 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 208.0, 147.9, 142.3, 141.2, 129.4, 128.9, 128.4, 126.0, 118.5, 113.9, 110.7, 42.7, 42.1, 38.4, 30.3. ν_{max}(KBr)/cm^{-1} 3365, 3026, 2920, 2851, 1707, 1598, 1489, 1164, 765, 696. HRMS-ESI (m/z): calcd for $C_{17}H_{19}NNaO$, $[M+Na]^+$: 276.1359, found 276.1361.



2a-d2

Yield: 90% (0.33 g) as a colorless oil with 1.1 equivalent Et_2O; ^1H NMR (400 MHz, $CDCl_3$) δ 5.86 – 5.76 (m, 1H), 5.16 - 5.08 (m, 2H), 4.71 (s, 1H), 2.31 (d, J = 6.9 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 134.9, 117.4, 60.9, 36.9.



3aa-d2

Yield: 43% (17.7 mg) as a yellow oil; ^1H NMR (400 MHz, $CDCl_3$) δ 7.10 (t, J = 8.0 Hz, 2H), 6.64 (t, J = 7.3 Hz, 1H), 6.53 (d, J = 7.5 Hz, 2H), 2.66 (s, 2H), 2.09 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 208.1, 147.7, 129.3, 117.7, 113.1, 42.5, 41.8, 30.3. ν_{max}(KBr)/cm^{-1} 3391, 2921, 2852, 1708, 1600, 1502, 1356, 1165, 751, 694. HRMS-ESI (m/z): calcd for $C_{10}H_{12}D_2NO$, $[M+H]^+$: 166.1195, found 166.1196.

Generic Display Report

Analysis Info

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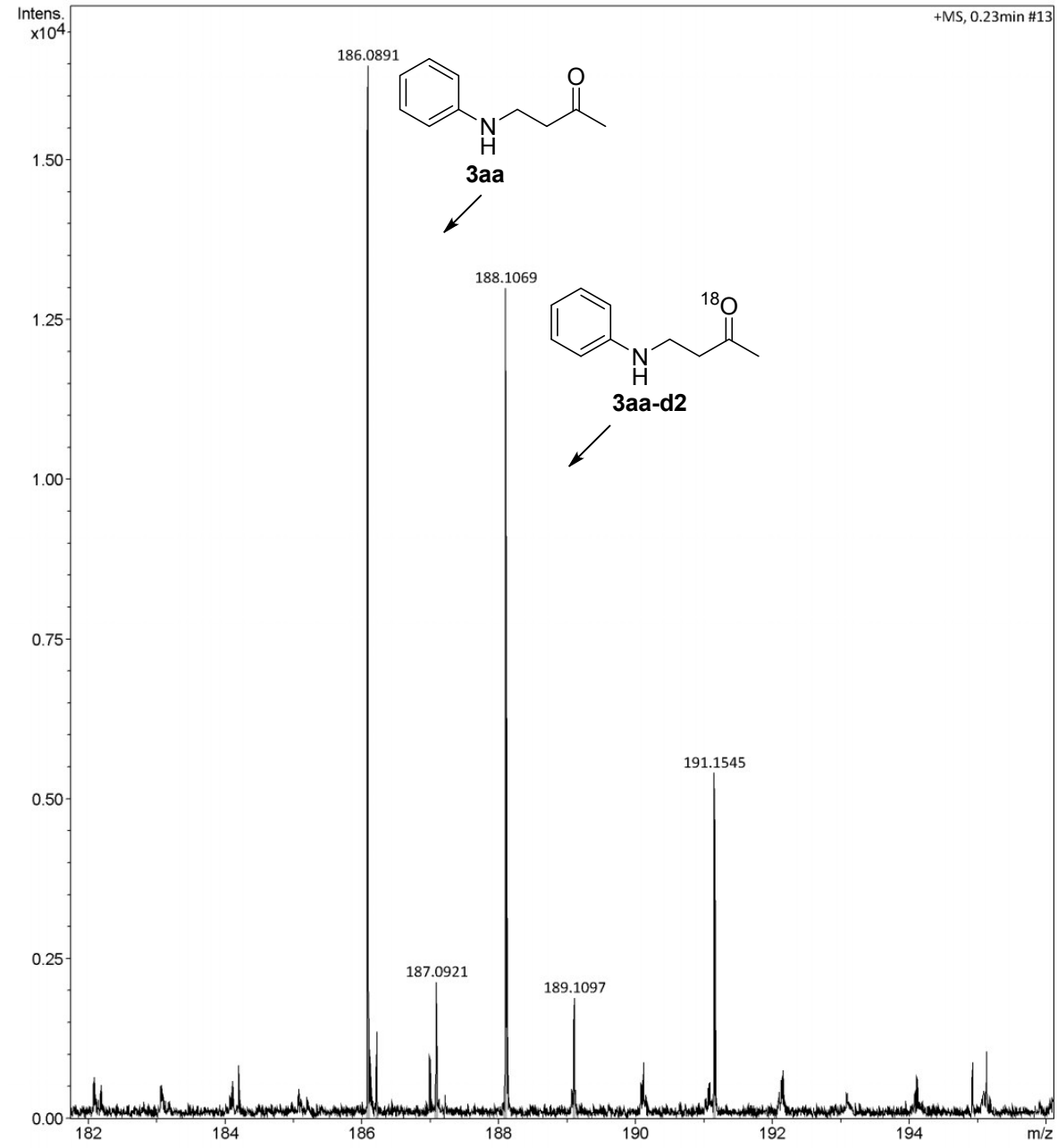
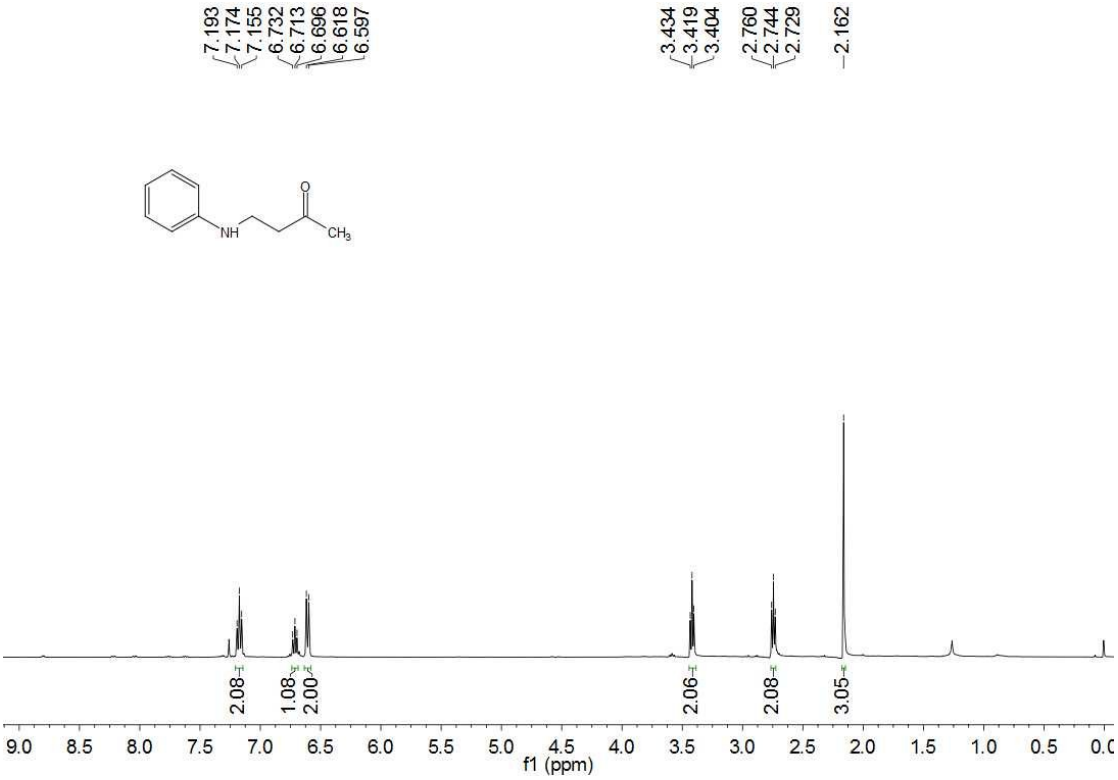


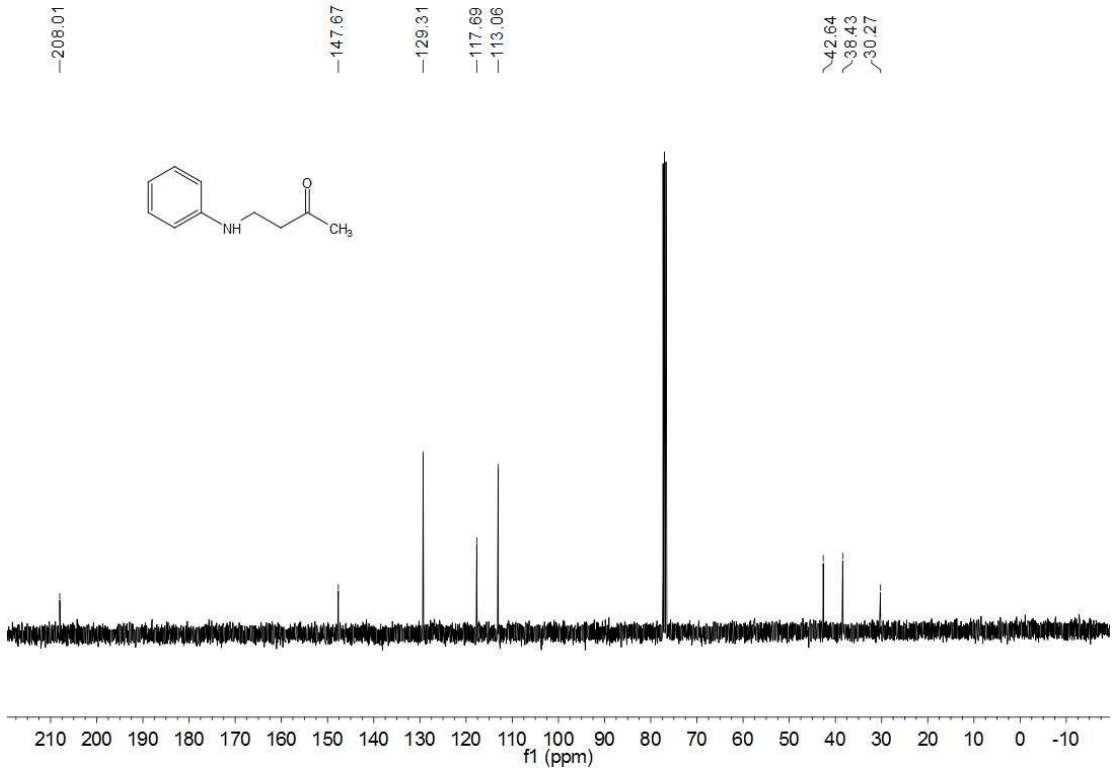
Bruker Compass DataAnalysis 4.1 printed: 5/22/2017 4:05:49 PM by: HSJ Page 1 of 1

Figure S1. HRMS of **3aa** and **3aa-d2**

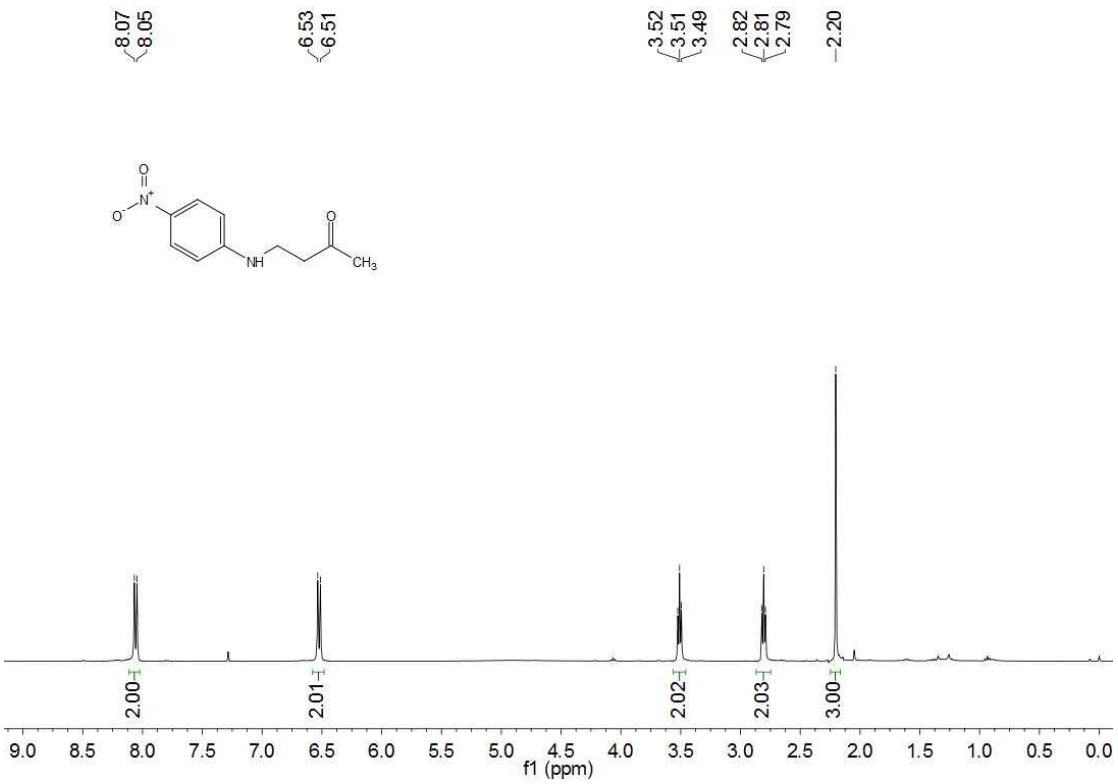
E. NMR Spectra

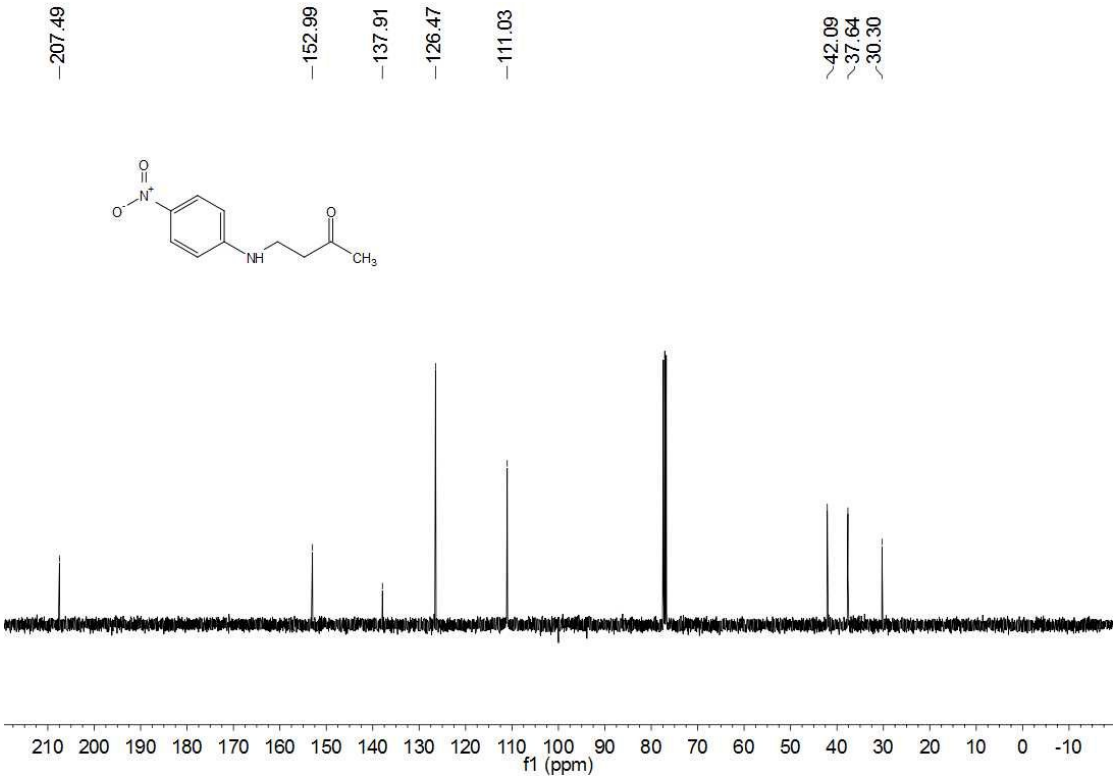
4-(Phenylamino)butan-2-one (3aa)



