Electronic Supplementary Material (ESI) for Green Chemistry

Catalyst-free synthesis of quinazoline derivatives using low melting sugar-urea-salt mixture as a solvent

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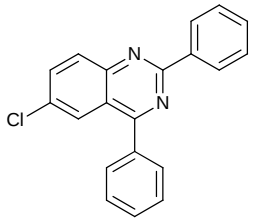
Supporting Information

General Information. All solvents and chemicals were obtained commercially and were used as received. Melting points were determined using an X-4 apparatus and are uncorrected. IR spectra were recorded using a Bruker-TENSOR 27 spectrometer instrument. NMR spectra were taken with a Bruker DRX-500 spectrometer at 500 MHz (^{1}H) and 125 MHz (^{13}C) using $CDCl_3$ as the solvent with TMS as internal standard. Elemental analyses were obtained on a Vario EL III CHNOS elemental analyzer.

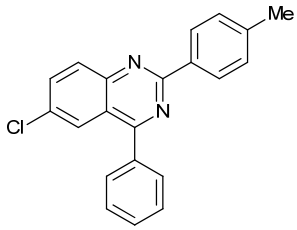
6-Chloro-2,4-diphenylquinazoline (4a).



^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.50-7.55 (m, 3H), 7.62-7.65 (m, 3H), 7.82 (dd, J = 9.0, 2.5 Hz, 1H), 7.86-7.88 (m, 2H), 8.09-8.11 (m, 2H), 8.68 (dd, J = 8.0, 2.0 Hz, 2H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 122.2, 125.8, 128.6, 128.7, 128.8, 130.1, 130.2, 130.8, 130.9, 132.6, 134.5, 137.1, 137.8, 150.5, 167.6 ppm.

6-Chloro-4-phenyl-2-(*p*-tolyl)quinazoline (4b).

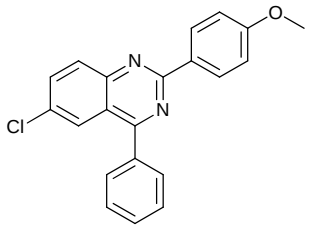


^{1}H NMR (500 MHz, $CDCl_3$) δ: 2.44 (s, 3H), 7.33 (d, J = 8.0 Hz, 2H), 7.61-7.63 (m, 3H), 7.81 (dd, J = 9.0, 2.0 Hz, 1H), 7.85-7.87 (m, 2H), 8.07-8.09 (m, 2H), 8.56 (dd, J = 8.5, 2.0 Hz, 2H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 21.6, 122.1, 125.8, 128.6, 128.7, 129.4, 130.1, 130.2, 130.8, 132.3, 134.4, 135.8, 137.2, 141.1, 150.5, 160.6, 167.4 ppm.

Anal. Calcd for $C_{21}H_{15}ClN_2$: C, 76.24; H, 4.57; N, 8.47. Found: C, 76.05; H, 4.74; N, 8.30.

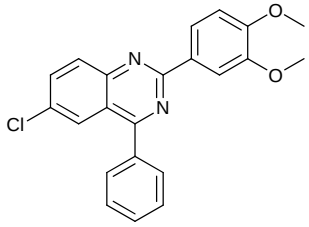
6-Chloro-2-(4-methoxyphenyl)-4-phenylquinazoline (4c).



^{1}H NMR (500 MHz, $CDCl_3$) δ: 3.90 (s, 3H), 7.03 (d, J = 8.5 Hz, 2H), 7.60-7.64 (m, 3H), 7.78 (dd, J = 9.0, 2.5 Hz, 1H), 7.84-7.86 (m, 2H), 8.03-8.06 (m, 2H), 8.13 (d, J = 8.5 Hz, 2H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 113.9, 121.9, 125.8, 128.8, 130.1, 130.4, 130.5, 132.0, 134.4, 137.2, 150.6, 160.3, 161.9, 167.4 ppm.

6-Chloro-2-(3,4-dimethoxyphenyl)-4-phenylquinazoline (4d).



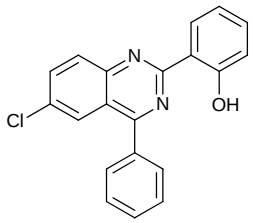
IR (neat): 3001, 2906, 2837, 1598, 1560, 1475, 1386, 1305, 1232, 1215, 1178, 1157, 1072, 1028, 985, 860, 779 cm^{-1};

^{1}H NMR (500 MHz, $CDCl_3$) δ: 3.98 (s, 3H), 4.06 (s, 3H), 7.01 (d, J = 8.5 Hz, 1H), 7.62-7.64 (m, 3H), 7.80 (dd, J = 9.0, 2.0 Hz, 1H), 7.85-7.87 (m, 2H), 8.06-8.08 (m, 2H), 8.24 (d, J = 2.0 Hz, 1H), 8.33 (dd, J = 8.5, 2.0 Hz, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 55.5, 55.6, 110.3, 110.7, 121.4, 121.8, 125.3, 128.2, 129.5, 129.6, 130.2, 130.2, 131.6, 133.9, 136.7, 148.6, 150.1, 151.1, 159.7, 166.9 ppm;

Anal. Calcd for $C_{22}H_{17}ClN_2O_2$: C, 70.12; H, 4.55; N, 7.43. Found: C, 70.30; H, 4.36; N, 7.61.

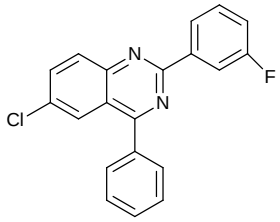
2-(6-Chloro-4-phenylquinazolin-2-yl)phenol (4e).



^{1}H NMR (500 MHz, $CDCl_3$) δ: 6.99 (t, J = 8.0 Hz, 1H), 7.07 (d, J = 8.0 Hz, 1H), 7.42 (dd, J = 8.5, 1.5 Hz, 1H), 7.62-7.65 (m, 3H), 7.85-7.87 (m, 3H), 8.02 (d, J = 9.0 Hz, 1H), 8.11 (d, J = 2.0 Hz, 1H), 7.70 (dd, J = 8.0, 1.5 Hz, 1H), 13.58 (s, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 117.9, 119.0, 119.1, 121.7, 126.2, 128.9, 129.4, 129.9, 130.0, 130.7, 132.9, 133.4, 131.3, 136.4, 160.9, 161.1 ppm.

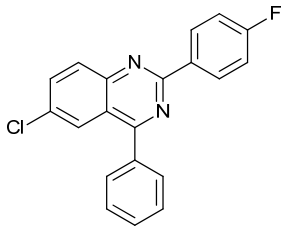
6-Chloro-2-(3-fluorophenyl)-4-phenylquinazoline (4f).



^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.20 (td, J = 8.0, 2.0 Hz, 1H), 7.47-7.51 (m, 3H), 7.62-7.64 (m, 3H), 7.83-7.88 (m, 3H), 8.09-8.11 (m, 2H), 8.36-8.39 (m, 1H), 8.47 (d, J = 7.5 Hz, 1H), 8.36-8.39 (m, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 115.4 (d, $^{2}J_{CF}$ = 22.6 Hz), 117.6 (d, $^{2}J_{CF}$ = 20.8 Hz), 122.3, 124.3, 125.8, 128.8, 130.0 (d, $^{3}J_{CF}$ = 7.4 Hz), 130.4, 130.9, 136.9, 140.2, 150.4, 159.2, 163.5 (d, $^{1}J_{CF}$ = 244.9 Hz), 167.6 ppm.

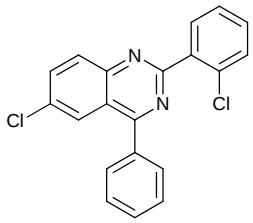
6-Chloro-2-(4-fluorophenyl)-4-phenylquinazoline (4g).



^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.20 (t, J = 8.5 Hz, 2H), 7.61-7.63 (m, 3H), 7.82 (dd, J = 9.0, 2.5 Hz, 1H), 7.84-7.86 (m, 2H), 8.06-8.09 (m, 2H), 8.67-8.70 (m, 2H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 115.5 (d, $^{2}J_{CF}$ = 21.4 Hz), 122.1, 125.8, 128.8, 130.3, 130.8 (d, $^{3}J_{CF}$ = 8.4 Hz), 132.6, 133.9, 134.6, 137.0, 150.5, 159.5, 164.7 (d, $^{1}J_{CF}$ = 249.1 Hz), 167.6 ppm.

6-Chloro-2-(2-chlorophenyl)-4-phenylquinazoline (4h).

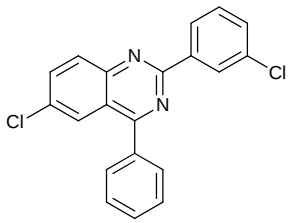


^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.39-7.43 (m, 2H), 7.53-7.55 9(m, 1H), 7.60-7.62 (m,3H), 7.85-7.92 (m, 4H), 8.14 (d, J = 9.0 Hz, 1H), 8.17 (d, J = 2.0 Hz, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 119.4, 123.3, 124.4, 126.3, 127.6, 127.8, 127.9, 128.1, 128.3, 129.3, 130.6, 131.0, 132.3, 134.1, 135.5, 147.6, 159.0, 165.0 ppm.

Anal. Calcd for $C_{20}H_{12}Cl_2N_2$: C, 68.39; H, 3.44; N, 7.98. Found: C, 68.58; H, 3.26; N, 8.15.

6-Chloro-2-(3-chlorophenyl)-4-phenylquinazoline (4i).



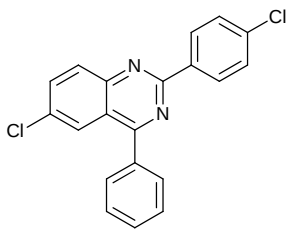
IR (neat): 3064, 1560, 1533, 1477, 1404, 1382, 1303, 1240, 1168, 1136, 1072, 985, 844, 808, 765 cm^{-1};

^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.44-7.49 (m, 2H), 7.63-7.64 (m, 3H), 7.83-7.87 (m, 3H), 8.09-8.11 (m, 2H), 8.57 (d, J = 7.0 Hz, 1H), 8.68 (s, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 122.4, 125.8, 126.8, 128.7, 128.8, 129.8, 130.1, 130.4, 130.7, 130.9, 133.1, 134.7, 134.8, 136.9, 139.7, 150.4, 159.1, 167.7 ppm;

Anal. Calcd for $C_{20}H_{12}Cl_2N_2$: C, 68.39; H, 3.44; N, 7.98. Found: C, 68.56; H, 3.26, N, 8.15.

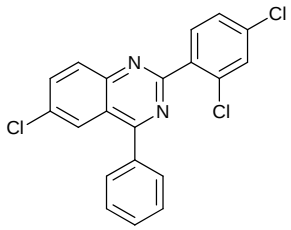
6-Chloro-2-(4-chlorophenyl)-4-phenylquinazoline (4j).



^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.49 (d, J = 8.5 Hz, 2H), 7.62-7.63 (m, 3H), 7.82-7.86 (m, 3H), 8.08 (dd, J = 7.5, 2.5 Hz, 2H), 8.63 (d, J = 8.5 Hz, 2H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 122.2, 125.8, 128.8, 130.0, 130.3, 130.8, 132.9, 134.7, 138.3, 136.9, 137.0, 150.5, 159.5, 167.7 ppm.

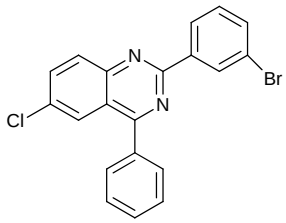
6-Chloro-2-(2,4-dichlorophenyl)-4-phenylquinazoline (4k).



^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.40 (dd, J = 8.5, 2.0 Hz, 1H), 7.57 (d, J = 2.0 Hz, 1H), 7.60-7.62 (m, 3H), 7.84-7.86 (m, 2H), 7.88-7.91 (m, 2H), 8.12 d, J = 9.0 Hz, 1H), 8.17 (d, J = 2.0 Hz, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 121.9, 125.9, 127.3, 128.9, 130.1, 130.4, 130.5, 130.9, 132.9, 133.8, 134.1, 134.9, 135.8, 136.5, 136.6, 150.1, 160.5, 167.6 ppm.

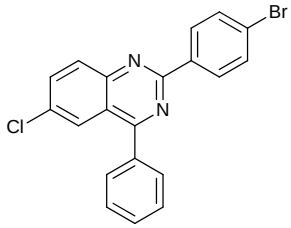
2-(3-Bromophenyl)-6-chloro-4-phenylquinazoline (4l).



^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.39 (t, J = 7.5 Hz, 1H), 7.62-7.64 (m, 4H), 7.82-7.87 (m, 3H), 8.07-8.10 (m, 2H), 8.61 (d, J = 7.5 Hz, 1H), 8.82 (d, J = 1.5 Hz, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 121.8, 122.4, 125.4, 126.7, 128.2, 129.6, 129.9, 130.4, 131.6, 133.1, 134.2, 136.4, 139.4, 149.9, 158.4, 167.2 ppm.

2-(4-Bromophenyl)-6-chloro-4-phenylquinazoline (4m).

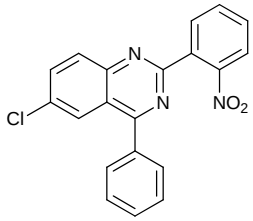


^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.33 (d, J = 8.0 Hz, 2H), 7.61-7.62 (m, 3H), 7.80 (dd, J = 9.0, 2.0 Hz, 1H), 7.85-7.87 (m, 2H), 8.06-8.08 (m, 2H), 8.56 ((d, J = 8.0 Hz, 2H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 122.1, 125.8, 128.6, 128.8, 129.4, 130.1, 130.2, 130.8, 132.3, 134.4, 135.1, 137.2, 141.1, 150.5, 160.5, 167.5 ppm.

Anal. Calcd for $C_{20}H_{12}BrClN_2$: C, 60.71; H, 3.06; N, 7.08. Found: C, 60.90; H, 2.90, N, 6.89.

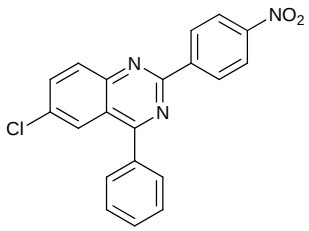
6-Chloro-2-(2-nitrophenyl)-4-phenylquinazoline (4n).



^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.39 (t, J = 8.0 Hz, 1H), 7.56 (t, J = 7.0 Hz, 1H), 7.60-7.63 (m, 3H), 7.87-7.92 (m, 3H), 8.14 (t, J = 8.5 Hz, 2H), 8.64 (d, J = 8.0 Hz, 1H), 8.86 (d, J = 1.5 Hz, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 121.9, 122.9, 127.1, 127.2, 127.4, 128.6, 129.2, 130.1, 130.2, 131.6, 133.4, 133.8, 137.5, 140.3, 151.9, 158.8, 168.5 ppm.

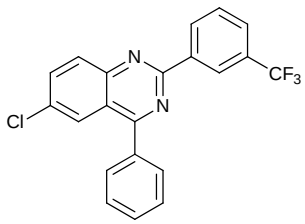
6-Chloro-2-(4-nitrophenyl)-4-phenylquinazoline (4o).



^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.63-7.65 (m, 3H), 7.84-7.88 (m, 3H), 8.12 (d, J = 9.0 Hz, 2H), 8.35 (d, J = 9.0 Hz, 2H), 8.84 (d, J = 8.5 Hz, 2H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 122.5, 123.7, 125.9, 128.9, 129.5, 130.0, 130.6, 131.1, 133.8, 135.0, 136.7, 143.6, 149.3, 150.3, 158.2, 167.9 ppm.

