HCO_2H-Catalyzed Hydrolysis of 2-Chloroquinolines to Quinolones

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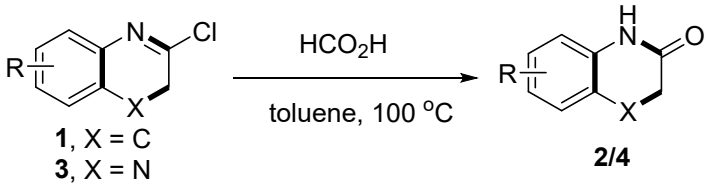
A. General Methods

Unless otherwise stated, all reactions were magnetically stirred and conducted under air and applied dried Schlenk tubes under confined conditions. All solvents and reagents were used as received from commercial suppliers unless otherwise indicated. Column chromatography was carried out using silica gel (100-400 mesh) and detected at 254 nm. All ^{1}H NMR, ^{13}C NMR, ^{19}F NMR spectra for compound characterization were recorded on a Bruker AVANCE-NEO 400 WB spectrometer in a suitable deuterated solvent unless specified otherwise. Chemical shifts were given in parts per million (ppm, δ), referenced to the solvent peak of $CDCl_3$, defined at δ = 7.26 (^{1}H NMR), defined at δ = 77.16 (^{13}C NMR), referenced to the solvent peak of DMSO-d_6, defined at δ = 2.50 (^{1}H NMR), defined at δ = 39.99 (^{13}C NMR). Coupling constants were quoted in Hz (J). ^{1}H NMR spectroscopy splitting patterns were designated as singlet (s), doublet (d), triplet (t), and quartet (q). HRMS was performed on a high-resolution mass spectrometer (LCMS-IT-TOF). Melt points were measured with WRR melting point apparatus.

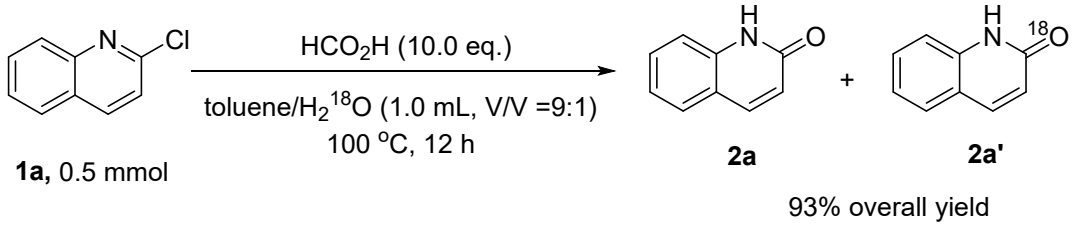
B. Procedure for for HCO_2H-Catalyzed Hydrolysis of 2-chloroquinolines

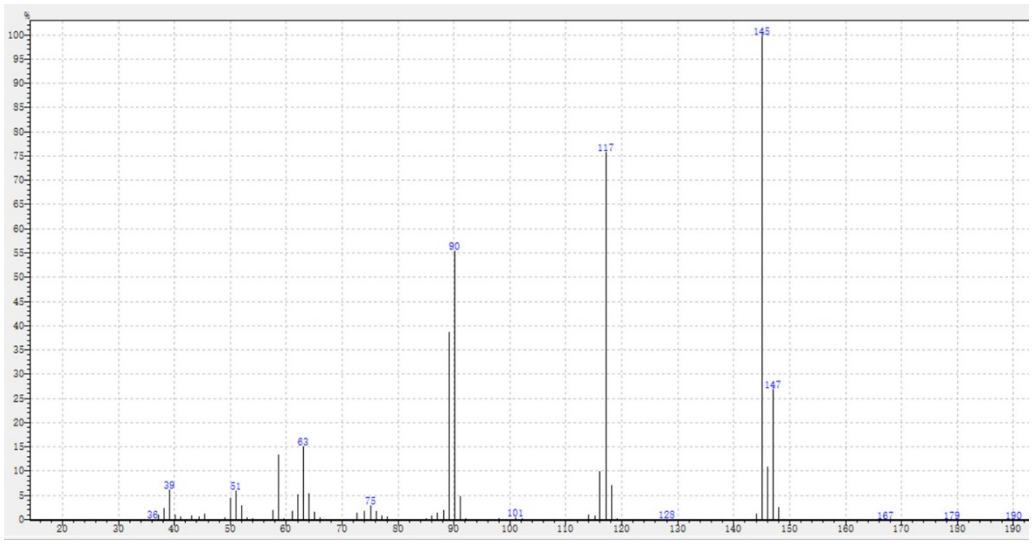


In the Schlenk tube, **1/3** (0.5 mmol), HCO_2H (5.0 mmol, 10 equivalent), and toluene (1.0 mL) were added. The mixture was stirred at 100 °C for 12 h under confined conditions. After the reaction was completed, the mixture was diluted with EtOAc (5.0 mL) carefully quenched with 5.0 mL of saturated $NaHCO_3$ solution. To determine the separation yield of product, the mixture was extracted with EtOAc (10.0 mL* 3 times), the organic layers were combined, washed with saturated NaCl. and dried with anhydrous $MgSO_4$. After removal of the EtOAc under vacuum, the crude product was purified by column chromatography on silica gel with hexanes or petroleum ether/ethyl acetate to give the desired products **2**/**4**.

C. Control experiment

Control experiment was conducted to gain more detail of this process. As showcased in Scheme S1, the corresponding product **2a** and desired ^{18}O product **2a'** were detected by GC-MS and afforded in 93% overall isolated yield.

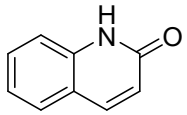




Scheme S1 Using mixed solvent of toluene and $H_2{}^{18}O$ as reaction media

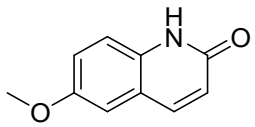
D. Analytical Data

quinolin-2(1*H*)-one (2a)[1]



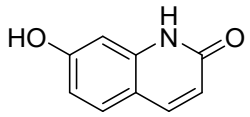
Yield: 70.3 mg (97%), white solid (mp: 197-199 °C). ^{1}H NMR (400 MHz, DMSO-d6) δ 11.80 (s, 1H), 7.87 (d, J = 9.5 Hz, 1H), 7.62 (dd, J = 7.8, 1.5 Hz, 1H), 7.52-7.43 (m, 1H), 7.32 (d, J = 8.2 Hz, 1H), 7.19-7.10 (m, 1H), 6.51 (d, J = 9.5 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d6) δ 162.5, 140.7, 139.3, 130.8, 128.3, 122.3, 122.2, 119.6, 115.6.

6-methoxyquinolin-2(1*H*)-one (2b)[2]



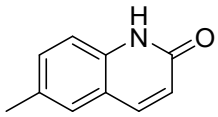
Yield: 63.8 mg (73%), white solid (mp: 218-219 °C). ^{1}H NMR (400 MHz, DMSO-d6) δ 11.69 (s, 1H), 7.86 (d, J = 9.5 Hz, 1H), 7.26 (d, J = 8.9 Hz, 1H), 7.22 (d, J = 2.6 Hz, 1H), 7.16 (dt, J = 8.8, 2.3 Hz, 1H), 6.51 (d, J = 9.5 Hz, 1H), 3.79 (s, 3H). ^{13}C NMR (100 MHz, DMSO-d6) δ 161.6, 154.1, 139.8, 133.3, 122.3, 119.7, 119.6, 116.4, 109.3, 55.4.

7-hydroxyquinolin-2(1*H*)-one (2c)[3]



Yield: 41.9 mg (52%), white solid (mp: 235-236 °C). ^{1}H NMR (400 MHz, DMSO-d6) δ 11.52 (s, 1H), 10.13 (s, 1H), 7.74 (d, J = 9.4 Hz, 1H), 7.45 (d, J = 8.5 Hz, 1H), 6.70 (d, J = 2.4 Hz, 1H), 6.63 (dd, J = 8.6, 2.3 Hz, 1H), 6.22 (d, J = 9.5 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d6) δ 162.8, 160.1, 141.3, 140.6, 129.8, 117.9, 112.9, 112.0, 100.3.

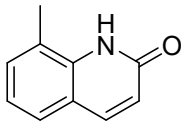
6-methylquinolin-2(1*H*)-one (2d)[4]



Yield: 71.5 mg (90%), white solid (mp: 239-241 °C). ^{1}H NMR (400 MHz, DMSO-d6) δ 11.71 (s, 1H), 7.83 (d, J = 9.5 Hz, 1H), 7.44 (s, 1H), 7.33 (dd, J = 8.3, 2.0 Hz, 1H),

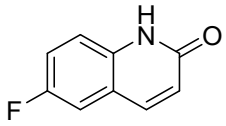
7.22 (d, *J* = 8.3 Hz, 1H), 6.48 (d, *J* = 9.5 Hz, 1H), 2.34 (s, 3H). ^{13}C NMR (100 MHz, DMSO-d6) *δ* 161.9, 140.0, 136.9, 131.6, 130.7, 127.4, 121.9, 119.1, 115.1, 20.4.

8-methylquinolin-2(1*H*)-one (2e)[5]



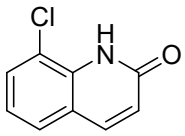
Yield: 69.2 mg (87%), white solid (mp: 218-219 °C). ^{1}H NMR (400 MHz, DMSO-d6) *δ* 10.93 (s, 1H), 7.88 (d, *J* = 9.8 Hz, 1H), 7.48 (d, *J* = 7.8 Hz, 1H), 7.33 (d, *J* = 7.2 Hz, 1H), 7.07 (t, *J* = 7.5 Hz, 1H), 6.51 (d, *J* = 9.5 Hz, 1H), 2.41 (s, 3H). ^{13}C NMR (100MHz, DMSO-d6) *δ* 163.0, 141.5, 137.6, 132.1, 126.5, 123.9, 122.1, 121.9, 119.6, 17.6.

6-fluoroquinolin-2(1*H*)-one (2f)[6]



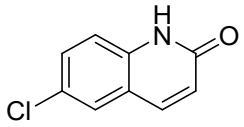
Yield: 69.3 mg (85%), white solid (mp: 276-277 °C). ^{1}H NMR (400 MHz, DMSO-d6) *δ* 11.84 (s, 1H), 7.89 (d, *J* = 9.6 Hz, 1H), 7.54 (dd, *J* = 9.2, 2.8 Hz, 1H), 7.41 (td, *J* = 8.8, 2.9 Hz, 1H), 7.33 (dd, *J* = 9.0, 4.9 Hz, 1H), 6.58 (d, *J* = 9.5 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d6) *δ* 162.1, 139.9, 136.1, 123.7, 120.3, 120.1, 118.9, 118.7, 117.4, 117.3, 113.2, 113.0. ^{19}F NMR (377 MHz, DMSO-d6) *δ* -121.4.

8-chloroquinolin-2(1*H*)-one (2g)[6]



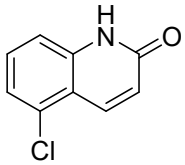
Yield: 63.5 mg (71%), yellow solid (mp: 207-208 °C). ^{1}H NMR (400 MHz, DMSO-d6) *δ* 11.06 (s, 1H), 7.98 (d, *J* = 9.5 Hz, 1H), 7.67 (t, *J* = 7.3 Hz, 2H), 7.21 (t, *J* = 7.8 Hz, 1H), 6.62 (d, *J* = 9.5 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d6) *δ* 162.4, 140.8, 135.7, 131.0, 127.7, 123.4, 123.0, 121.3, 118.9.

6-chloroquinolin-2(1*H*)-one (2h)[6]



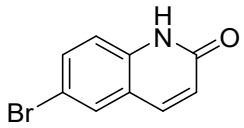
Yield: 83.2 mg (93%), white solid (mp: 266-267 °C). ^{1}H NMR (400 MHz, DMSO-d6) δ 11.91 (s, 1H), 7.86 (dd, J = 9.9, 4.5 Hz, 1H), 7.73 (q, J = 2.5 Hz, 1H), 7.50 (dq, J = 8.3, 2.5 Hz, 1H), 7.29 (dd, J = 8.9, 4.6 Hz, 1H), 6.55 (dd, J = 9.7, 4.6 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d6) δ 162.0, 139.5, 137.7, 130.4, 127.1, 125.9, 123.2, 120.5, 117.2.

5-chloroquinolin-2(1*H*)-one (2i)[7]



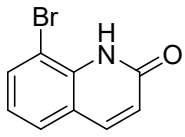
Yield: 73.4 mg (82%), white solid (mp: >280 °C). ^{1}H NMR (400 MHz, DMSO-d6) δ 12.04 (s, 1H), 8.07 (d, J = 9.9 Hz, 1H), 7.50 (t, J = 8.1 Hz, 1H), 7.31 (d, J = 7.3 Hz, 2H), 6.65 (d, J = 9.8 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d6) δ 162.0, 140.8, 136.0, 131.6, 131.5, 123.9, 122.7, 116.9, 115.1.

6-bromoquinolin-2(1*H*)-one (2j)[6]



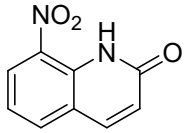
Yield: 101.5 mg (91%), white solid (mp: 274-275 °C). ^{1}H NMR (400 MHz, DMSO-d6) δ 11.90 (s, 1H), 7.93 (d, J = 2.4 Hz, 1H), 7.89 (d, J = 9.5 Hz, 1H), 7.65 (dd, J = 8.8, 2.3 Hz, 1H), 7.27 (d, J = 8.8 Hz, 1H), 6.57 (d, J = 9.6 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d6) δ 162.1, 139.6, 138.4, 133.3, 130.3, 123.6, 121.3, 117.7, 113.8.

8-bromoquinolin-2(1*H*)-one (2k)[8]



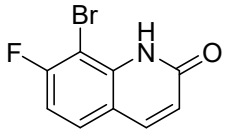
Yield: 109.3 mg (98%), white solid (mp: 184-185 °C). ^{1}H NMR (400 MHz, DMSO-d6) δ 10.50 (s, 1H), 7.92 (d, J = 9.5 Hz, 1H), 7.72 (dd, J = 38.7, 7.8 Hz, 2H), 7.12 (t, J = 7.9 Hz, 1H), 6.59 (d, J = 9.5 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d6) δ 162.4, 141.0, 136.6, 134.3, 128.4, 123.6, 123.1, 121.4, 108.6.

8-nitroquinolin-2(1*H*)-one (2l)[9]



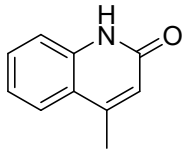
Yield: 90.3 mg (95%), yellow solid (mp: 165-166 °C). ^{1}H NMR (400 MHz, DMSO-d6) δ 11.02 (s, 1H), 8.41 (dd, J = 8.3, 1.4 Hz, 1H), 8.15 (dd, J = 7.7, 1.4 Hz, 1H), 8.11 (d, J = 9.7 Hz, 1H), 7.40 (t, J = 8.0 Hz, 1H), 6.72 (d, J = 9.7 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d6) δ 161.2, 141.1, 136.4, 133.7, 133.3, 128.0, 123.1, 122.0, 121.9.

8-bromo-7-fluoroquinolin-2(1*H*)-one (2m)[10]



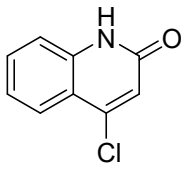
Yield: 109.7mg (91%), yellow solid (mp: 188-189 °C). ^{1}H NMR (400 MHz, DMSO-d6) δ 10.82 (s, 1H), 7.97 (d, J = 9.5 Hz, 1H), 7.79 (dd, J = 8.7, 5.9 Hz, 1H), 7.24 (t, J = 8.6 Hz, 1H), 6.59 (d, J = 9.5 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d6) δ 162.5, 161.3, 158.9, 140.6, 138.7, 129.9, 129.8, 121.8, 117.9, 111.0, 110.8. ^{19}F NMR (377 MHz, DMSO-d6) δ -101.9.

4-methylquinolin-2(1*H*)-one (2n)[6]



Yield: 73.1 mg (92%), white solid (mp: 224-225 °C). ^{1}H NMR (400 MHz, DMSO-d6) δ 11.67 (s, 1H), 7.72 (d, J = 8.1 Hz, 1H), 7.52 (ddd, J = 8.3, 7.1, 1.4 Hz, 1H), 7.35 (d, J = 7.1 Hz, 1H), 7.22 (t, J = 7.6 Hz, 1H), 6.43 (s, 1H), 2.44 (s, 3H). ^{13}C NMR (100 MHz, DMSO-d6) δ 161.9, 148.3, 138.7, 130.5, 124.9, 121.9, 120.9, 119.8, 115.6, 18.6.

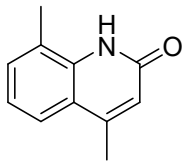
4-chloroquinolin-2(1*H*)-one (2o)[2]



Yield: 82.3 mg (92%), white solid (mp:253-254 °C). ^{1}H NMR (400 MHz, DMSO-d6) δ 12.04 (s, 1H), 7.81 (d, J = 8.0 Hz, 1H), 7.60 (t, J = 7.8 Hz, 1H), 7.37 (d, J = 8.3 Hz,

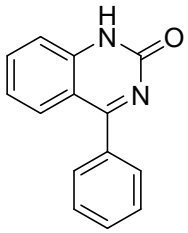
1H), 7.27 (t, *J* = 7.7 Hz, 1H), 6.80 (s, 1H). ^{13}C NMR (100 MHz, DMSO-d6) δ 161.0, 144.5, 139.0, 132.4, 125.0, 123.1, 121.7, 117.6, 116.2.

4,8-dimethylquinolin-2(1*H*)-one (2p)



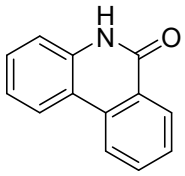
Yield: 77.9 mg (90%), white solid (mp: 221-222 ^{o}C). ^{1}H NMR (400 MHz, DMSO-d6) δ 10.73 (s, 1H), 7.57 (d, *J* = 7.4 Hz, 1H), 7.36 (d, *J* = 7.2 Hz, 1H), 7.12 (t, *J* = 7.7 Hz, 1H), 6.43 (s, 1H), 2.43 (s, 6H). ^{13}C NMR (100 MHz, DMSO-d6) δ 162.0, 148.4, 137.0, 131.6, 123.6, 122.7, 121.4, 120.7, 119.7, 18.9, 17.5.

4-phenylquinazolin-2(1*H*)-one (2q)[11]



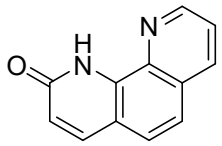
Yield: 54.4 mg (49%), yellow solid (mp: 255-256 ^{o}C). ^{1}H NMR (400 MHz, DMSO-d6) δ 12.01 (s, 1H), 7.76 (t, *J* = 7.8 Hz, 1H), 7.69 (dd, *J* = 7.6, 2.0 Hz, 2H), 7.66 (d, *J* = 8.1 Hz, 1H), 7.64-7.56 (m, 3H), 7.41 (d, *J* = 8.3 Hz, 1H), 7.23 (t, *J* = 7.6 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d6) δ 175.5, 155.4, 143.8, 136.9, 135.6, 130.8, 129.6, 128.9, 128.8, 122.8, 116.0, 114.6.

phenanthridin-6(5*H*)-one (2r)[12]



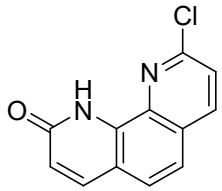
Yield: 89.7 mg (92%), white solid (mp: >280 ^{o}C). ^{1}H NMR (400 MHz, DMSO-d6) δ 11.72 (s, 1H), 8.41 (d, *J* = 8.2 Hz, 1H), 8.35 (d, *J* = 8.0 Hz, 1H), 8.30 (d, *J* = 8.1 Hz, 1H), 7.79 (t, *J* = 7.6 Hz, 1H), 7.61 (t, *J* = 7.5 Hz, 1H), 7.46 (t, *J* = 7.6 Hz, 1H), 7.39 (d, *J* = 8.1 Hz, 1H), 7.21 (t, *J* = 7.6 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d6) δ 161.3, 137.0, 134.7, 133.2, 130.0, 128.3, 127.9, 126.2, 123.6, 123.0, 122.7, 118.0, 116.6.

1,10-phenanthrolin-2(1*H*)-one (2s)[13]



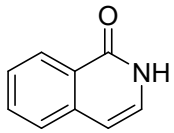
Yield: 83.3 mg (85%), white solid (mp: 156-157 °C). ^{1}H NMR (400 MHz, DMSO-d6) δ 11.13 (s, 1H), 8.88 (dd, J = 4.3, 1.7 Hz, 1H), 8.34 (dd, J = 8.3, 1.6 Hz, 1H), 8.01 (d, J = 9.5 Hz, 1H), 7.68 (d, J = 8.6 Hz, 1H), 7.63 (dd, J = 8.3, 4.2 Hz, 1H), 7.56 (d, J = 8.6 Hz, 1H), 6.69 (d, J = 9.4 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d6) δ 161.6, 149.9, 141.0, 136.8, 136.3, 135.5, 128.5, 126.0, 123.8, 123.6, 121.2, 117.4.