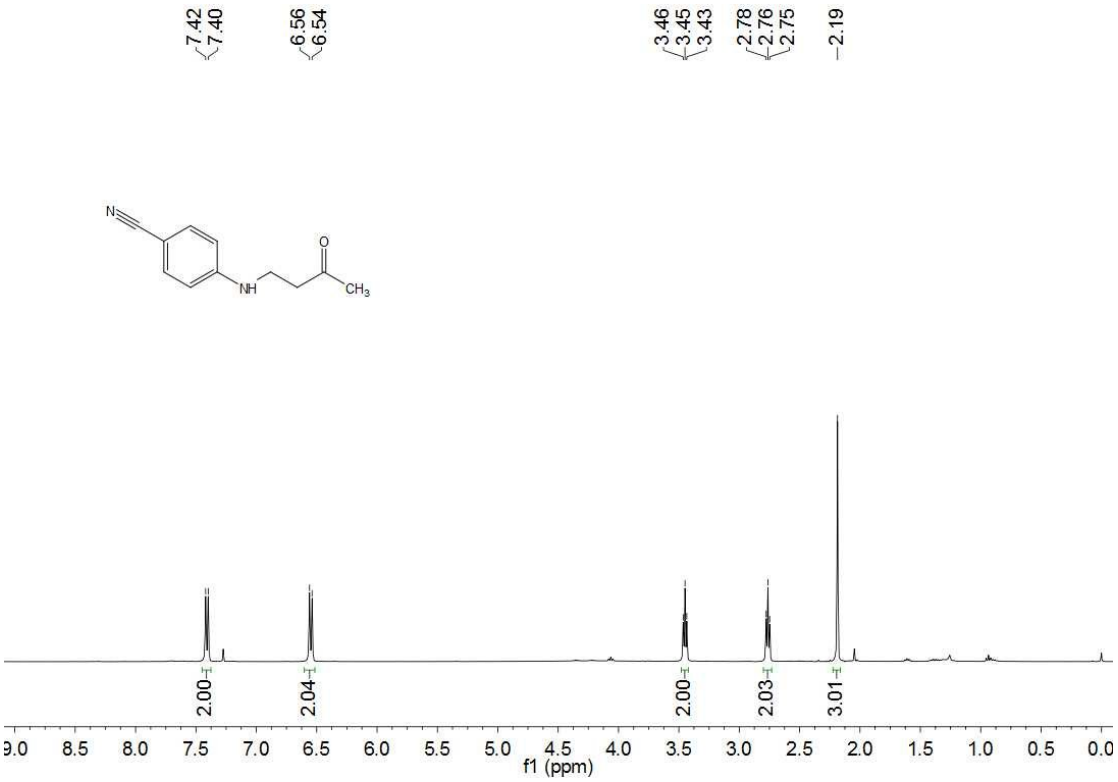


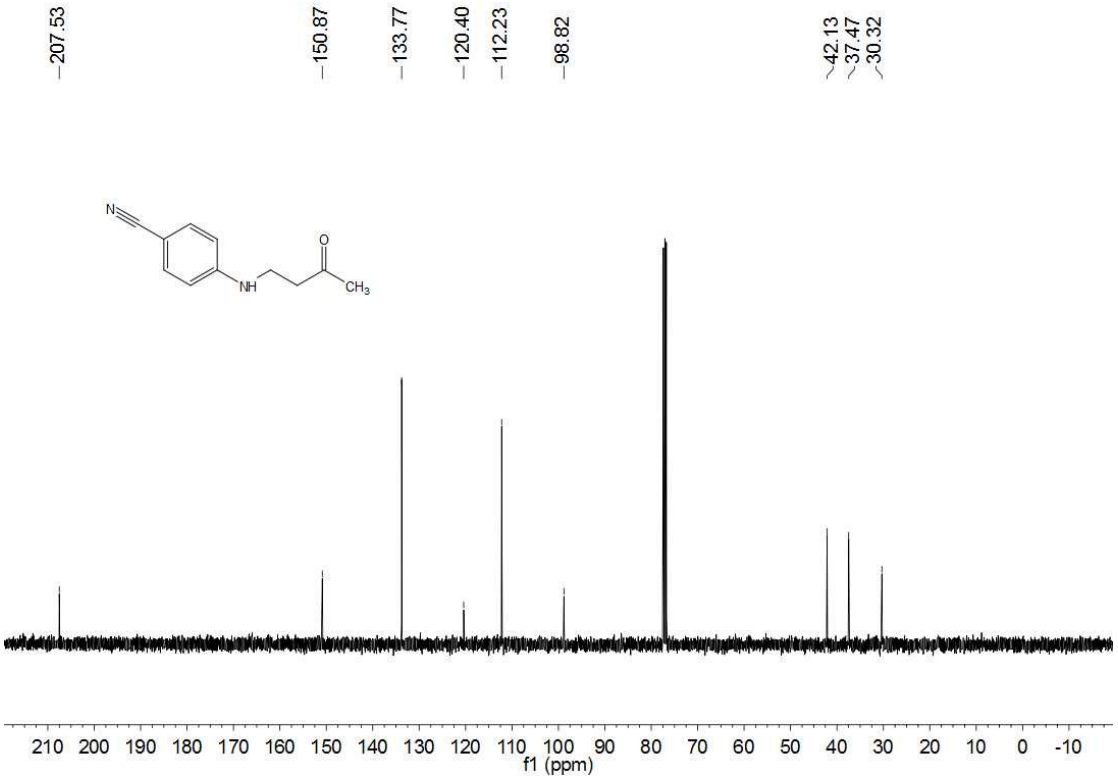
4-((4-Nitrophenyl)amino)butan-2-one (3ab)



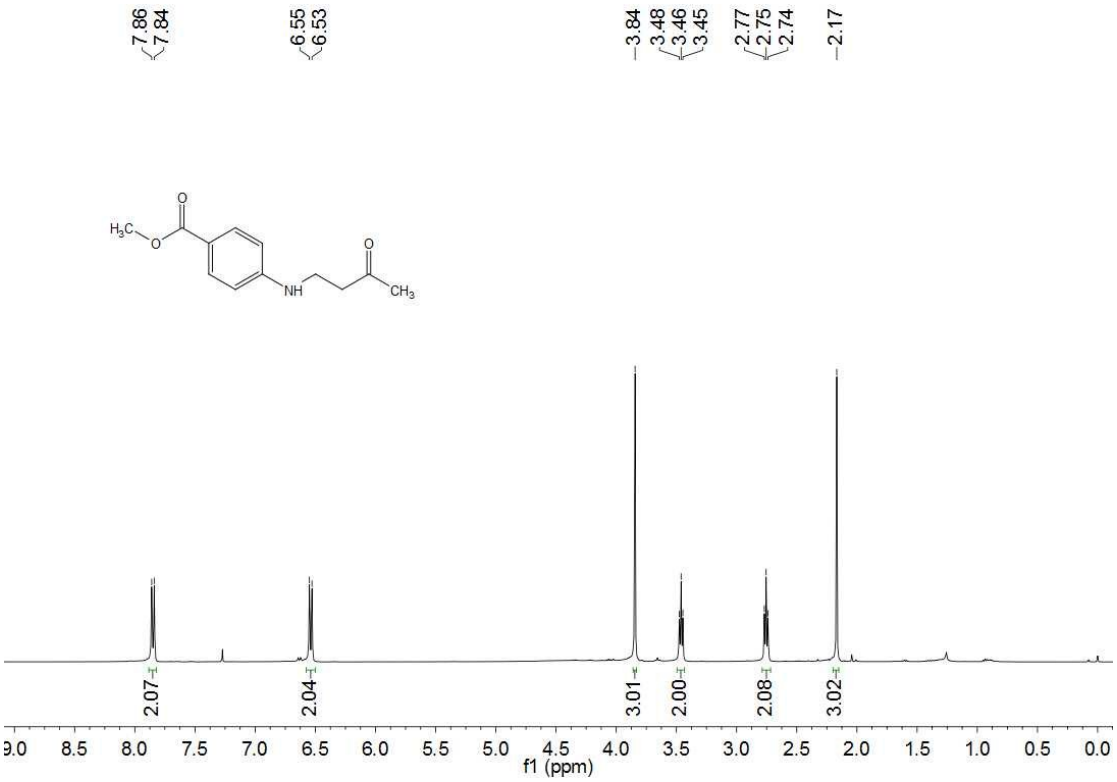


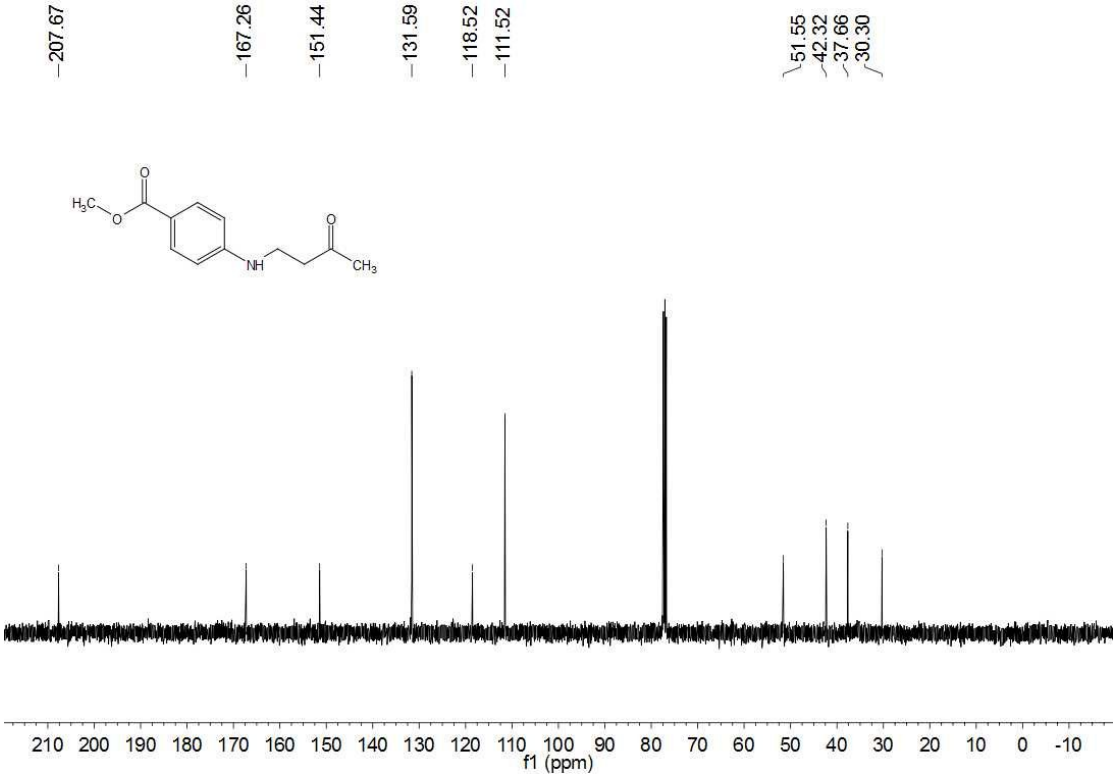
4-((3-Oxobutyl)amino)benzonitrile (3ac)



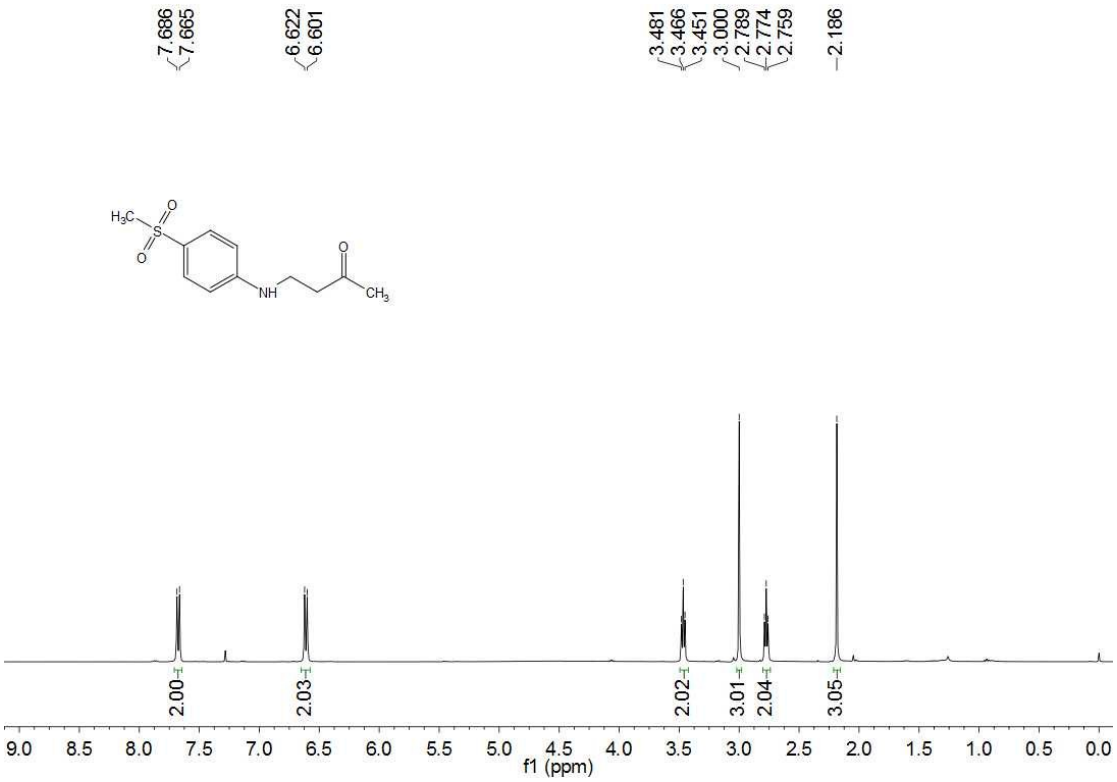


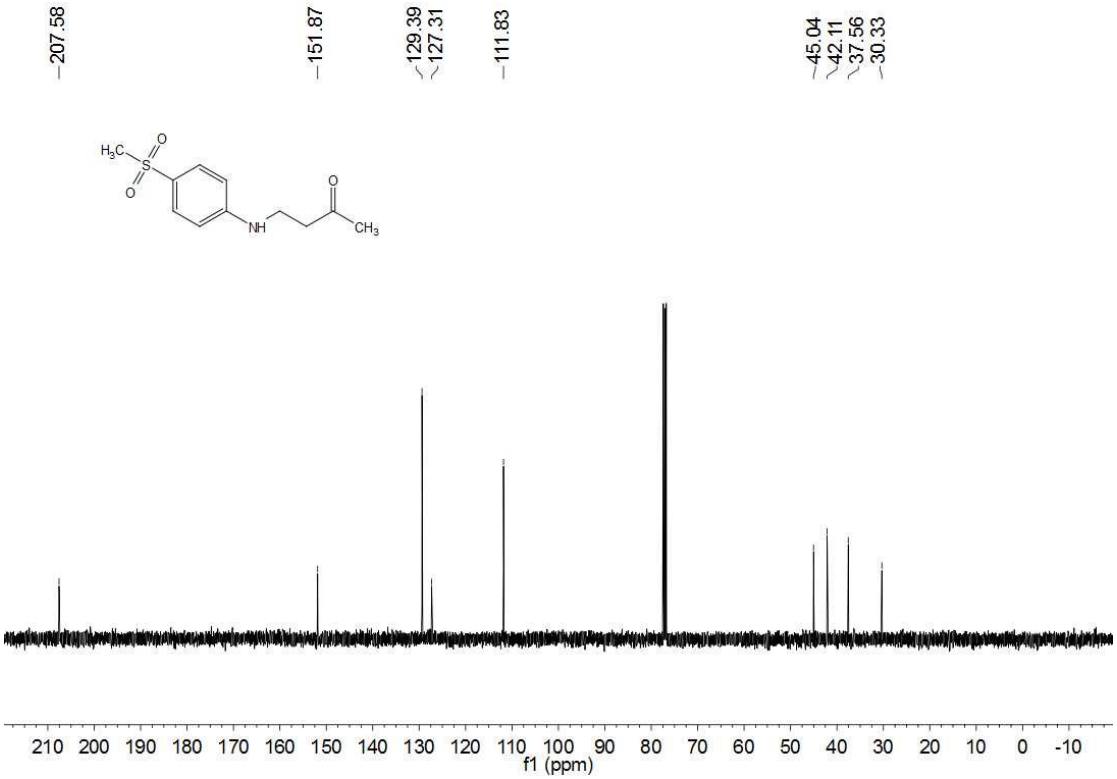
Methyl 4-((3-oxobutyl)amino)benzoate (3ad)



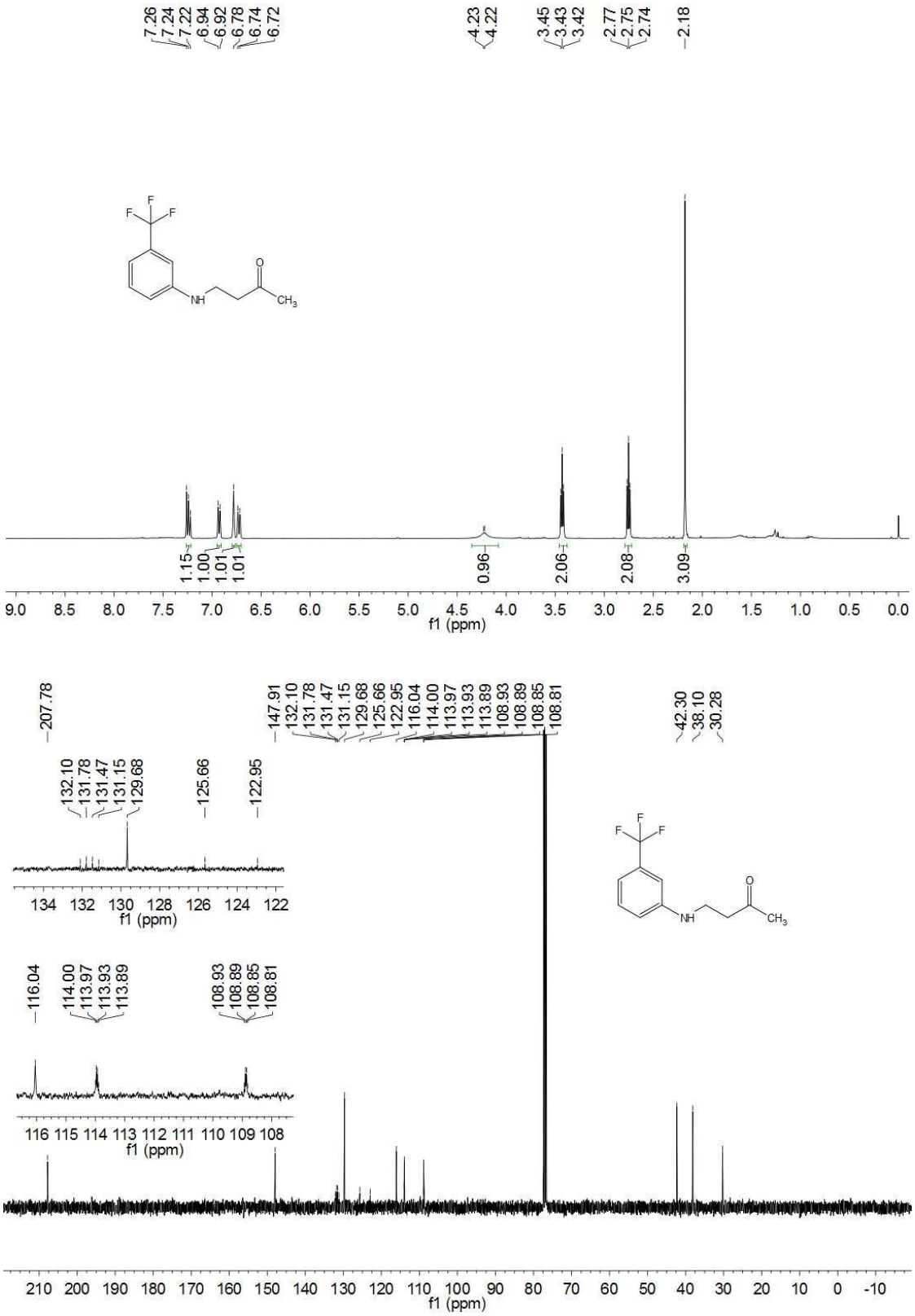


4-((4-(Methylsulfonyl)phenyl)amino)butan-2-one (3ae)