6-Chloro-4-phenyl-2-(3-(trifluoromethyl)phenyl)quinazoline (4p).



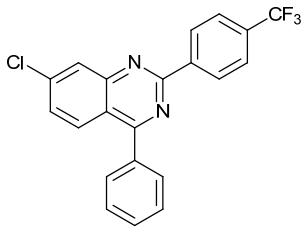
IR (neat): 3053, 1560, 1537, 1479, 1388, 1326, 1307, 1116, 1072, 1060, 1014, 889, 837, 773 cm^{-1};

^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.65-7.67 (m, 3H), 7.79 (d, J = 8.5 Hz, 2H), 7.87-7.89 (m, 3H), 8.14-8.16 (m, 2H), 8.82(d, J = 8.0 Hz, 2H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 122.4, 124.2 (q, $^{1}J_{FC}$ = 270.8 Hz), 125.4 (q, $^{3}J_{FC}$ = 3.7 Hz), 125.9 128.8, 128.9, 130.0, 130.4, 131.0, 132.2 (q, $^{2}J_{FC}$ = 32.0 Hz), 133.3, 134.8, 136.9, 141.1, 150.4, 159.0, 167.8 ppm;

Anal. Calcd for $C_{21}H_{12}ClF_3N_2$: C, 65.55; H, 3.14; N, 7.28. Found: C, 65.72; H, 2.98, N, 7.10.

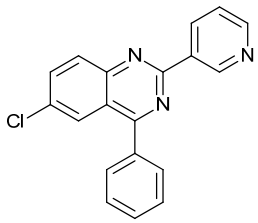
6-Chloro-4-phenyl-2-(4-(trifluoromethyl)phenyl)quinazoline (4q).



^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.64 (t, J = 7.5 Hz, 2H), 7.77 (d, J = 8.0 Hz, 2H), 7.86-7.88 (m, 3H), 8.11-8.13 (m, 2H), 8.79 (d, J = 8.0 Hz, 2H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 122.4, 125.4 (q, $^{3}J_{FC}$ = 3.5 Hz), 125.8, 127.8 (q, $^{1}J_{FC}$ = 283.0 Hz), 128.9, 129.0, 1301., 130.2, 130.4, 132.2 (q, $^{2}J_{FC}$ = 31.9 Hz), 133.3, 134.8, 136.8, 141.0, 150.3, 159.0, 167.8 ppm;

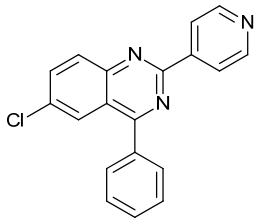
6-Chloro-4-phenyl-2-(pyridin-3-yl)quinazoline (4r).



^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.45 (dd, J = 8.0, 5.0 Hz, 1H), 7.64 (t, J = 8.0 Hz, 3H), 7.85-7.88 (m, 3H), 8.11-8.13 (m, 2H), 8.74 (dd, J = 5.0, 1.5 Hz, 1H), 8.92 (d, J = 8.0 Hz, 1H), 9.86 (d, J = 1.5 Hz, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 122.5, 123.5, 126.0, 128.9, 130.2, 131.0, 133.3, 133.4, 134.9, 135.9, 136.9, 150.5, 151.5, 158.8, 167.9 ppm.

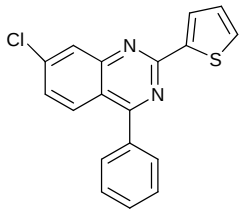
6-Chloro-4-phenyl-2-(pyridin-4-yl)quinazoline (4s).



^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.20 (t, J = 8.0 Hz, 2H), 7.62-7.64 (m, 3H), 7.82 (dd, J = 9.0, 2.5 Hz, 1H), 7.84-7.87 (m, 2H), 8.07 (d, J = 9.0 Hz, 1H), 8.09-8.11 (m, 1H), 8.37-8.48 (m, 1H), 8.68 (dd, J = 9.0, 5.5 Hz, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 115.5, 115.6, 117.7, 122.1, 124.3, 125.8, 128.8, 130.0, 130.3, 130.7, 130.9, 132.7, 134.6, 137.0, 150.5, 159.5, 167.6 ppm.

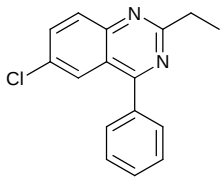
7-Chloro-4-phenyl-2-(thiophen-2-yl)quinazoline (4t).



^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.18 (dd, J = 5.0, 4.0 Hz, 1H), 7.52 (dd, J = 5.0, 2.0 Hz, 1H), 7.79 (dd, J = 9.0, 2.5 Hz, 1H), 7.83-7.86 (m, 2H), 8.01 (d, J = 9.0 Hz, 1H), 8.04 (d, J = 2.0 Hz, 1H), 8.19 (dd, J = 4.0, 1.5 Hz, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 121.5, 125.5, 127.8, 128.3, 129.2, 129.7, 129.8, 129.9, 131.8, 134.2, 136.3, 143.3, 149.9, 157.0, 167.2 ppm.

6-Chloro-2-ethyl-4-phenylquinazoline (4u).



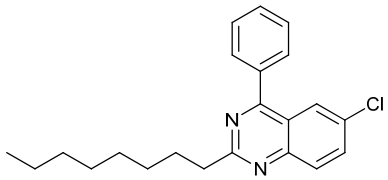
IR (neat): 2976, 1652, 1548, 1521, 1477, 1390, 1375, 1265, 1141, 900, 842 cm^{-1};

^{1}H NMR (500 MHz, $CDCl_3$) δ: 1.49 (t, J = 7.5 Hz, 3H), 3.19 (q, J = 7.5 Hz, 2H), 7.55-7.62 (m, 3H), 7.73-7.75 (m, 1H), 7.79 (d, J = 9.0 Hz, 1H), 7.99 (d, J = 8.5 Hz, 1H), 8.03 (s, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 12.9, 33.1, 121.7, 125.7, 128.8, 129.8, 130.0, 130.1, 132.2, 134.3, 136.9, 149.9, 167.7, 168.3 ppm;

Anal. Calcd for $C_{16}H_{13}ClN_2$: C, 71.51; H, 4.88; N, 10.42. Found: C, 71.33; H, 5.05, N, 10.25.

6-Chloro-2-octyl-4-phenylquinazoline (4v).



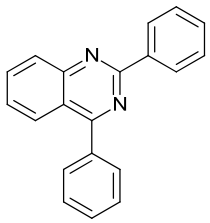
IR (neat): 2918, 1548, 1479, 1467, 1413, 1340, 1272, 1139, 1083, 931, 837 cm^{-1};

^{1}H NMR (500 MHz, $CDCl_3$) δ: 0.87 (t, J = 7.0 Hz, 3H), 1.22-1.33 (m, 6H), 1.37 (quin, J = 7.0 Hz, 2H), 1.46 (quin, J = 7.0 Hz, 2H), 1.96 (quin, J = 7.0 Hz, 2H), 3.15 (t, J = 7.0 Hz, 2H), 7.56-7.59 (m, 3H), 7.73-7.78 (m, 3H), 7.97 (d, J = 9.0 Hz, 1H), 8.01 (d, J = 2.0 Hz, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 14.1, 22.6, 28.9, 29.2, 29.5, 29.6, 31.8, 40.0, 121.7, 125.6, 128.7, 129.8, 130.0, 130.1, 132.2, 134.3, 136.9, 149.9, 167.5, 167.6 ppm;

Anal. Calcd for $C_{22}H_{25}ClN_2$: C, 74.88; H, 7.14; N, 7.94. Found: C, 75.06; H, 6.95, N, 8.15.

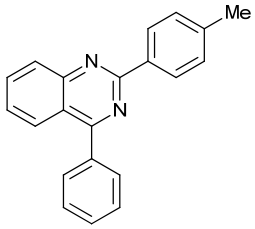
2,4-Diphenylquinazoline (4w).



^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.50-7.57 9m, 4H), 7.60-7.63 (m, 3H), 7.88-7.91 (m, 3H), 8.13 (d, J = 8.5 Hz, 1H), 8.16 (d, J = 8.0 Hz, 1H), 8.70 (d, J = 7.0 Hz, 2H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 121.2, 126.5, 128.1, 128.2, 128.7, 129.5, 129.7, 130.1, 133.1, 137.2, 137.8, 151.6, 159.8, 167.8 ppm.

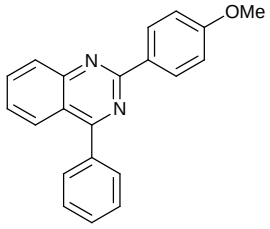
4-Phenyl-2-(*p*-tolyl)quinazoline (4x).



^{1}H NMR (500 MHz, $CDCl_3$) δ: 2.45 (s, 3H), 7.33 (d, J = 8.0 Hz, 2H), 7.53 (t, J = 7.5 Hz, 1H), 7.59-7.62 (m, 3H), 7.86-7.90 (m, 3H), 8.11 (d, J = 8.0 Hz, 1H), 8.14 (d, J = 8.5 Hz, 1H), 8.59 (d, J = 8.5 Hz, 2H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 21.1, 121.2, 126.3, 126.5, 128.1, 128.2, 128.6, 128.9, 129.4, 129.8, 133.0, 135.1, 137.3, 140.3, 151.6, 159.9, 167.7 ppm.

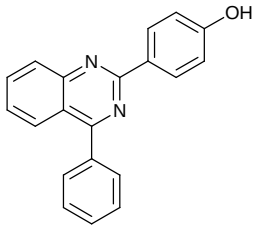
2-(4-Methoxyphenyl)-4-phenylquinazoline (4y).



^{1}H NMR (500 MHz, $CDCl_3$) δ: 3.89 (s, 3H), 7.04 (d, J = 8.5 Hz, 2H), 7.50 (t, J = 7.5 Hz, 1H), 7.59-7.62 (m, 3H), 7.84-7.89 (m, 3H), 8.10 (t, J = 8.0 Hz, 2H), 8.66 (d, J = 8.5 Hz, 2H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 54.9, 113.4, 120.9, 126.1, 126.5, 128.0, 128.5, 129.4, 129.7, 129.8, 130.5, 132.3, 151.6, 159.6, 161.3, 167.7 ppm.

4-(4-Phenylquinazolin-2-yl)phenol (4z).



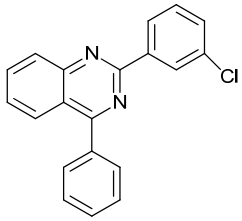
IR (neat): 3031, 1606, 1537, 1517, 1433, 1340, 1278, 1234, 1161, 1101, 999, 846, 777 cm^{-1};

^{1}H NMR (500 MHz, $CDCl_3$) δ: 5.54 (br s, 1H), 6.95 (d, J = 8.5 Hz, 2H), 7.52 (t, J = 7.5 Hz, 1H), 7.59-7.61 (m, 3H), 7.85-7.89 (m, 3H) , 8.11 (t, J = 9.0 Hz, 2H), 8.59 (d, J = 9.0 Hz, 2H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 115.0, 120.9, 126.1, 126.6, 128.0, 128.2, 129.4, 129.7, 130.2, 130.3, 133.1, 137.2, 151.43 157.7, 159.7, 167.9 ppm;

Anal. Calcd for $C_{20}H_{14}N_2O$: C, 80.52; H, 4.73; N, 9.39. Found: C, 80.70; H, 4.92, N, 9.21.

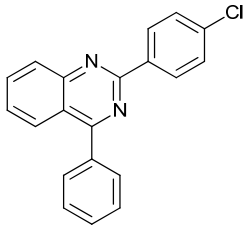
2-(3-Chlorophenyl)-4-phenylquinazoline (4aa).



^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.44-7.48 (m, 2H), 7.58 (t, J = 8.0 Hz, 1H), 7.61-7.63 (m, 3H), 7.88-7.93 (m, 3H), 8.15 (t, J = 8.0 Hz, 2H), 8.58-8.60 (m, 1H), 8.70 (s, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 121.4, 126.3, 126.6, 126.9, 128.1, 128.2, 128.7, 129.3, 129.6, 129.8, 130.0, 133.2, 134.2, 137.0, 139.7, 151.4, 158.4, 168.0 ppm.

2-(4-Chlorophenyl)-4-phenylquinazoline (4ab).



^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.48 (d, J = 8.5 Hz, 2H), 7.54-7.61 (m, 4H), 7.87-7.91 (m, 3H), 8.12-8.14 (m, 2H), 8.65 (d, J = 8.0 Hz, 2H) ppm;

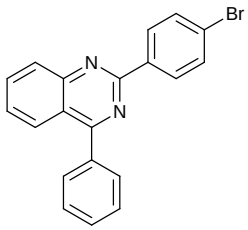
^{13}C NMR (125 MHz, $CDCl_3$) δ: 121.2, 126.6, 126.7, 128.1, 128.4, 128.7, 129.5, 129.7, 130.4, 133.2, 137.1, 151.5, 158.7, 167.9 ppm.

2-(3-Bromophenyl)-4-phenylquinazoline (4ac).

^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.50-7.54 (m, 3H), 7.61-7.64 (m, 3H), 7.82 (dd, J = 7.5, 2.5 Hz, 1H), 7.87 (dd, J = 7.5, 2.5 Hz, 2H), 8.09-8.11 (m, 2H), 8.68 (dd, J = 8.0, 2.0 Hz, 2H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 122.2, 125.8, 128.6, 128.7, 130.3, 130.8, 132.6, 134.5, 137.1, 137.8, 150.5, 160.5, 167.6 ppm.

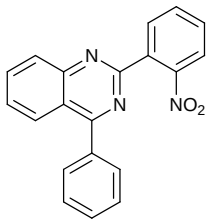
2-(4-Bromophenyl)-4-phenylquinazoline (4ad).



^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.57 (t, J = 8.0 Hz, 1H), 7.59-7.61 (m, 3H), 7.65 (d, J = 8.5 Hz, 2H), 7.87-7.92 (m, 3H), 8.13 (d, J = 7.5 Hz, 1H), 8.14 (d, J = 8.5 Hz, 1H), 8.58 (d, J = 8.5 Hz, 2H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 121.3, 124.8, 126.6, 126.8, 128.1, 128.7, 129.6, 129.7, 129.8, 131.2, 133.2, 136.7, 137.5, 151.5, 158.8, 167.9 ppm.

2-(2-Bromophenyl)-4-phenylquinazoline (4ae).

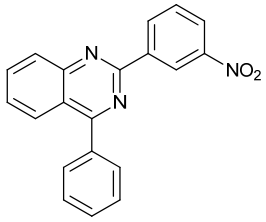


^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.56-7.59 (m, 4H), 7.62 (t, J = 8.0 Hz, 1H), 7.70 (t, J = 7.5 Hz, 1H), 7.80-7.82 (m, 2H), 7.88 (d, J = 8.0 Hz, 1H), 7.92 (t, J = 8.5 Hz, 1H), 8.14 (d, J = 8.0 Hz, 1H), 8.18 (d, J = 8.0 Hz, 1H), 7.21 (d, J = 7.5 Hz, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 121.6, 124.2, 127.2, 128.1, 129.2, 130.1, 130.3, 131.8, 132.3, 134.1, 136.9, 150.2, 151.7, 158.9, 168.5 ppm.

Anal. Calcd for $C_{20}H_{13}N_3O_2$: C, 73.38; H, 4.00; N, 12.84. Found: C, 73.56; H, 3.82, N, 13.01.