9-chloro-1,10-phenanthrolin-2(1*H*)-one (2t)[14]



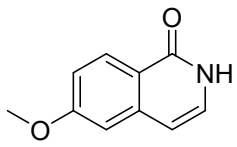
Yield: 102.4 mg (89%), white solid (mp: 265-266 °C). ^{1}H NMR (400 MHz, DMSO-d6) δ 11.04 (s, 1H), 8.47 (d, J = 8.6 Hz, 1H), 8.08 (d, J = 9.5 Hz, 1H), 7.81 (d, J = 8.6 Hz, 1H), 7.70 (dd, J = 12.4, 8.6 Hz, 2H), 6.75 (d, J = 9.5 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d6) δ 149.7, 140.8, 140.6, 136.0, 134.7, 127.4, 126.7, 124.7, 124.4, 121.0, 118.5.

isoquinolin-1(2*H*)-one (4a)[15]



Yield: 67.4 mg (93%), white solid (mp: 209-211 °C). ^{1}H NMR (400 MHz, DMSO-d6) δ 11.28 (s, 1H), 8.19 (d, J = 6.9 Hz, 1H), 7.73-7.60 (m, 2H), 7.47 (ddd, J = 8.2, 6.7, 1.5 Hz, 1H), 7.17 (d, J = 7.1 Hz, 1H), 6.55 (d, J = 7.1 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d6) δ 162.4, 138.4, 132.8, 129.4, 127.1, 126.8, 126.7, 126.5, 105.2, 39.9.

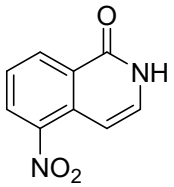
6-methoxyisoquinolin-1(2*H*)-one (4b)[16]



Yield: 80.5 mg (92%), white solid (mp: 181-182 °C). ^{1}H NMR (400 MHz, DMSO-d6) δ 11.13 (s, 1H), 8.11 (d, J = 8.8 Hz, 1H), 7.15 (d, J = 7.2 Hz, 1H), 7.08 (d, J = 2.6 Hz,

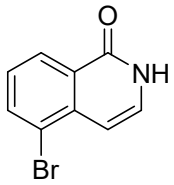
1H), 7.03 (dd, *J* = 8.8, 2.5 Hz, 1H), 6.47 (d, *J* = 7.2 Hz, 1H), 3.84 (s, 3H). ^{13}C NMR (100 MHz, DMSO-d6) *δ* 162.7, 162.1, 140.5, 129.9, 129.2, 120.3, 116.2, 107.5, 105.1, 55.8.

5-nitroisoquinolin-1(2*H*)-one (4c)[17]



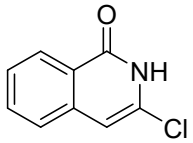
Yield: 88.4 mg (93%), yellow solid (mp: 221-222 °C). ^{1}H NMR (400 MHz, DMSO-d6) *δ* 11.76 (s, 1H), 8.53 (d, *J* = 7.0 Hz, 1H), 8.40 (d, *J* = 6.7 Hz, 1H), 7.62 (t, *J* = 8.0 Hz, 1H), 7.41 (dd, *J* = 7.8, 4.1 Hz, 1H), 6.94 (d, *J* = 7.6 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d6) *δ* 160.5, 144.5, 133.3, 133.3, 131.1, 129.5, 127.8, 125.8, 98.7.

5-bromoisoquinolin-1(2*H*)-one (4d)[15]



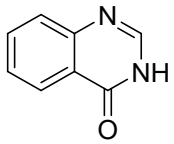
Yield: 211.9 mg (95%), white solid (mp: 240-241 °C). ^{1}H NMR (400 MHz, DMSO-d6) *δ* 11.55 (s, 1H), 8.22 (dd, *J* = 8.0, 1.0 Hz, 1H), 8.03 (dd, *J* = 7.7, 1.2 Hz, 1H), 7.41 (t, *J* = 7.9 Hz, 1H), 7.34 (dd, *J* = 7.4, 5.4 Hz, 1H), 6.67 (d, *J* = 7.4 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d6) *δ* 161.6, 137.2, 136.5, 131.3, 128.1, 127.8, 127.2, 120.4, 103.2.

3-chloroisoquinolin-1(1*H*)-one (4e)[18]



Yield: 40.3 mg (45%), white solid (mp: 216-217 °C). ^{1}H NMR (400 MHz, DMSO-d6) *δ* 12.34 (s, 1H), 8.20 (d, *J* = 8.0 Hz, 1H), 7.74 (ddd, *J* = 8.3, 7.1, 1.4 Hz, 1H), 7.64 (d, *J* = 6.9 Hz, 1H), 7.53 (ddd, *J* = 8.2, 7.0, 1.3 Hz, 1H), 6.77 (s, 1H). ^{13}C NMR (100 MHz, DMSO-d6) *δ* 162.7, 137.9, 133.4, 129.6, 127.2, 127.1, 126.3, 124.6, 104.5.

quinazolin-4(3*H*)-one (4f)[19]



Yield: 67.9 mg (93%), white solid (mp: 216-217 ^{o}C). ^{1}H NMR (400 MHz, DMSO-d6) δ 12.32 (s, 1H), 8.25-8.08 (m, 2H), 7.85 (t, J = 7.6 Hz, 1H), 7.71 (d, J = 8.1 Hz, 1H), 7.56 (t, J = 7.5 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d6) δ 160.9, 148.8, 145.5, 134.4, 127.3, 126.9, 125.9, 122.7.

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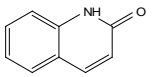
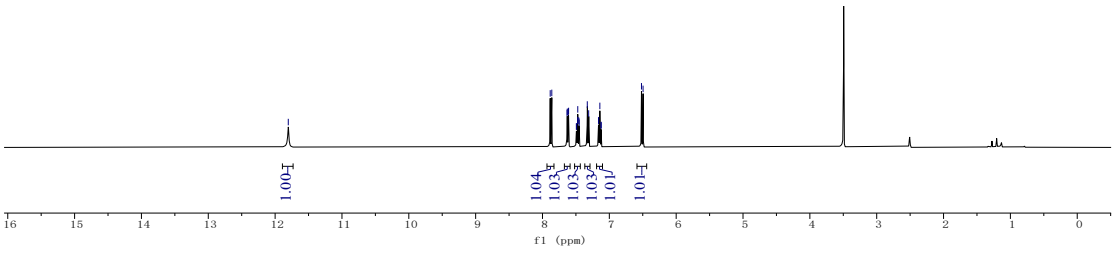
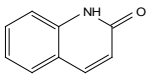
F. NMR Spectrum

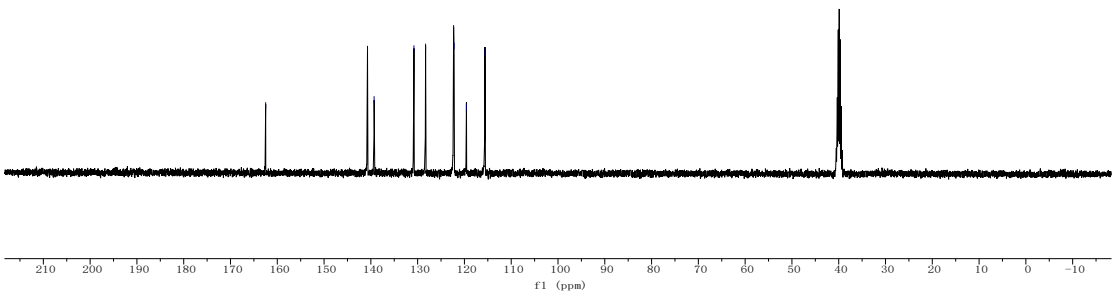
^{1}H NMR Spectra of quinolin-2(1*H*)-one (2a)



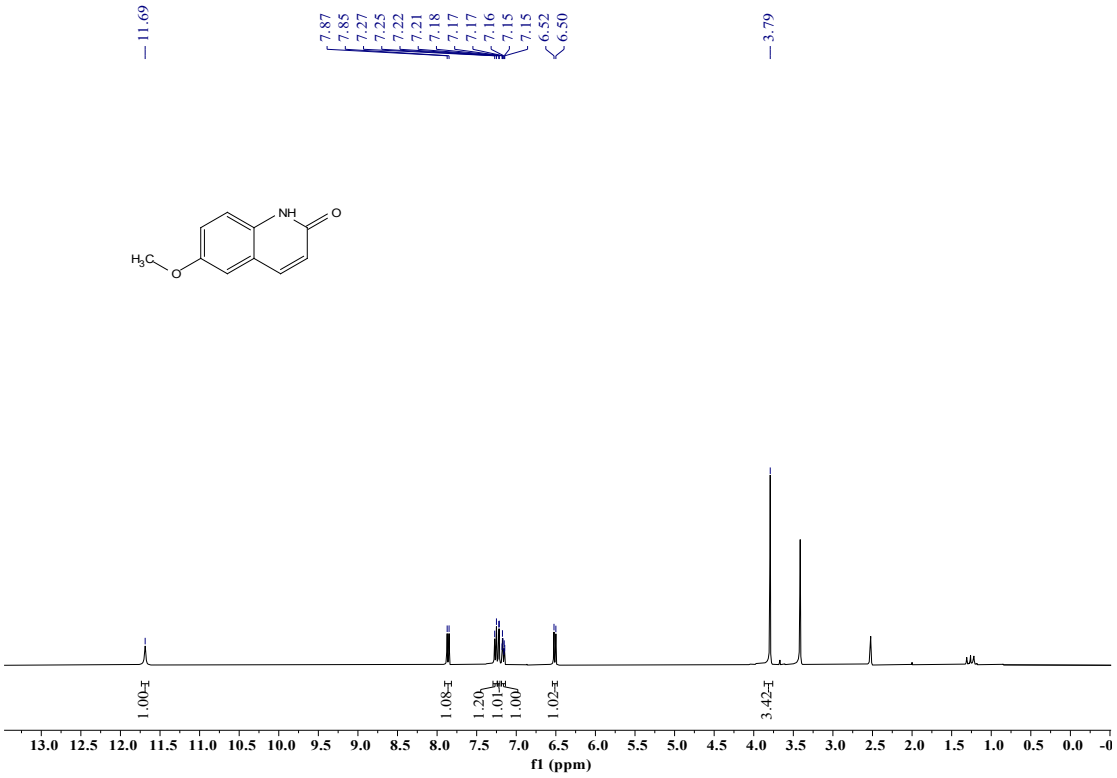


^{13}C NMR Spectra of quinolin-2(1*H*)-one (2a)

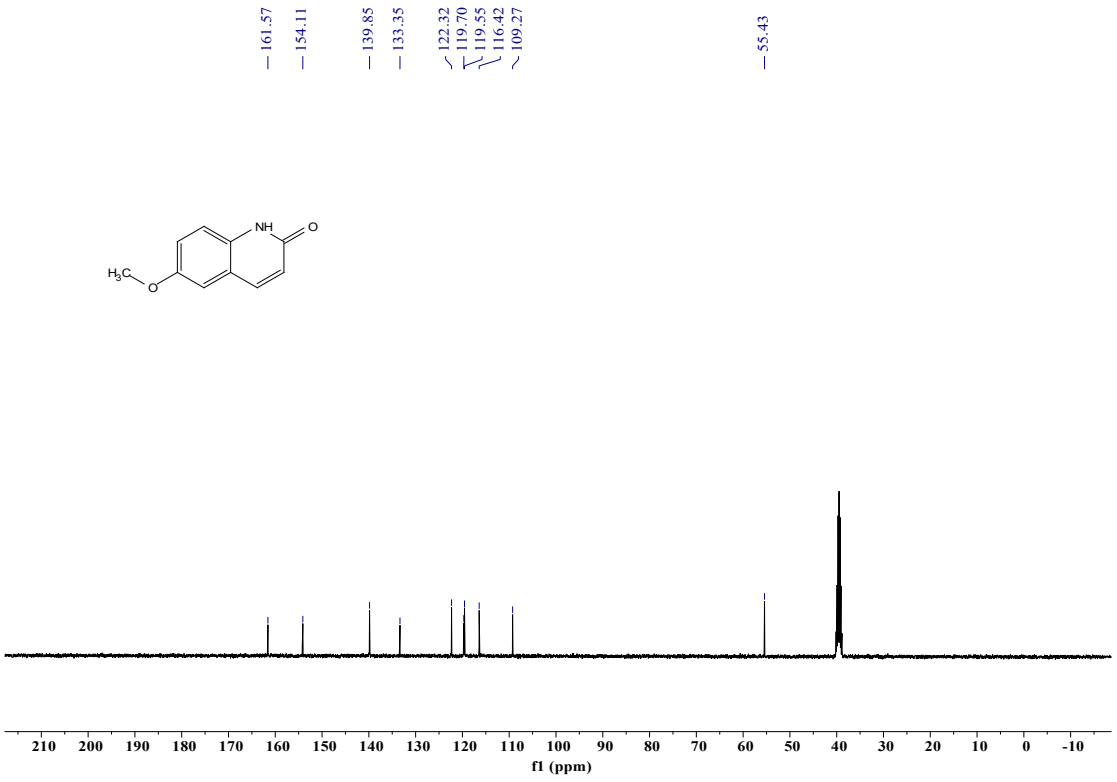




^{1}H NMR Spectra of 6-methoxyquinolin-2(1*H*)-one (2b)



^{13}C NMR Spectra of 6-methoxyquinolin-2(1*H*)-one (2b)



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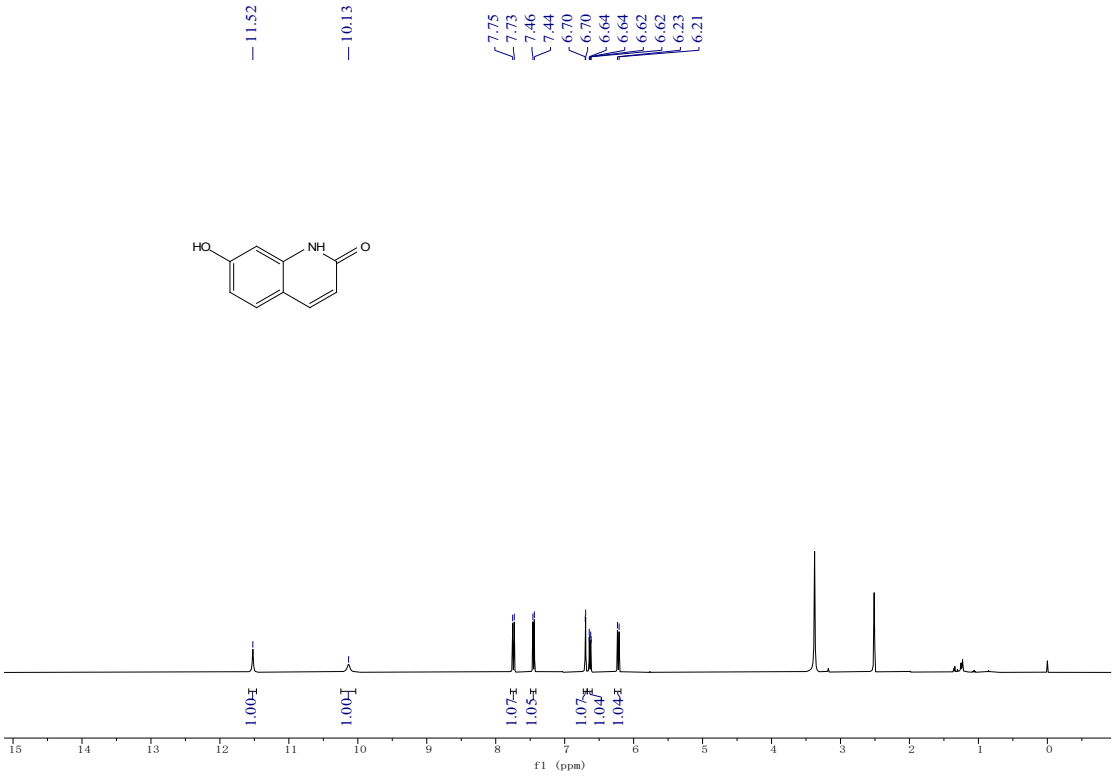

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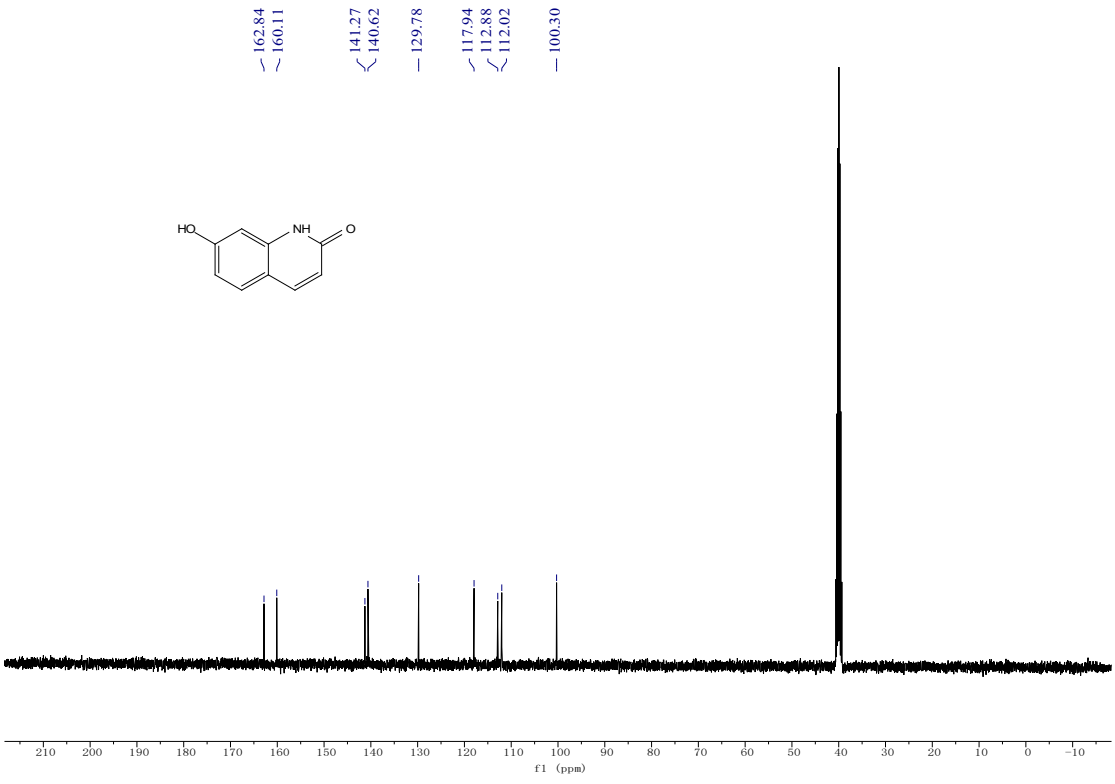
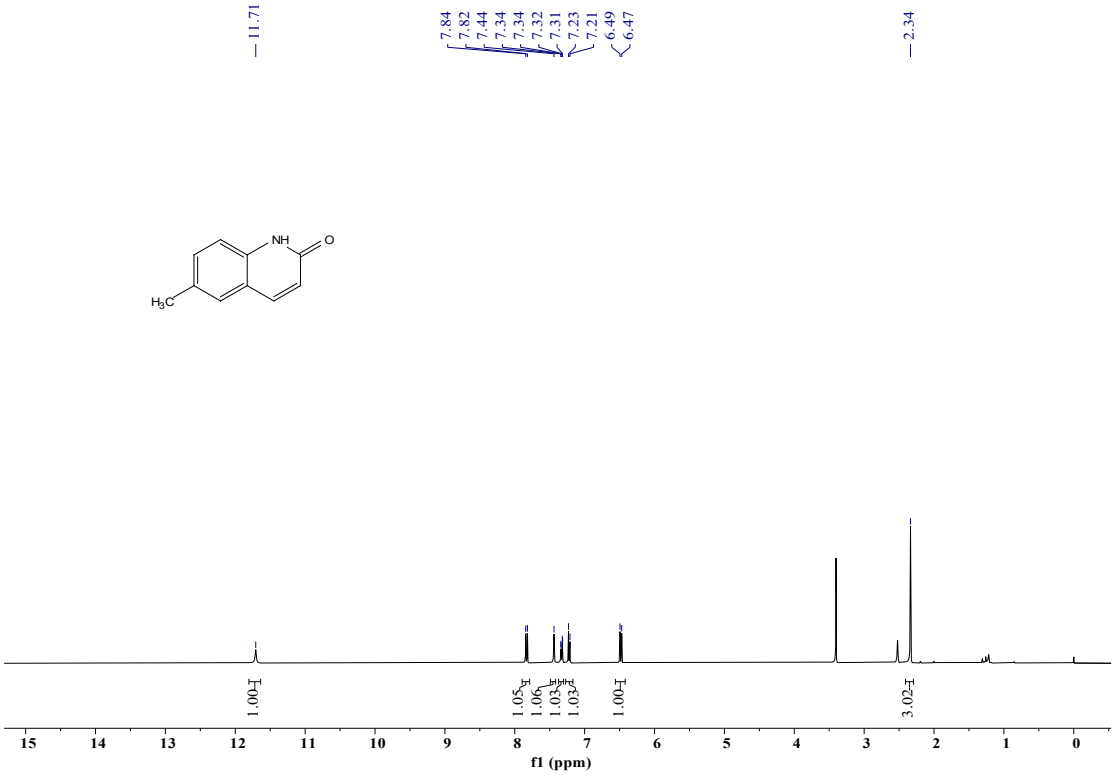