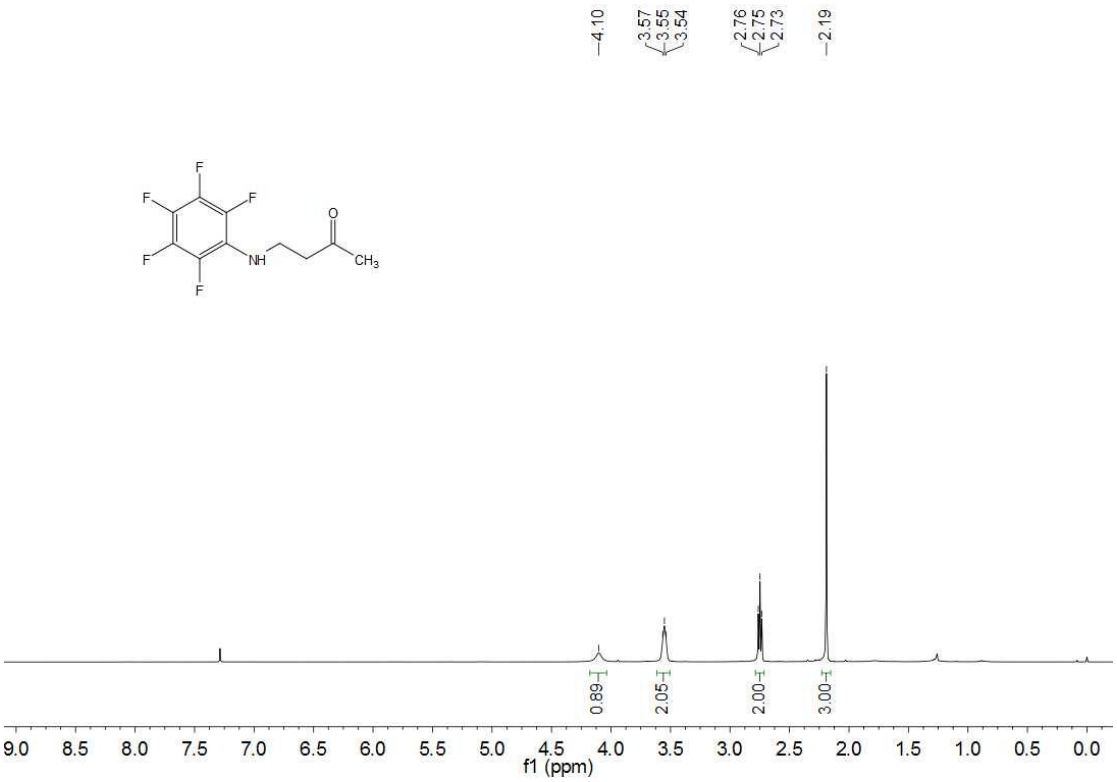


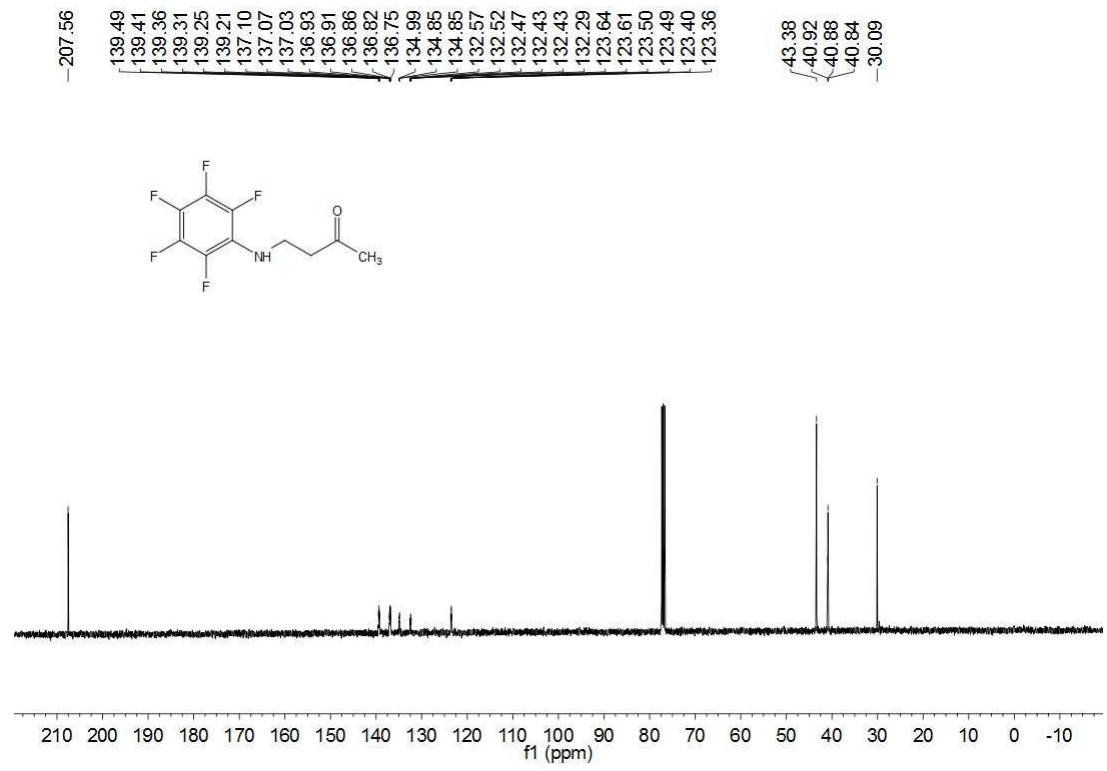


4-((3-(Trifluoromethyl)phenyl)amino)butan-2-one (3af)

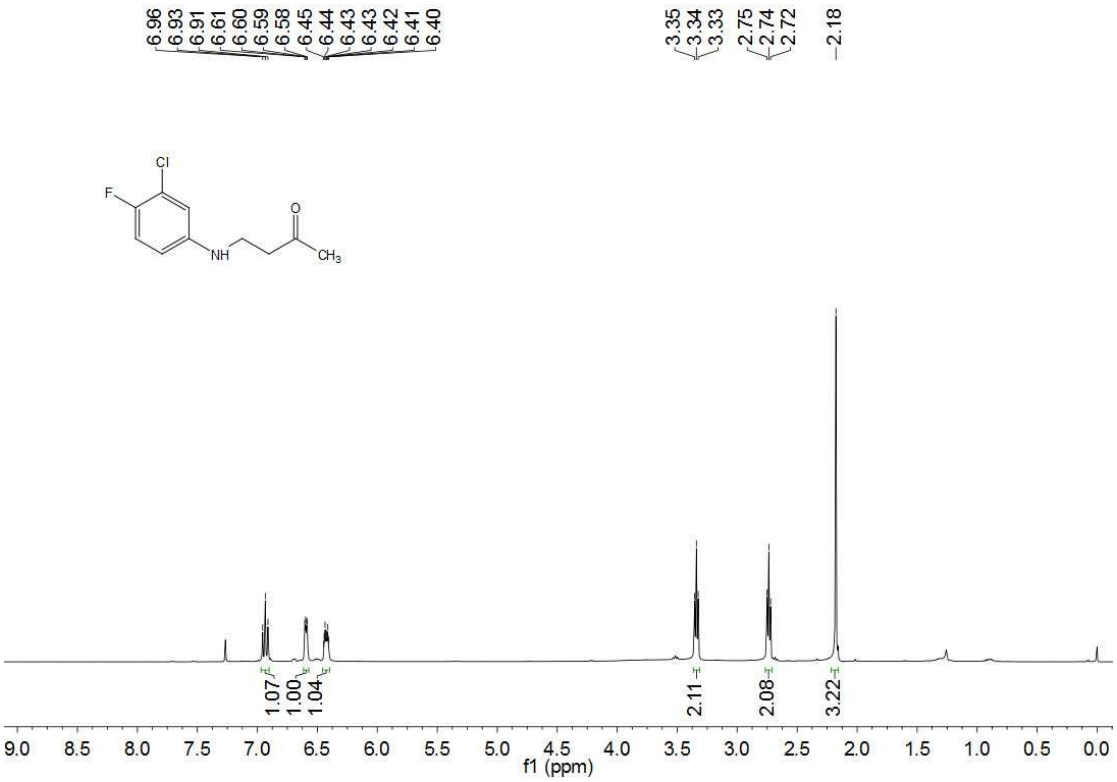


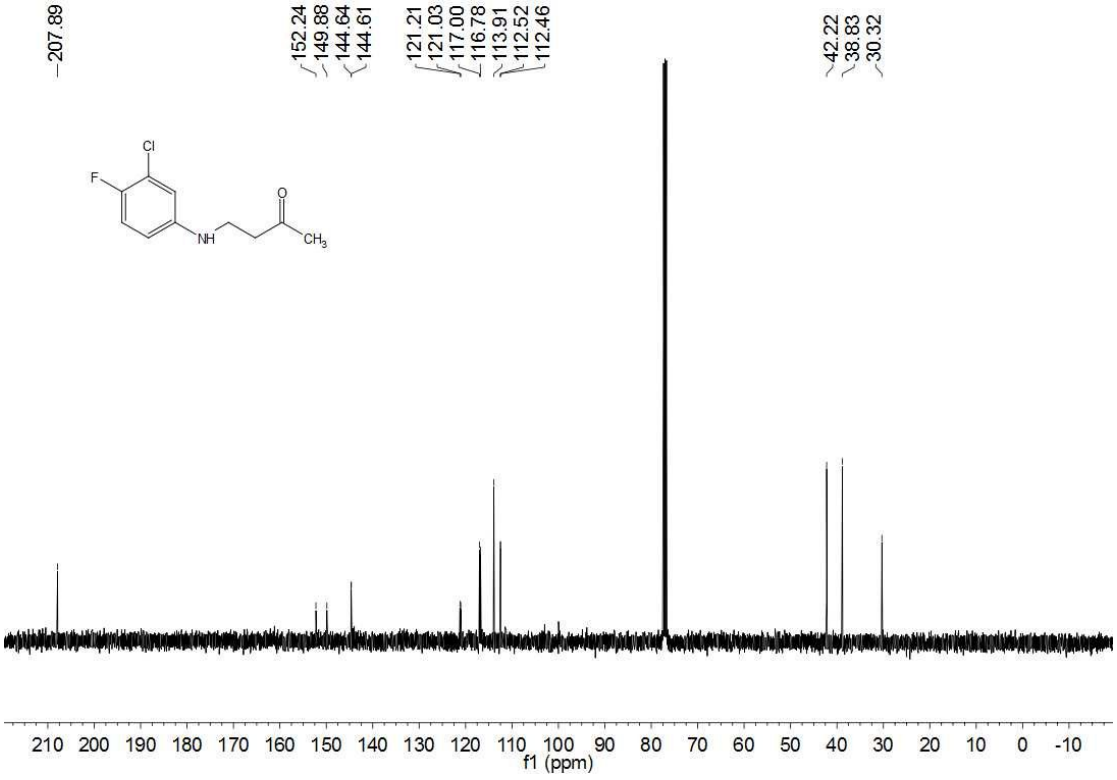
4-((Perfluorophenyl)amino)butan-2-one (3ag)



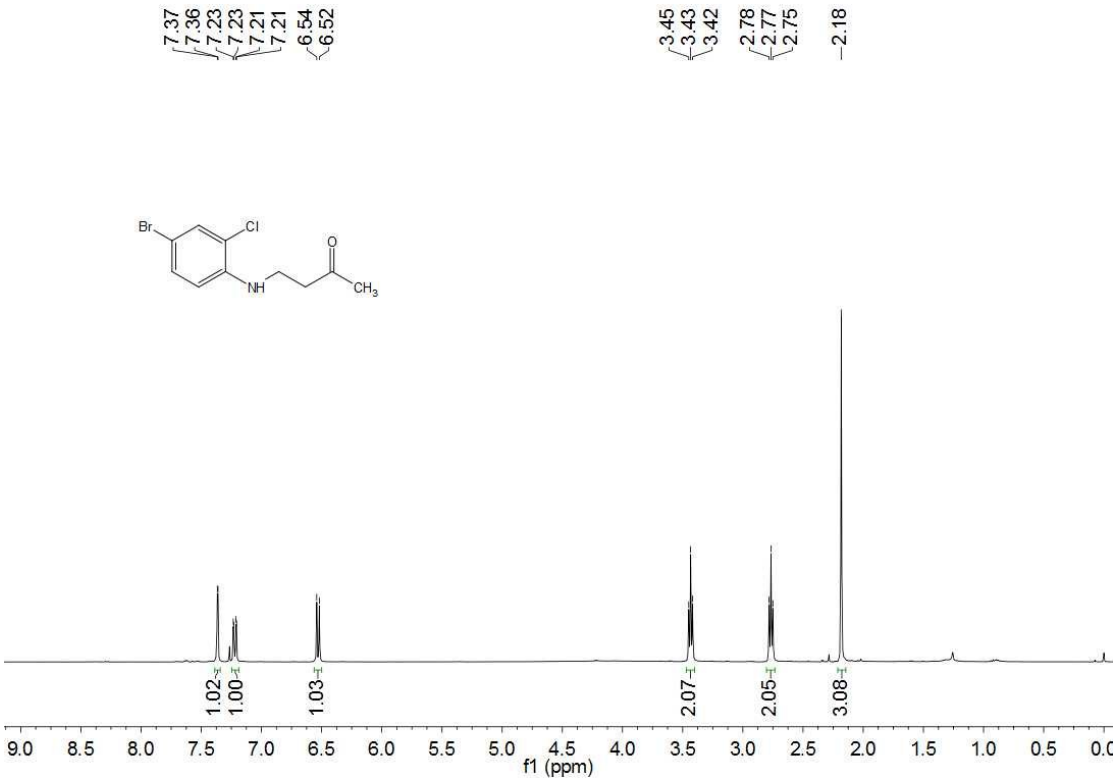


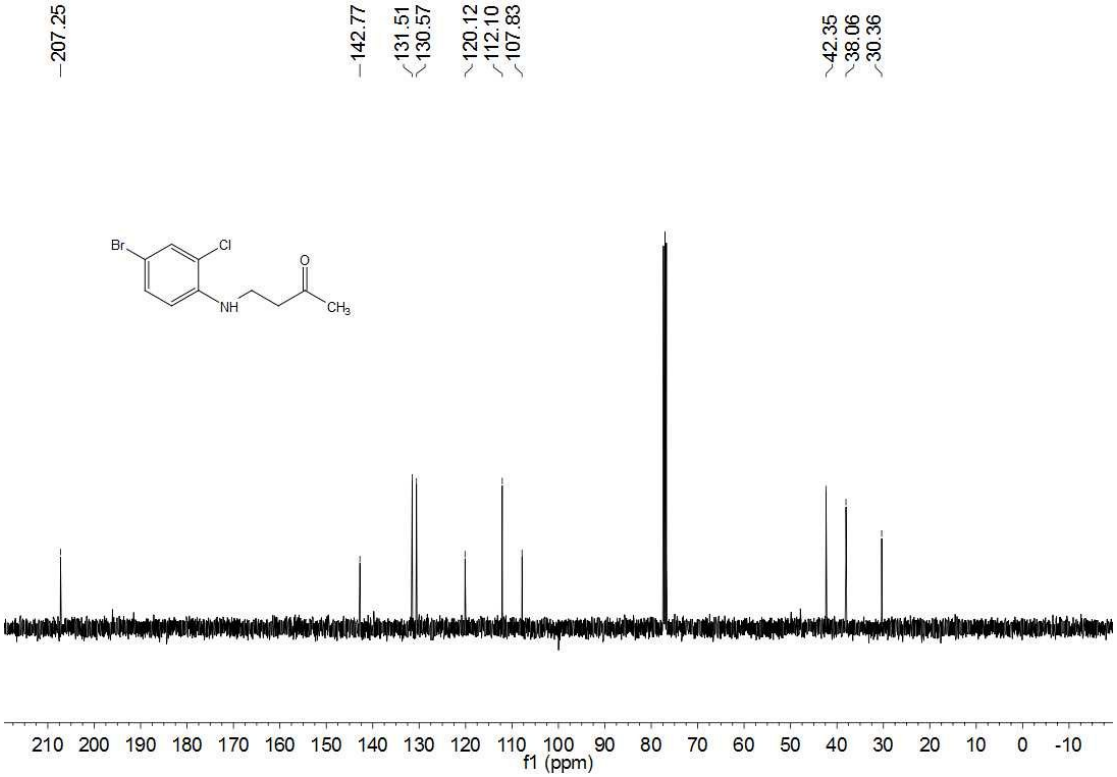
4-((3-Chloro-4-fluorophenyl)amino)butan-2-one (3ah)