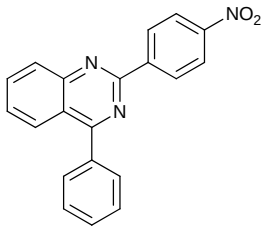
2-(3-Nitrophenyl)-4-phenylquinazoline (4af).



^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.60-7.63 (m, 4H), 7.69 (t, J = 8.0 Hz, 1H), 7.88-7.90 (m, 2H), 7.94 (t, J = 8.0 Hz, 1H), 8.18 (t, J = 8.0 Hz, 2H), 8.33 (d, J = 9.0 Hz, 1H), 9.04 (d, J = 8.0 Hz, 1H), 9.53 (s, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 121.6, 123.1, 124.5, 126.7, 127.4, 128.9, 129.8, 133.5, 133.9, 136.8, 139.6, 148.3, 151.4, 157.4, 168.3 ppm.

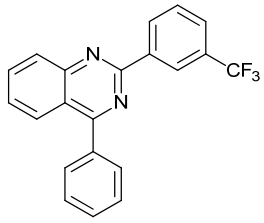
2-(4-Nitrophenyl)-4-phenylquinazoline (4ag).



^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.62-7.65 (m, 4H), 7.88-7.90 (m, 2H), 7.96 (t, J = 7.5 Hz, 1H), 8.19 (t, J = 8.0 Hz, 2H), 8.37 (d, J = 9.0 Hz, 2H), 8.89 (d, J = 9.0 Hz, 2H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 121.5, 123.2, 126.6, 128.2, 128.9, 129.0, 129.7, 129.8, 133.6, 136.8, 143.6, 148.7, 151.4, 157.5, 168.3 ppm.

4-Phenyl-2-(3-(trifluoromethyl)phenyl)quinazoline (4ah).



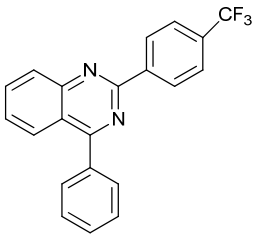
IR (neat): 3070, 1614, 1566, 1541, 1483, 1392, 1346, 1332, 1309, 1272, 1226, 1157, 1124, 1089, 1070, 1001, 920, 777 cm^{-1};

^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.60-7.68 (m, 5H), 7.77 (d, J = 8.0 Hz, 1H), 7.91-7.96 (m, 3H), 8.18 (d, J = 8.0 Hz, 1H), 8.20 (d, J = 8.5 Hz, 1H), 8.92 (d, J = 8.0 Hz, 1H), 9.01 (s, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 121.9, 124.3 (q, $^1J_{FC}$ = 270.8 Hz), 125.5 (q, $^3J_{FC}$ = 3.7 Hz), 126.9 (q, $^3J_{FC}$ = 3.7 Hz), 127.1, 127.5, 128.6, 128.9, 129.2, 130.1, 130.2, 130.9 (q, $^2J_{FC}$ = 32.1 Hz), 131.8, 133.8, 137.4, 139.1, 151.9, 158.7, 168.6 ppm;

Anal. Calcd for $C_{21}H_{13}F_3N_2$: C, 71.99; H, 3.74; N, 8.00. Found: C, 72.16; H, 3.93, N, 8.18.

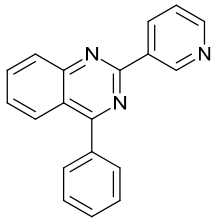
4-Phenyl-2-(4-(trifluoromethyl)phenyl)quinazoline (4ai).



^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.56 (t, J = 8.0 Hz, 1H), 7.61-7.63 (m, 3H), 7.78 (d, J = 8.0 Hz, 2H), 7.86-7.89 (m, 3H), 8.14 (t, J = 8.5 Hz, 2H), 8.81 (d, J = 8.0 Hz, 2H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 121.9, 125.1(q, $^{1}J_{FC}$ = 270.8 Hz), 125.4 (q, $^{3}J_{FC}$ = 3.6 Hz), 127.1, 127.6, 128.6, 129.3, 130.1, 131.8 (q, $^{2}J_{FC}$ = 32.0 Hz), 133.8, 137.4, 141.9, 158.7, 168.5 ppm;

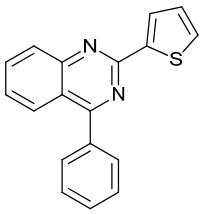
4-Phenyl-2-(pyridin-3-yl)quinazoline (4aj).



^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.45 (dd, J = 8.0, 5.0 Hz, 1H), 7.58-7.62 (m, 4H), 7.88-7.95 (m, 2H), 7.93 (d, J = 8.0 Hz, 1H), 8.17 (t, J = 7.5 Hz, 2H), 8.74 (dd, J = 5.0, 1.5 Hz, 1H), 8.93 (d, J = 8.0 Hz, 1H), 9.88 (d, J = 1.5 Hz, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 122.0, 123.4, 127.2, 127.7, 128.7, 129.3, 130.2, 130.3, 133.8, 133.9, 136.0, 137.5, 138.5, 151.3, 152.0, 158.5, 168.7 ppm.

4-Phenyl-2-(thiophen-2-yl)quinazoline (4ak).



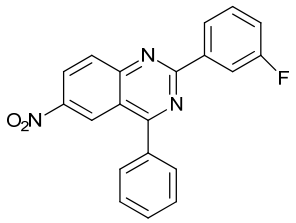
IR (neat): 3045, 1612, 1541, 1485, 1452, 1425, 1386, 1340, 1353, 1217, 1114, 1055, 840, 777 cm^{-1};

^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.18 (dd, J = 5.0, 4.0 Hz, 1H), 7.50-7.53 (m, 2H), 7.58-7.60 (m, 3H), 7.84-7.87 (m, 3H), 8.07-8.09 (m, 2H), 8.20 (dd, J = 4.0, 1.5 Hz, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 121.1, 126.2, 126.7, 127.7, 128.0, 128.3, 128.8, 129.3, 129.5, 129.7, 133.2, 136.8, 143.7, 151.4, 156.8, 167.9 ppm;

Anal. Calcd for $C_{18}H_{12}N_2S$: C, 74.97; H, 4.19; N, 9.71. Found: C, 75.16; H, 4.38, N, 9.90.

2-(3-Fluorophenyl)-6-nitro-4-phenylquinazoline (4al).

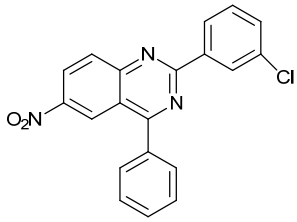


^{1}H NMR (500 MHz, DMSO-d_6) δ: 7.47 (t, J = 8.0 Hz, 1H), 7.64-7.68 (m, 1H), 7.70-7.73 (m, 3H), 7.98 (d, J = 6.0 Hz, 2H), 8.33 (t, J = 8.0 Hz, 2H), 8.48 (d, J = 8.5 Hz, 1H), 8.72 (d, J = 8.5 Hz, 1H), 8.85 (s, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 115.9 (d, $^{2}J_{FC}$ = 23.4 Hz), 118.6 (d, $^{2}J_{FC}$ = 21.3 Hz), 120.7, 124.3, 124.8, 127.1, 129.2, 130.2 (d, $^{3}J_{FC}$ = 8.1 Hz), 130.3, 131.1, 136.2, 139.5 (d, $^{3}J_{FC}$ = 7.8 Hz), 145.7, 154.4, 161.7, 163.2 (d, $^{1}J_{FC}$ = 143.9 Hz), 170.6 ppm;

Anal. Calcd for $C_{20}H_{12}FN_3O_2$: C, 69.56; H, 3.50; N, 12.17;. Found: C, 69.39; H, 3.66, N, 11.98.

2-(3-Chlorophenyl)-6-nitro-4-phenylquinazoline (4am).

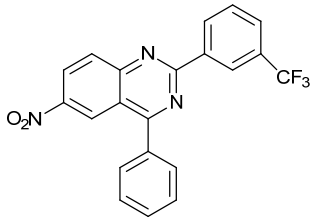


^{1}H NMR (500 MHz, DMSO-d_6) δ: 7.49 (t, J = 8.0 Hz, 1H), 7.53 (d, J = 8.0 Hz, 1H), 7.68-7.70 (m, 3H), 7.90-7.92 (m, 2H), 8.27 (d, J = 9.0 Hz, 2H), 8.63 (d, J = 7.5 Hz, 1H), 8.67 (dd, J = 9.0, 2.5 Hz, 1H), 8.73 (s, 1H), 9.08 (d, J = 2.5 Hz, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 120.7, 124.3, 127.2, 127.3, 129.1, 129.2, 130.3, 131.2, 131.6, 134.9, 136.2, 138.9, 145.7, 154.4, 161.6, 170.7 ppm;

Anal. Calcd for $C_{20}H_{12}ClN_3O_2$: C, 66.40; H, 3.34; N, 11.61;. Found: C, 66.58; H, 3.16, N, 11.80.

6-Nitro-4-phenyl-2-(3-(trifluoromethyl)phenyl)quinazoline (4an).

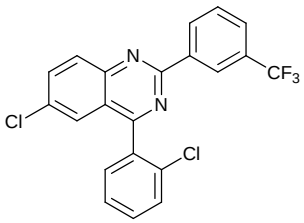


^{1}H NMR (500 MHz, DMSO-d_6) δ: 7.67-7.70 (m, 4H), 7.82 (d, J = 7.5 Hz, 1H), 7.91-7.93 (m, 2H), 8.30 (d, J = 9.0 Hz, 1H), 8.68 (dd, J = 9.0, 2.5 Hz, 1H), 8.94 d, J = 8.0 Hz, 1H), 9.02 (s, 1H), 9.09 (d, J = 2.5 Hz, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 120.7, 124.1 (q, $^1J_{FC}$ = 270.8 Hz), 124.3, 126.0 (q, $^3J_{FC}$ = 3.6 Hz), 127.2, 128.1(q, $^3J_{FC}$ = 3.6 Hz), 129.1, 129.2, 130.3, 130.5, 131.2 (q, $^2J_{FC}$ = 32.4 Hz), 132.3, 136.1, 137.9, 145.8, 154.3, 161.4, 170.8 ppm;

Anal. Calcd for $C_{21}H_{12}F_3N_3O_2$: C, 63.80; H, 3.06; N, 10.63;. Found: C, 63.62; H, 2.88, N, 10.80.

6-Chloro-4-(2-chlorophenyl)-2-(3-(trifluoromethyl)phenyl) quinazoline (4ao).



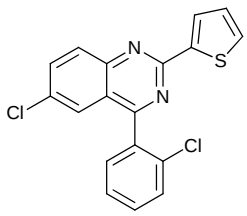
IR (neat): 2918, 2849, 1595, 1541, 1468, 1383, 1333, 1300, 1275, 1169, 1119, 1072, 1053, 988, 916, 835, 768 cm^{-1};

^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.49-7.57 (m, 3H), 7.62-7.63 (m, 3H), 7.76 (d, *J* = 8.0 Hz, 1H), 7.84 (dd, *J* = 9.0, 2.5 Hz, 1H), 8.13 (d, *J* = 9.0 Hz, 1H), 8.84 (d, *J* = 8.0 Hz, 1H), 8.94 (s, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 123.1, 124.2 (q, $^1J_{FC}$ = 270.7 Hz), 125.6 (q, $^3J_{FC}$ = 3.7 Hz), 125.7, 127.1, 127.2 (q, $^3J_{FC}$ = 3.6 HZ), 129.1, 130.2, 130.8, 131.0 (q, $^2J_{FC}$ = 31.5 Hz), 131.1, 131.9, 132.9, 133.4, 135.2, 135.7, 138.5, 149.8, 159.2, 166.7 ppm;

Anal. Calcd for $C_{21}H_{11}Cl_2F_3N_2$: C, 60.16; H, 2.64; N, 6.68. Found: C, 59.98; H, 2.81, N, 6.50.

6-Chloro-4-(2-chlorophenyl)-2-(thiophen-2-yl)quinazoline (4ap).



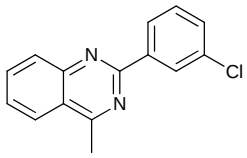
IR (neat): 2918, 2849, 1595, 1541, 1468, 1383, 1333, 1300, 1275, 1169, 1119, 1072, 1053, 988, 916, 881, 835, 825, 808, 768 cm^{-1};

^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.17 (t, *J* = 4.5 Hz, 1H), 7.49-7.54 (m, 5H), 7.60 (d, *J* = 7.5 Hz, 1H), 7.78 (dd, *J* = 9.0, 2.0 Hz, 1H), 8.01 (d, *J* = 9.0 Hz, 1H), 8.16 (d, *J*= 3.5 Hz, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 122.6, 125.7, 127.1, 128.4, 130.0, 130.2, 130.3, 130.4, 130.9, 131.1, 132.5, 132.9, 135.1, 135.6, 143.5, 149.8, 157.6, 166.5 ppm;

Anal. Calcd for $C_{18}H_{10}Cl_2N_2S$: C, 60.51; H, 2.82; N, 7.84. Found: C, 60.32; H, 3.01, N, 8.01.

2-(3-Chlorophenyl)-4-methylquinazoline (4aq).



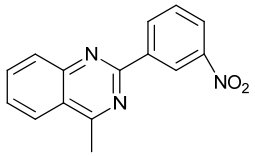
IR (neat): 2922, 1652, 1560, 1490, 1419, 1388, 1340, 1236, 1072, 970, 754 cm^{-1};

^1H NMR (500 MHz, $CDCl_3$) δ: 2.99 (s, 3H), 7.42-7.47 (m, 2H, ArH), 7.59 (t, J = 8.0 Hz, 1H), 7.86 (t, J = 7.5 Hz, 1H), 8.06 (t, J = 9.0 Hz, 2H), 8.50-8.52 (m, 1H), 8.63 (s, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 21.9, 123.1, 124.9, 126.6, 127.2, 128.6, 129.2, 129.7, 130.3, 133.6, 134.6, 140.2, 150.2, 158.7, 168.3 ppm;

Anal. Calcd for $C_{15}H_{11}ClN_2$: C, 70.73; H, 4.35; N, 11.00. Found: C, 70.55; H, 4.18, N, 10.82.

4-Methyl-2-(3-nitrophenyl)quinazoline (4ar).

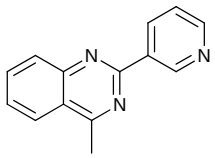


^1H NMR (500 MHz, $CDCl_3$) δ: 3.04 (s, 3H), 7.66 (t, J = 8.0 Hz, 1H), 7.92 (t, J = 8.0 Hz, 1H), 8.10 (d, J = 8.0 Hz, 1H), 8.13 (d, J = 8.0 Hz, 1H), 8.35 (d, J = 9.0 Hz, 2H), 8.81 (d, J = 9.0 Hz, 2H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 21.5, 122.8, 123.2, 124.6, 127.4, 128.9, 129.0, 133.5, 143.7, 148.6, 149.7, 157.4, 168.2 ppm.

Anal. Calcd for $C_{15}H_{11}N_3O_2$: C, 67.92; H, 4.18; N, 15.84. Found: C, 68.10; H, 3.99, N, 15.68.

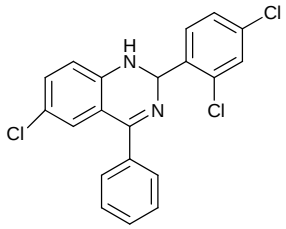
4-Methyl-2-(pyridin-3-yl)quinazoline (4as).