^{1}H NMR Spectra of 6-methylquinolin-2(1*H*)-one (2d)



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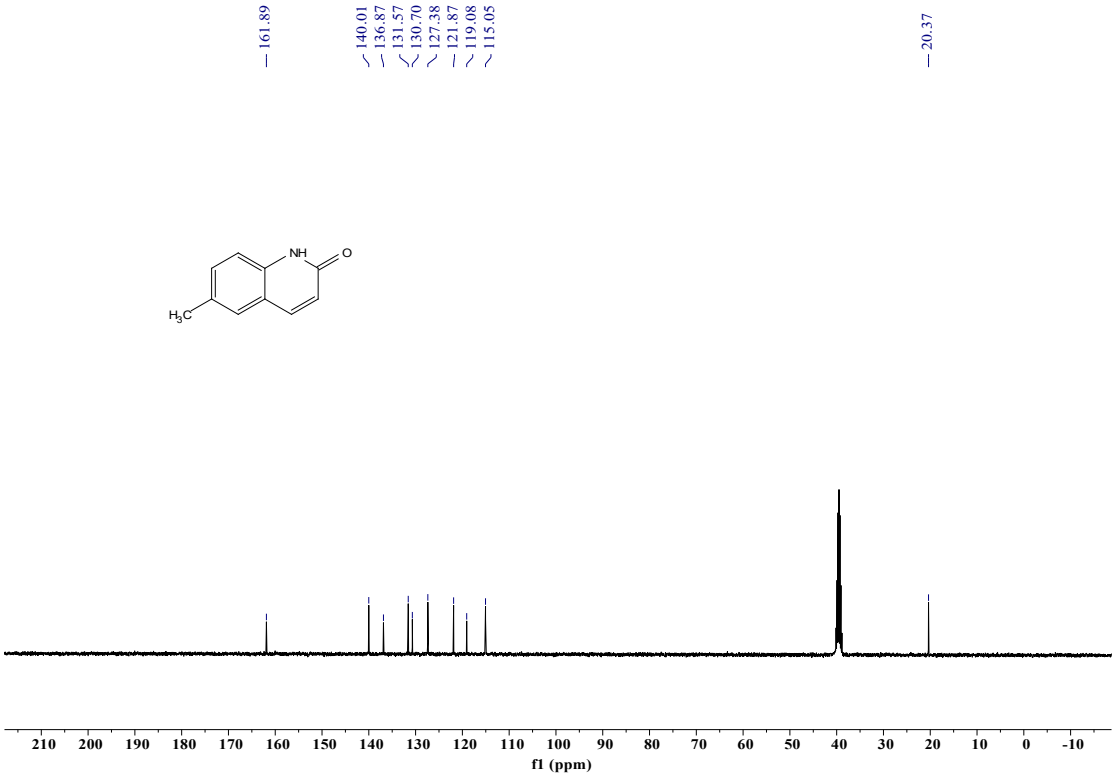

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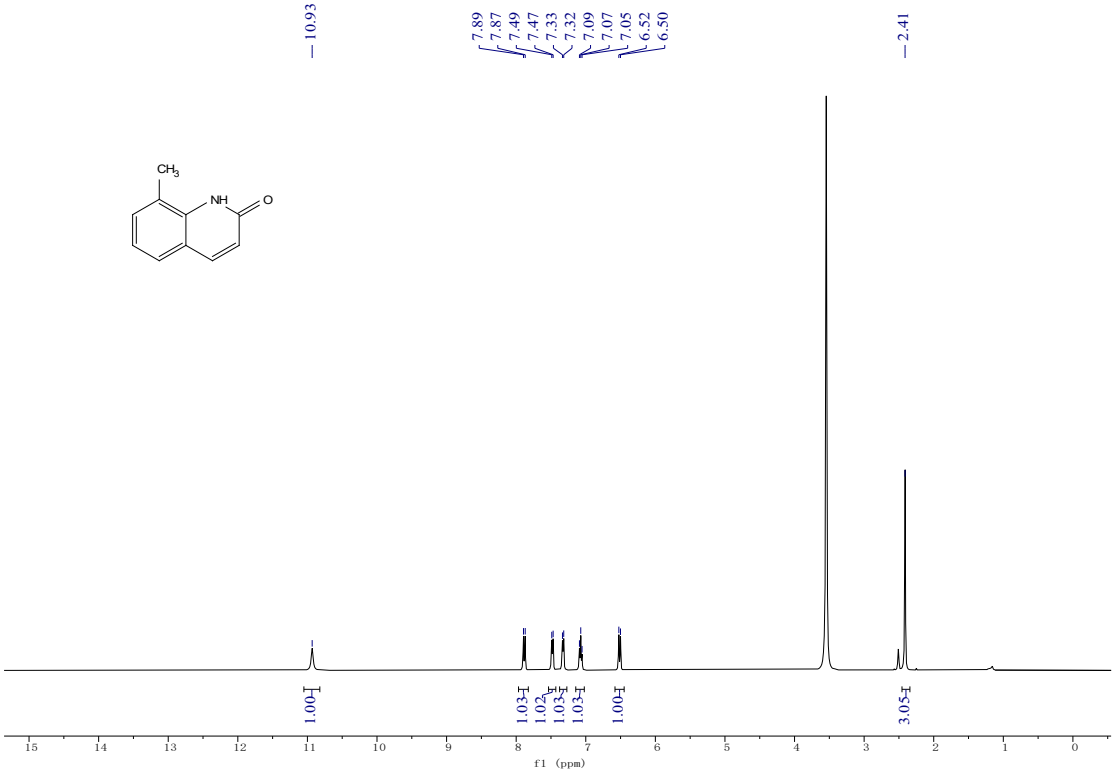

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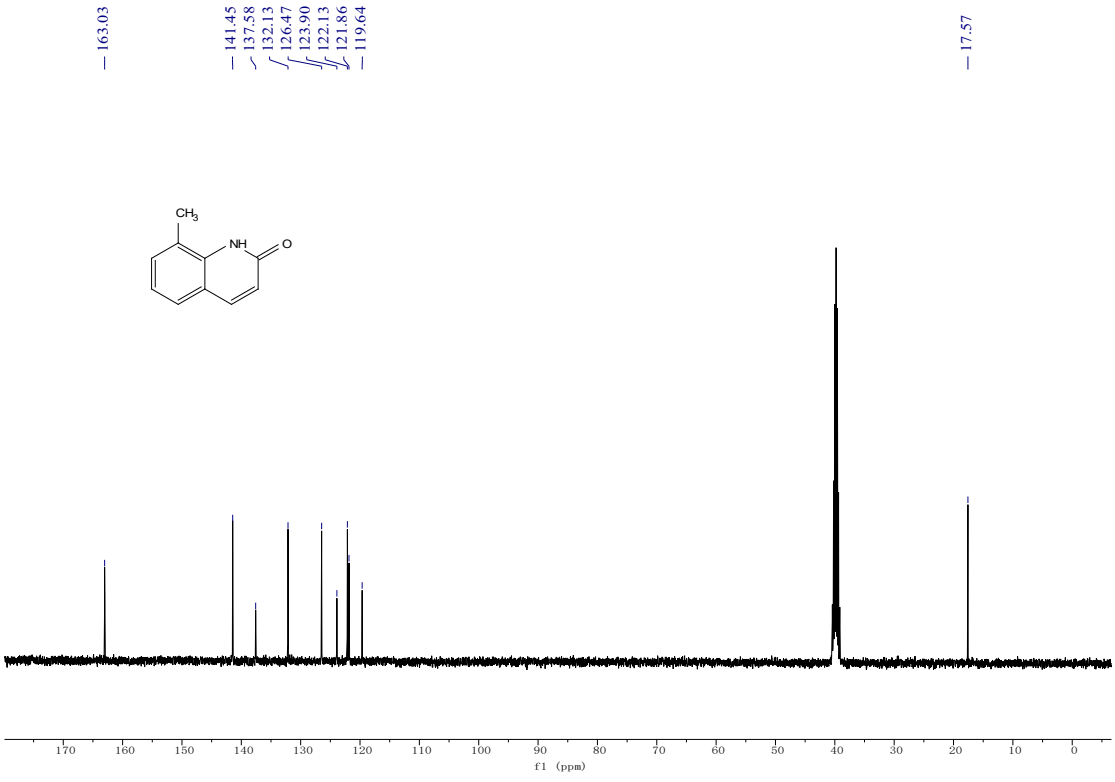
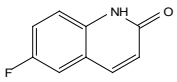
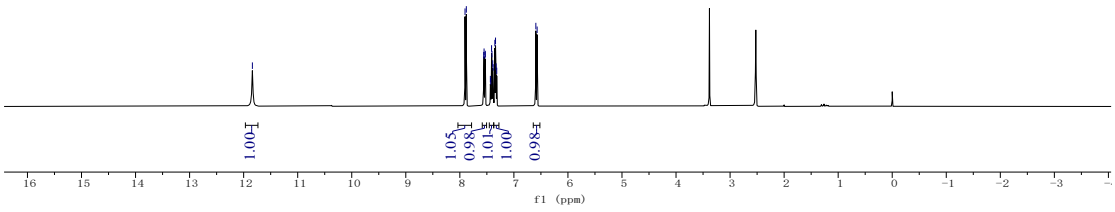


^{1}H NMR Spectra of 6-fluoroquinolin-2(1*H*)-one (2f)





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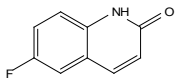
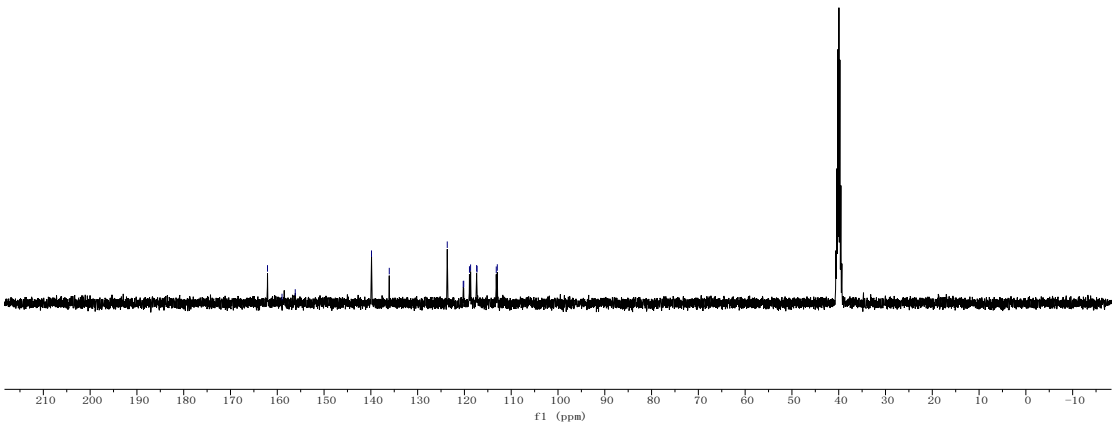
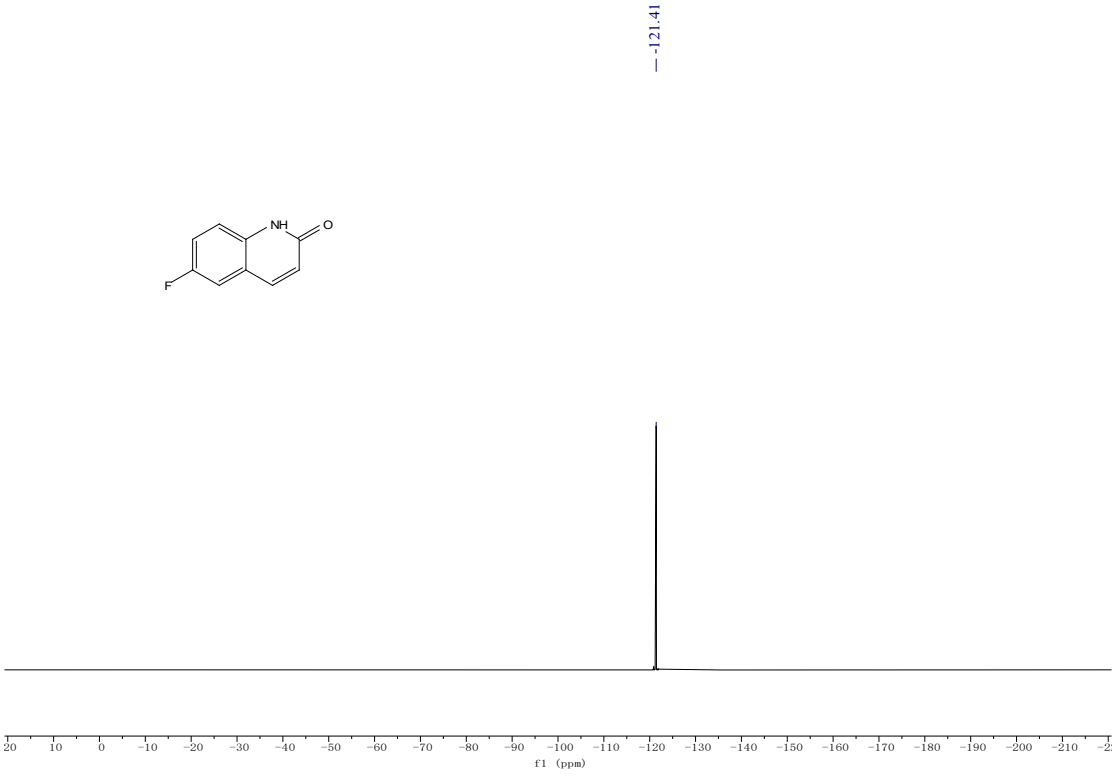
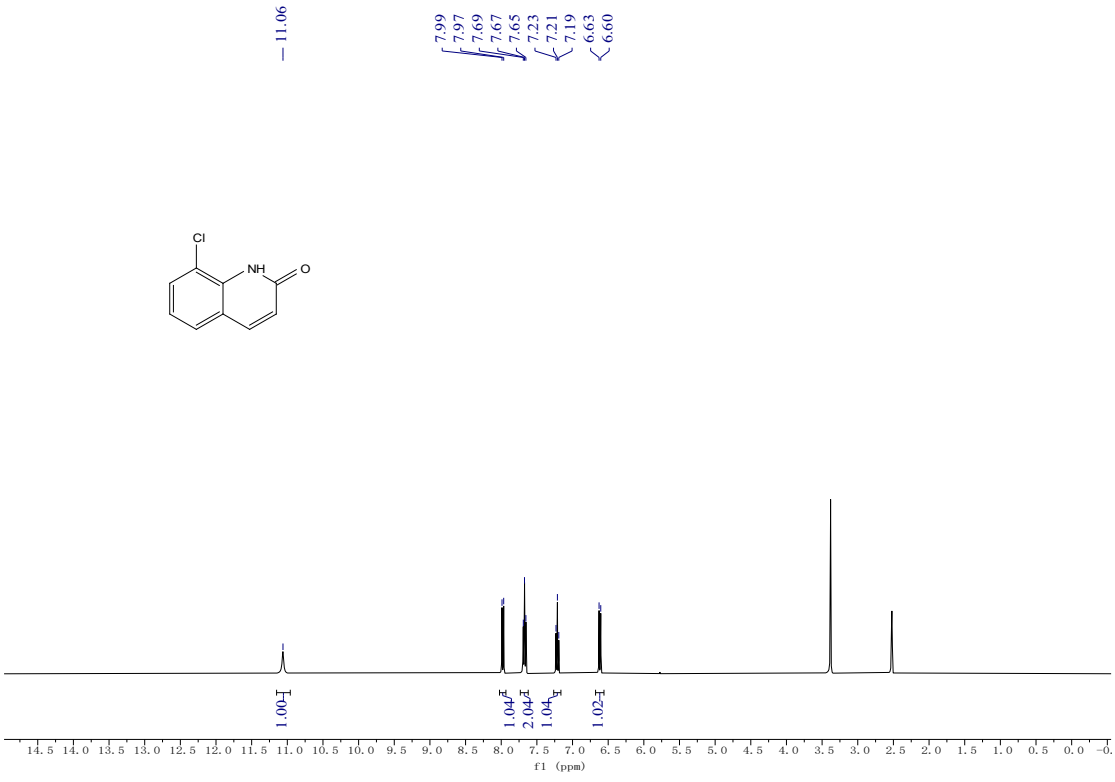




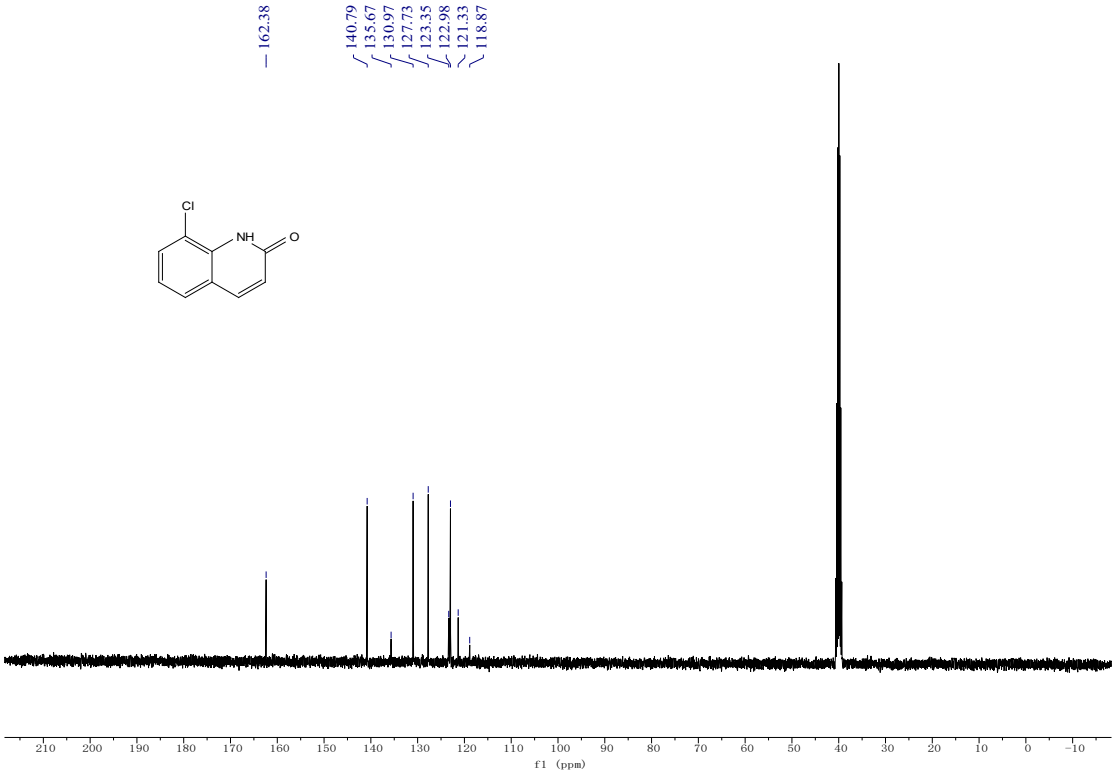
^{19}F NMR Spectra of 6-fluoroquinolin-2(1*H*)-one (2f)



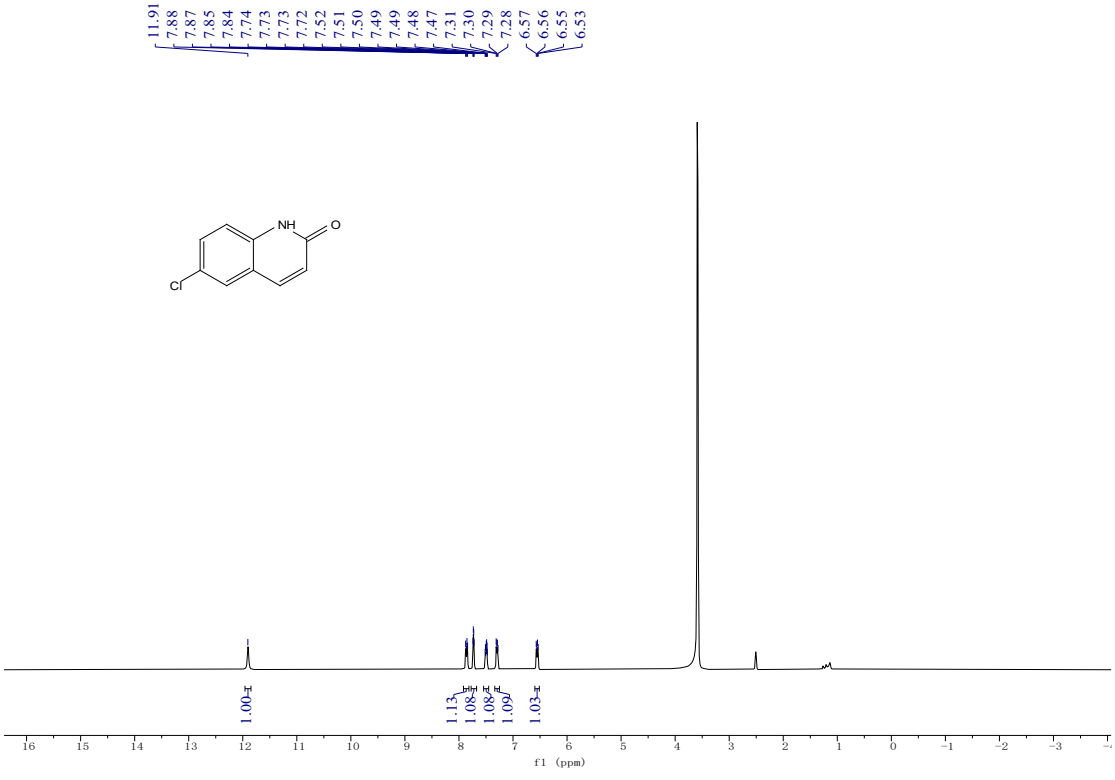
^{1}H NMR Spectra of 8-chloroquinolin-2(1*H*)-one (2g)