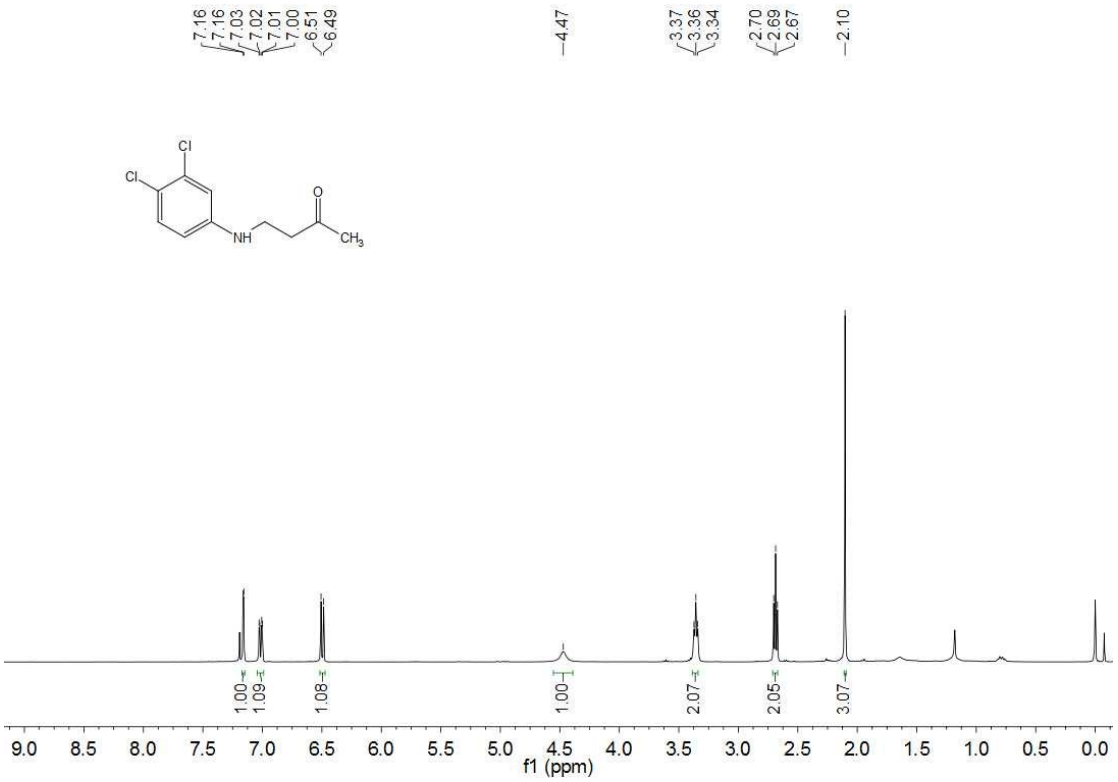


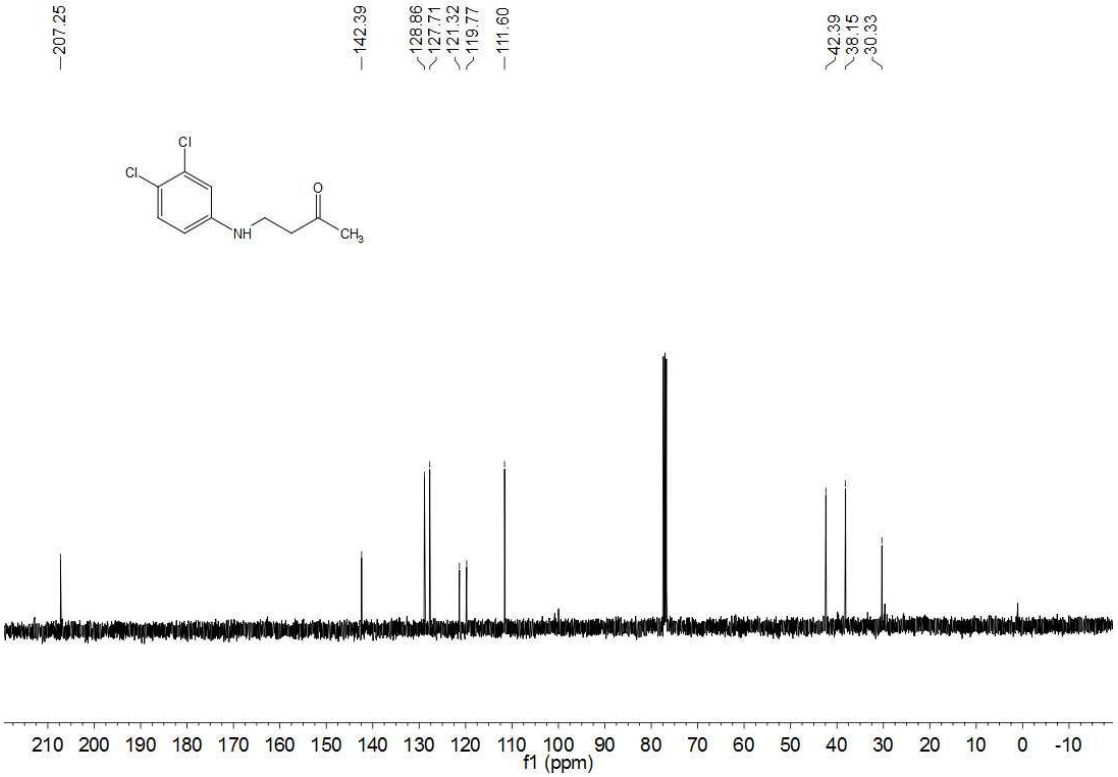
4-((4-Bromo-2-chlorophenyl)amino)butan-2-one (3ai)



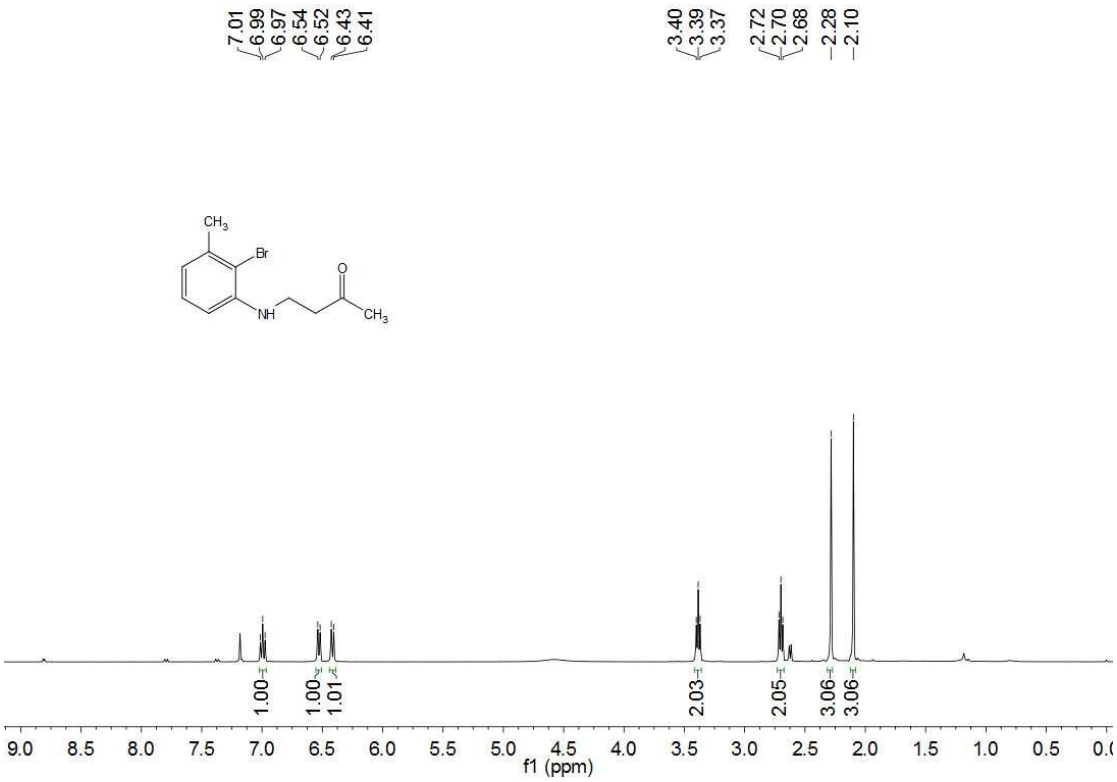


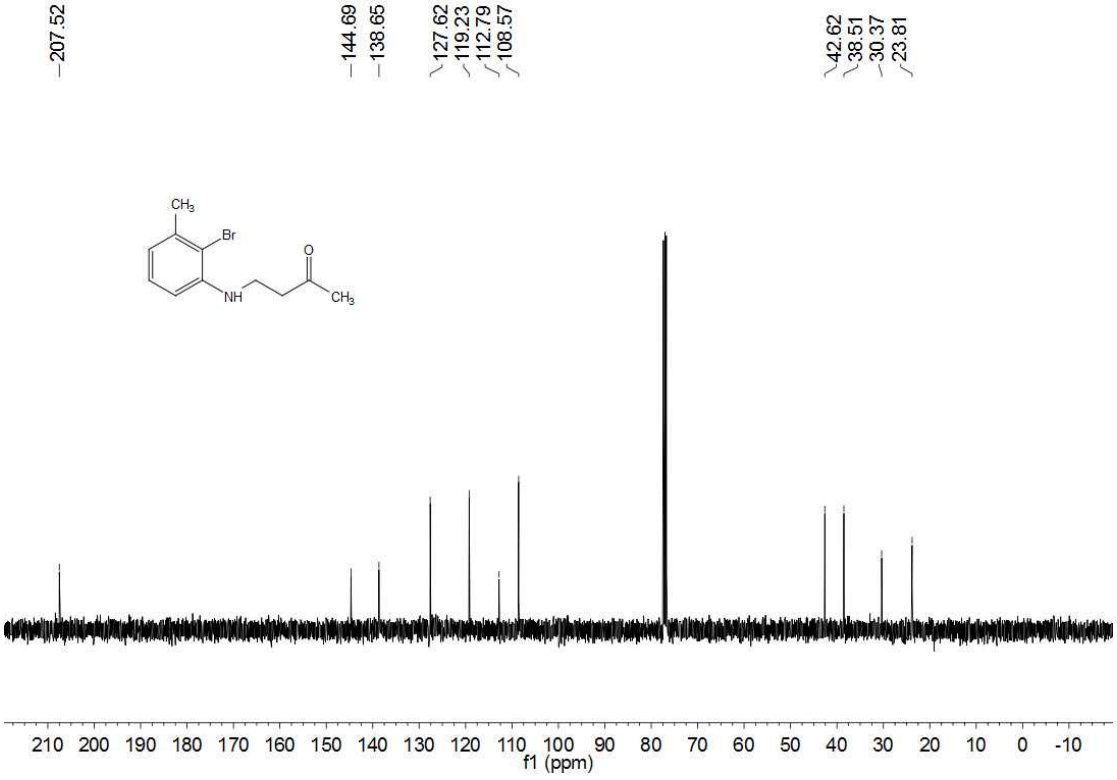
4-((3,4-Dichlorophenyl)amino)butan-2-one (3aj)



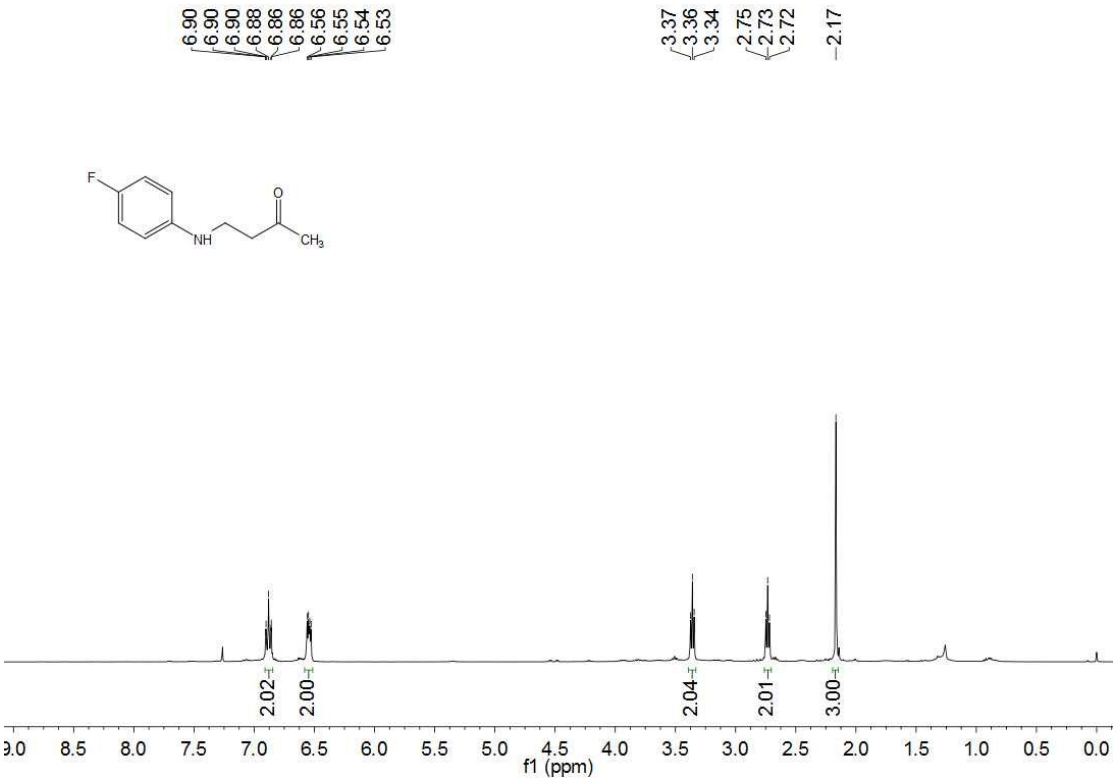


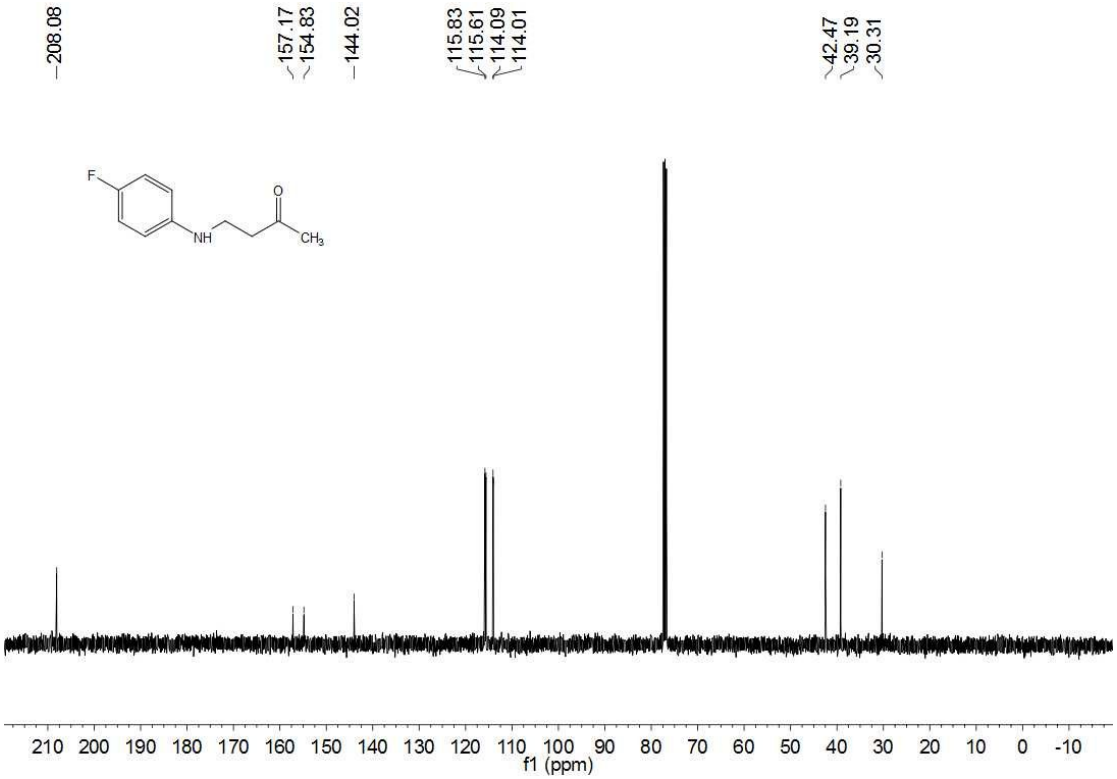
4-((2-Bromo-3-methylphenyl)amino)butan-2-one (3ak)



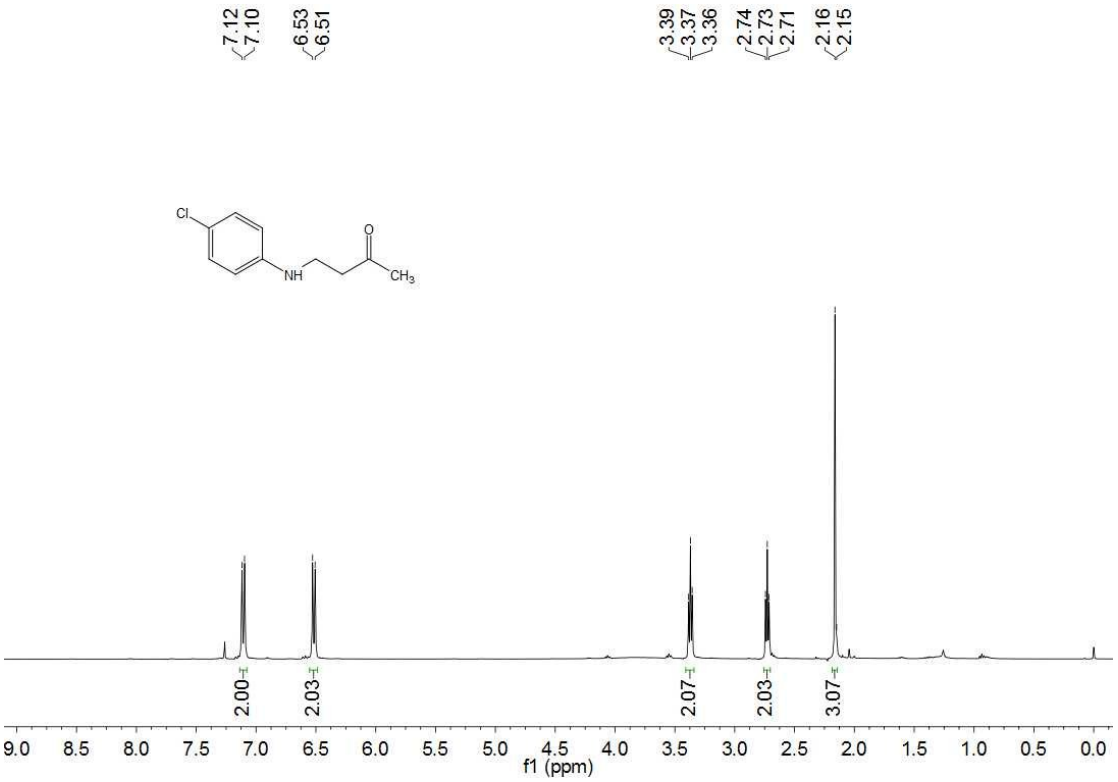


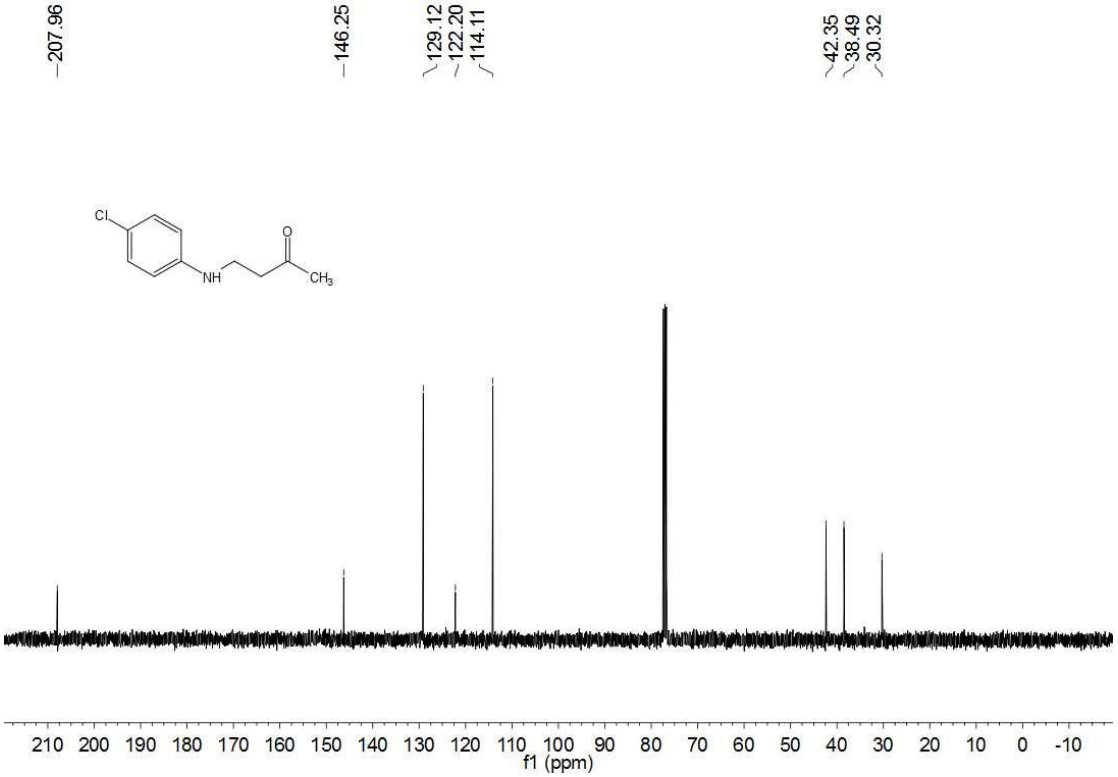
4-((4-Fluorophenyl)amino)butan-2-one (3al)