^1H NMR (500 MHz, $CDCl_3$) δ: 7.43 (dd, J = 8.0, 5.0 Hz, 1H), 7.60 (t, J = 8.0 Hz, 1H), 7.86 (td, J = 8.0, 2.0 Hz, 1H), 8.06 (d, J = 8.0 Hz, 1H), 8.08 (d, J = 8.0 Hz, 1H), 8.71 (dd, J = 5.0, 2.0 Hz, 1H), 8.85 (d, J = 8.0 Hz, 1H), 9.80 (d, J = 2.0 Hz, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 21.5, 122.7, 122.8, 124.6, 126.9, 128.8, 133.3, 135.3, 149.8, 150.5, 157.8, 168.1 ppm.

7-Chloro-2-(2,4-dichlorophenyl)-4-phenyl-1,2-dihydroquinazoline (intermediate **IV).**

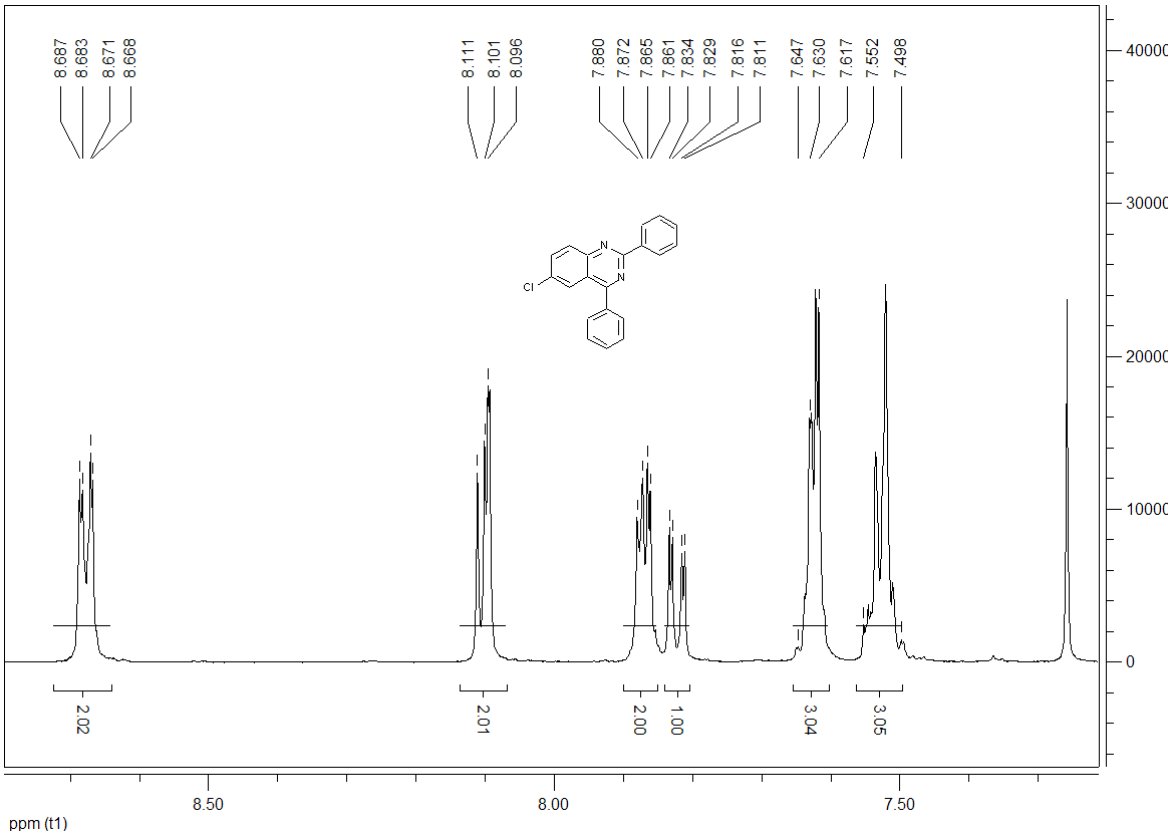


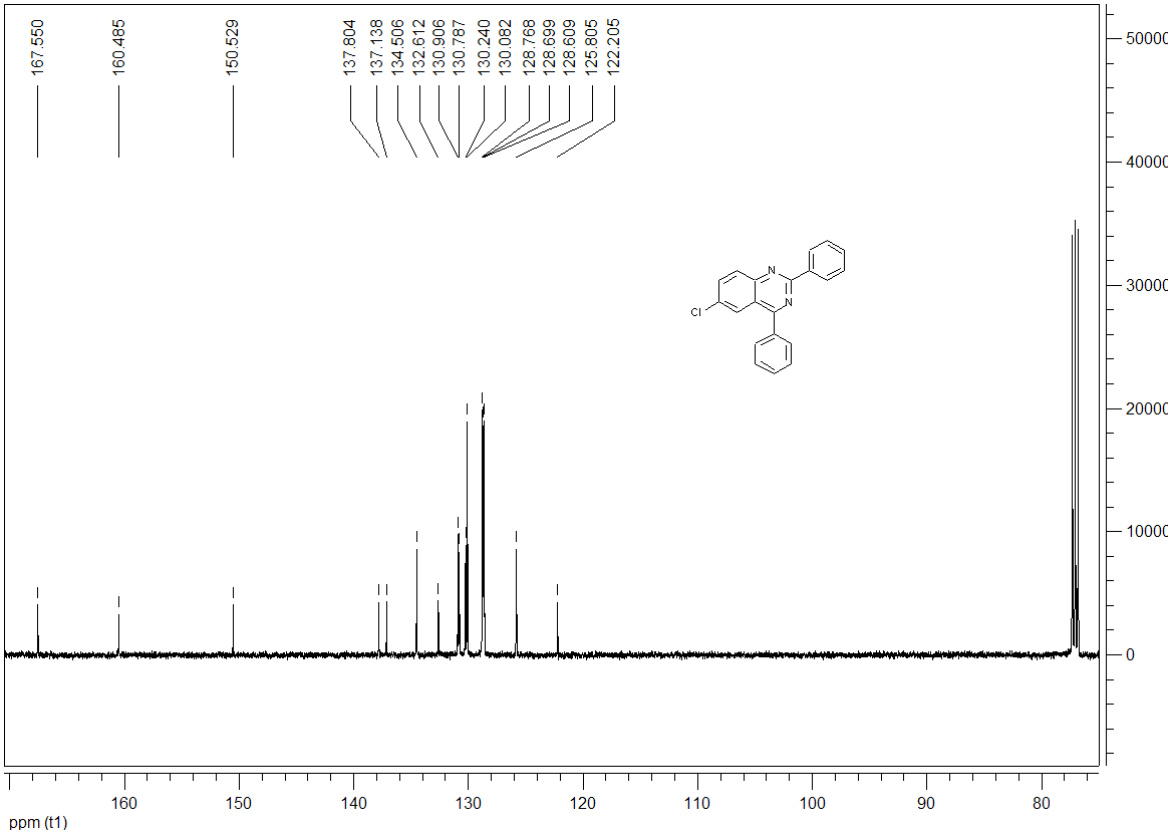
^{1}H NMR (500 MHz, $CDCl_3$) δ: 6.32 (br s, 1H, NH), 6.62 (d, J = 8.5 Hz, 1H), 7.18 (d, J = 2.0 Hz, 1H), 7.21 (dd, J = 9.0, 2.5 Hz, 1H), 7.28 ((dd, J = 8.5, 2.5 Hz, 1H), 7.44 (d, J = 2.0 Hz, 1H), 7.47 (s, 1H), 7.48-7.50 (m, 2H), 7.56-7.62 (m, 3H), 7.68 (d, J = 8.5 Hz, 1H) ppm;

^{13}C NMR (125 MHz, $CDCl_3$) δ: 68.6, 115.8, 118.6, 123.3, 127.7, 128.3, 128.5, 129.0, 129.9, 130.8, 132.8, 133.1, 134.8, 137.2, 137.4, 145.0, 165.9 ppm.

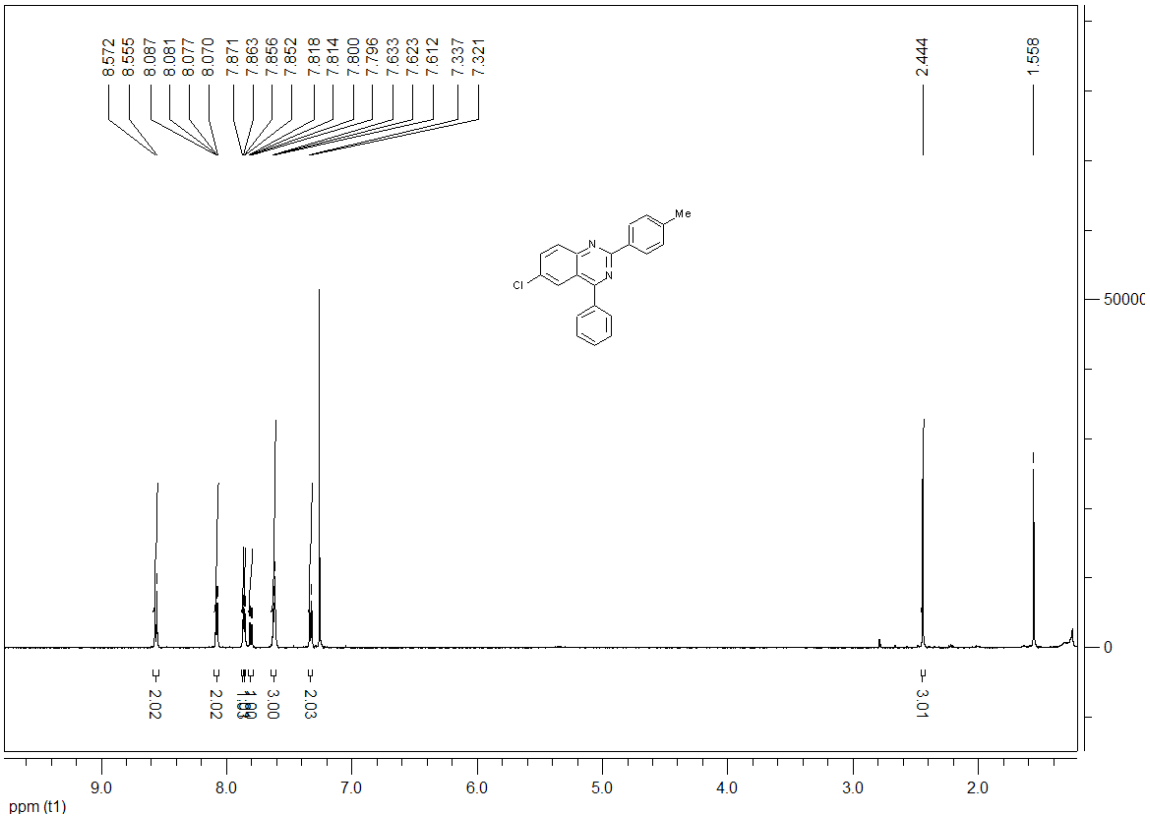
Anal. Calcd for $C_{20}H_{13}Cl_3N_2$: C, 61.96; H, 3.38; N, 7.23. Found: C, 72.15; H, 3.56, N, 7.08.

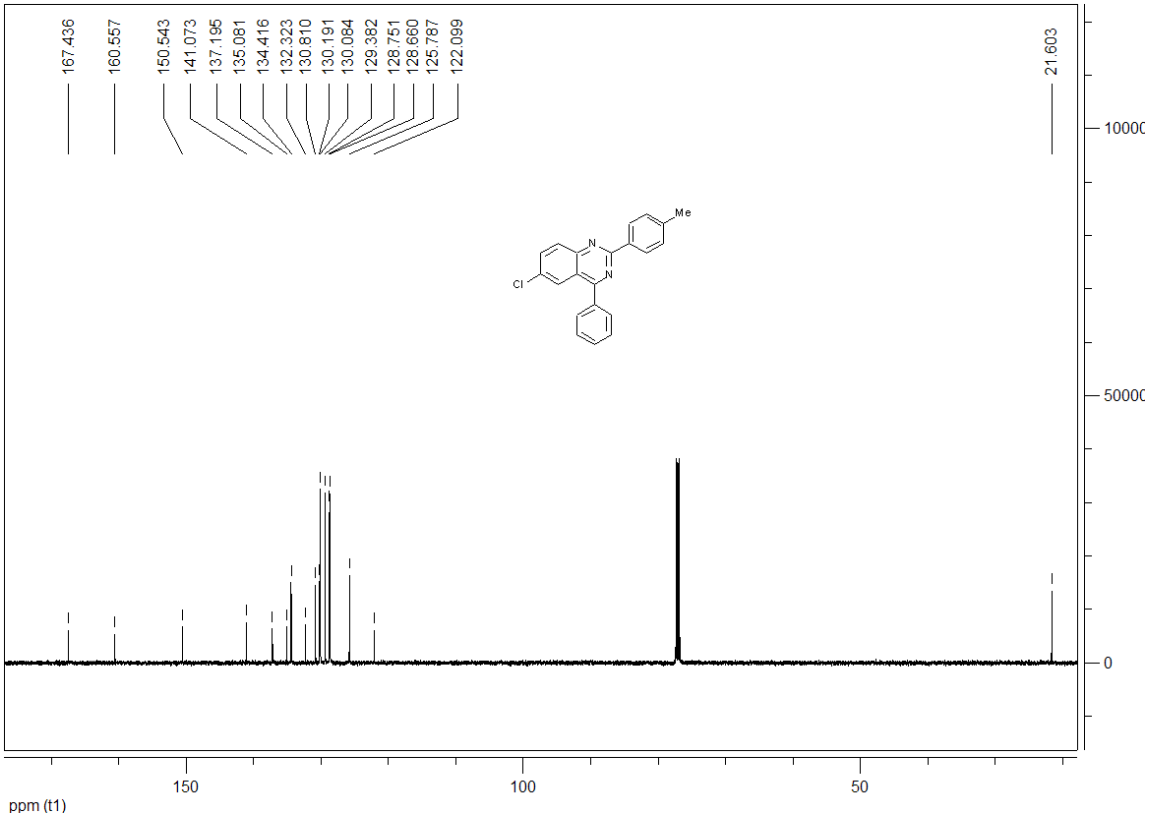
^{1}H NMR and ^{13}C NMR of compound **4a**