^{13}C NMR Spectra of 8-chloroquinolin-2(1*H*)-one (2g)



^{1}H NMR Spectra of 6-chloroquinolin-2(1*H*)-one (2h)



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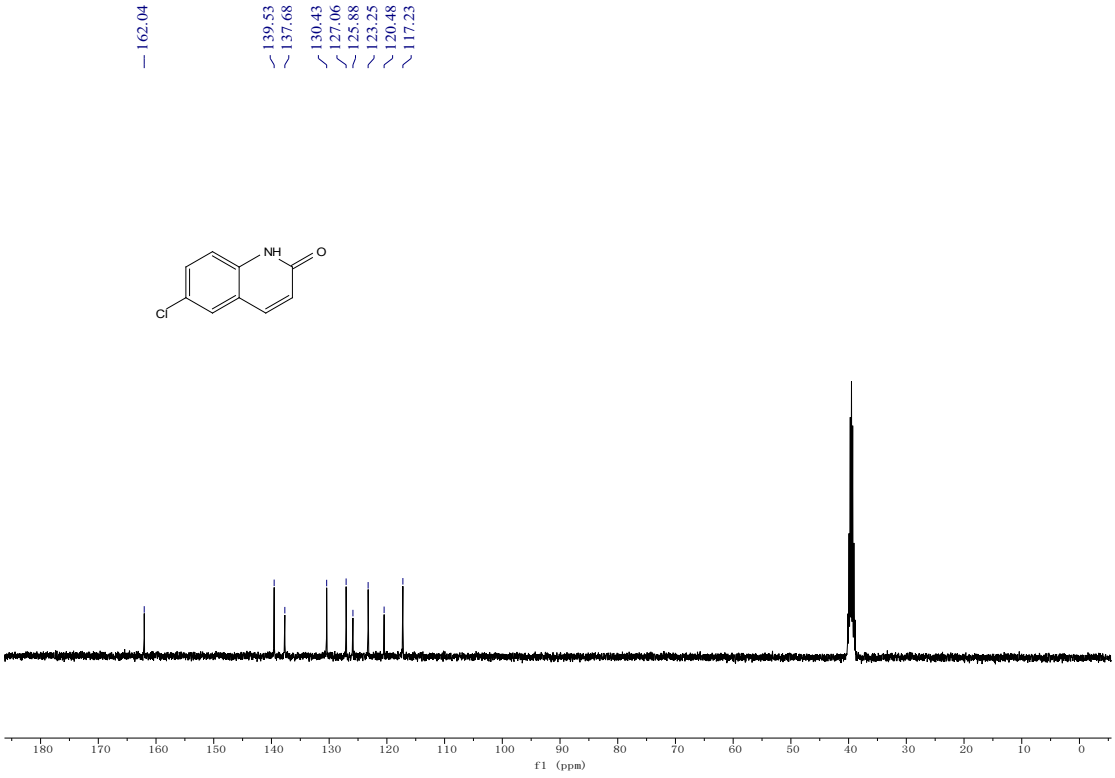
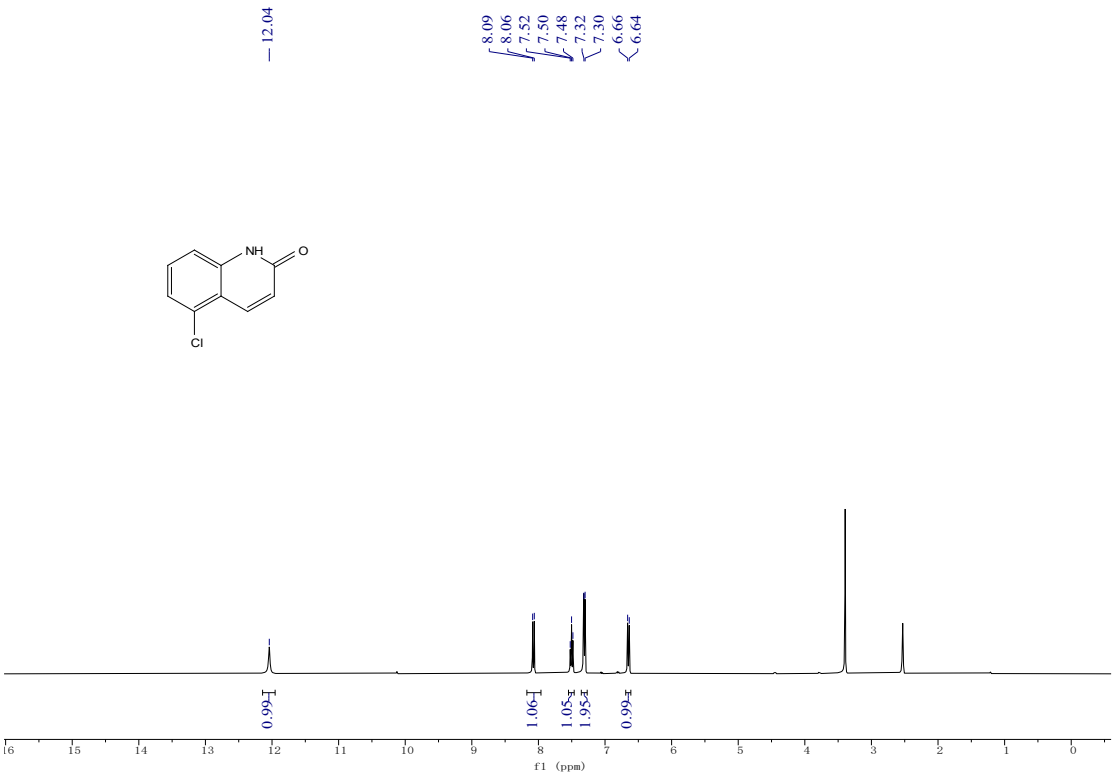


^{1}H NMR Spectra of 5-chloroquinolin-2(1*H*)-one (2i)



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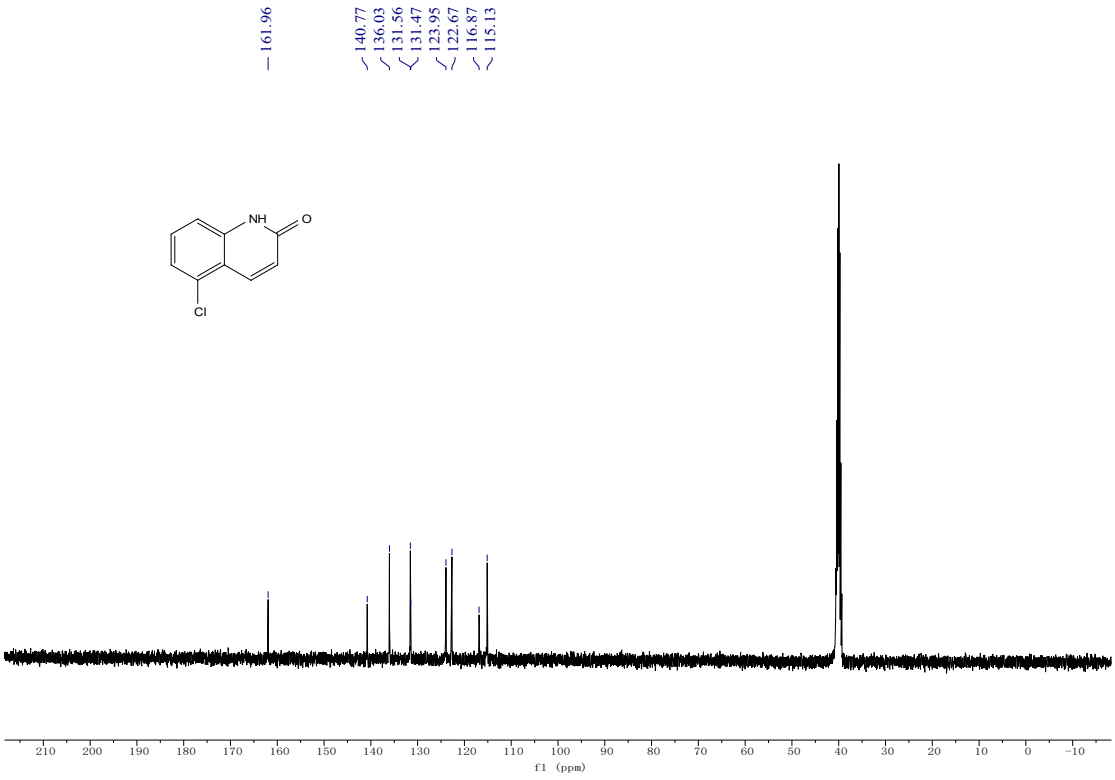

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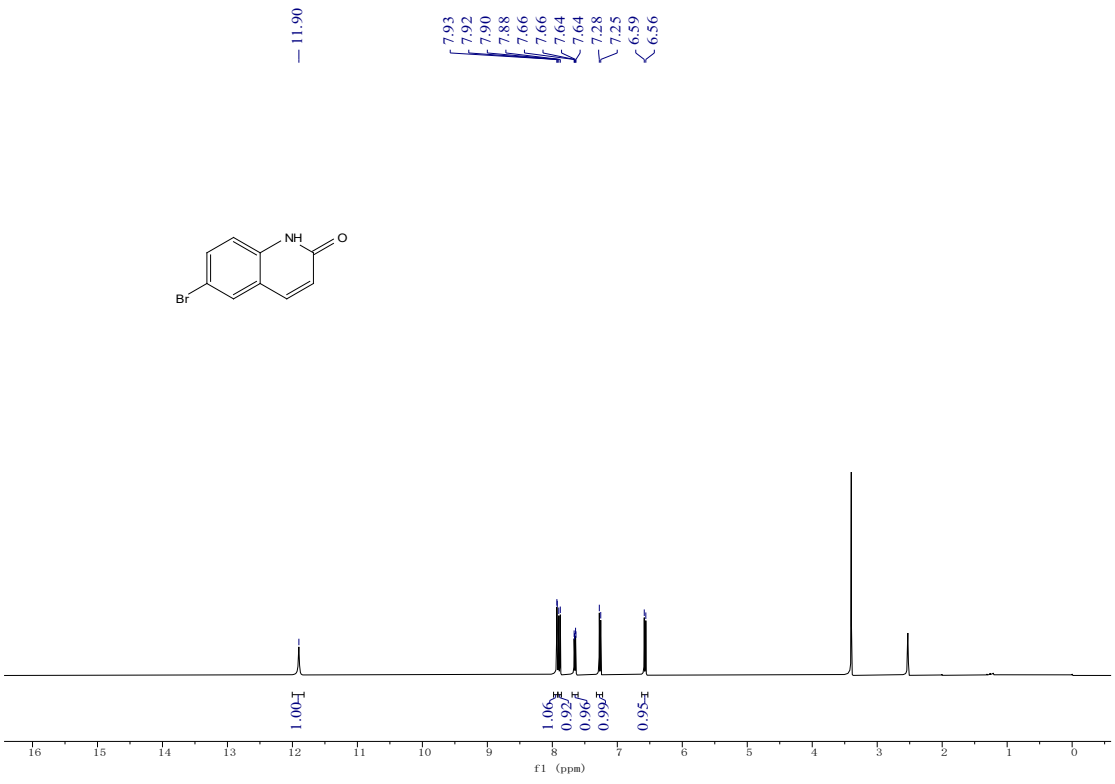
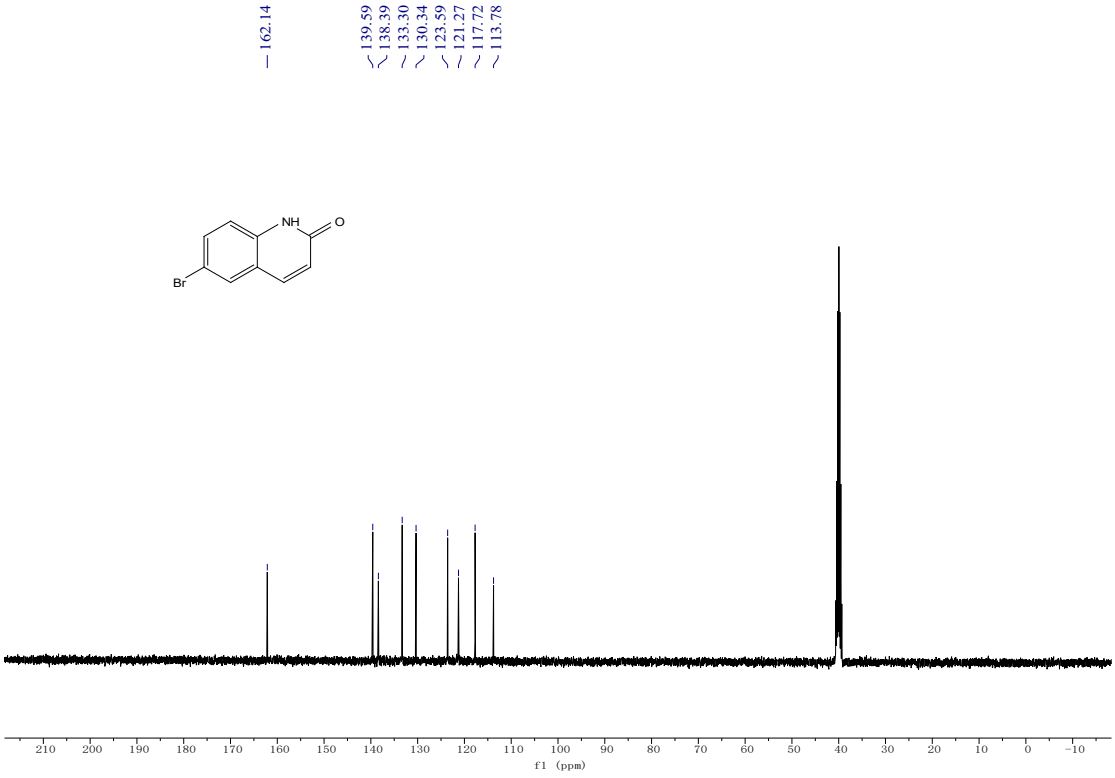
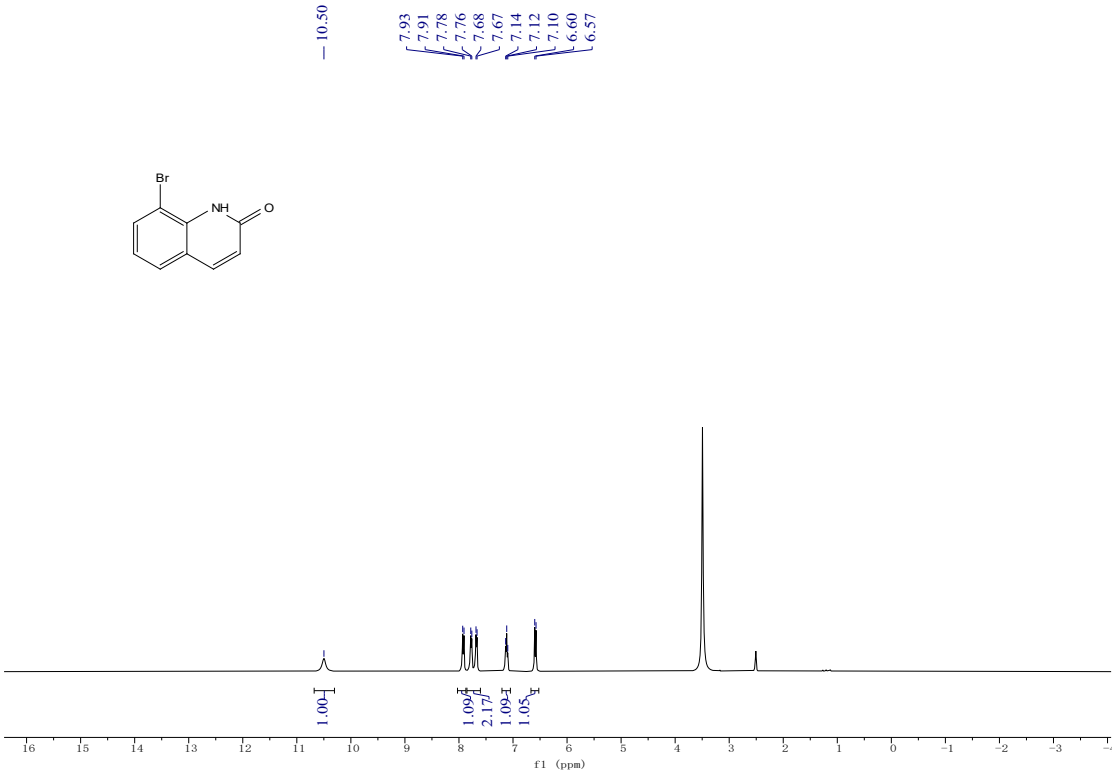


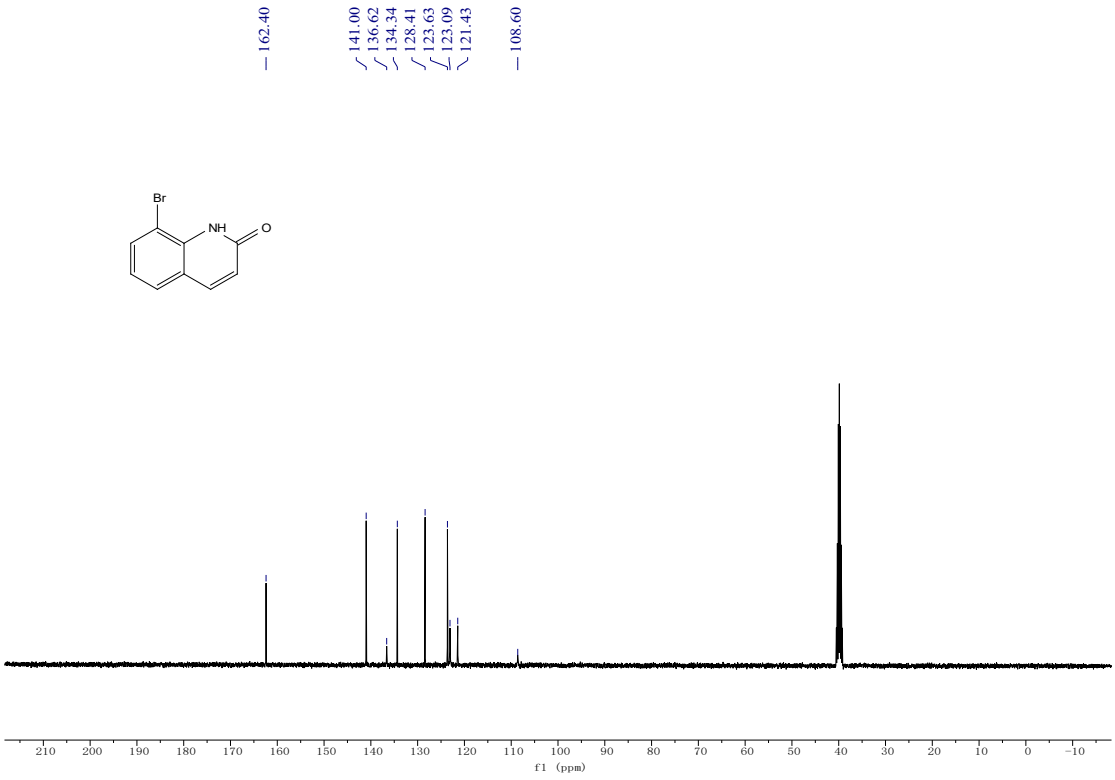
^{13}C NMR Spectra of 6-bromoquinolin-2(1*H*)-one (2j)