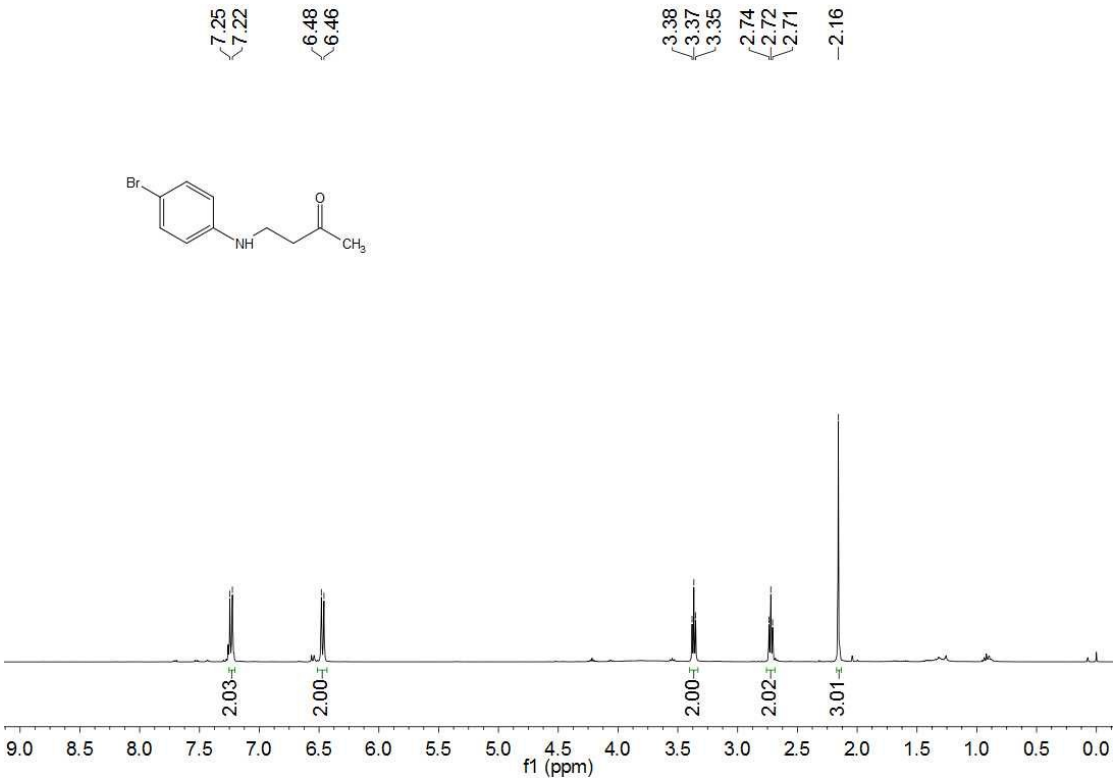


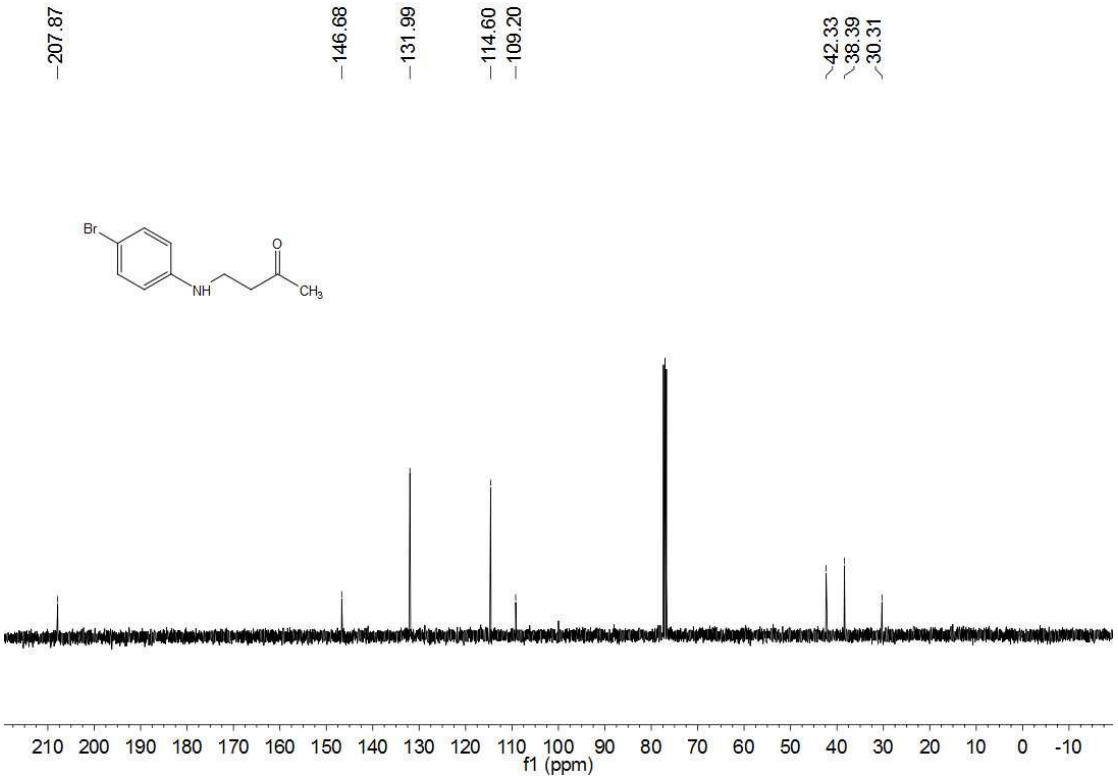
4-((4-Chlorophenyl)amino)butan-2-one (3am)



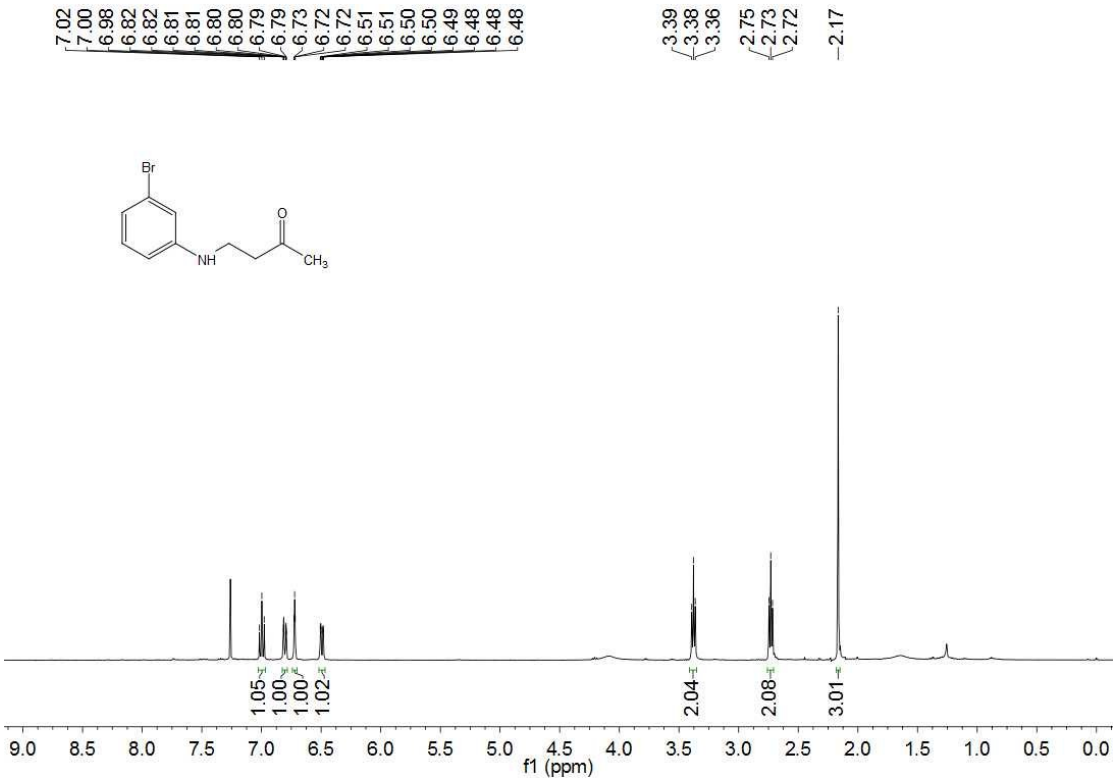


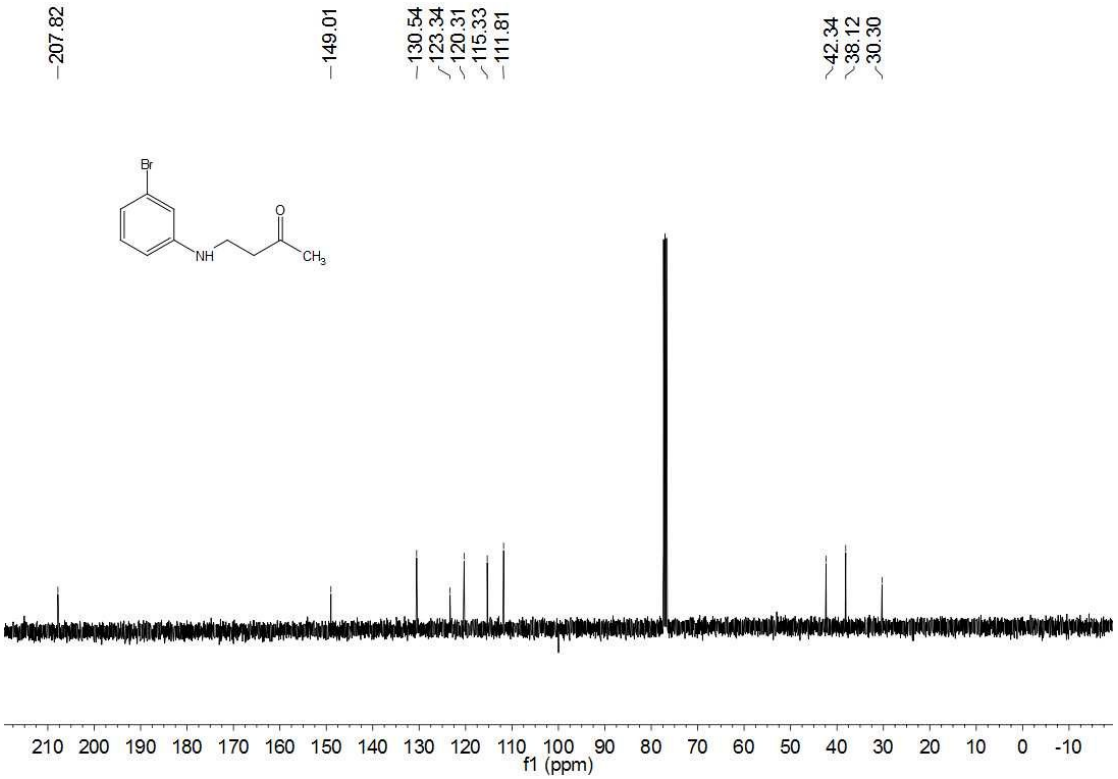
4-((4-Bromophenyl)amino)butan-2-one (3an)



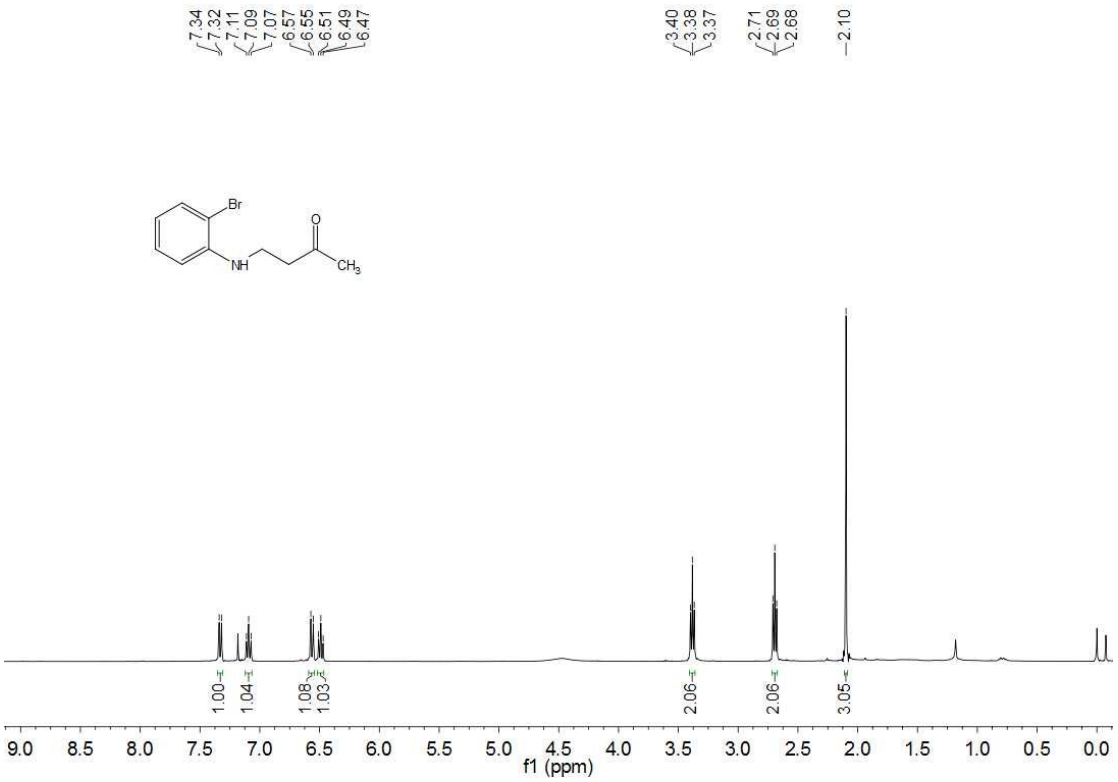


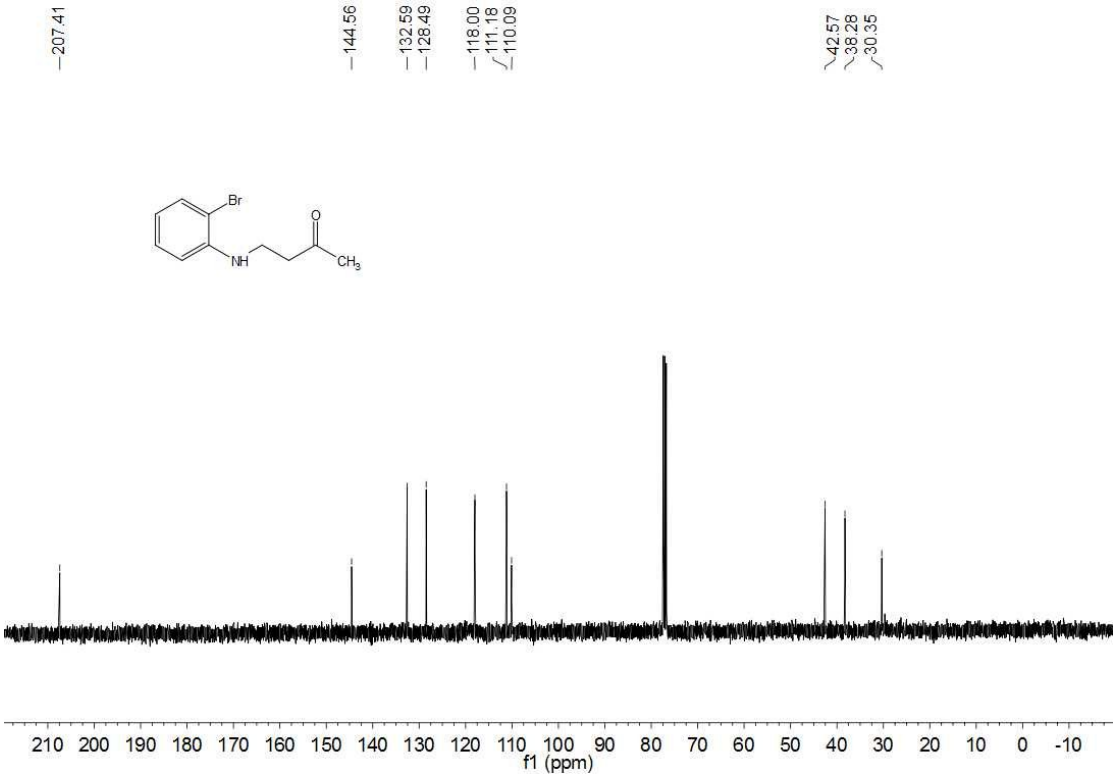
4-((3-Bromophenyl)amino)butan-2-one (3ao)