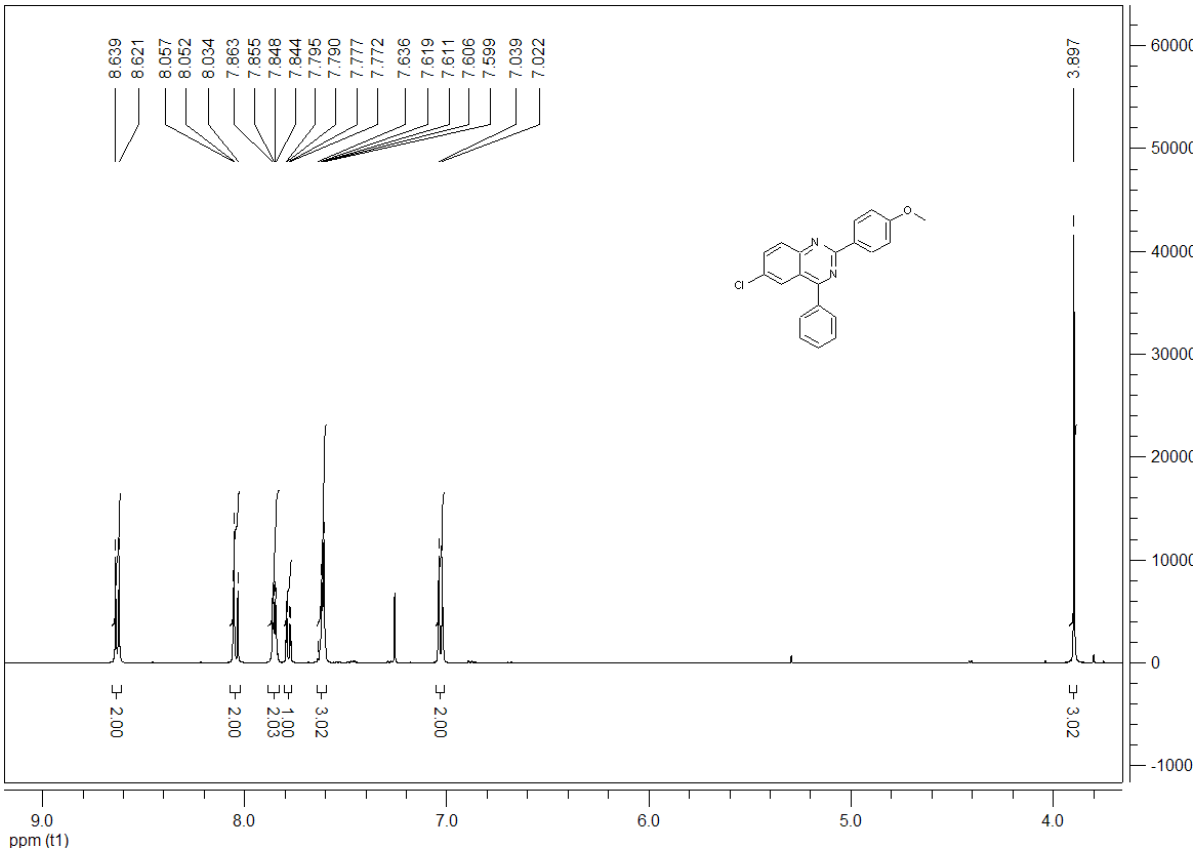


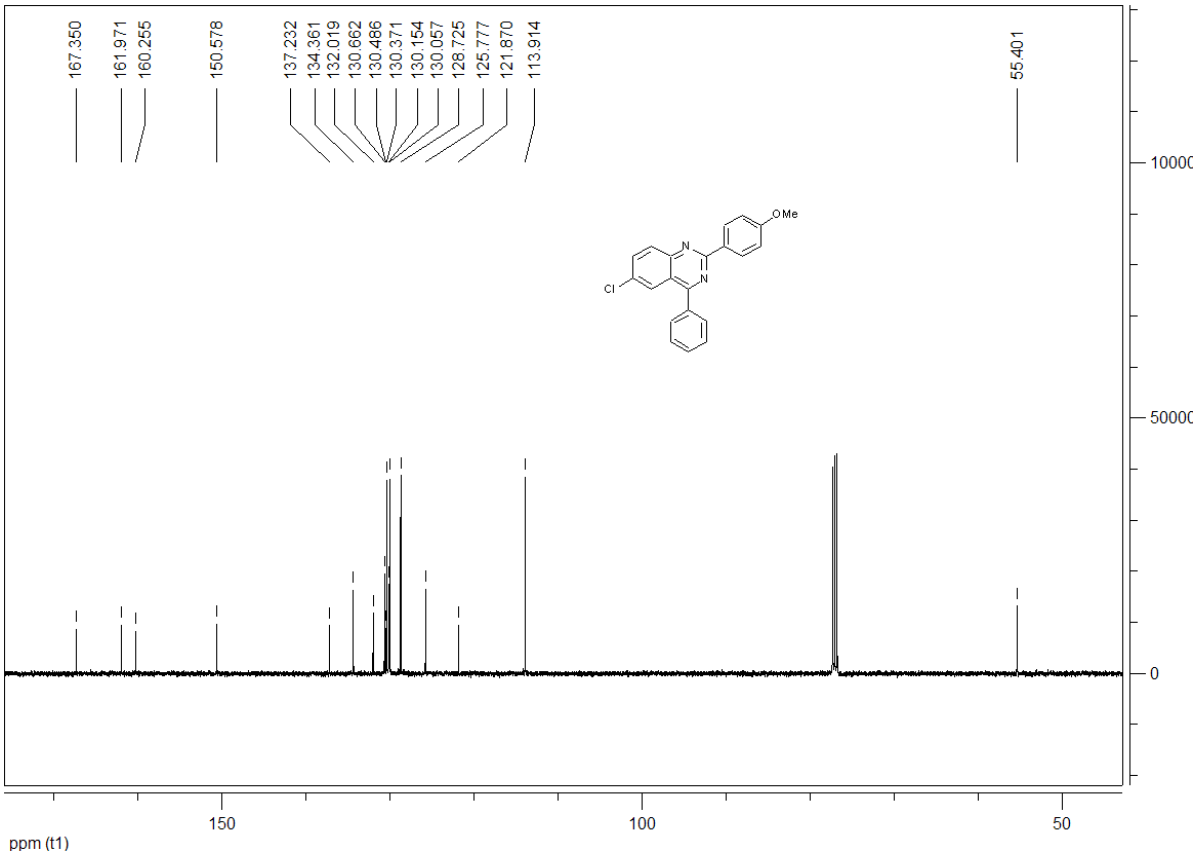
^{1}H NMR and ^{13}C NMR of compound **4b**



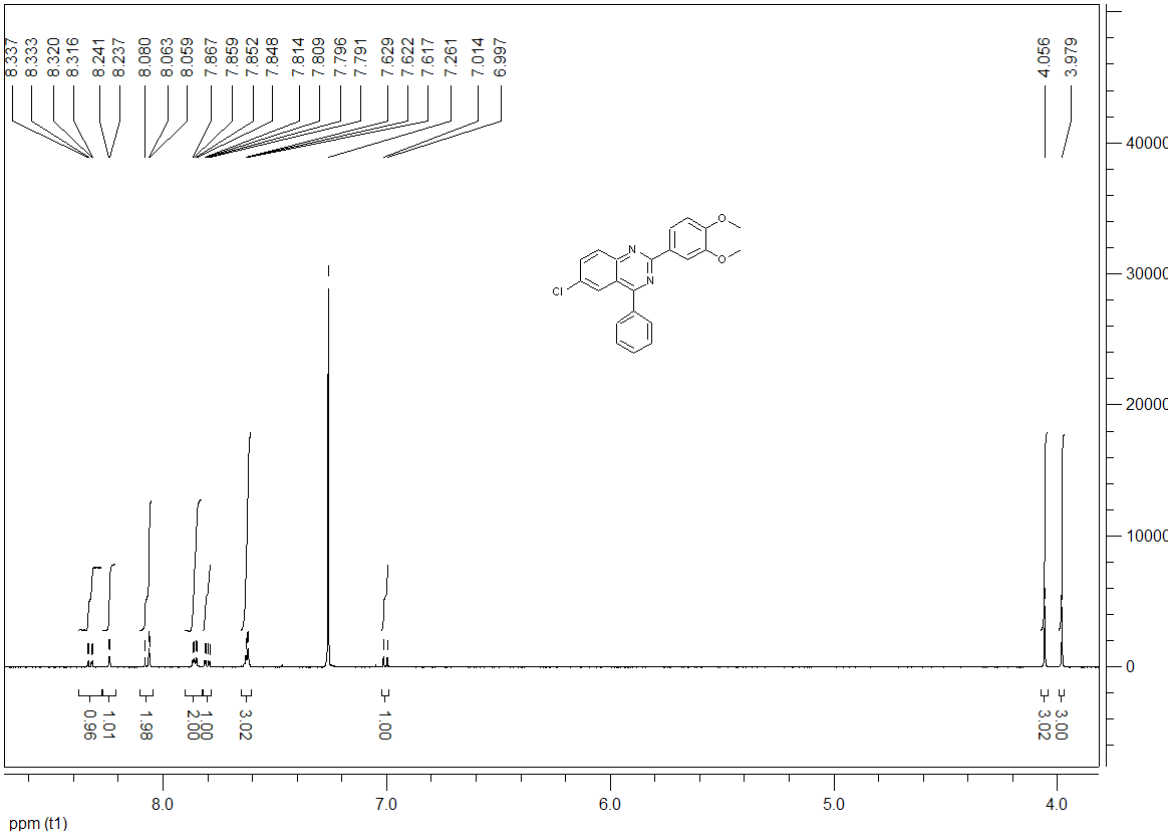


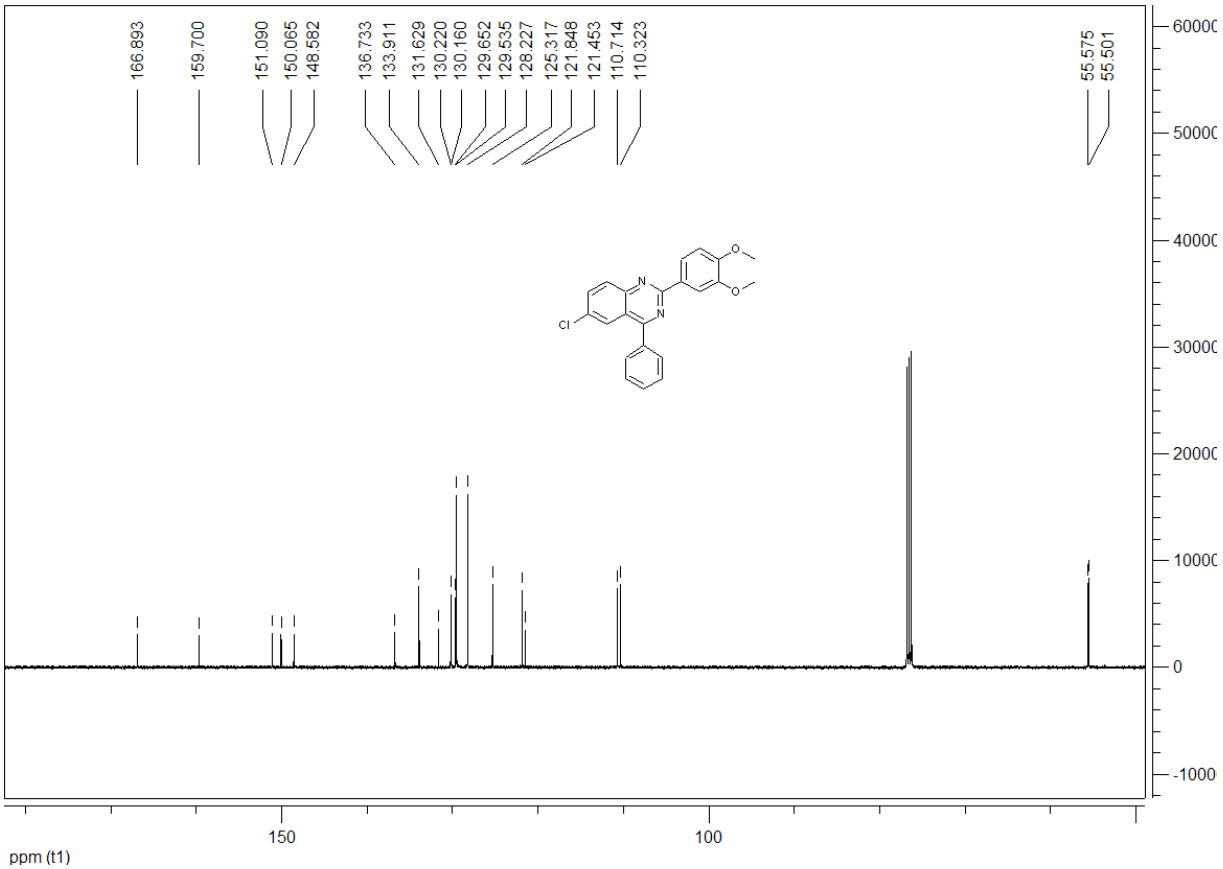
^{1}H NMR and ^{13}C NMR of compound **4c**



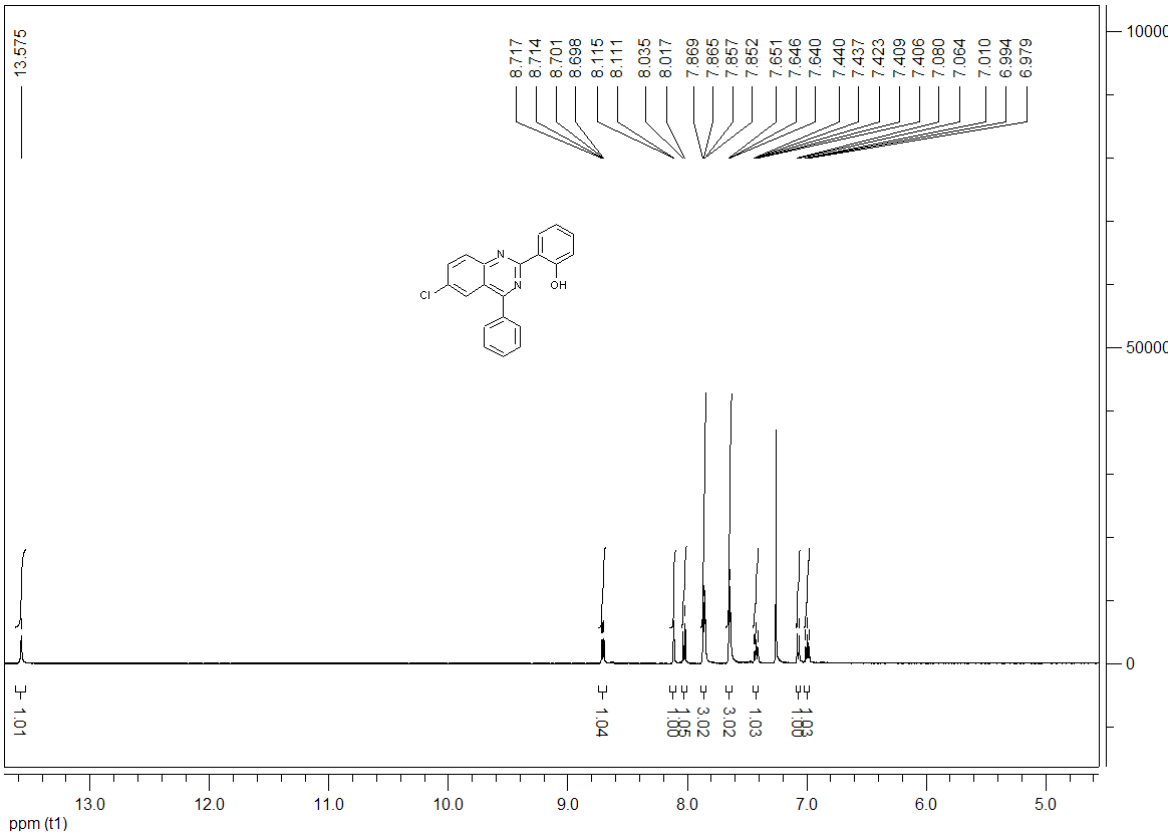


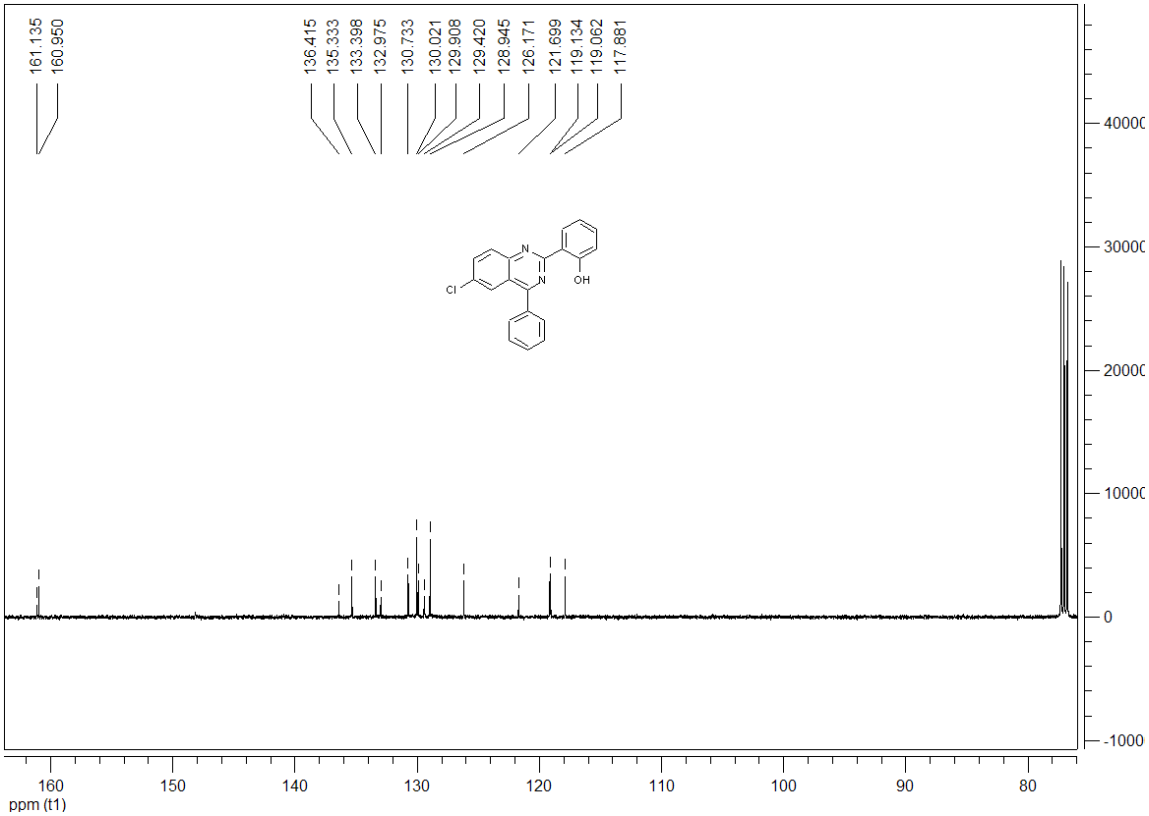
^{1}H NMR and ^{13}C NMR of compound **4d**