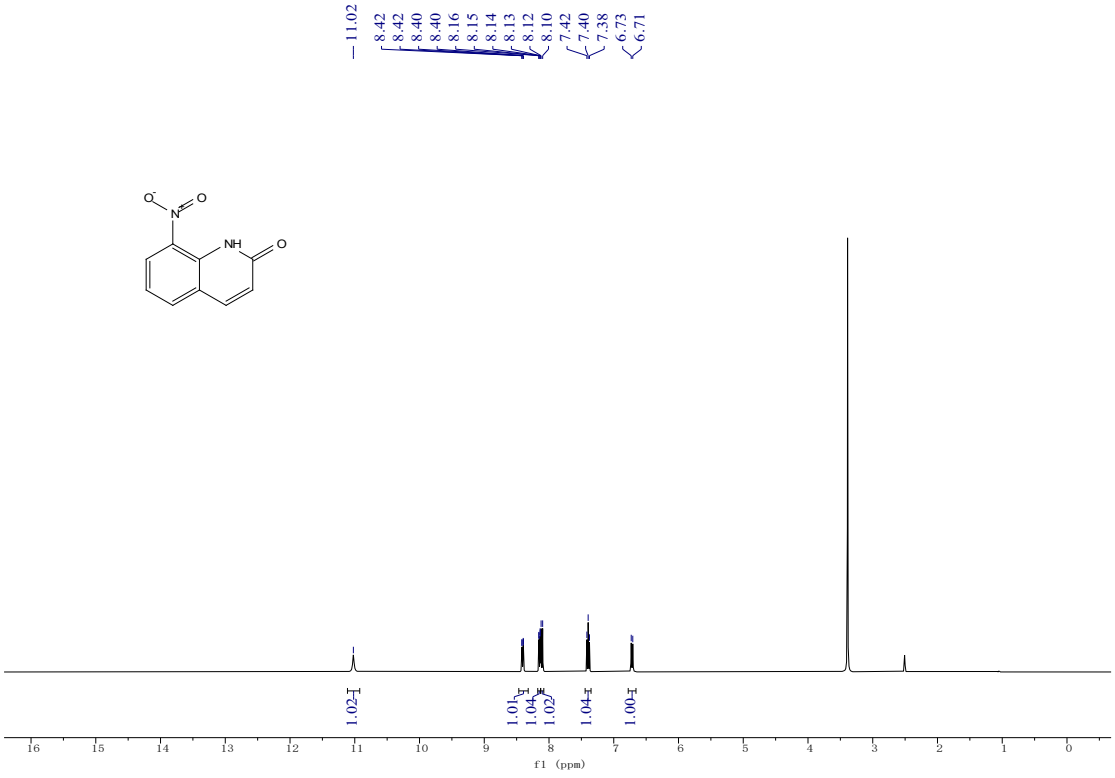
^{1}H NMR Spectra of 8-bromoquinolin-2(1*H*)-one (2k)



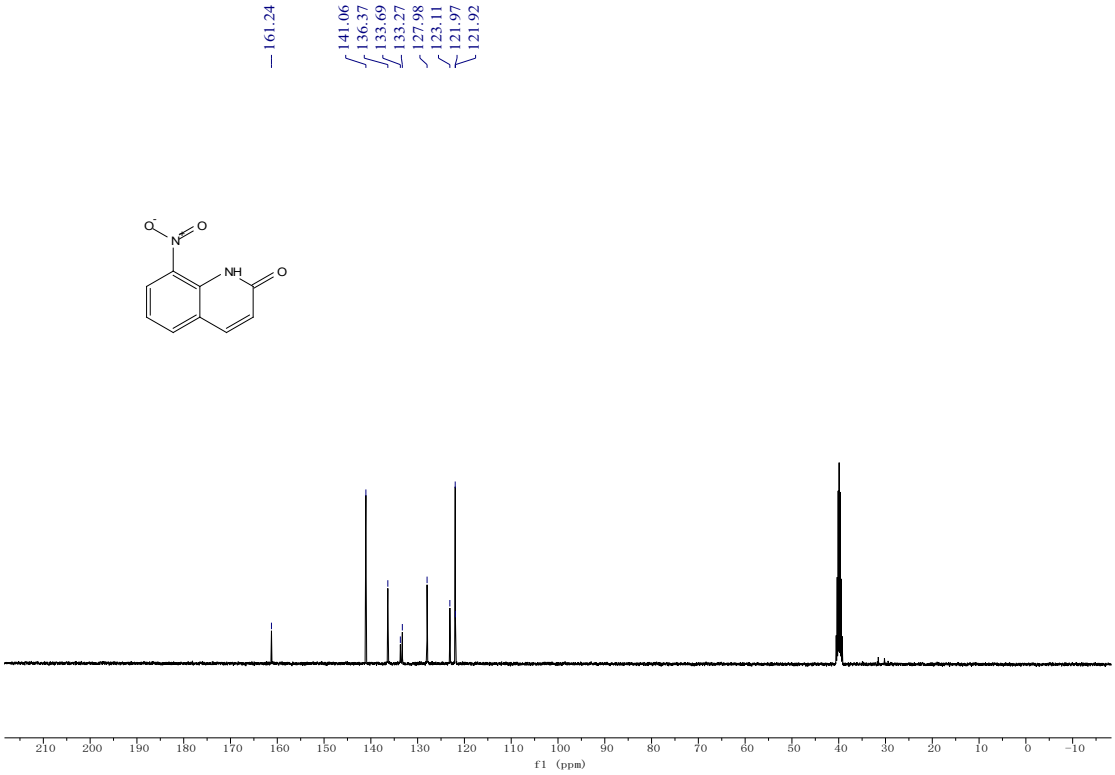
^{13}C NMR Spectra of 8-bromoquinolin-2(1*H*)-one (2k)



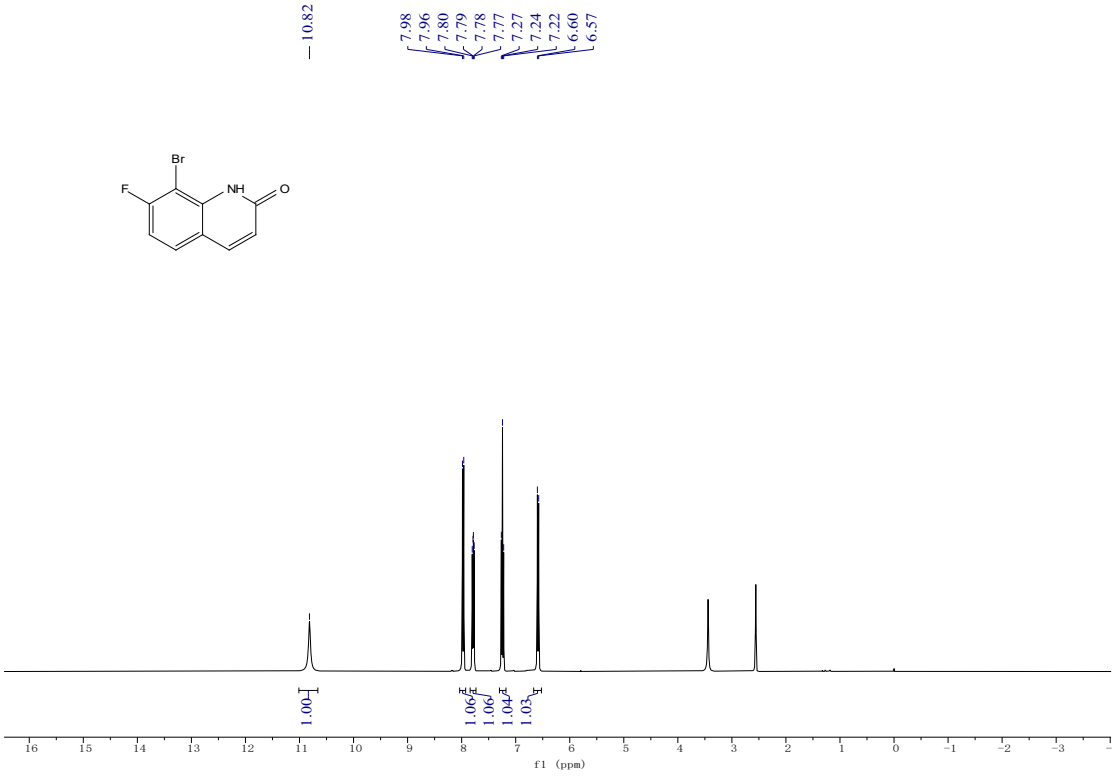
^{1}H NMR Spectra of 8-nitroquinolin-2(1*H*)-one (2l)



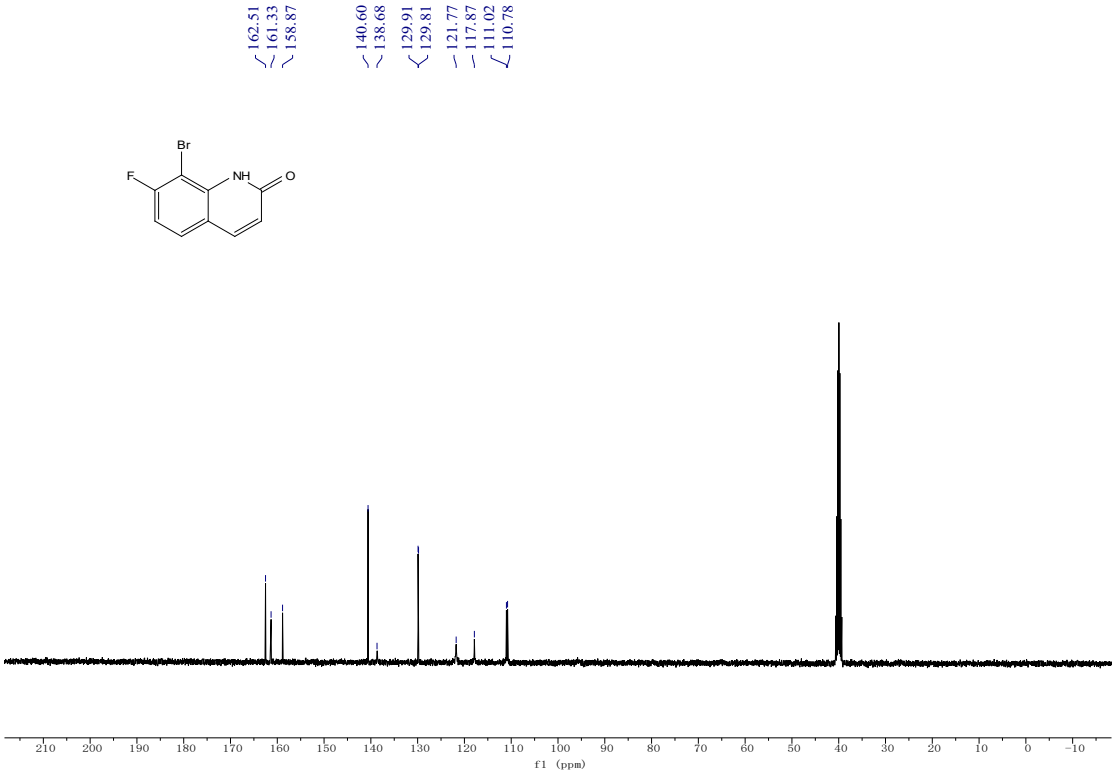
^{13}C NMR Spectra of 8-nitroquinolin-2(1*H*)-one (2l)



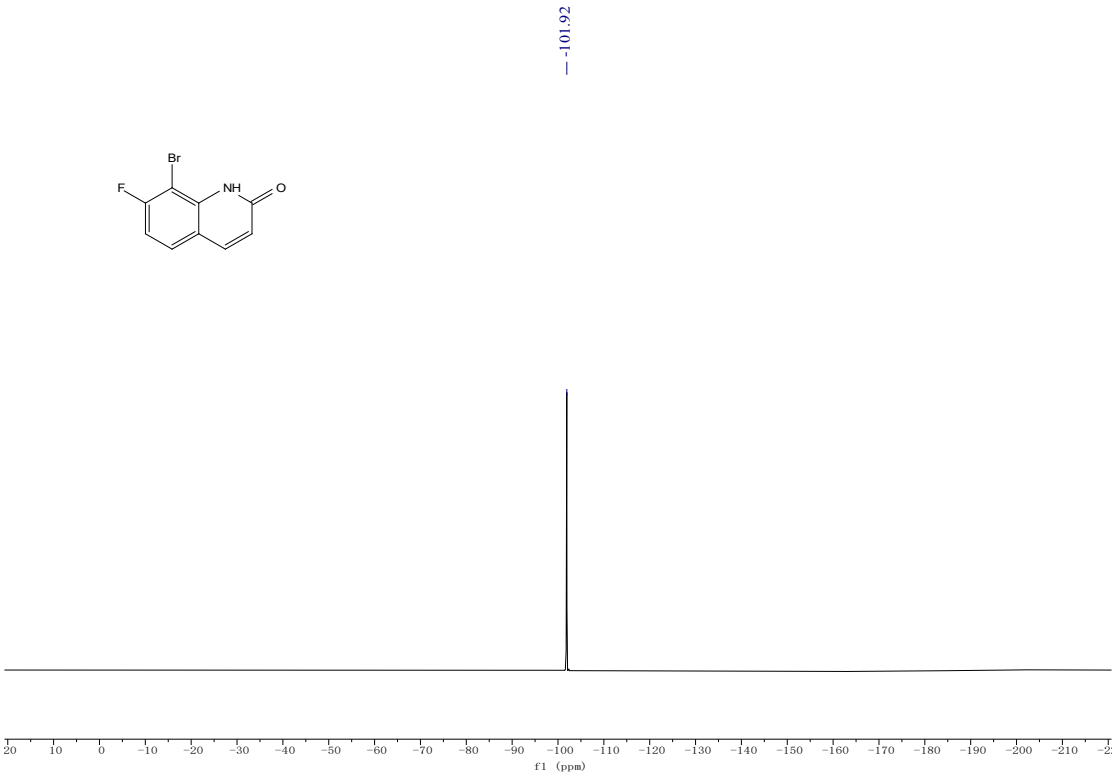
^{1}H NMR Spectra of 8-bromo-7-fluoroquinolin-2(1*H*)-one (2m)



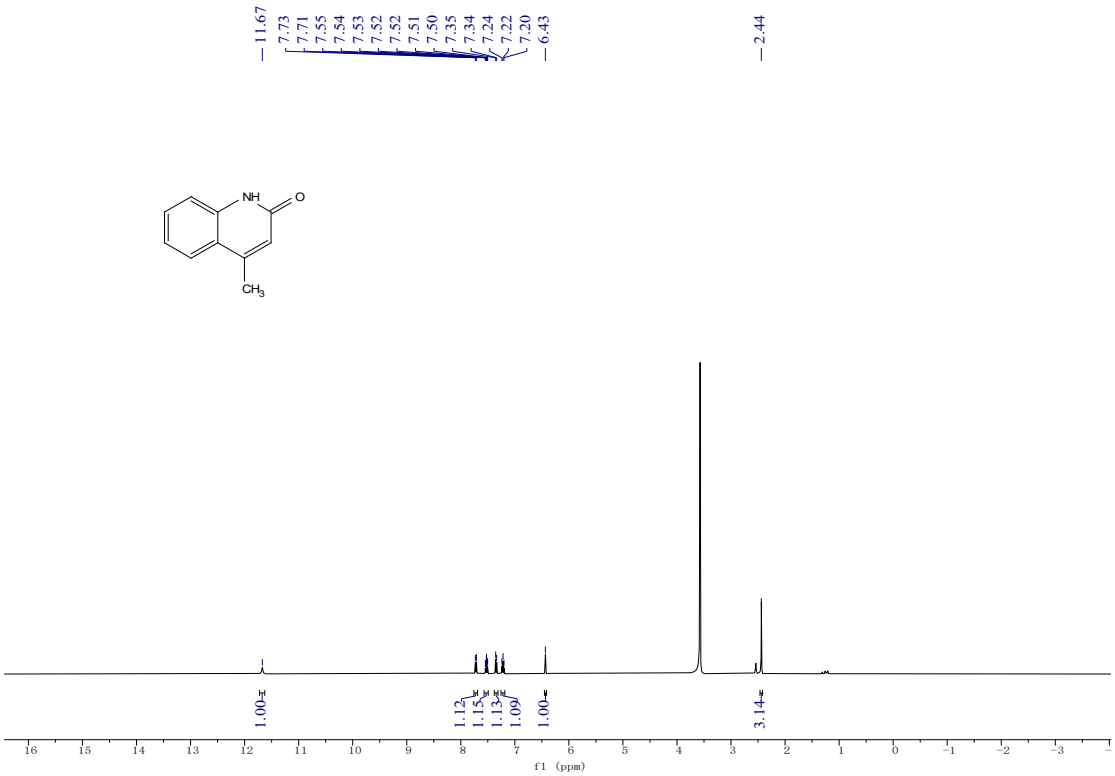
^{13}C NMR Spectra of 8-bromo-7-fluoroquinolin-2(1*H*)-one (2m)



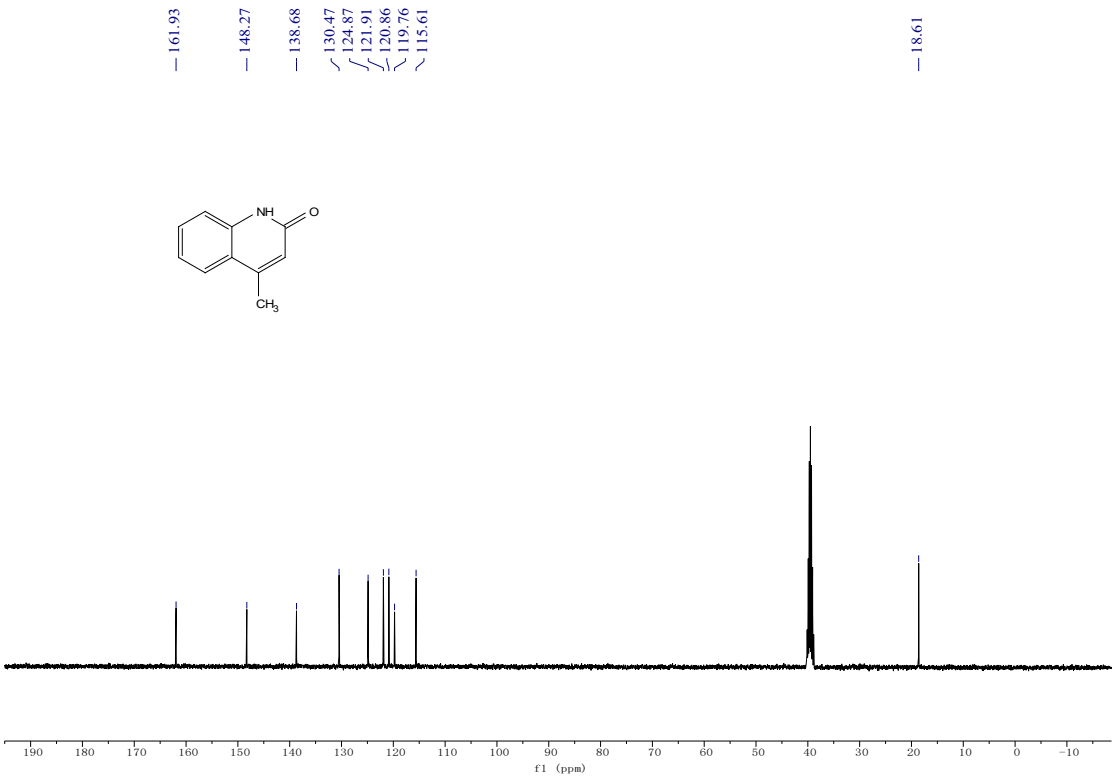
^{19}F NMR Spectra of 8-bromo-7-fluoroquinolin-2(1*H*)-one (2m)



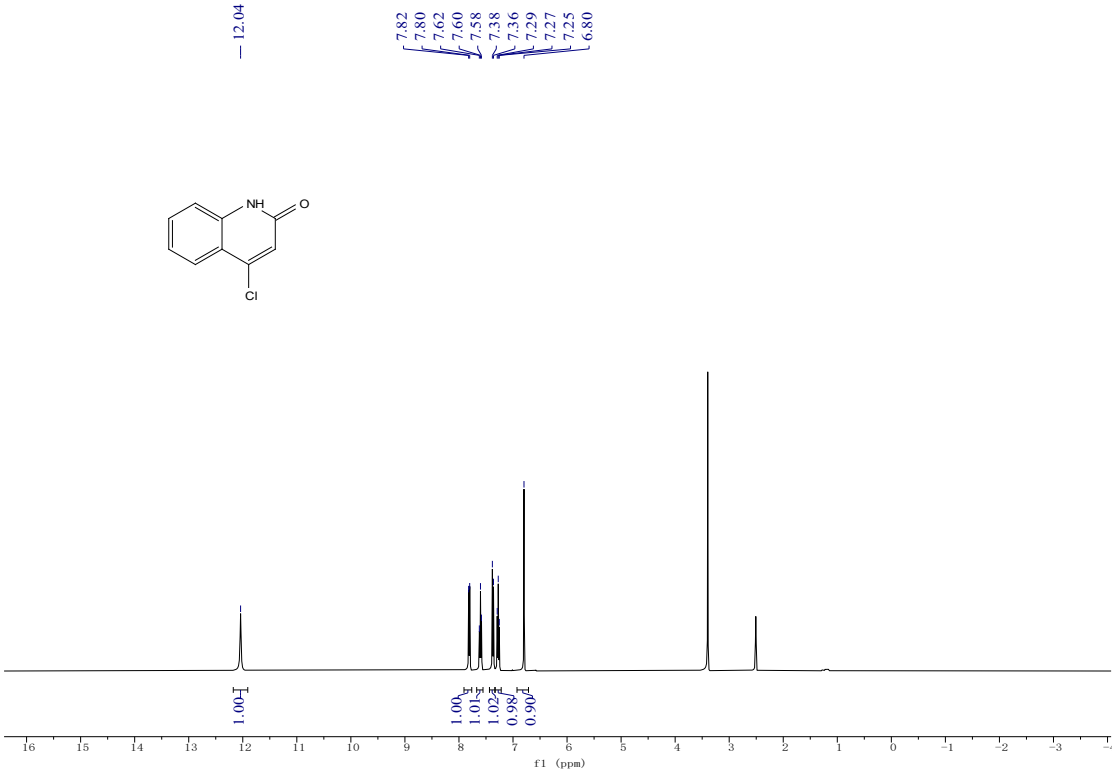
^{1}H NMR Spectra of 4-methylquinolin-2(1*H*)-one (2n)