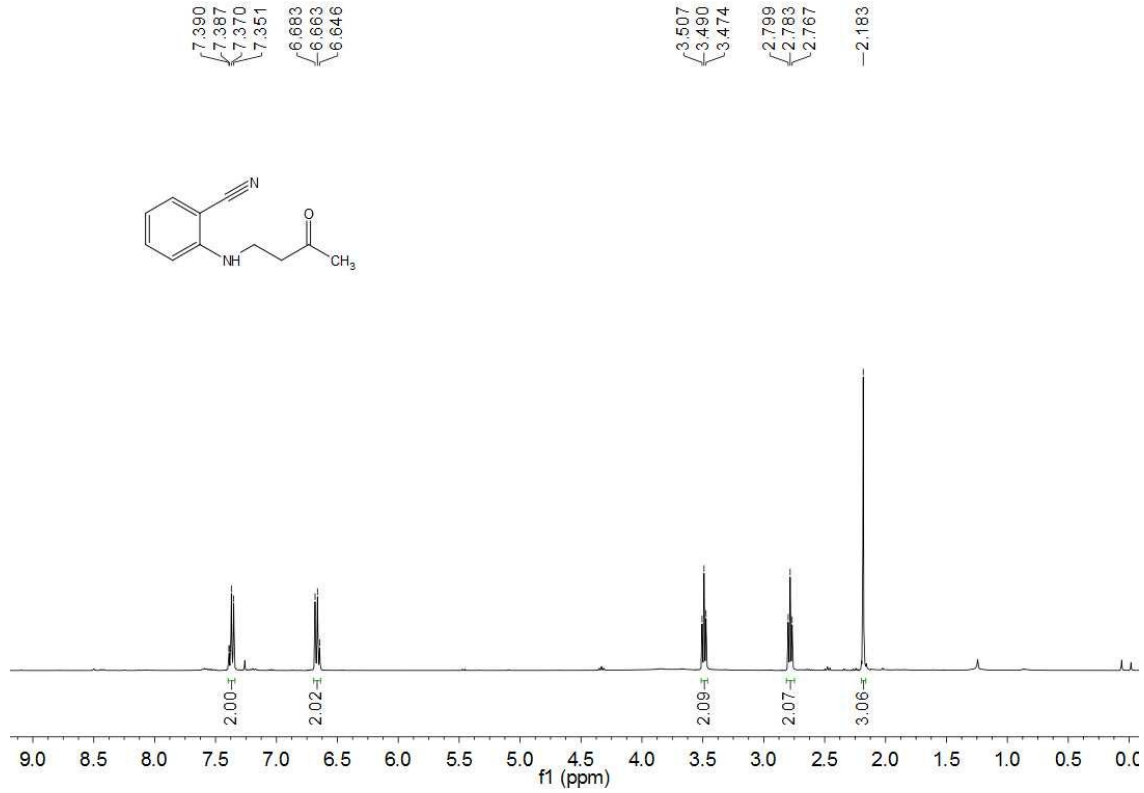


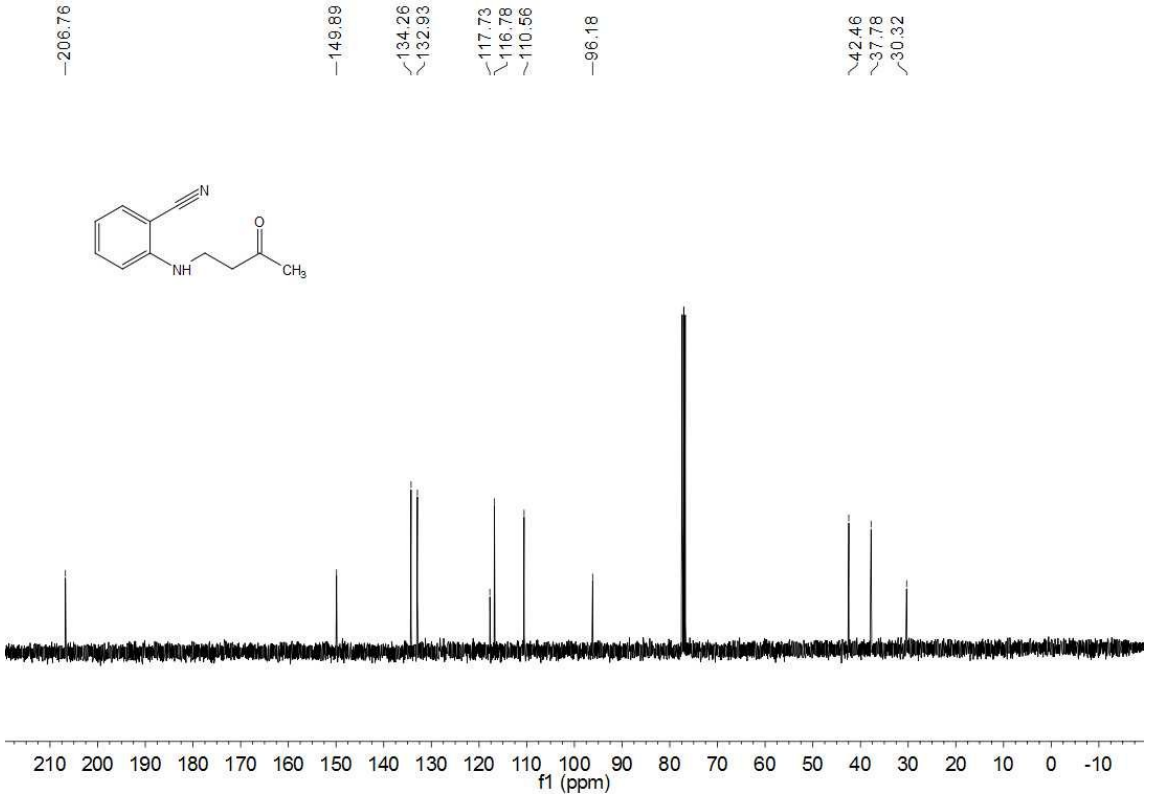
4-((2-Bromophenyl)amino)butan-2-one (3ap)



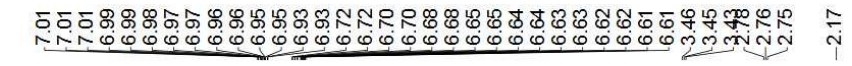


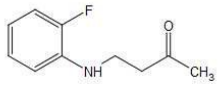
2-((3-Oxobutyl)amino)benzonitrile (3aq)

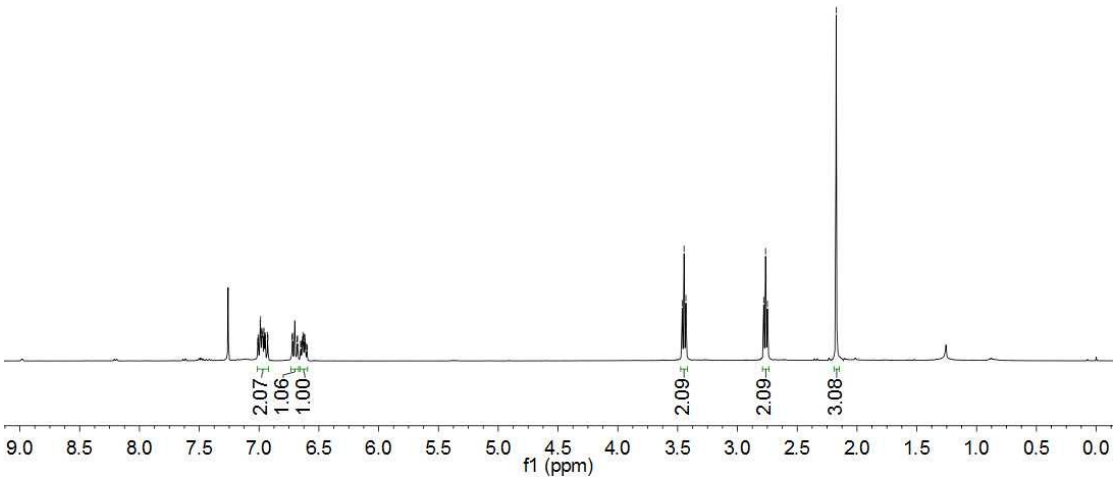


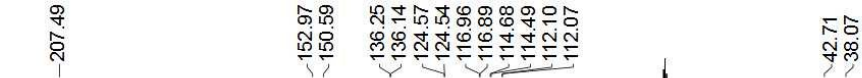


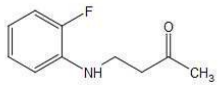
4-((2-Fluorophenyl)amino)butan-2-one (3ar)



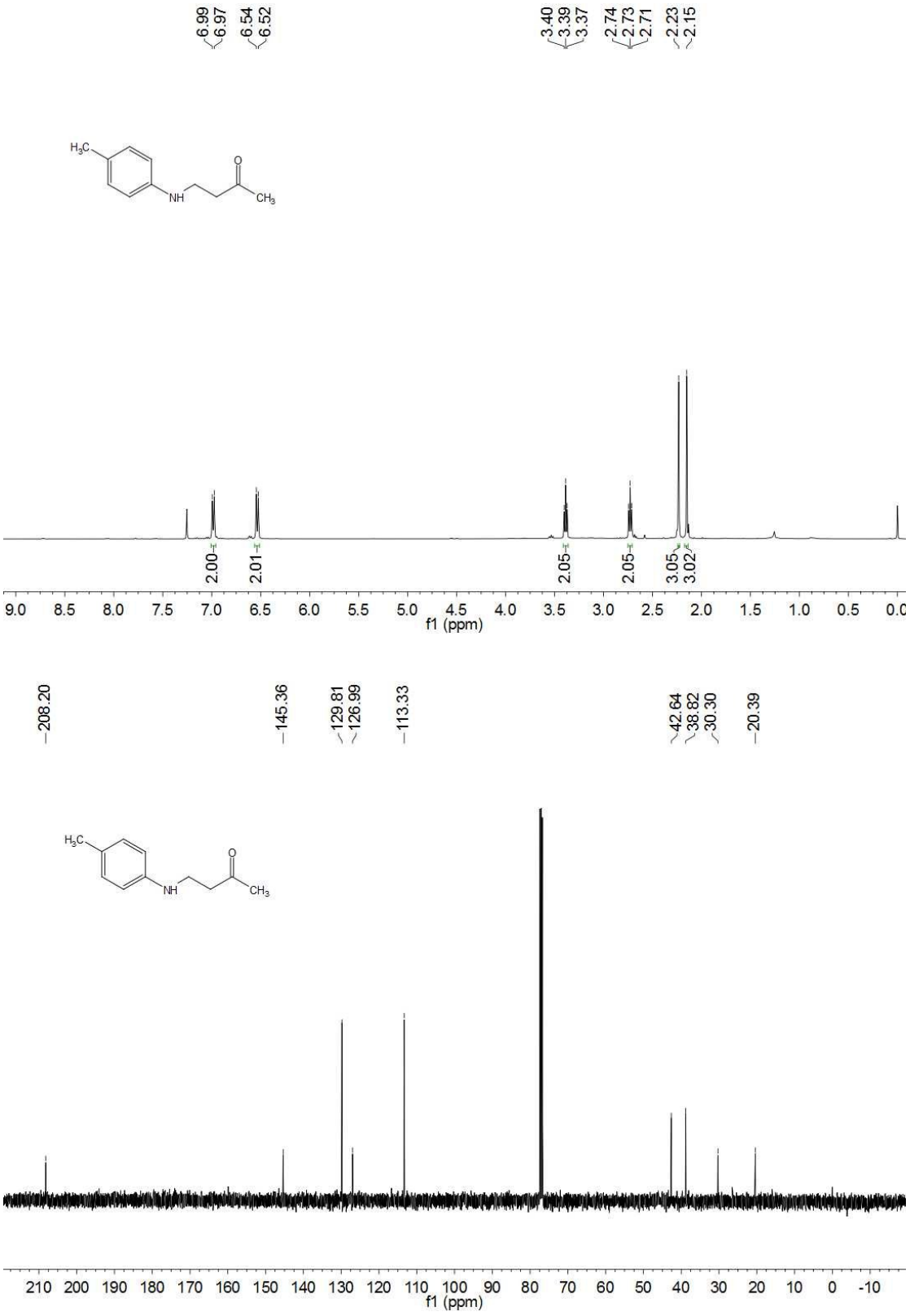




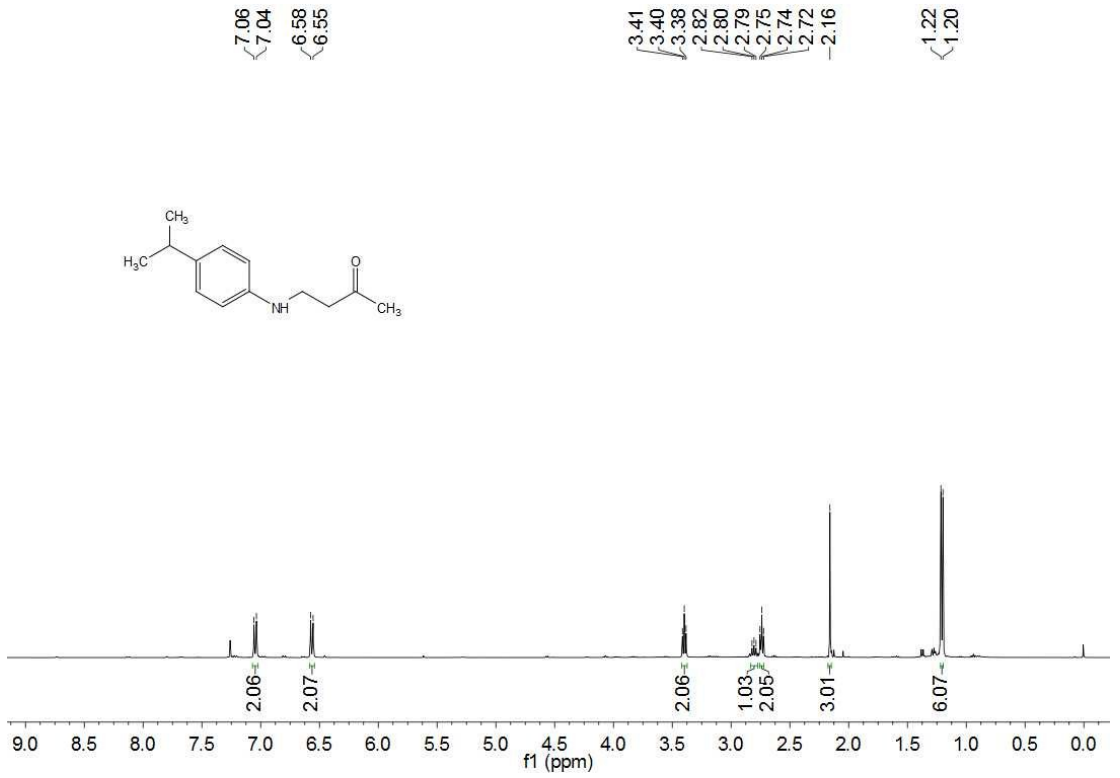


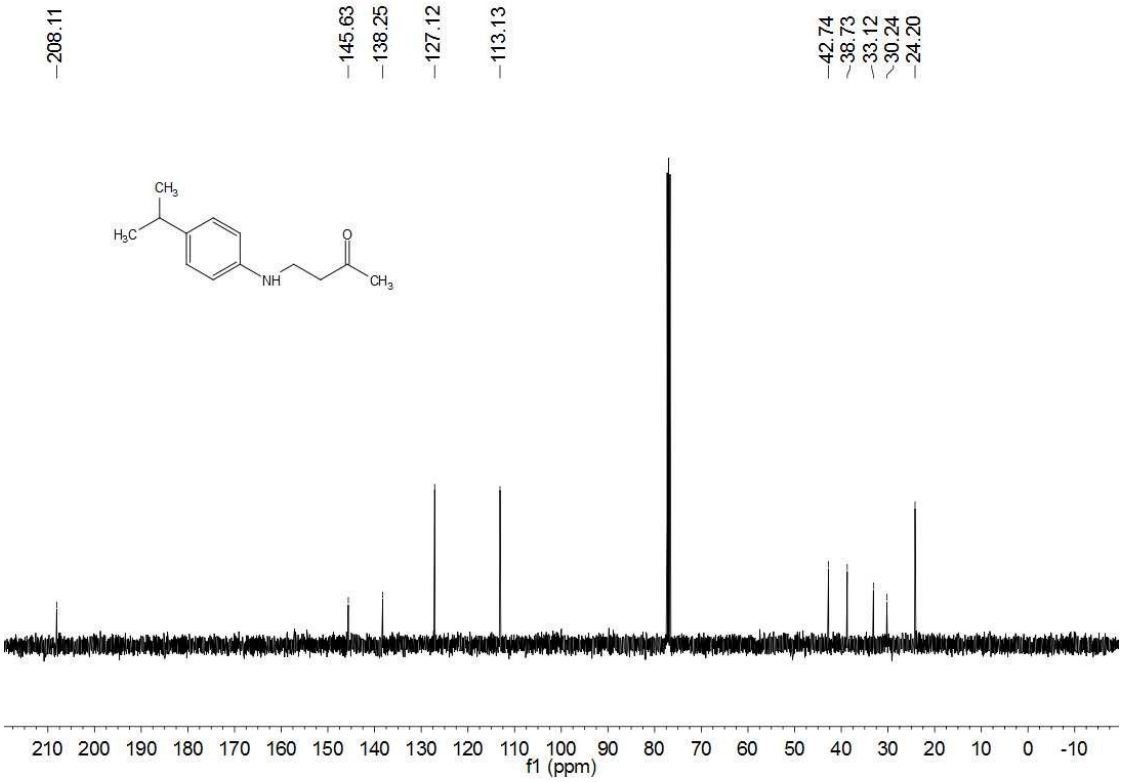


4-(*p*-tolylamino)butan-2-one (3as)