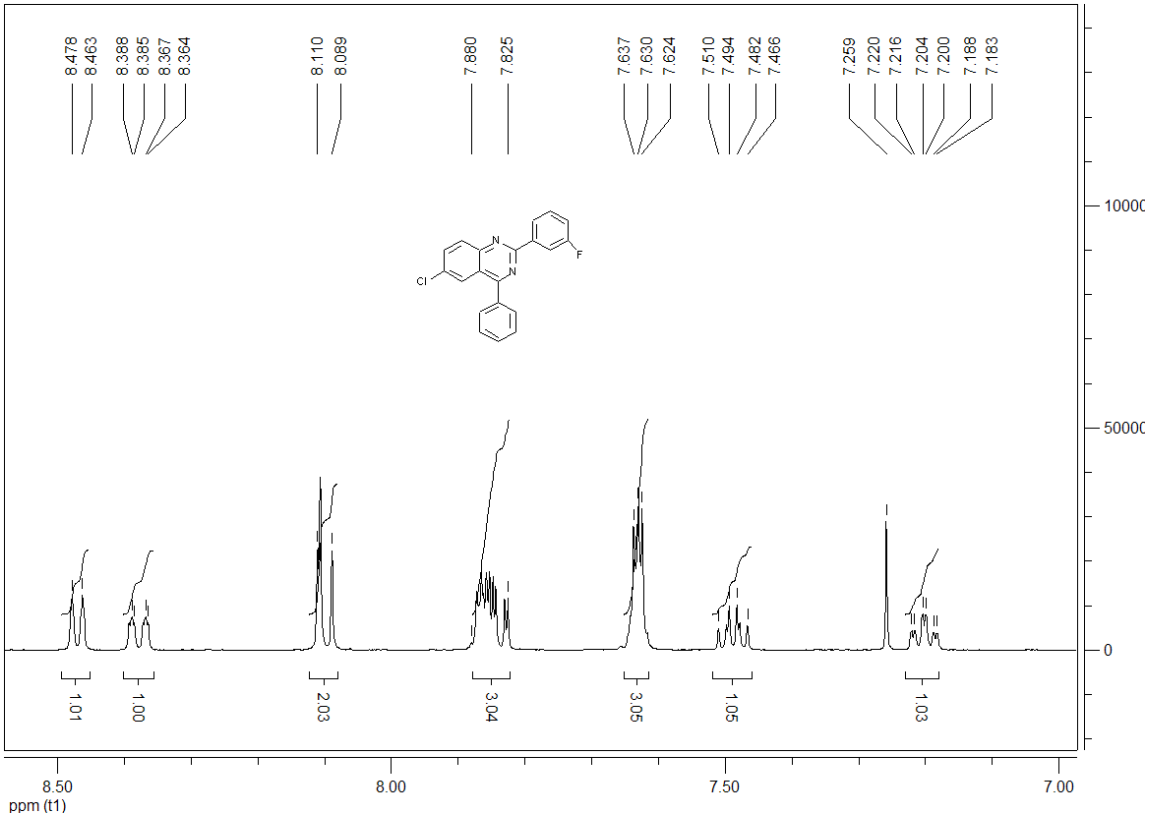


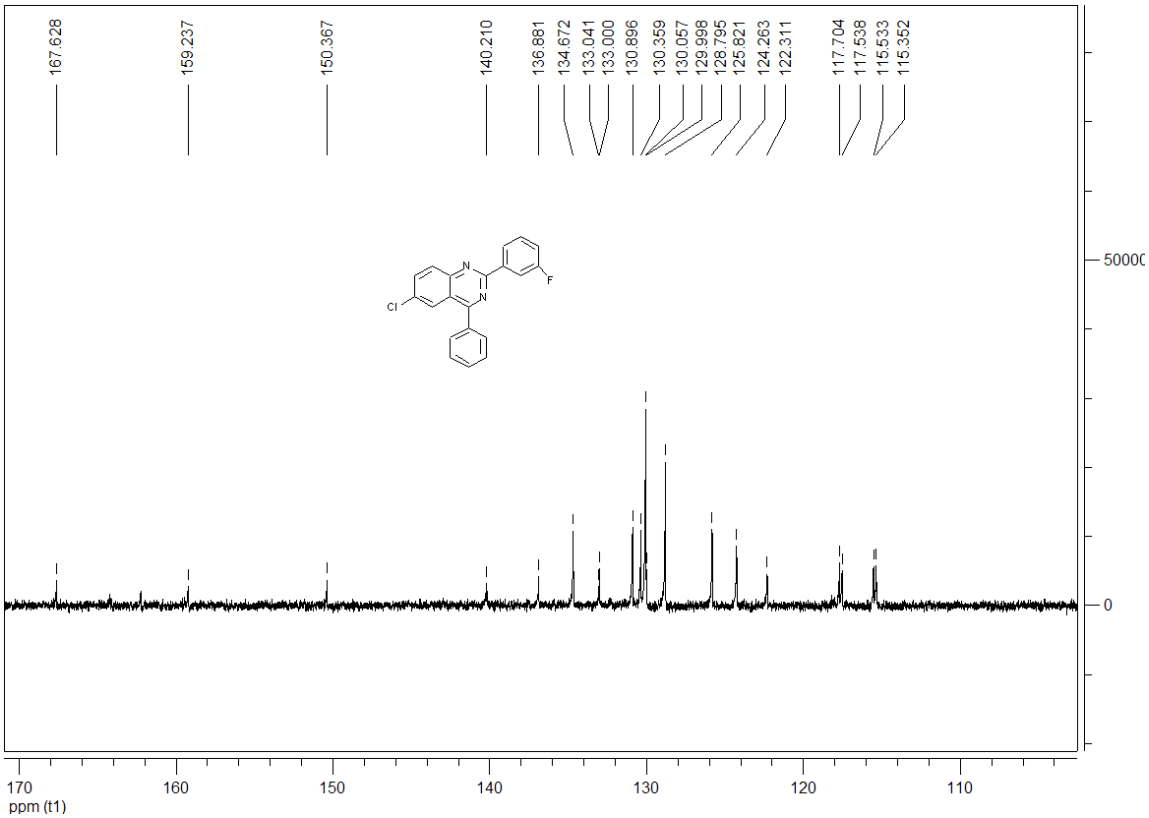
^{1}H NMR and ^{13}C NMR of compound **4e**



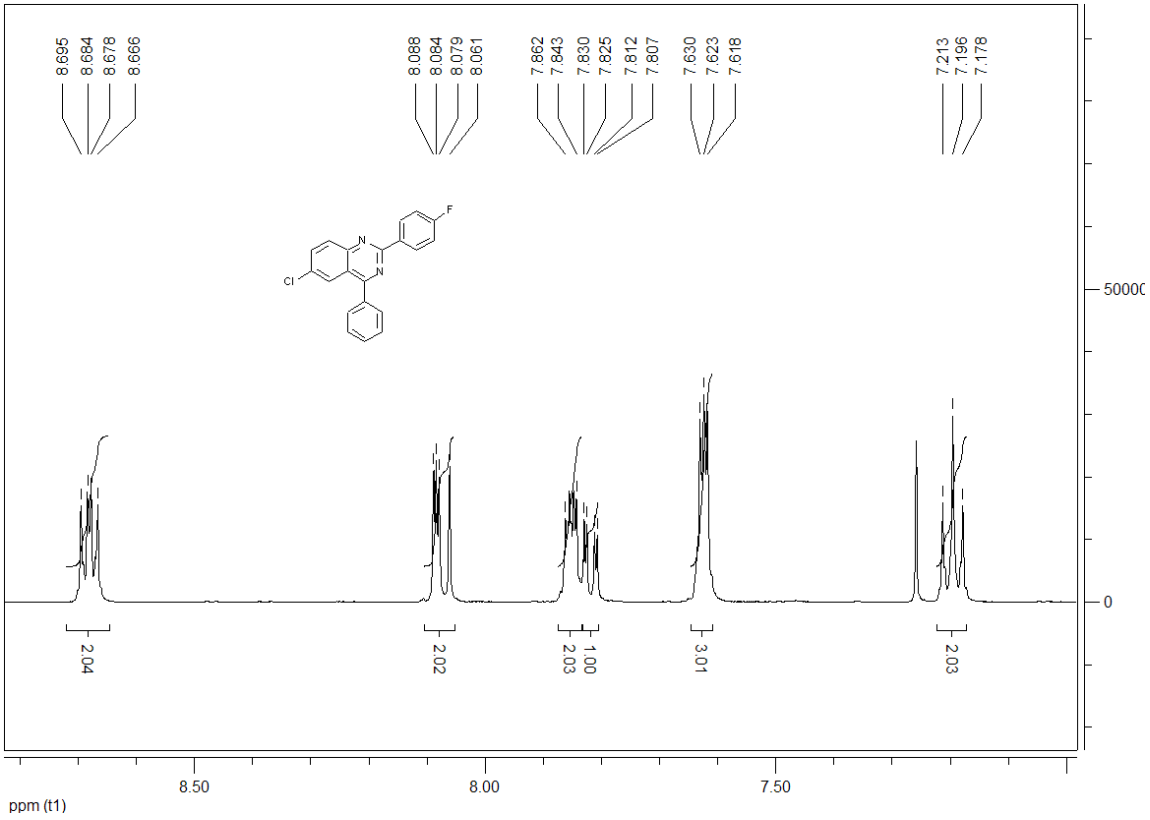


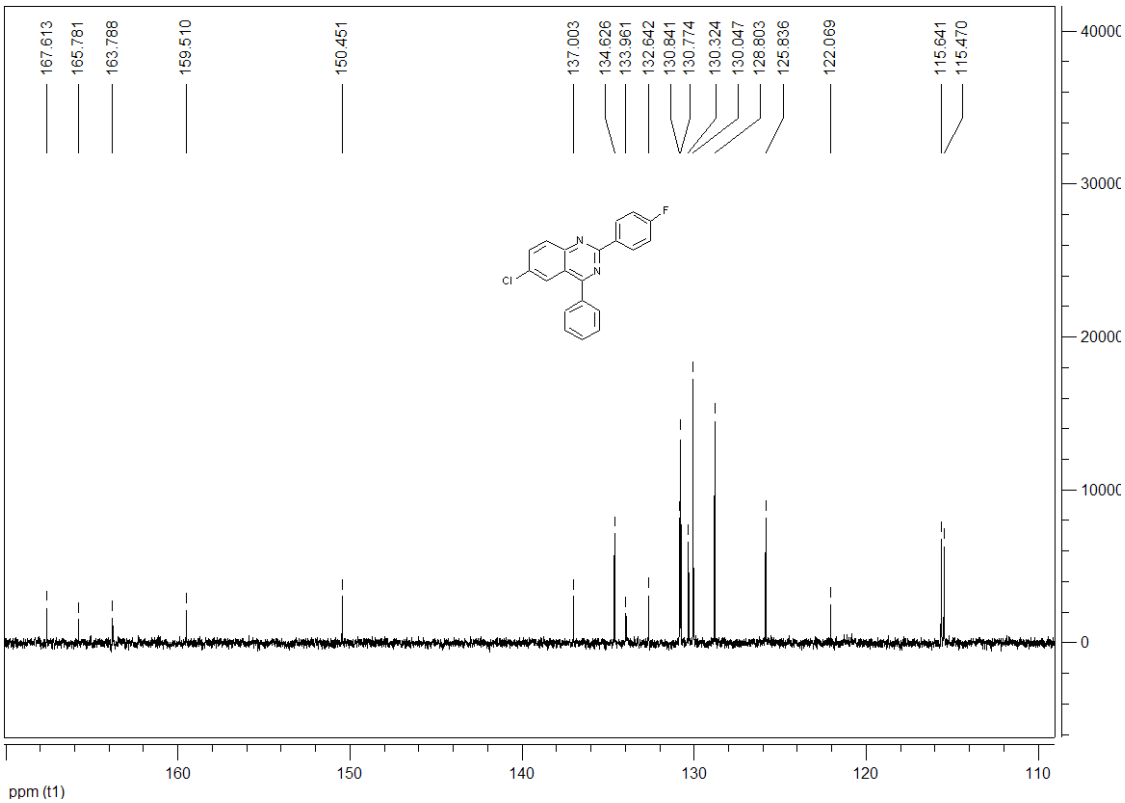
^{1}H NMR and ^{13}C NMR of compound **4f**