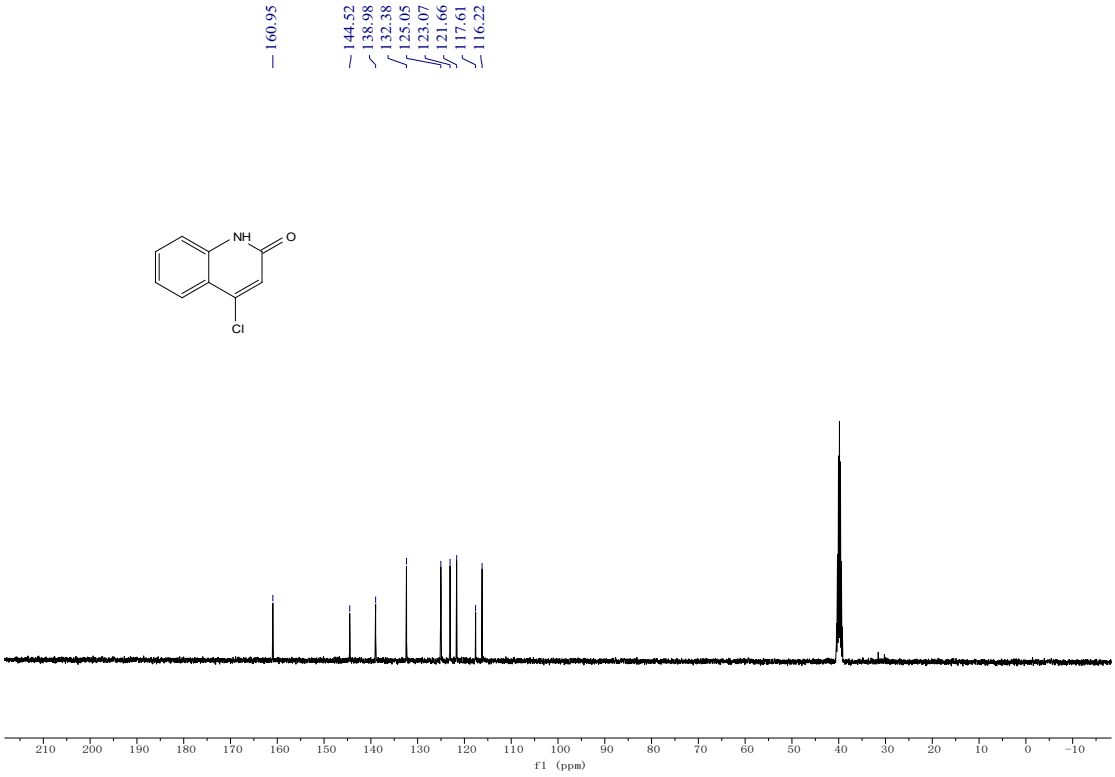
^{13}C NMR Spectra of 4-methylquinolin-2(1*H*)-one (2n)



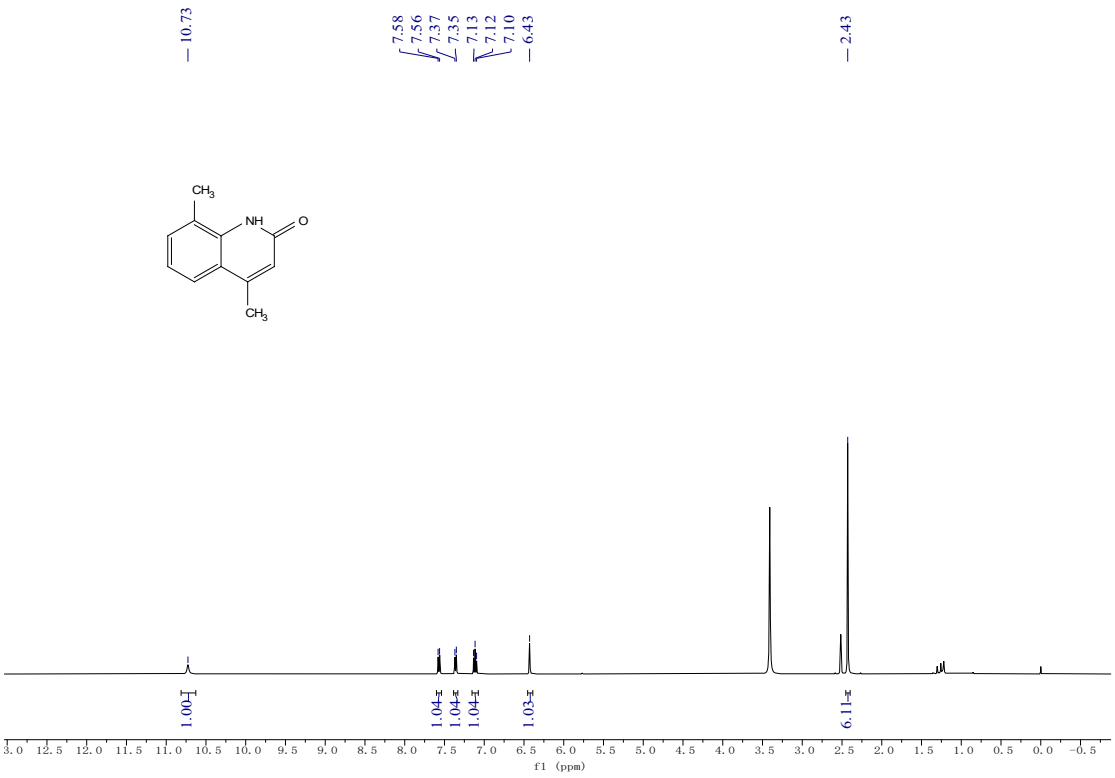
^{1}H NMR Spectra of 4-chloroquinolin-2(1*H*)-one (2o)



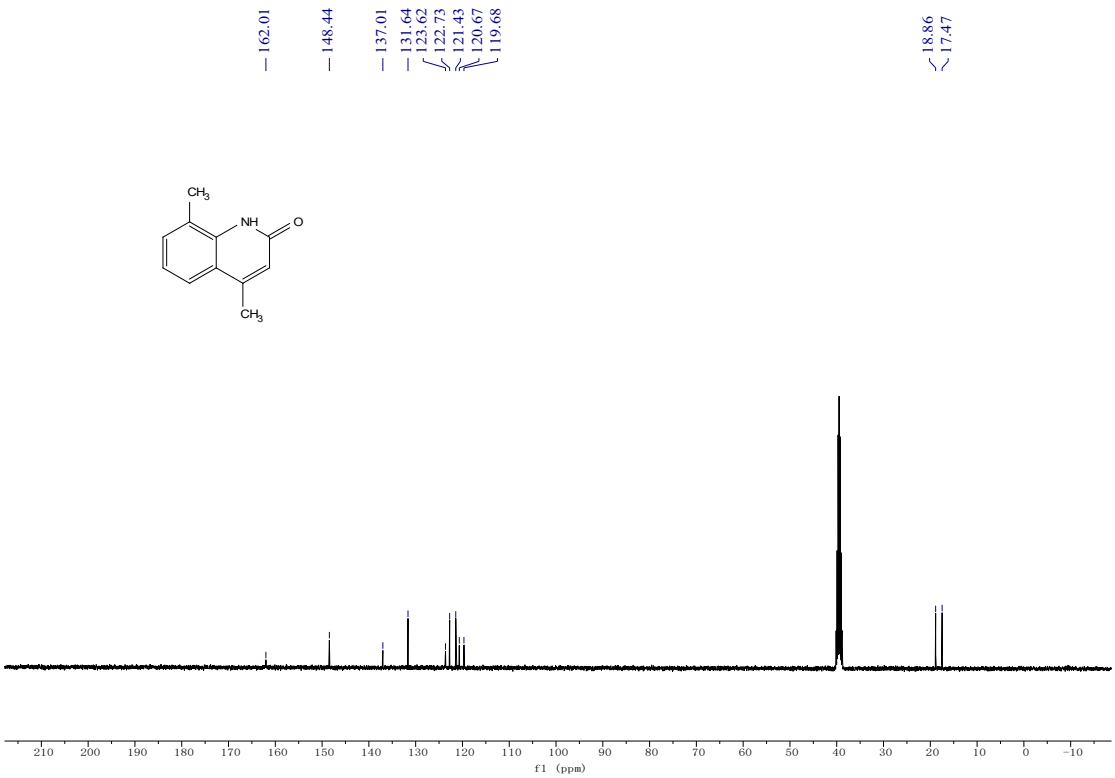
^{13}C NMR Spectra of 4-chloroquinolin-2(1*H*)-one (2o)



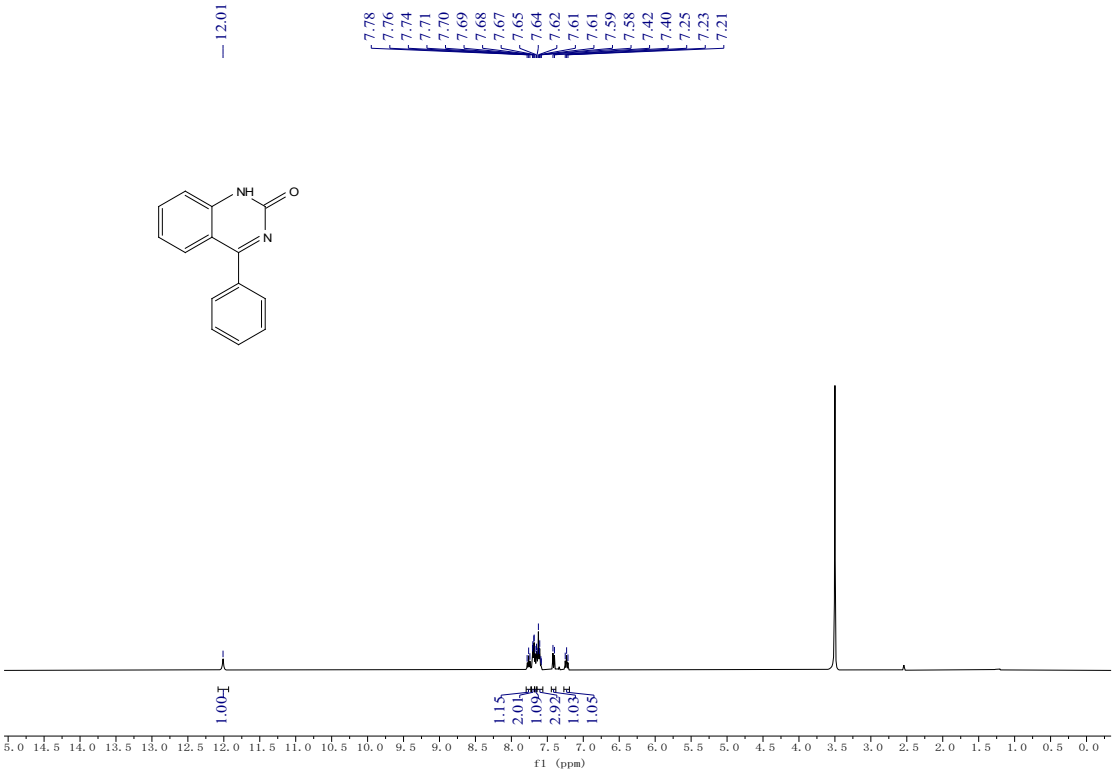
^{1}H NMR Spectra of 4,8-dimethylquinolin-2(1*H*)-one (2p)



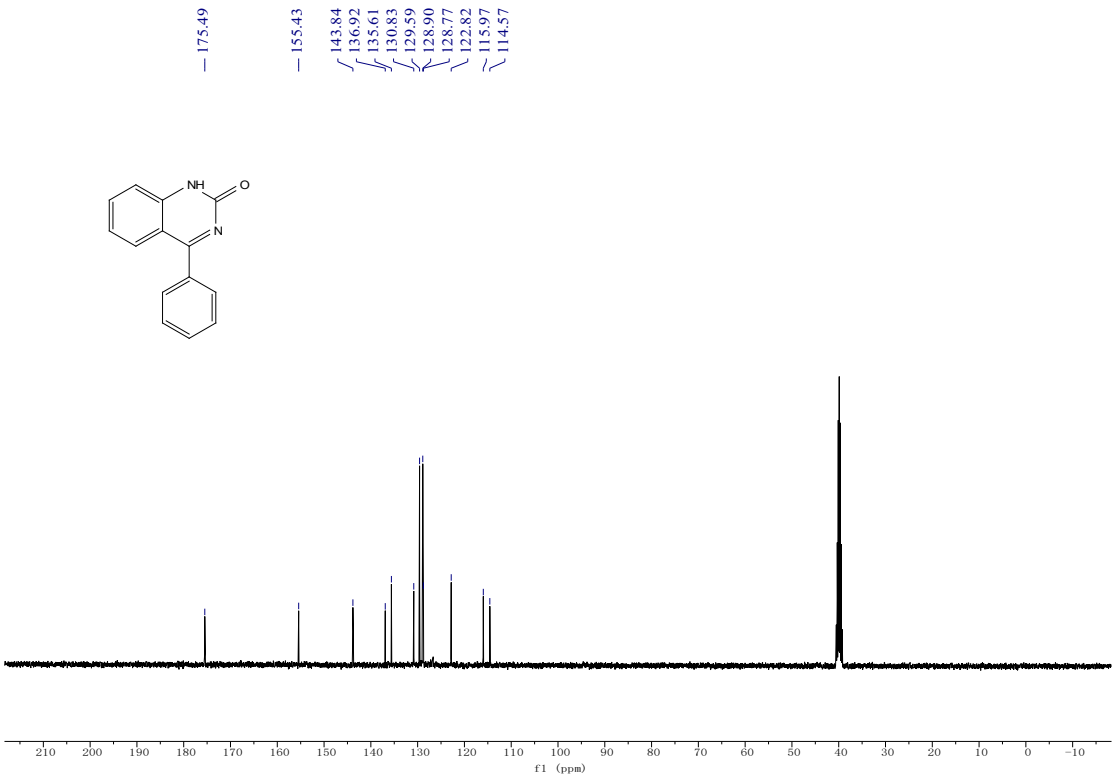
^{13}C NMR Spectra of 4,8-dimethylquinolin-2(1*H*)-one (2p)



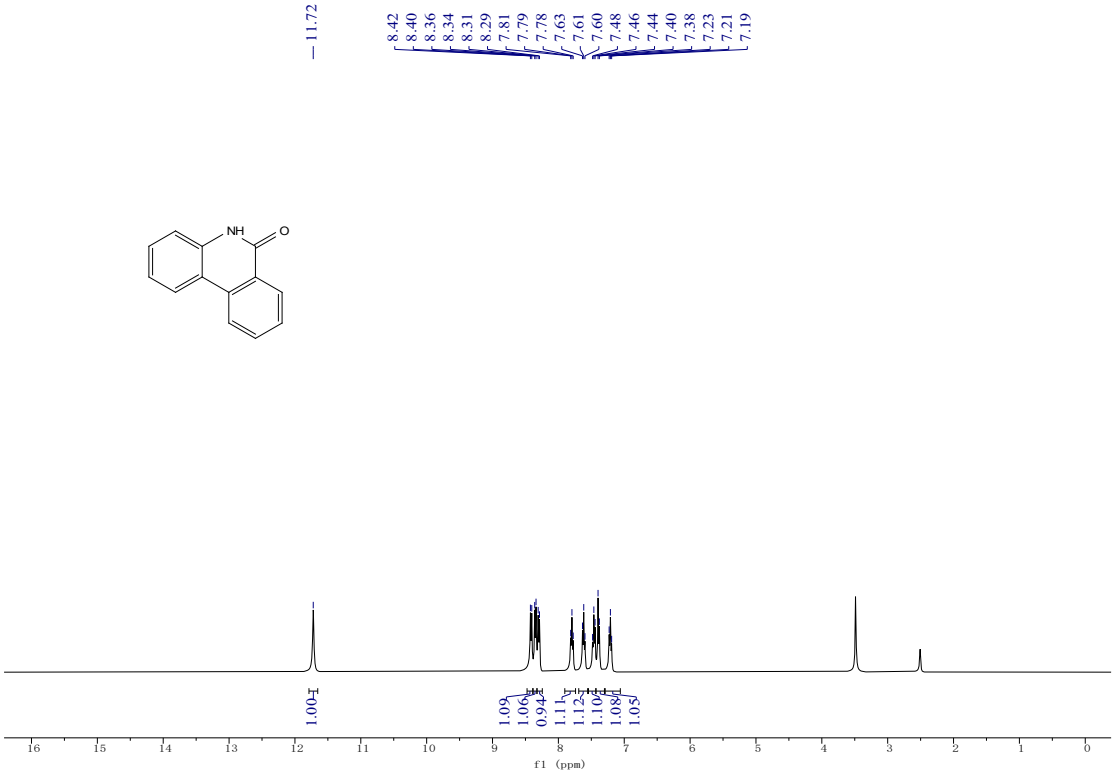
^{1}H NMR Spectra of 4-phenylquinazolin-2(1*H*)-one (2q)



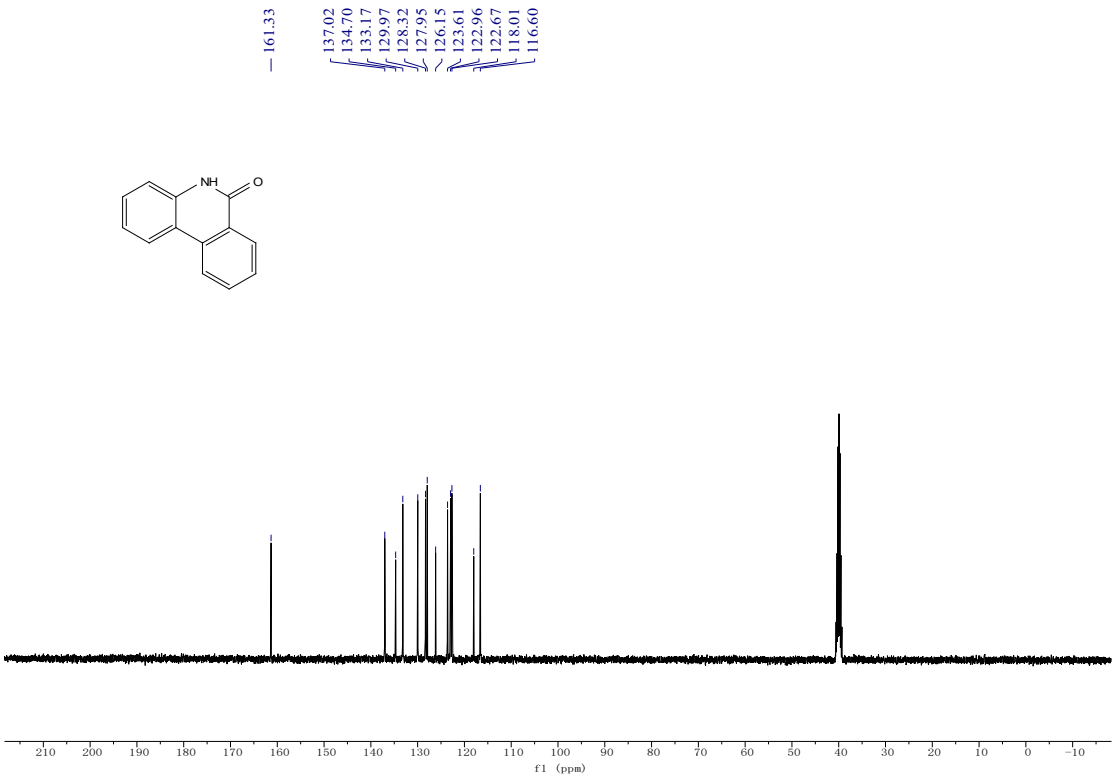
^{13}C NMR Spectra of 4-phenylquinazolin-2(1*H*)-one (2q)