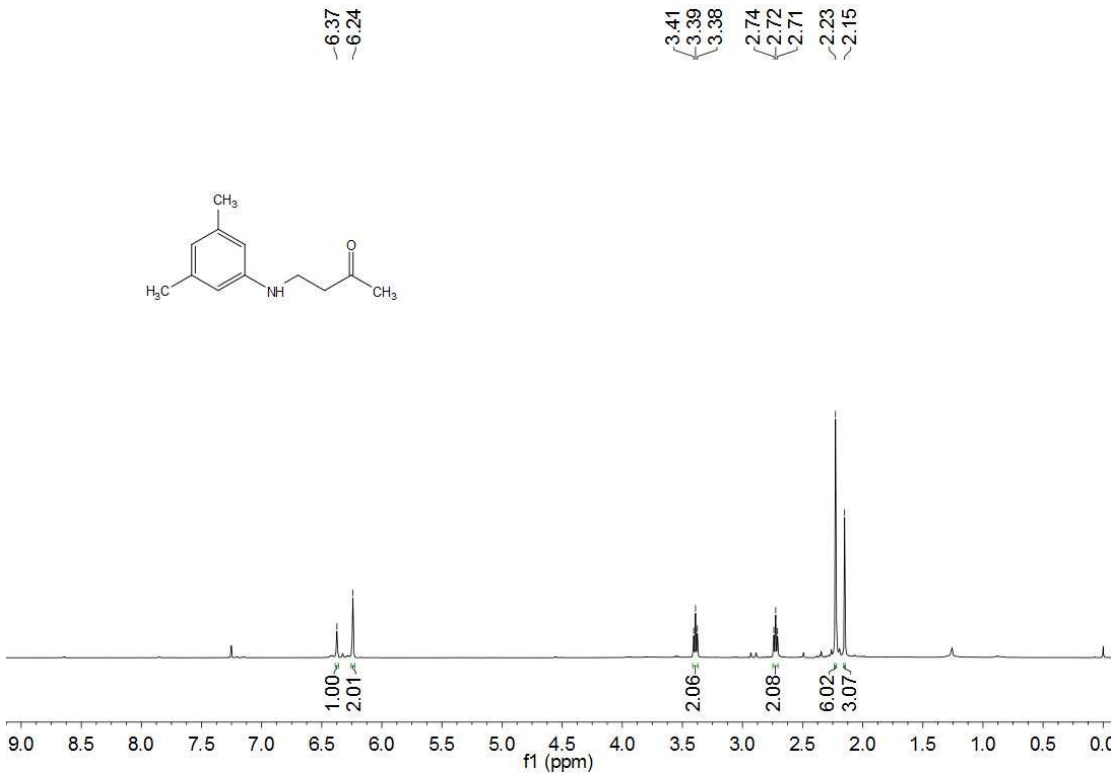


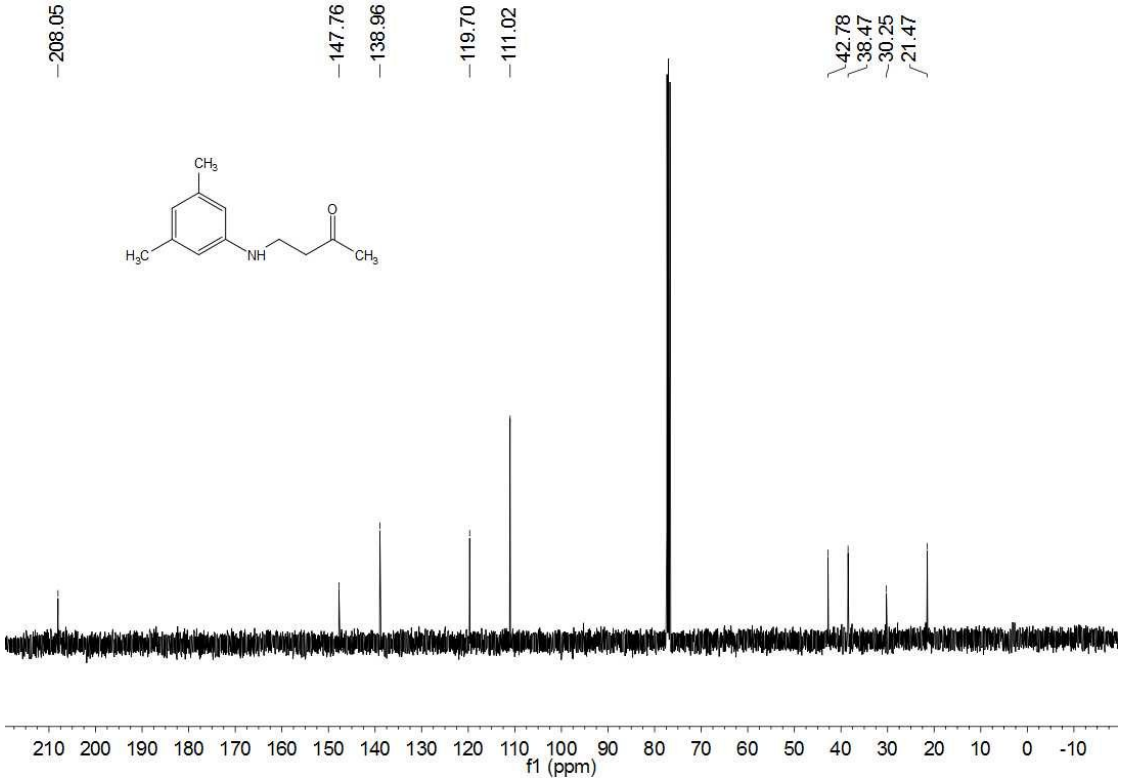
4-((4-Isopropylphenyl)amino)butan-2-one (3at)



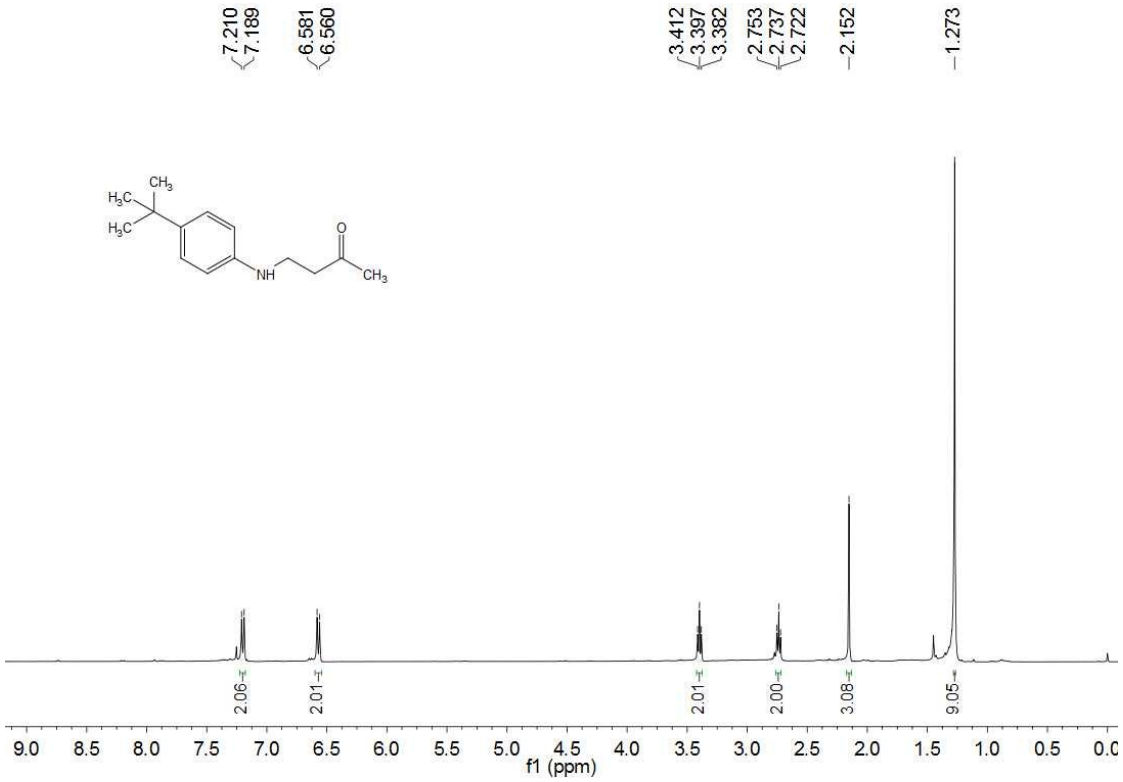


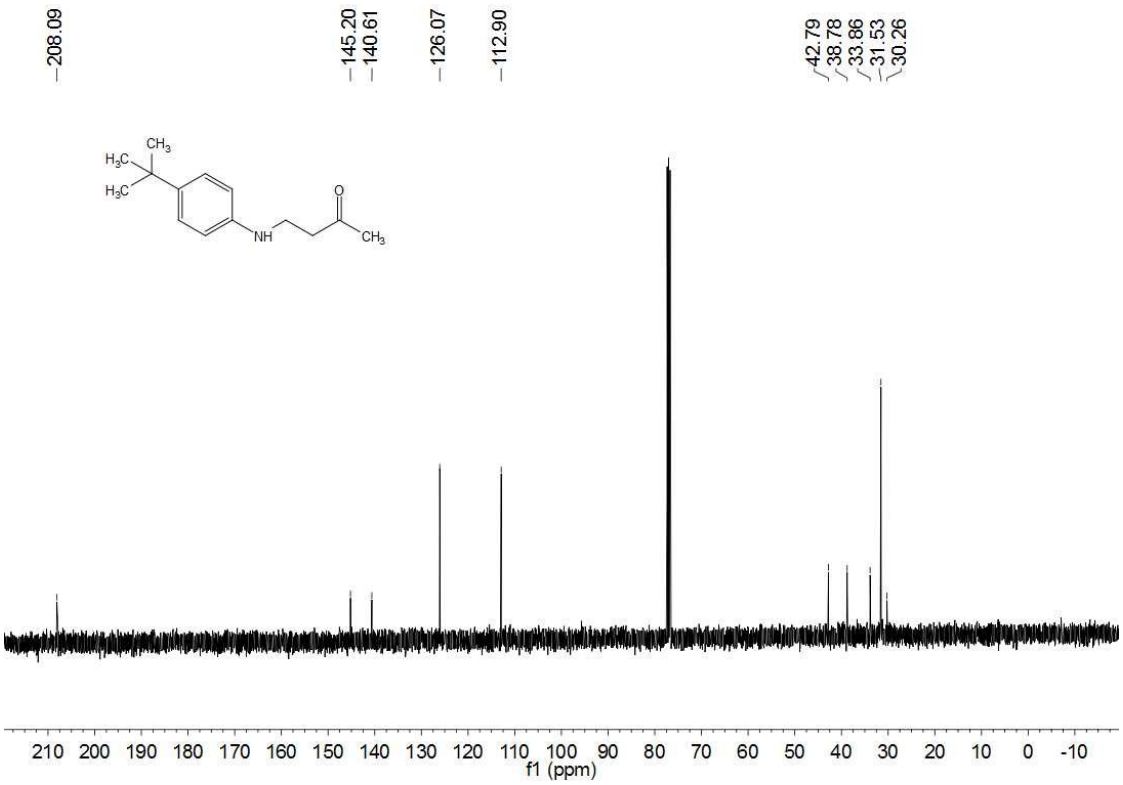
4-((3,5-Dimethylphenyl)amino)butan-2-one (3au)



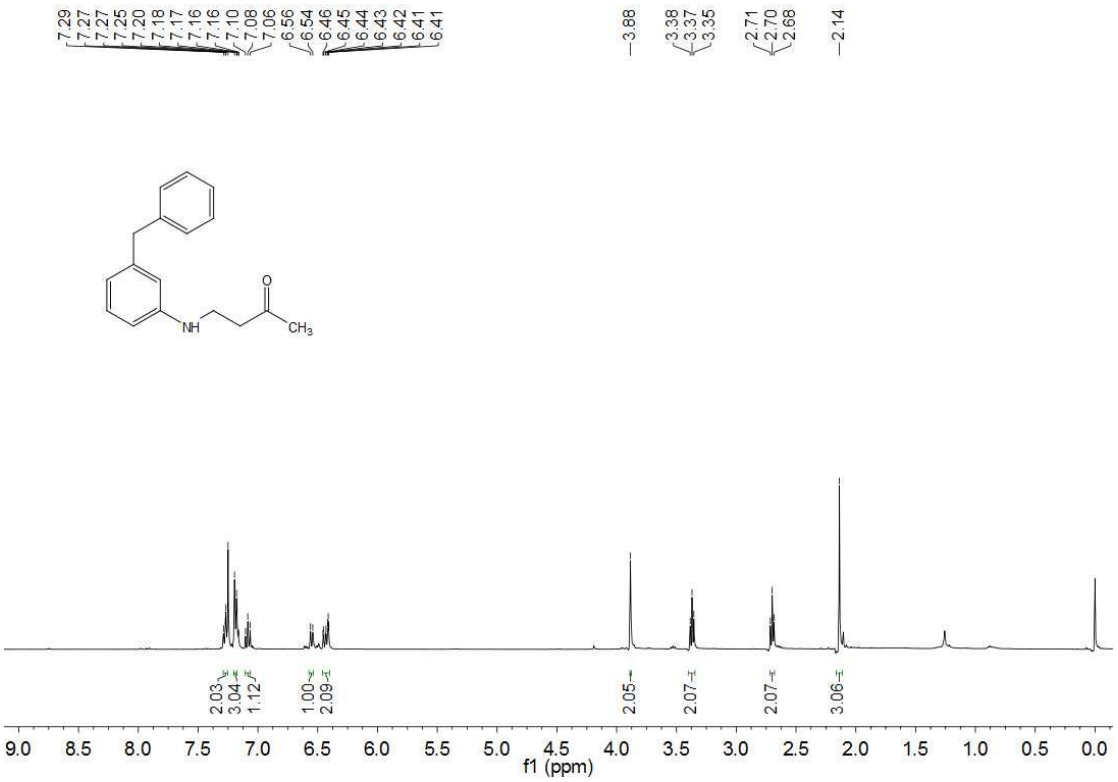


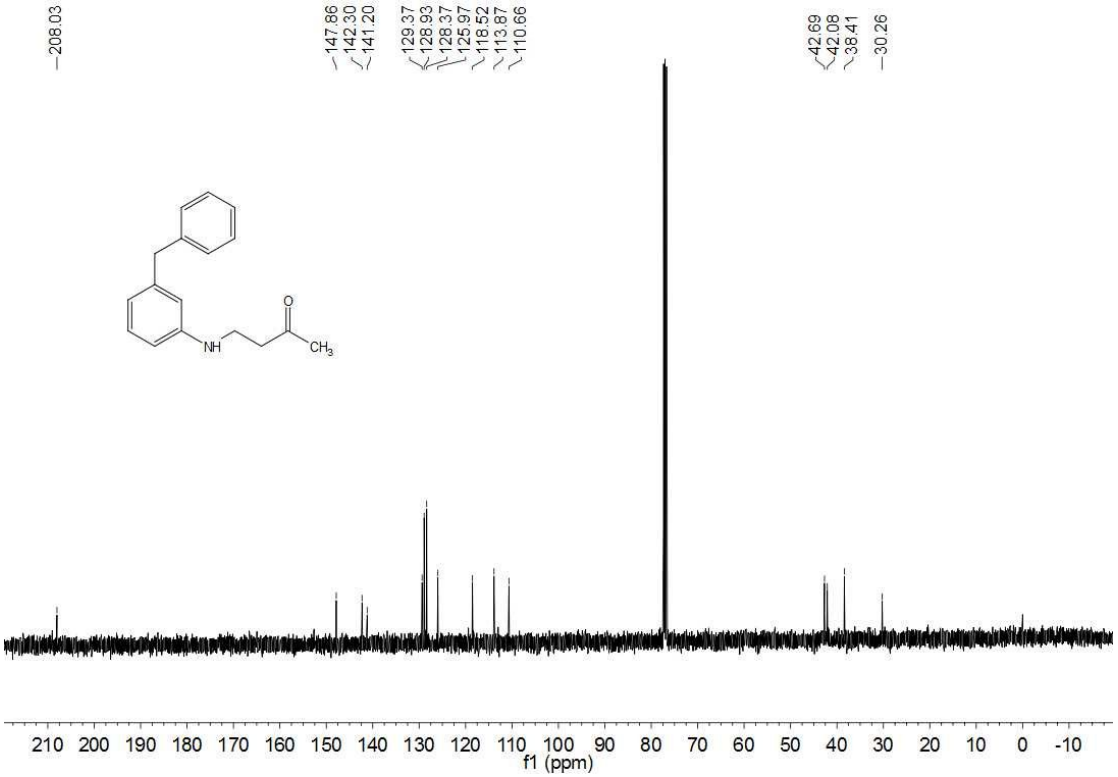
4-((4-(*tert*-Butyl)phenyl)amino)butan-2-one (3av)



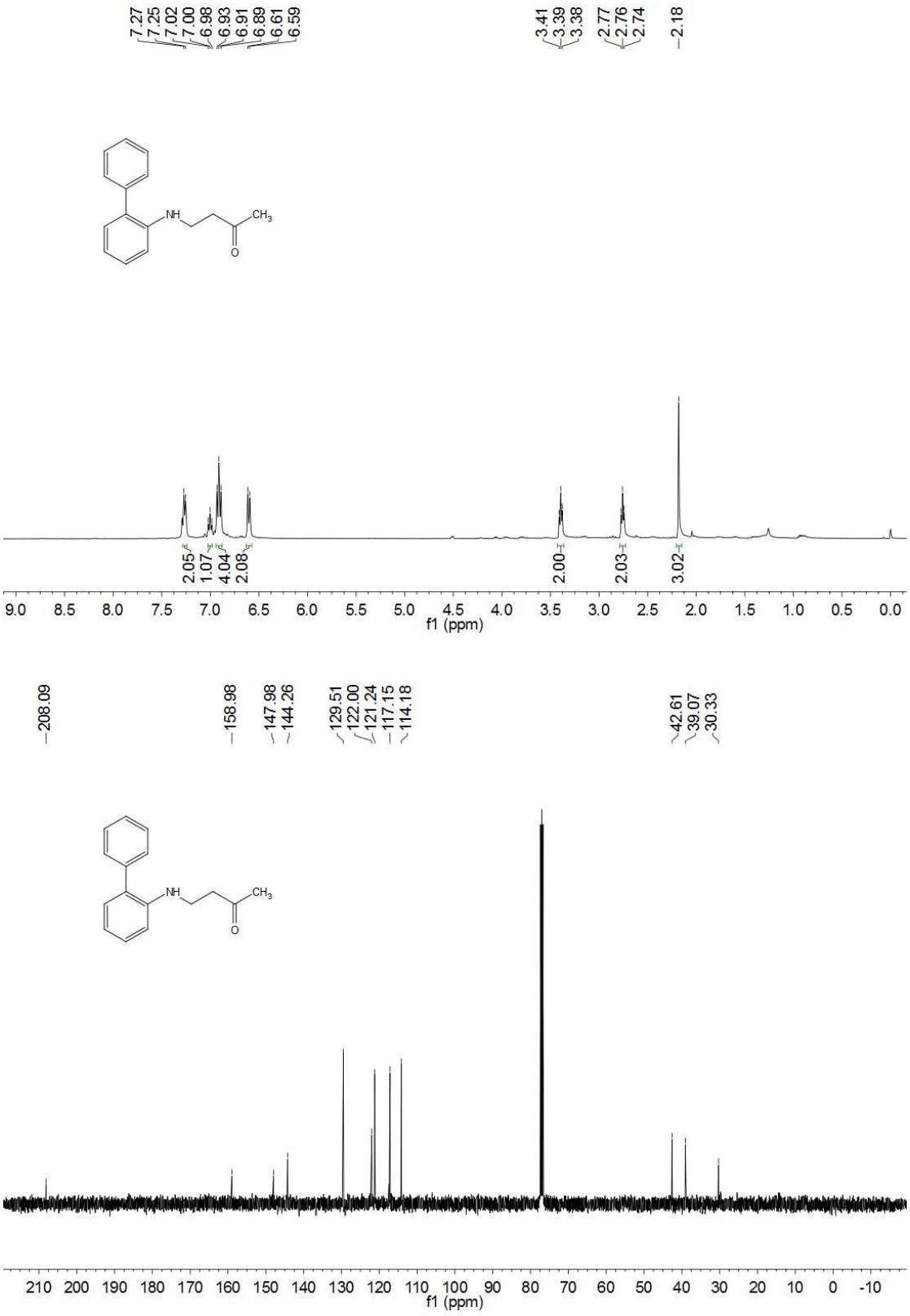


4-((4-Benzylphenyl)amino)butan-2-one (3aw)