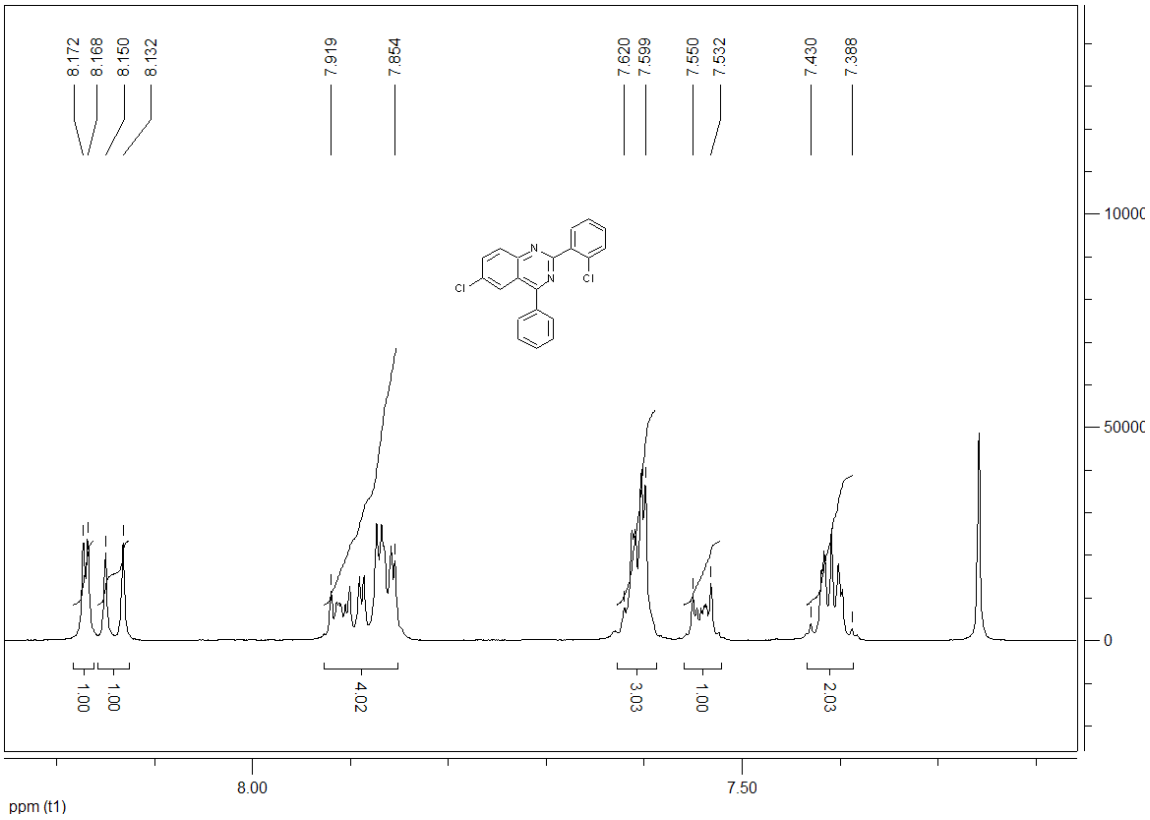


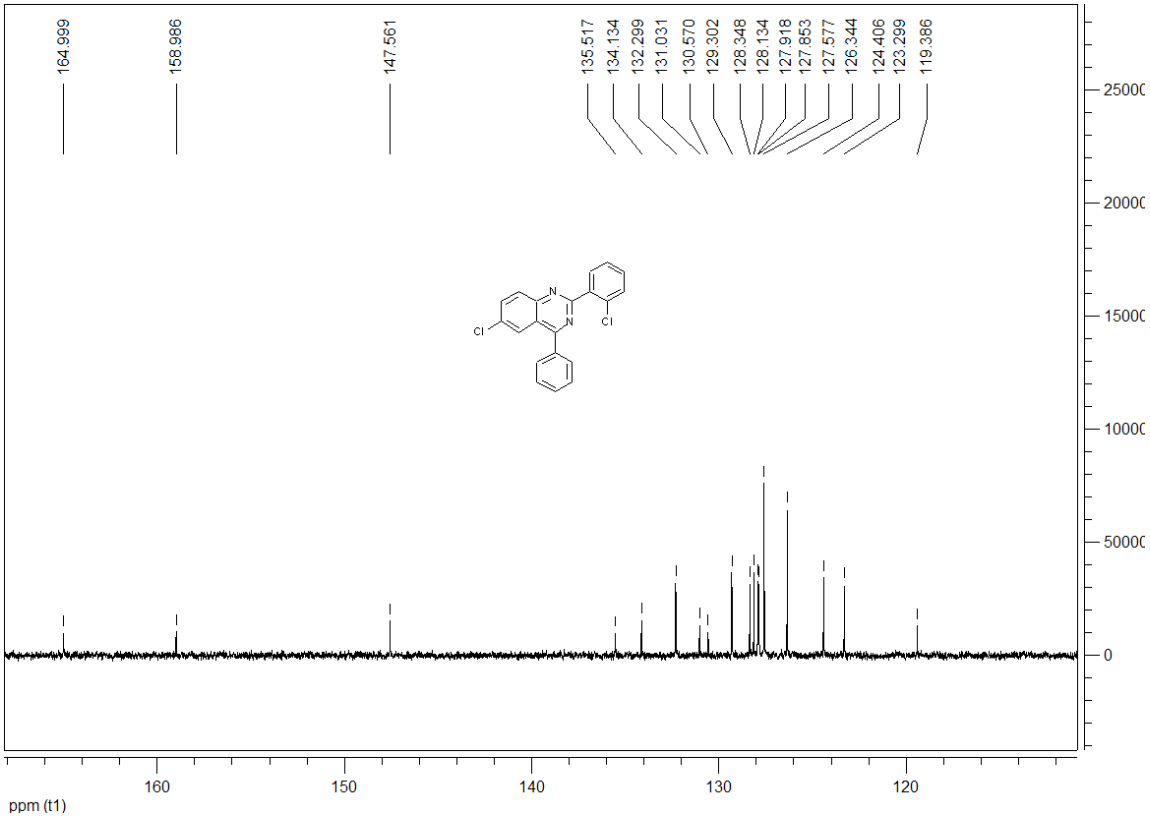
^{1}H NMR and ^{13}C NMR of compound **4g**