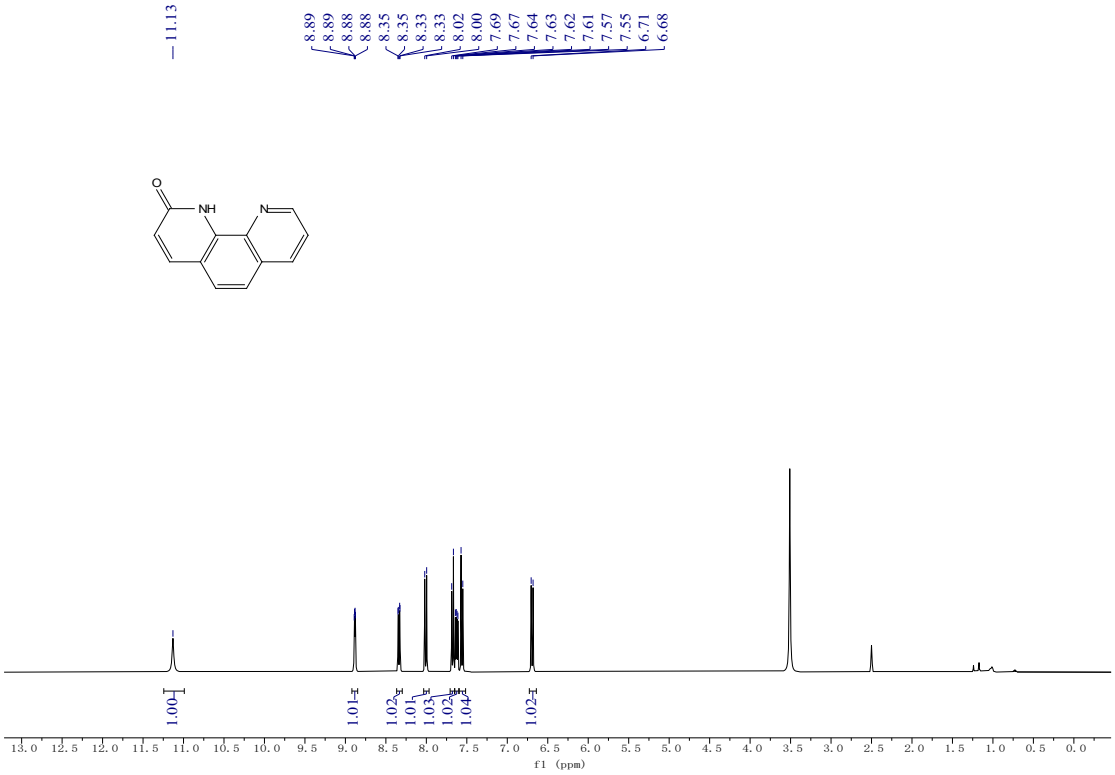
^{1}H NMR Spectra of phenanthridin-6(5*H*)-one (2r)



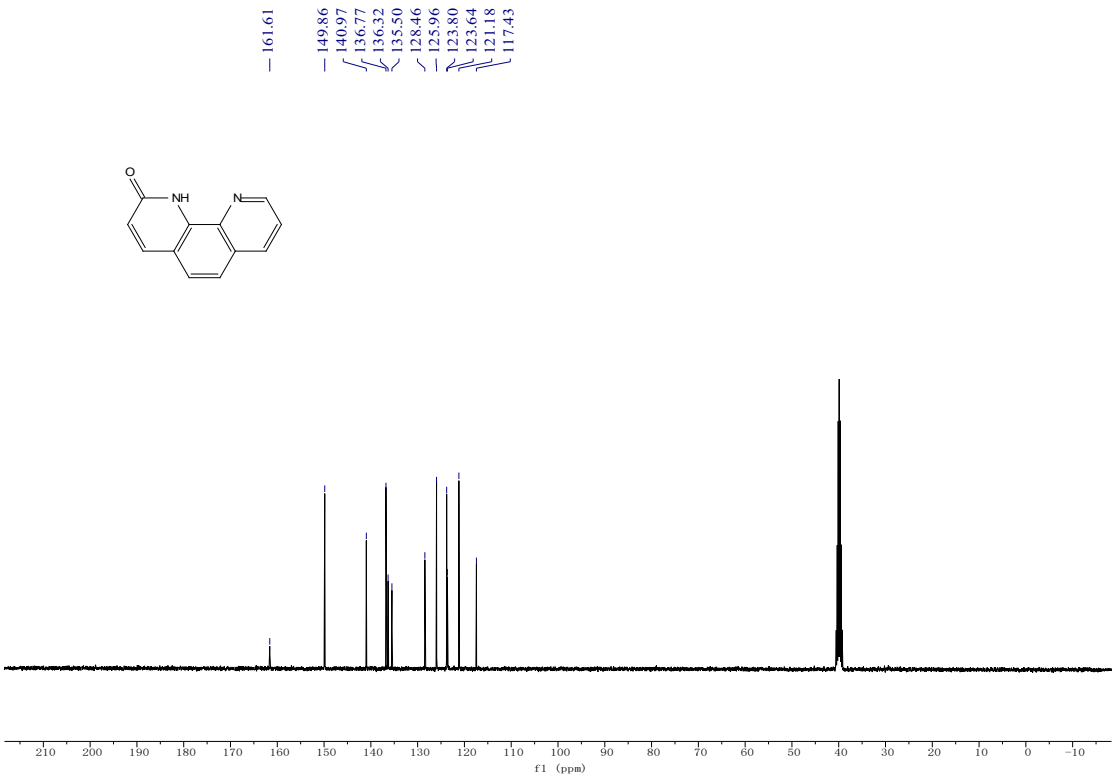
^{13}C NMR Spectra of phenanthridin-6(5*H*)-one (2r)



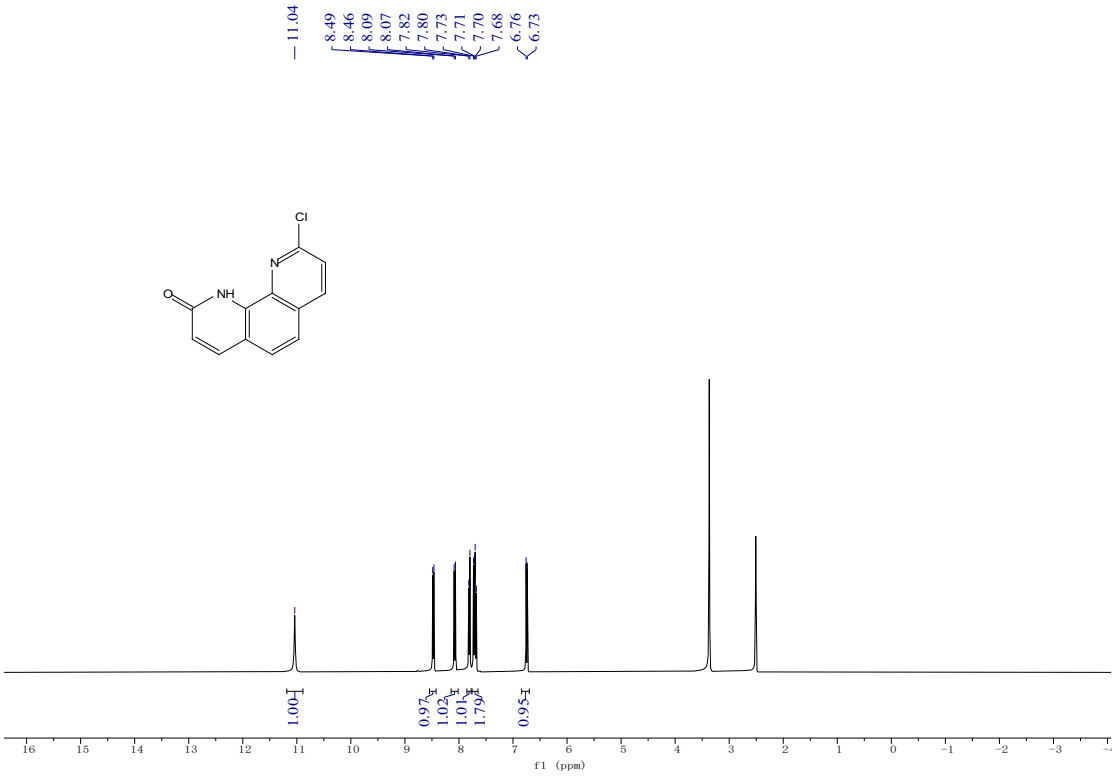
^{1}H NMR Spectra of 1,10-phenanthrolin-2(1*H*)-one (2s)



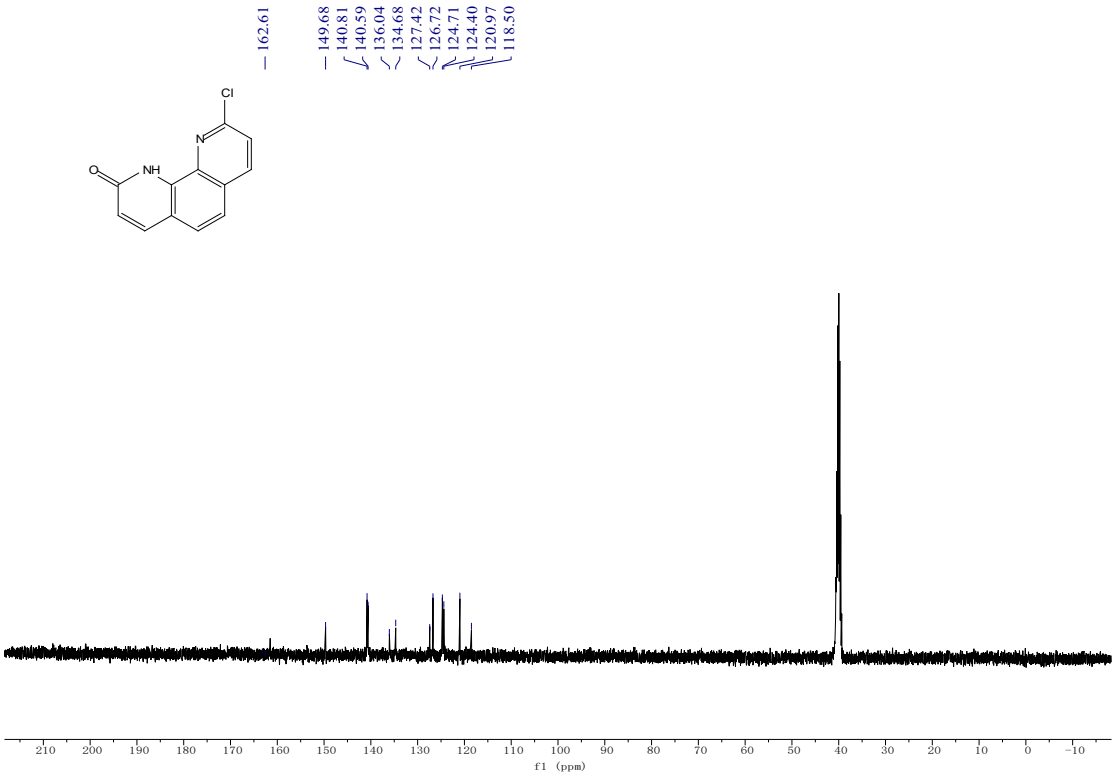
^{13}C NMR Spectra of 1,10-phenanthrolin-2(1*H*)-one (2s)



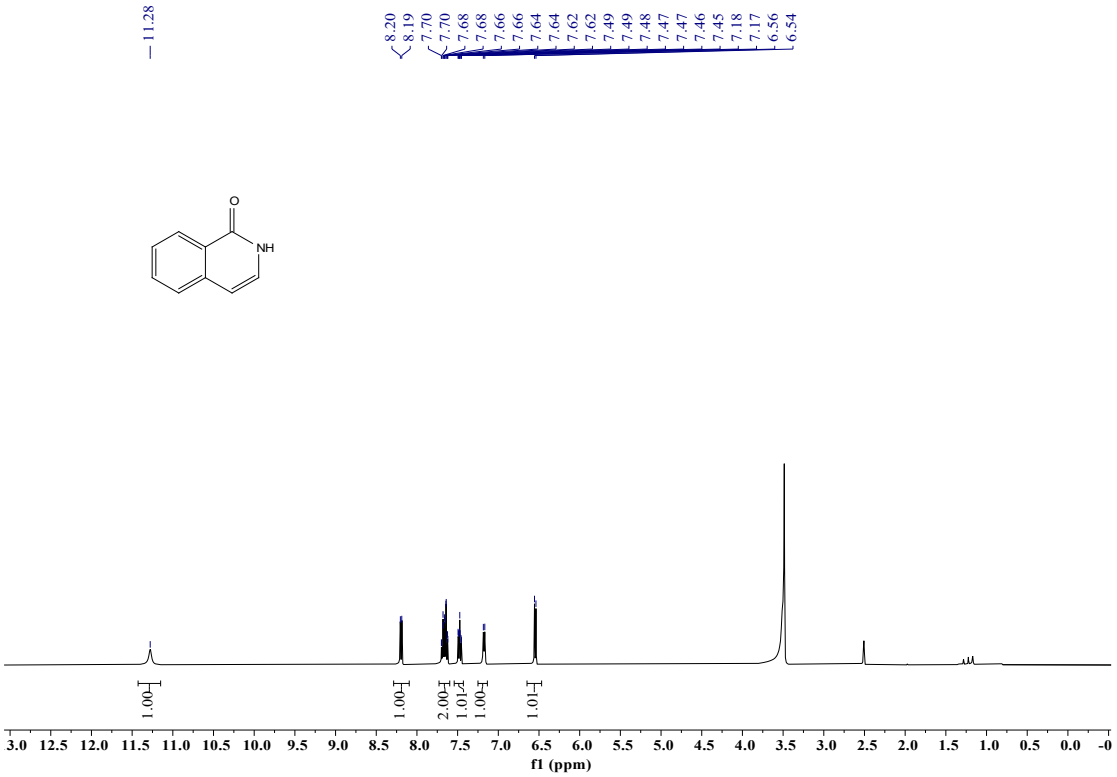
^{1}H NMR Spectra of 9-chloro-1,10-phenanthrolin-2(1*H*)-one (2t)



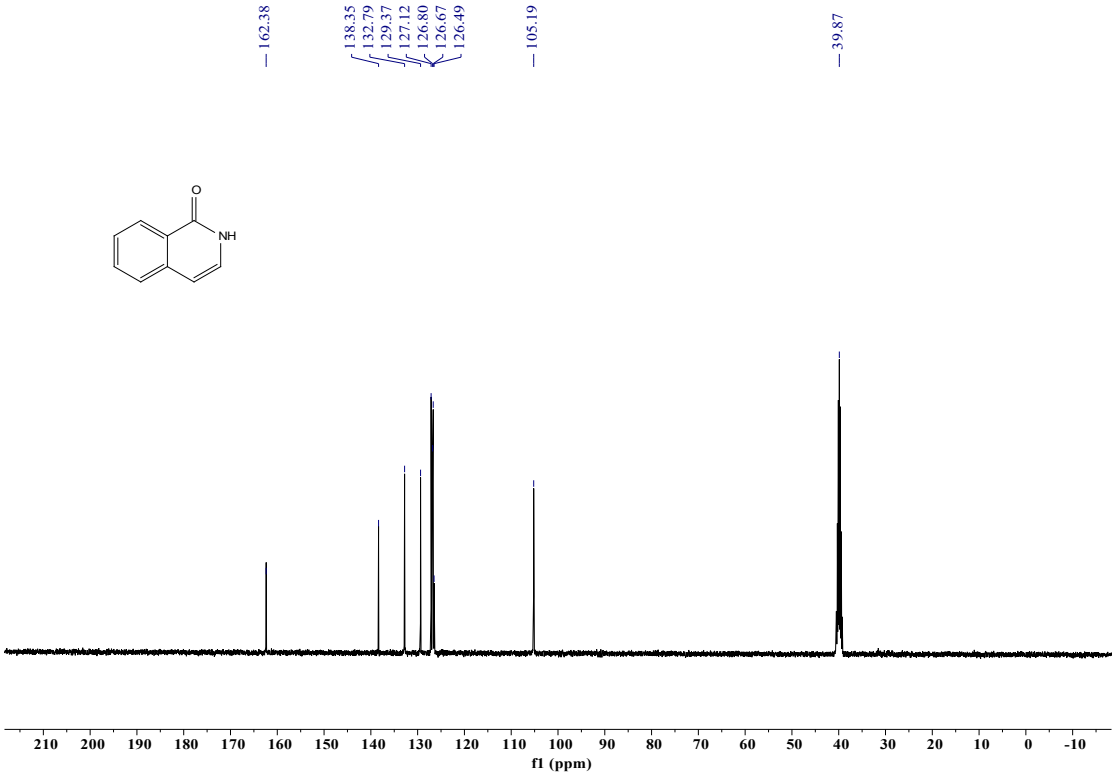
^{13}C NMR Spectra of 9-chloro-1,10-phenanthrolin-2(1*H*)-one (2t)



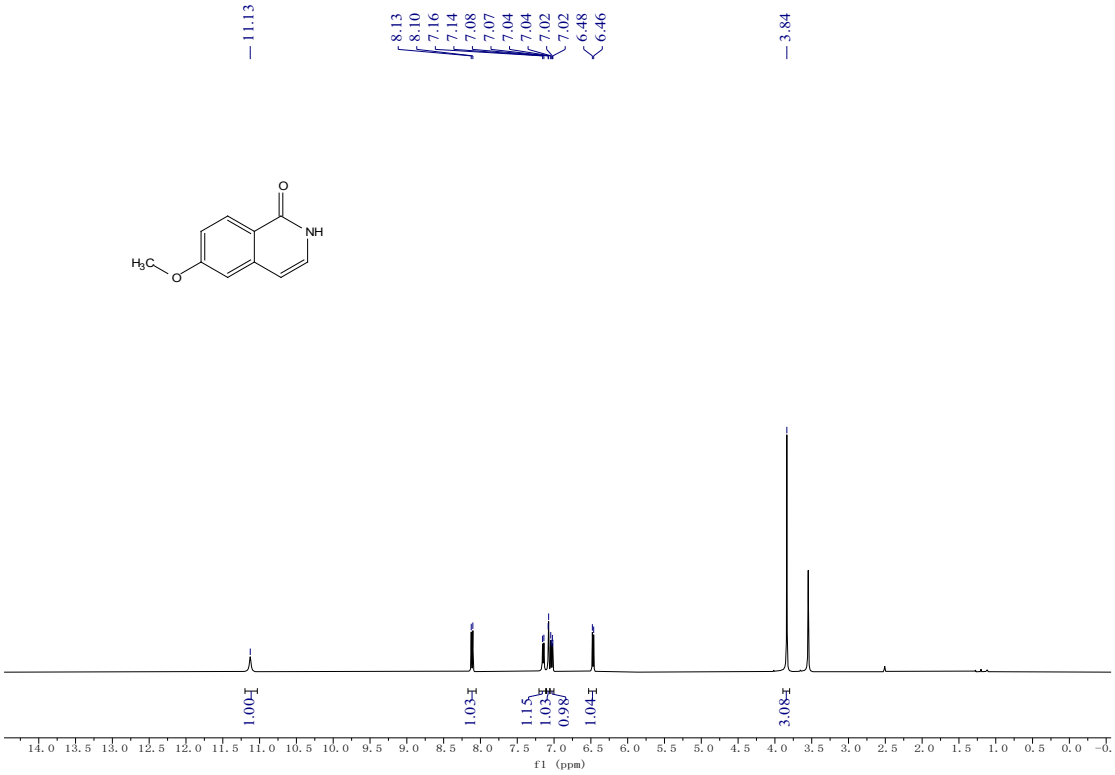
^{1}H NMR Spectra of isoquinolin-1(2*H*)-one (4a)



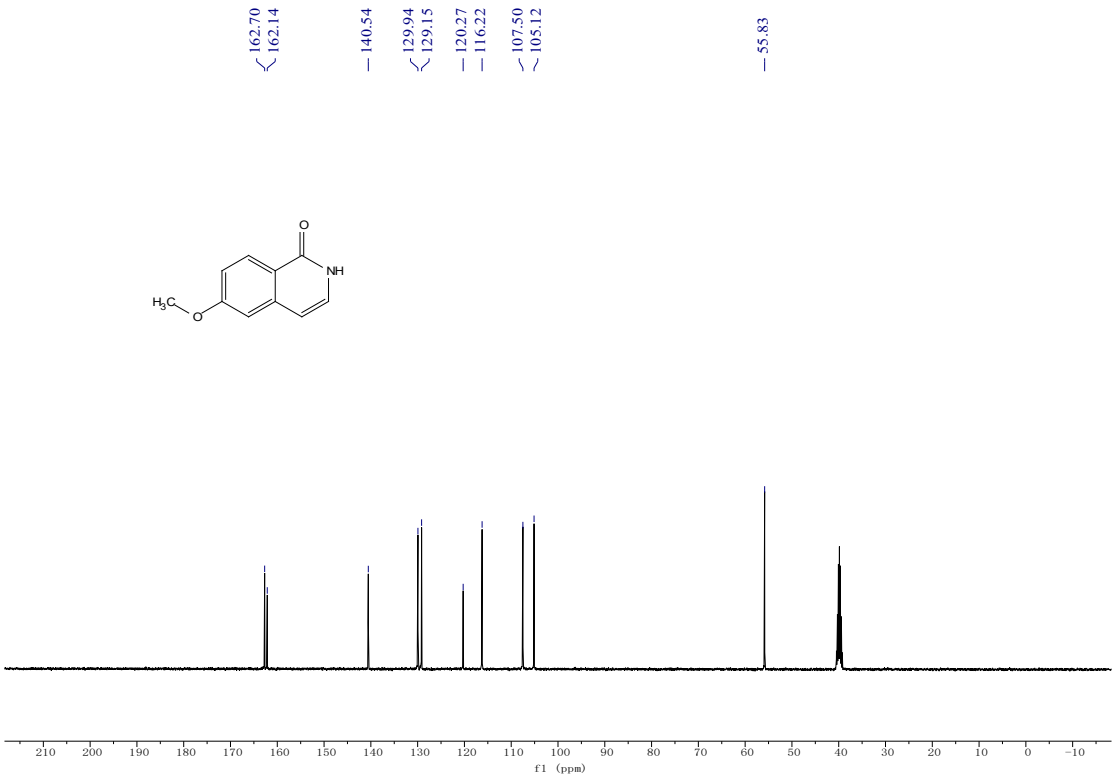
^{13}C NMR Spectra of isoquinolin-1(2*H*)-one (4a)