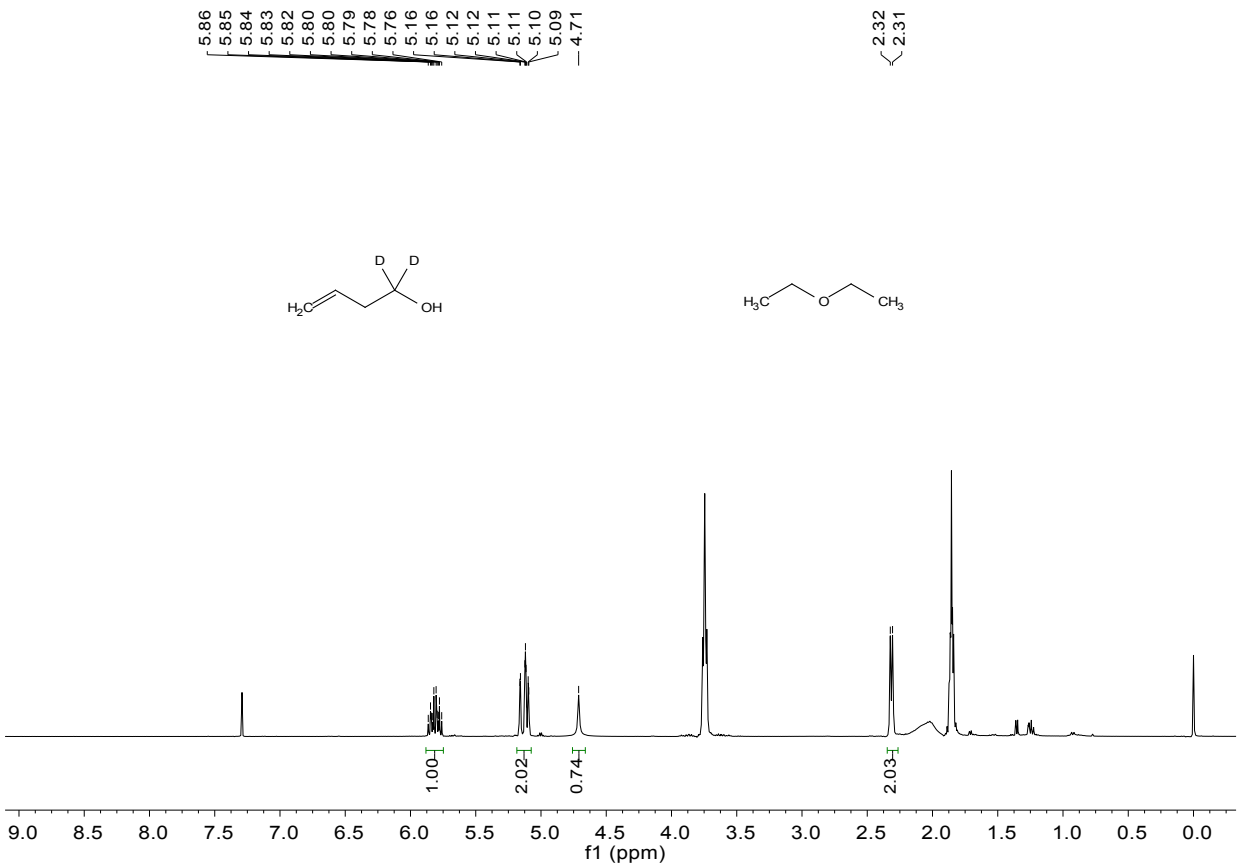




4-([1,1'-Biphenyl]-2-ylamino)butan-2-one (3ax)



2a-d2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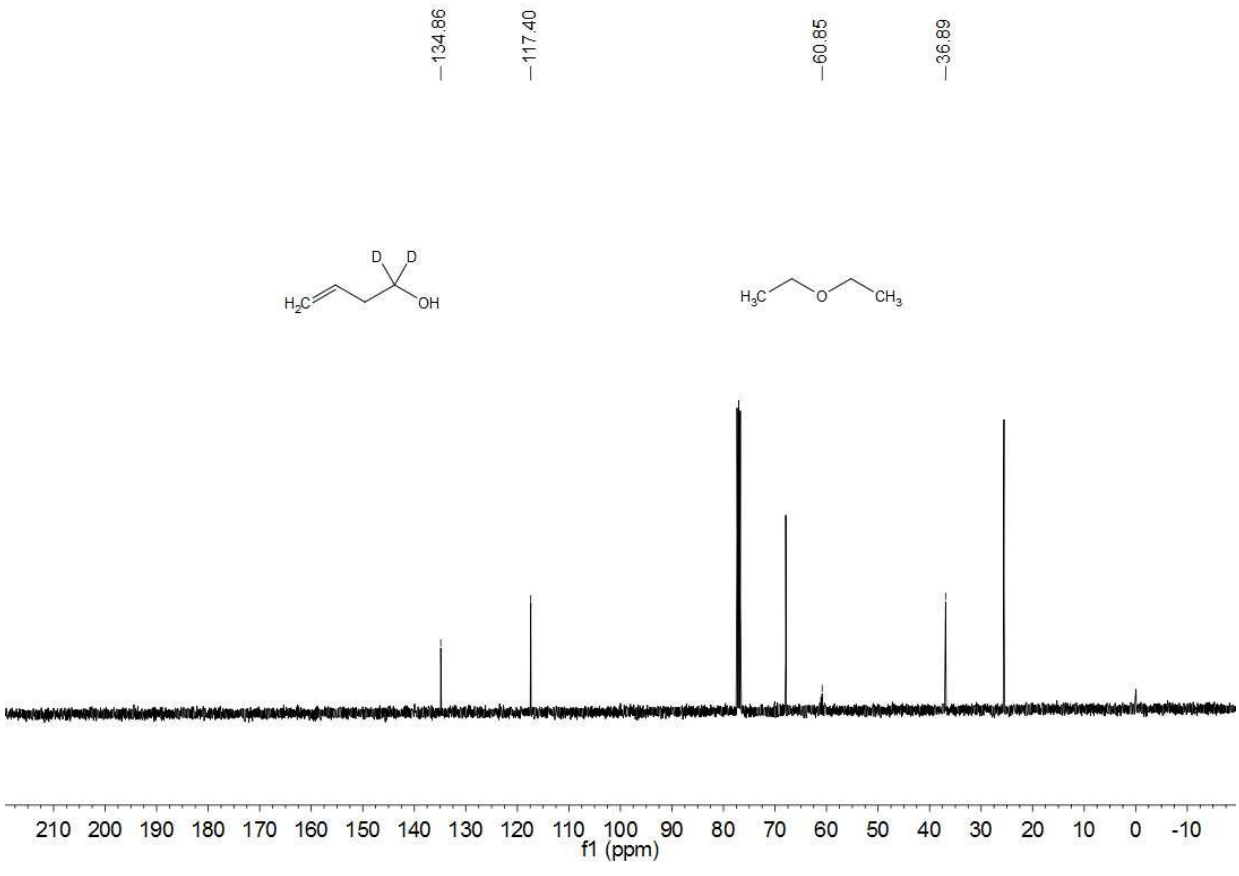
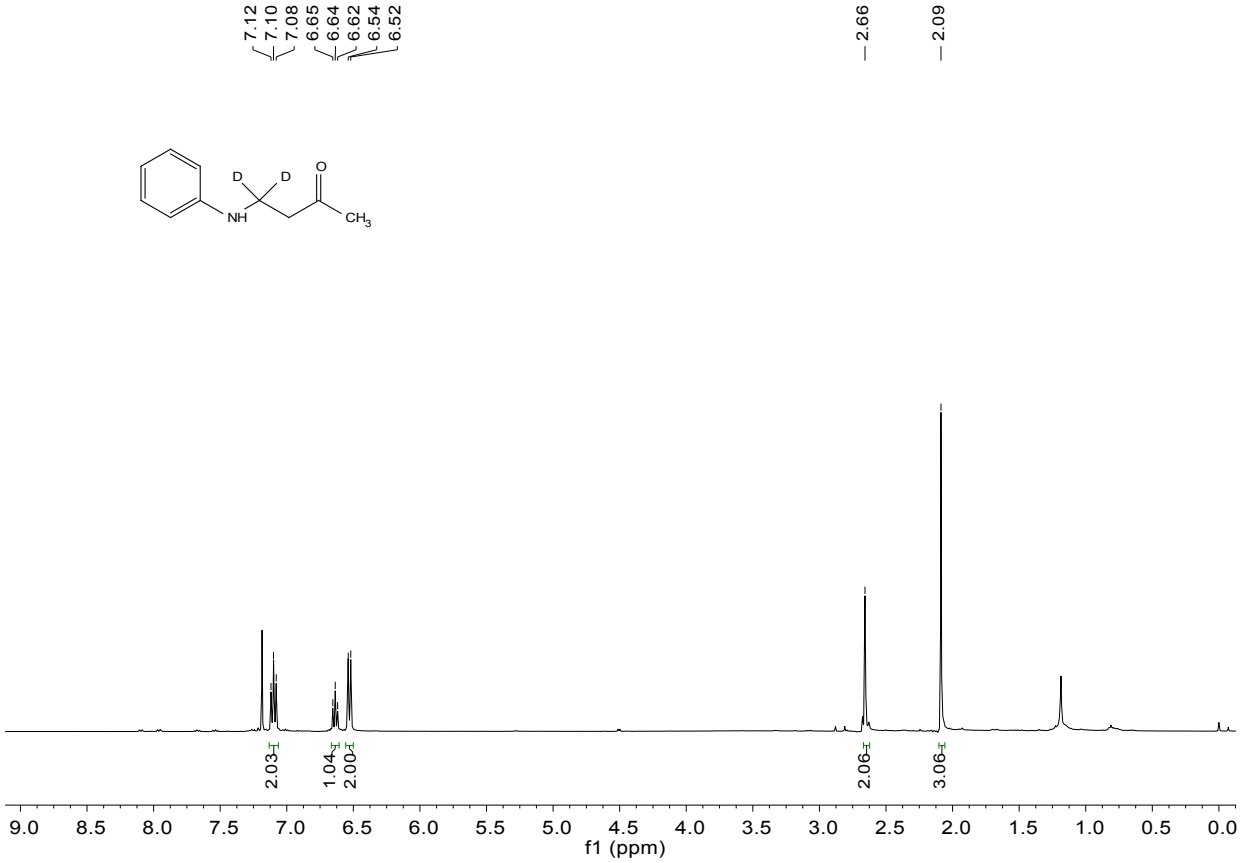
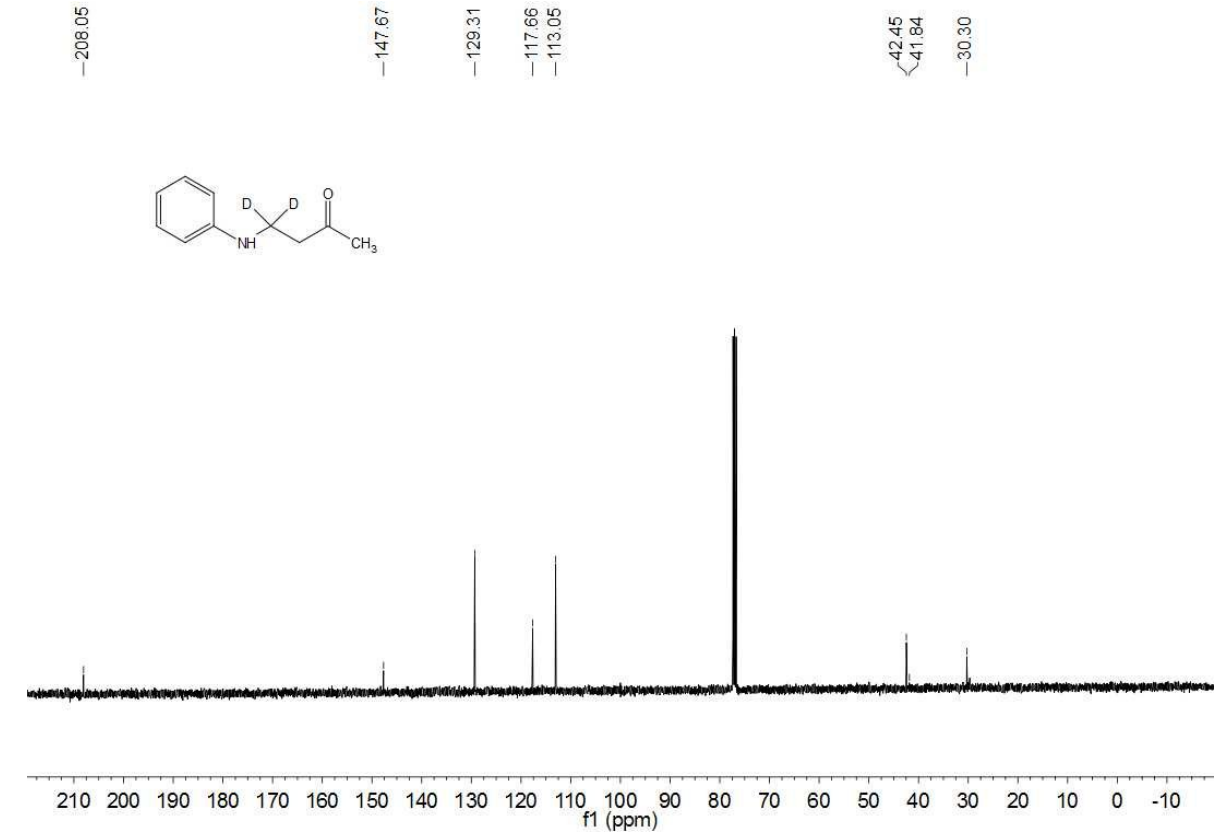
5.85
5.84
5.83
5.82
5.80
5.80
5.79
5.78
5.76
5.16
5.12
5.12
5.11
5.11
5.10
5.09
4.71
2.32
2.31
D
D
H2C
OH
H3C
O
CH3
1.00
2.02
0.74
2.03
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


134.86
117.40
60.85
36.89
D
D
H2C
OH
H3C
O
CH3
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

3aa-d2


7.12
7.10
7.08
6.65
6.64
6.62
6.54
6.52
2.66
2.09
D
D
O
NH
CH3
2.03
1.04
2.00
2.06
3.06
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


208.05
147.67
129.31
117.66
113.05
42.45
41.84
30.30
D
D
O
NH
CH3
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

F. X-ray Crystallographic Data

Single-crystal X-ray diffraction data for **3ac** were collected on a Rigaku Mercury CCD diffractometer operated at 90 kV and 50 mA using MoKα radiation (λ = 0.71073 Å) at the temperature 100.00(10)K. All empirical absorption corrections were performed using the CrystalClear program. The structure was solved by a direct method and refined on F^2 by the full-matrix least squares technique using the SHELXTL-97 program package. All non-hydrogen atoms were refined with anisotropic displacement parameters. Hydrogen atoms attached to carbon were placed in geometrically idealized positions and refined using a riding model. Crystallographic data for compound **3ac** is given in Table S1. Metrical parameters for the structures of **3ac** are available free of charge from the Cambridge Crystallographic Data Centre under accession numbers CCDC- 1559763, respectively.

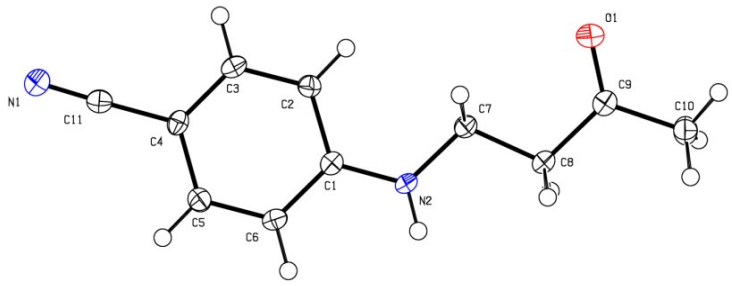


Figure S1. X-ray crystal structure of compound **3ca**

Table S1. Crystal data and structure refinements for **3ac**

Compound	**3ac**
Empirical formula	$C_{11}H_{12}N_2O_2$
Formula weight	188.23
Temperature (K)	100.00(10)
Wavelength (Å)	0.71073
Crystal system	triclinic
Space group	P_{-1}
	a = 6.2899(4)Å α = 85.248(6)°
	b = 7.1826(5)Å β = 82.608(6) °
	c = 11.47223(8)Å γ = 72.427(6)°
Volume (Å^3)	489.46(6)
Z	2
Density (calcd g cm^{-3})	1.277
Absorption coeff. (mm^{-1})	0.084
F(000)	200
Crystal size (mm)	0.18 × 0.14 × 0.11
Crystal color and shape	Orange block
θ range for data collection	3.404 to 29.539 deg.
Limiting indices	-8≤ h ≤ 6, -9 ≤ k ≤ 9, -14≤ l ≤ 14
Reflections collected	4215
Unique	2259 [$R_{(int)}$ = 0.0202]
Refinement method	Full-matrix least-squares on F^2
Data/restraints/parameters	2259 / 0 / 128
Goodness-of-fit on F^2	1.036
Final R indexes [$I>=2\sigma\ (I)$]	R_1 = 0.0502, wR_2 = 0.1164
R indexes (all data)	R_1 = 0.0674, wR_2 = 0.1294