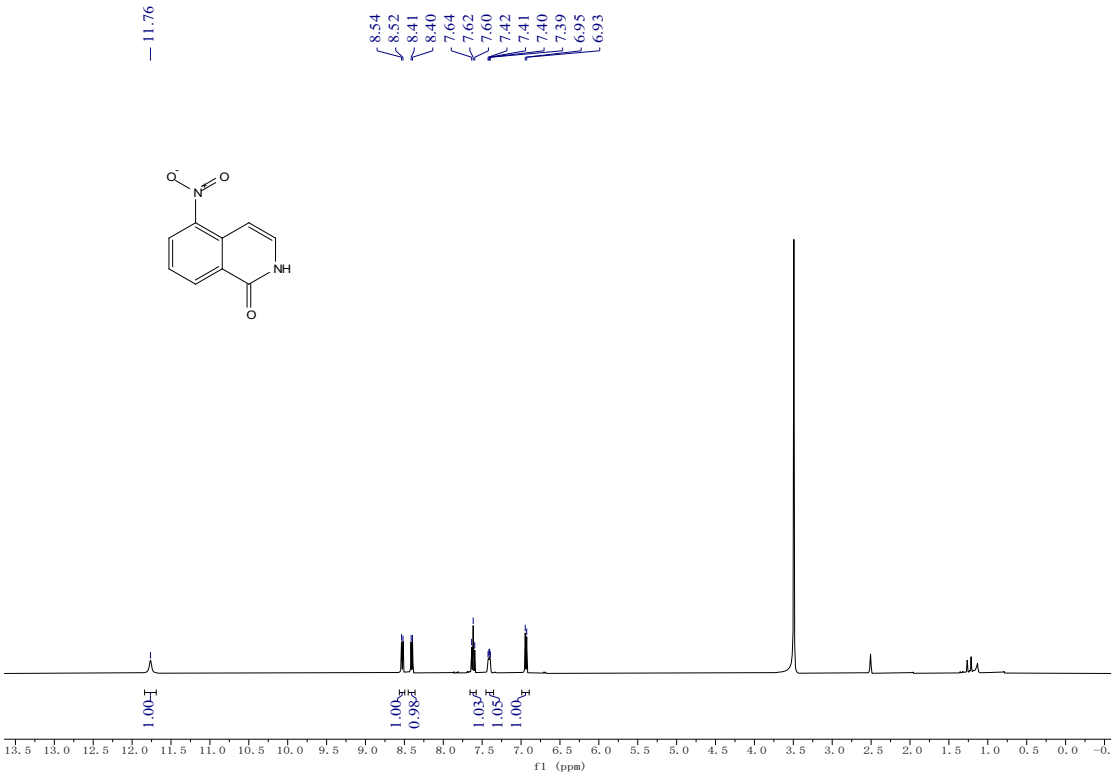
^{1}H NMR Spectra of 6-methoxyisoquinolin-1(2*H*)-one (4b)



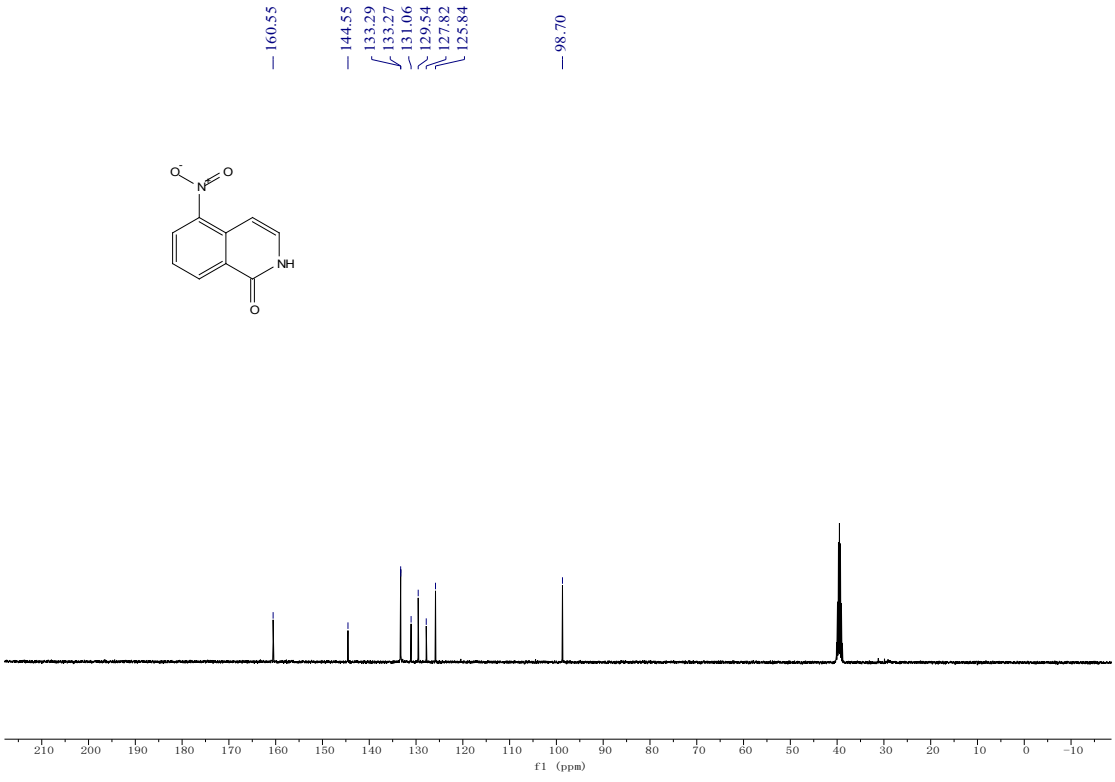
^{13}C NMR Spectra of 6-methoxyisoquinolin-1(2*H*)-one (4b)



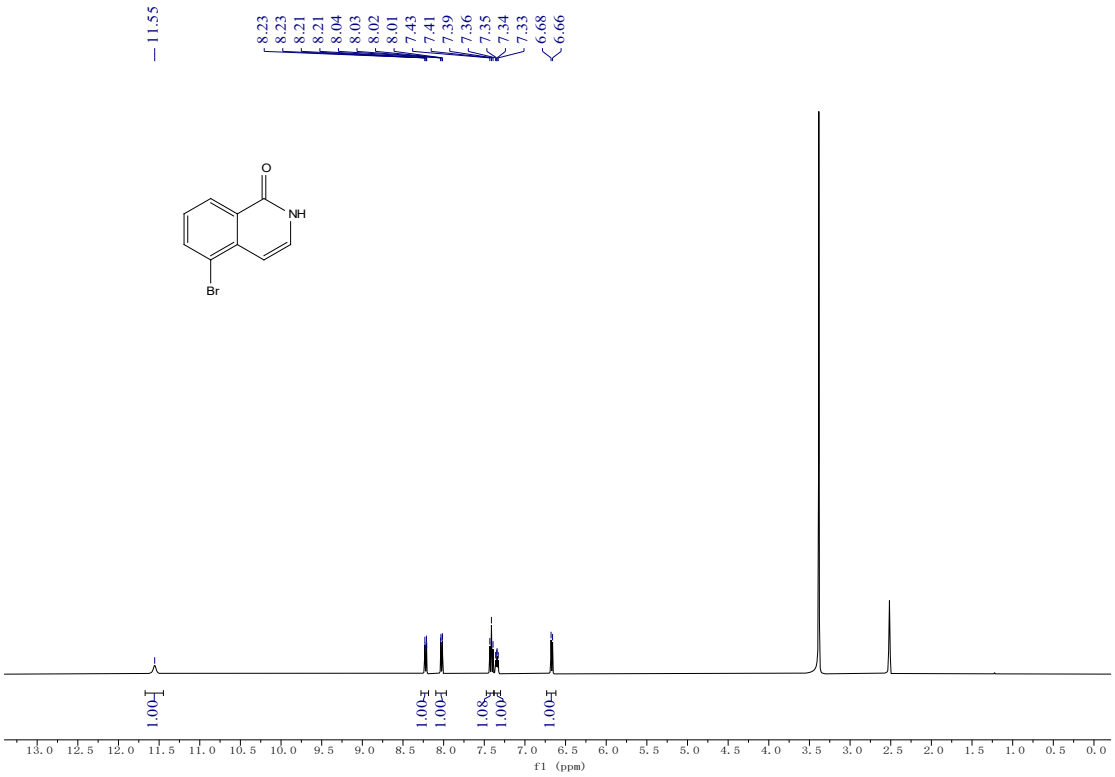
^{1}H NMR Spectra of 5-nitroisoquinolin-1(2*H*)-one (4c)



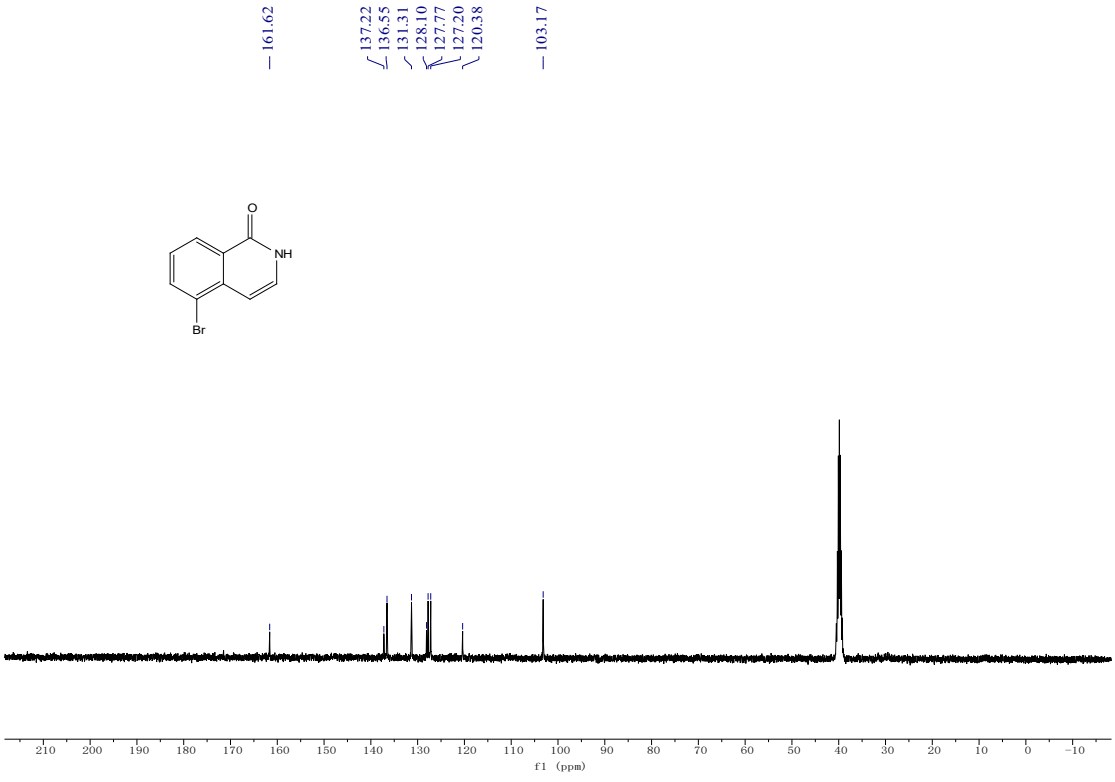
^{13}C NMR Spectra of 5-nitroisoquinolin-1(2*H*)-one (4c)



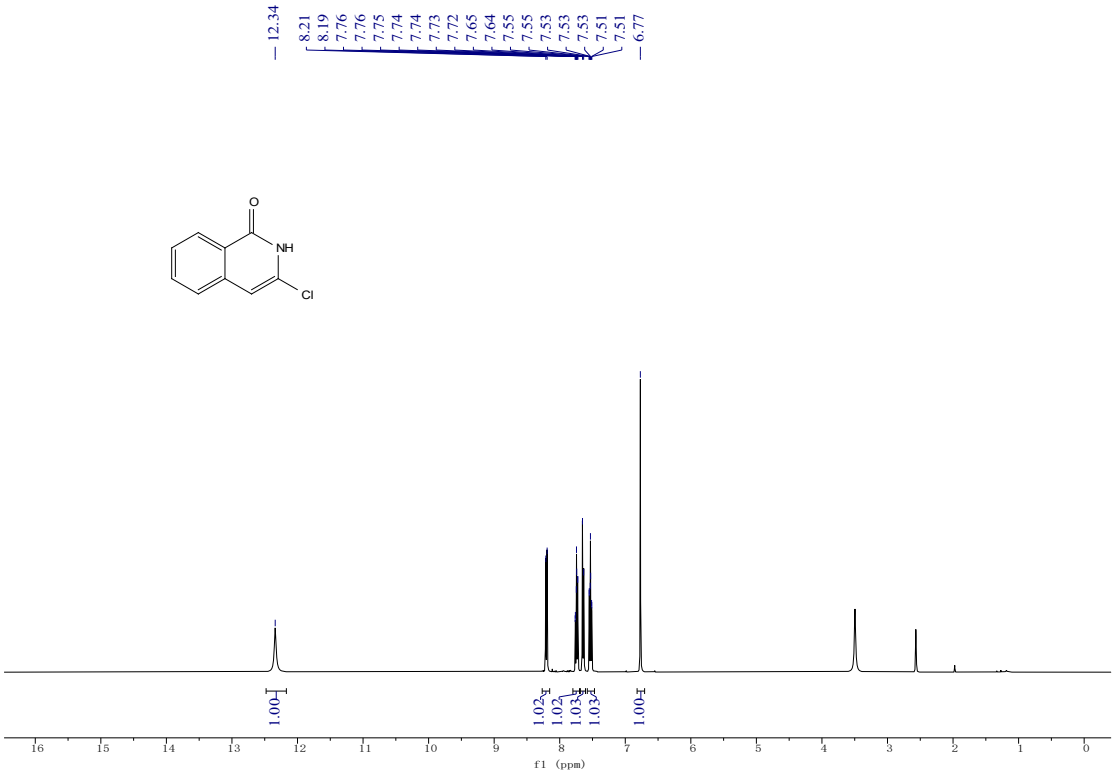
^{1}H NMR Spectra of 5-bromoisoquinolin-1(2*H*)-one (4d)



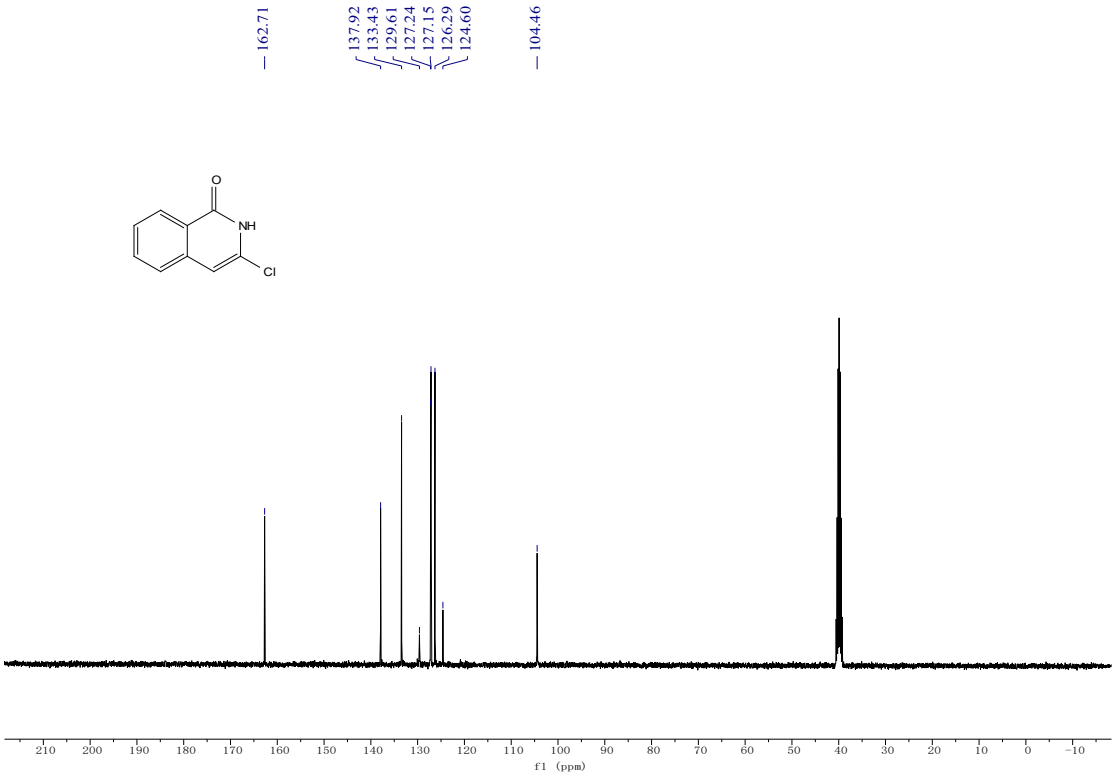
^{13}C NMR Spectra of 5-bromoisoquinolin-1(2*H*)-one (4d)



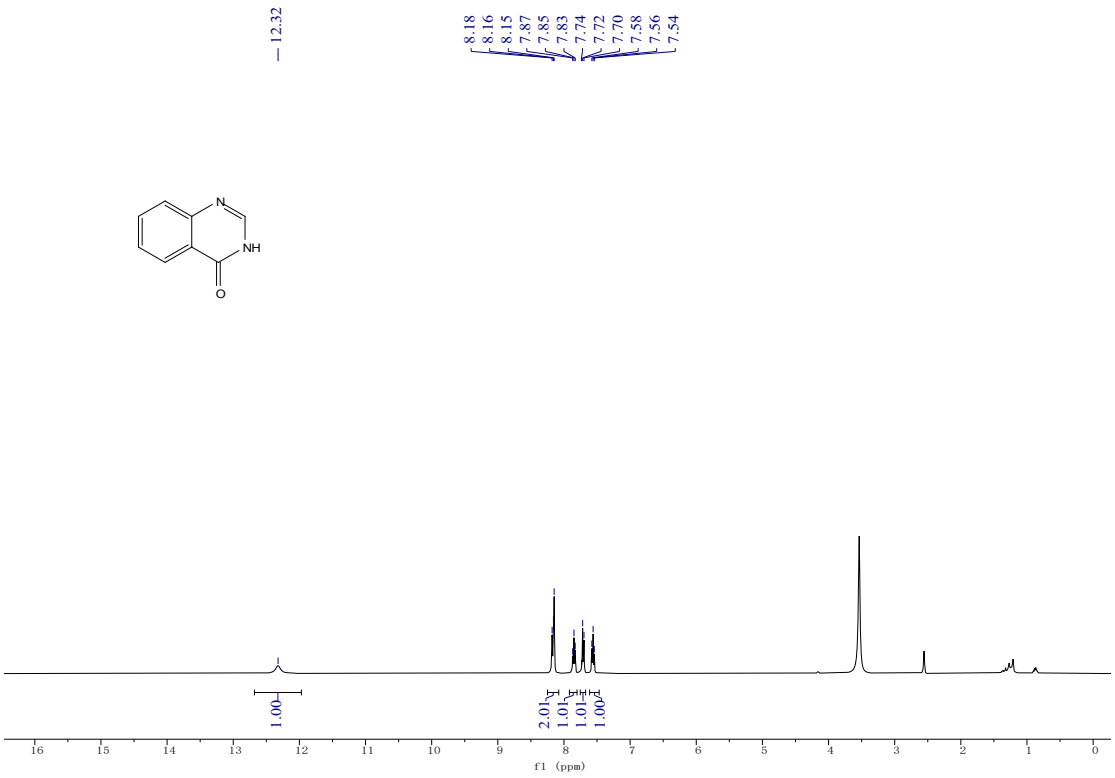
^{1}H NMR Spectra of 3-chloroisoquinolin-1(2*H*)-one (4e)



^{13}C NMR Spectra of 3-chloroisoquinolin-1(2*H*)-one (4e)



^{1}H NMR Spectra of quinazolin-4(3*H*)-one (4f)



^{13}C NMR Spectra of quinazolin-4(3*H*)-one (4f)