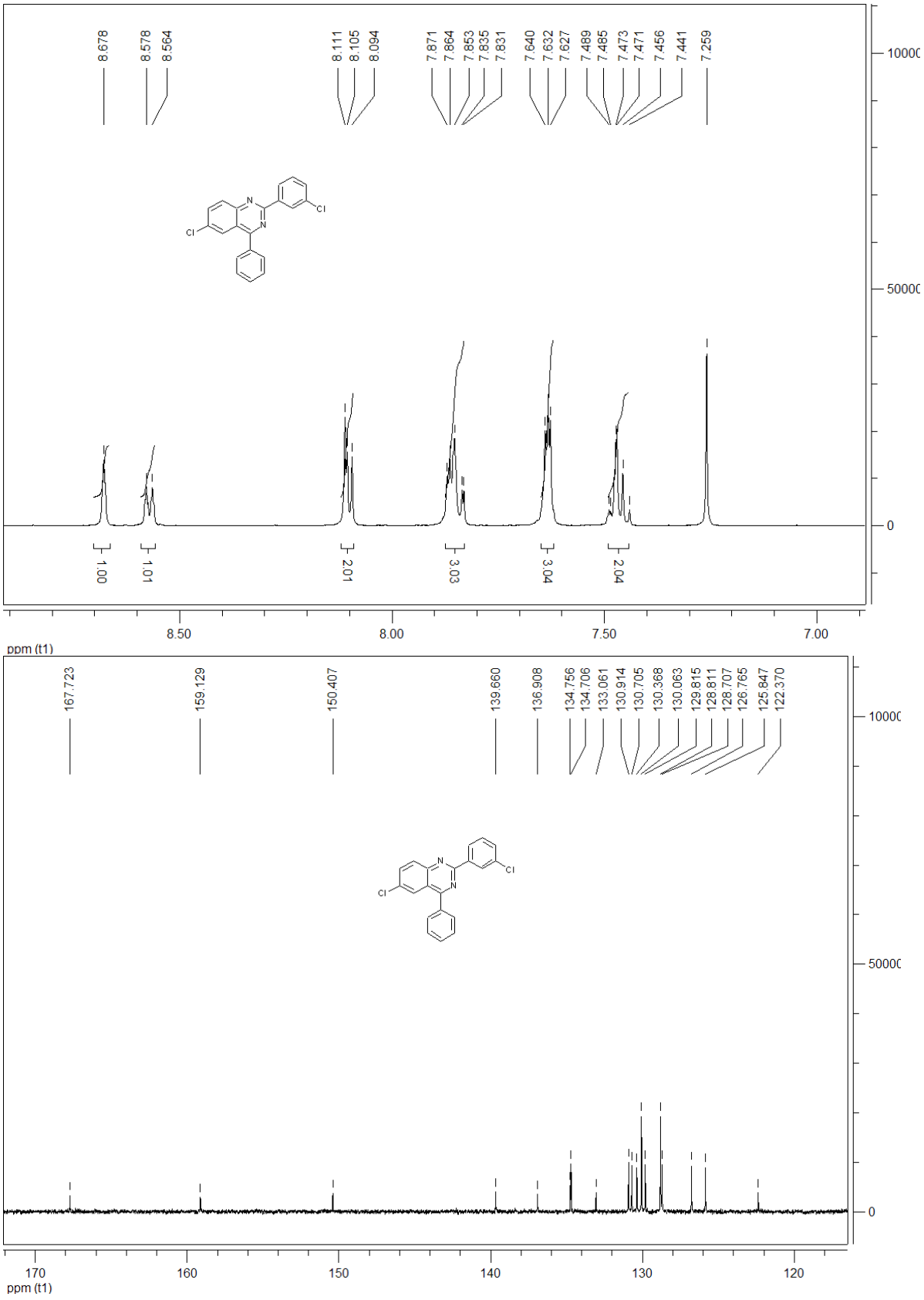


^{1}H NMR and ^{13}C NMR of compound **4h**

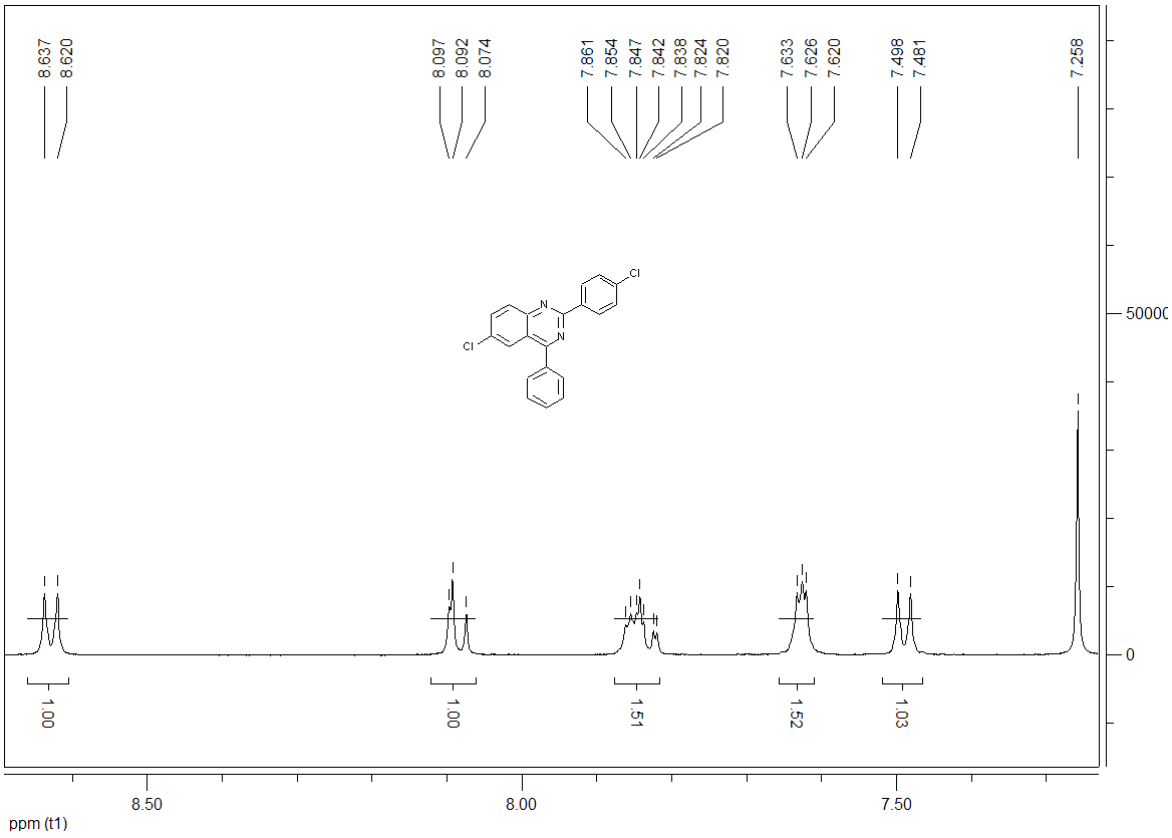


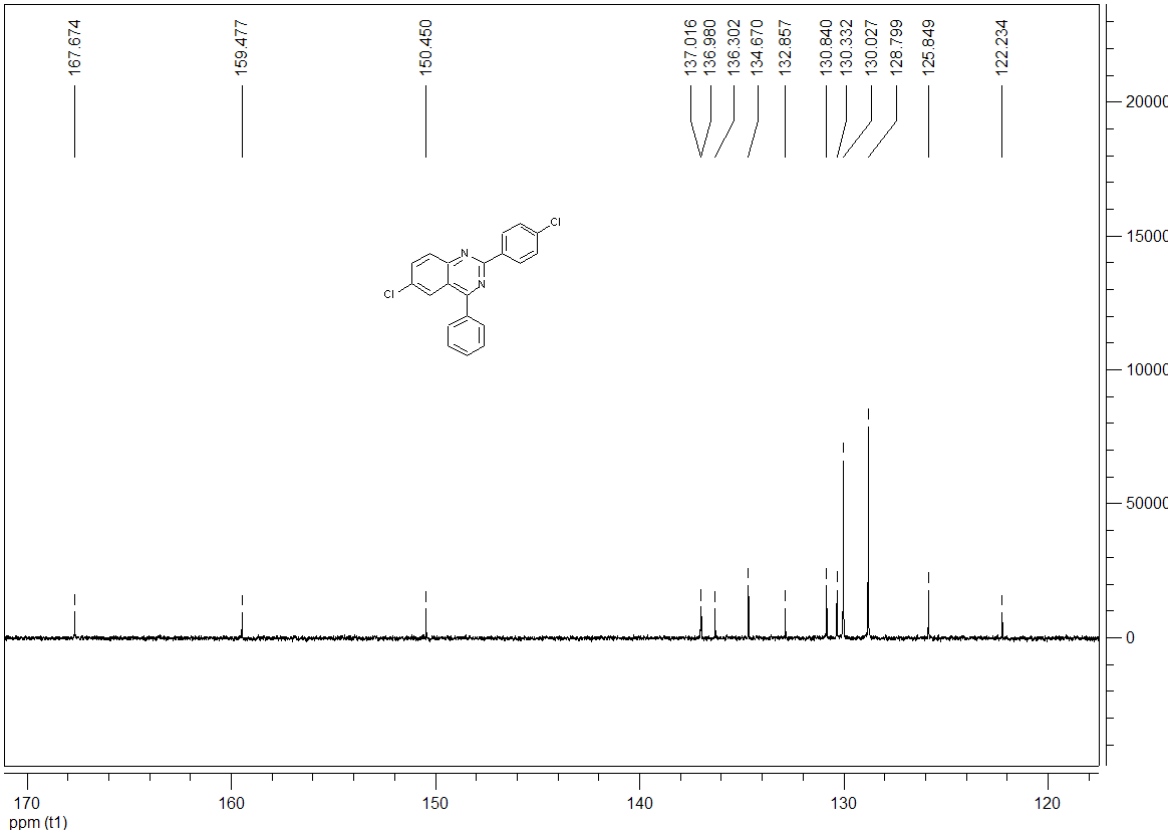


^{1}H NMR and ^{13}C NMR of compound **4i**

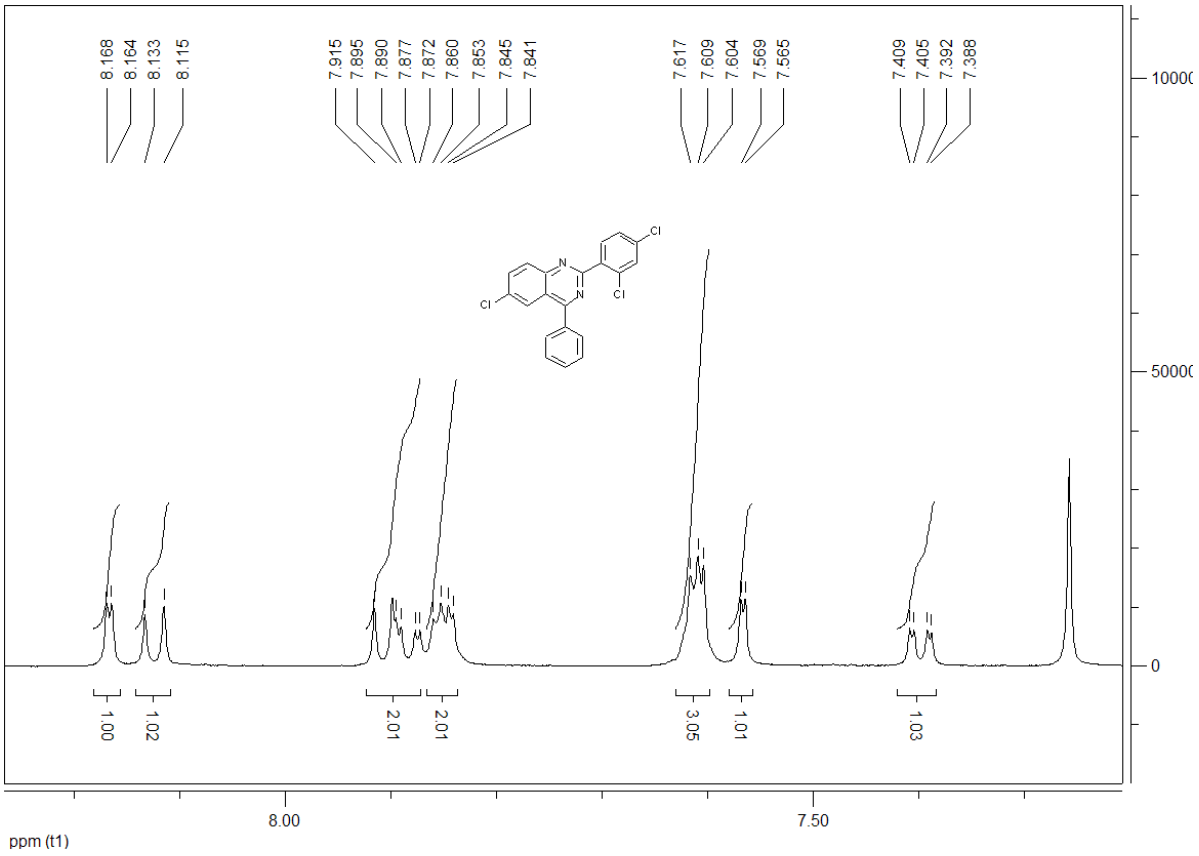


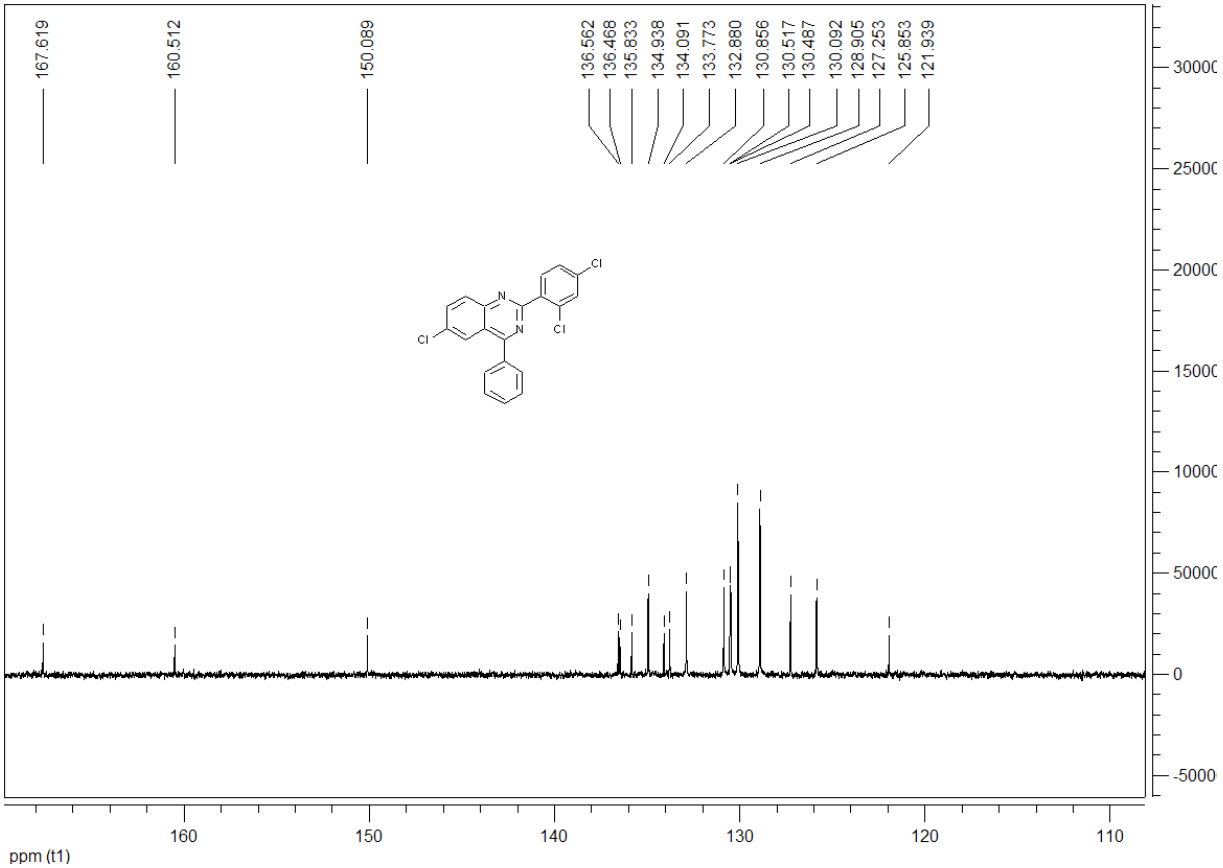
^{1}H NMR and ^{13}C NMR of compound **4j**



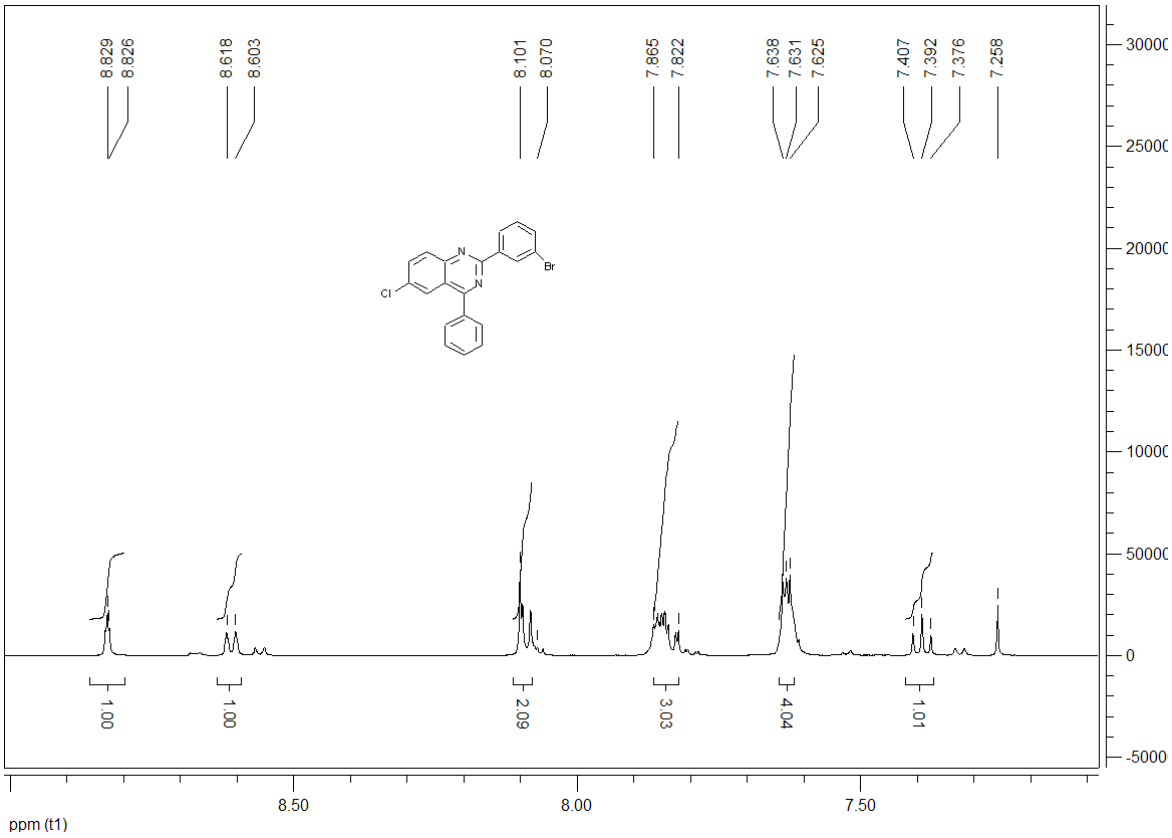


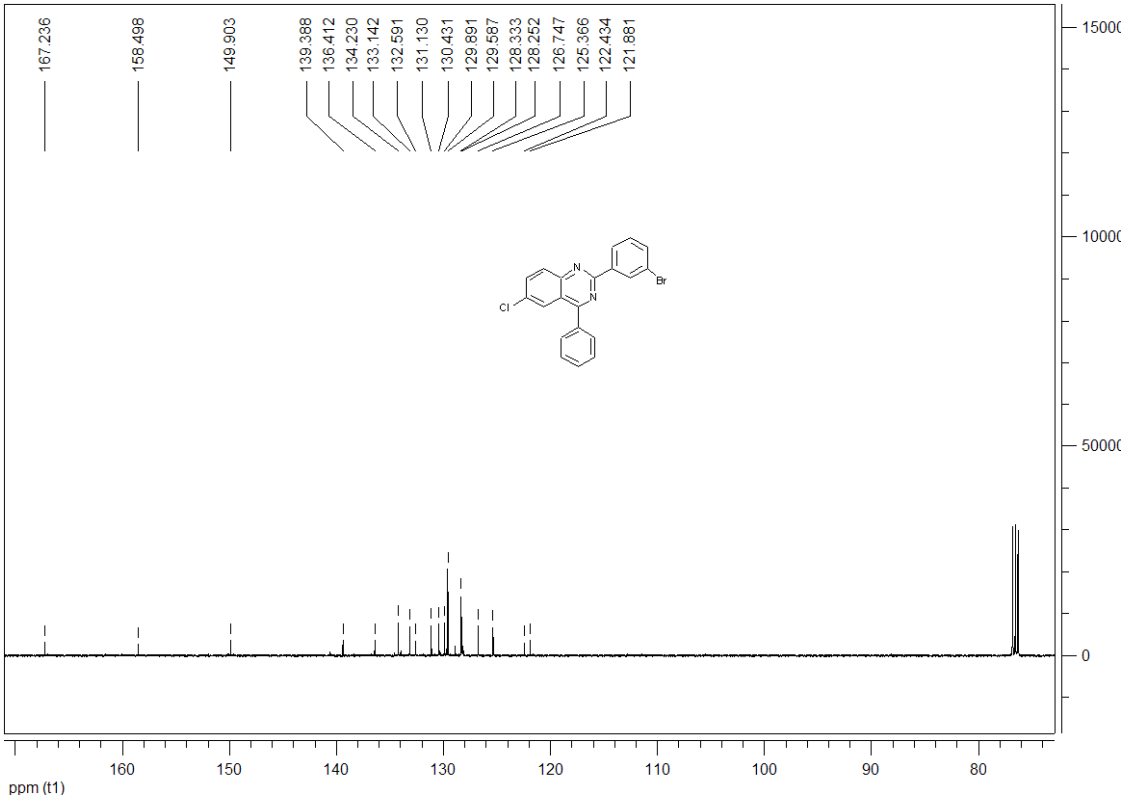
^{1}H NMR and ^{13}C NMR of compound **4k**



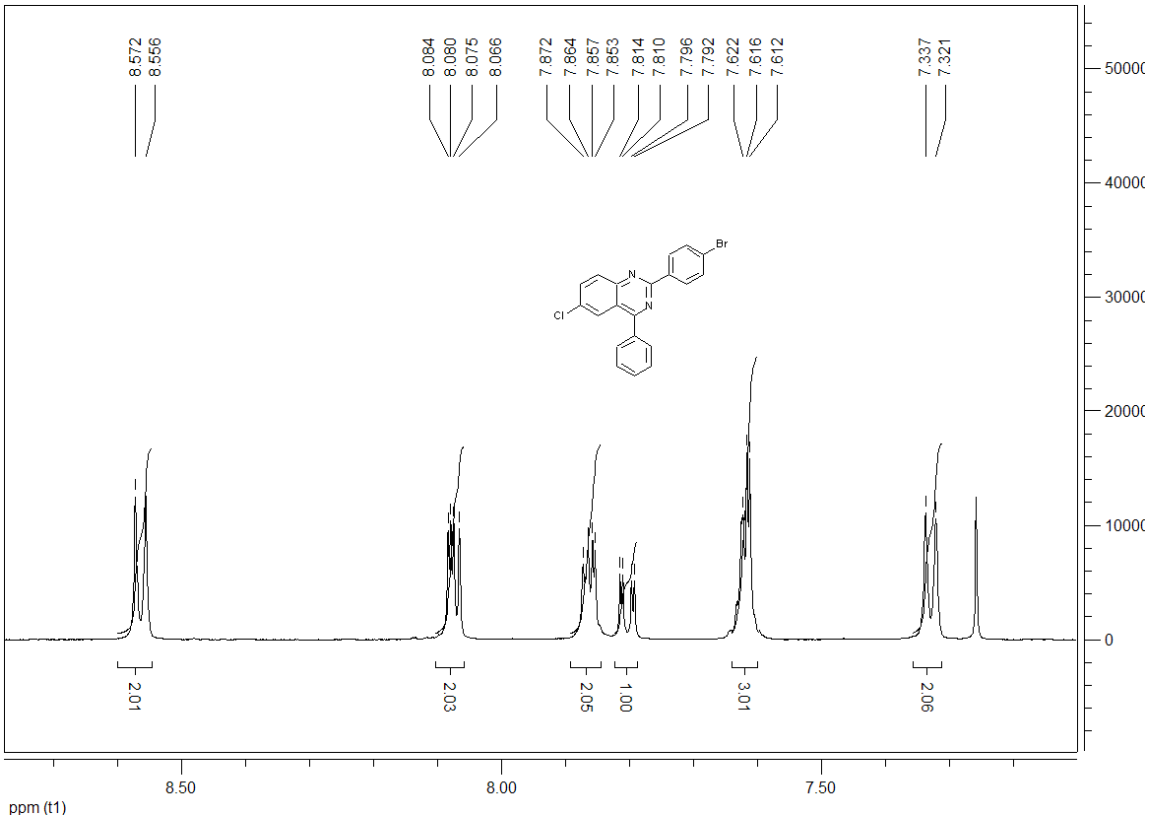


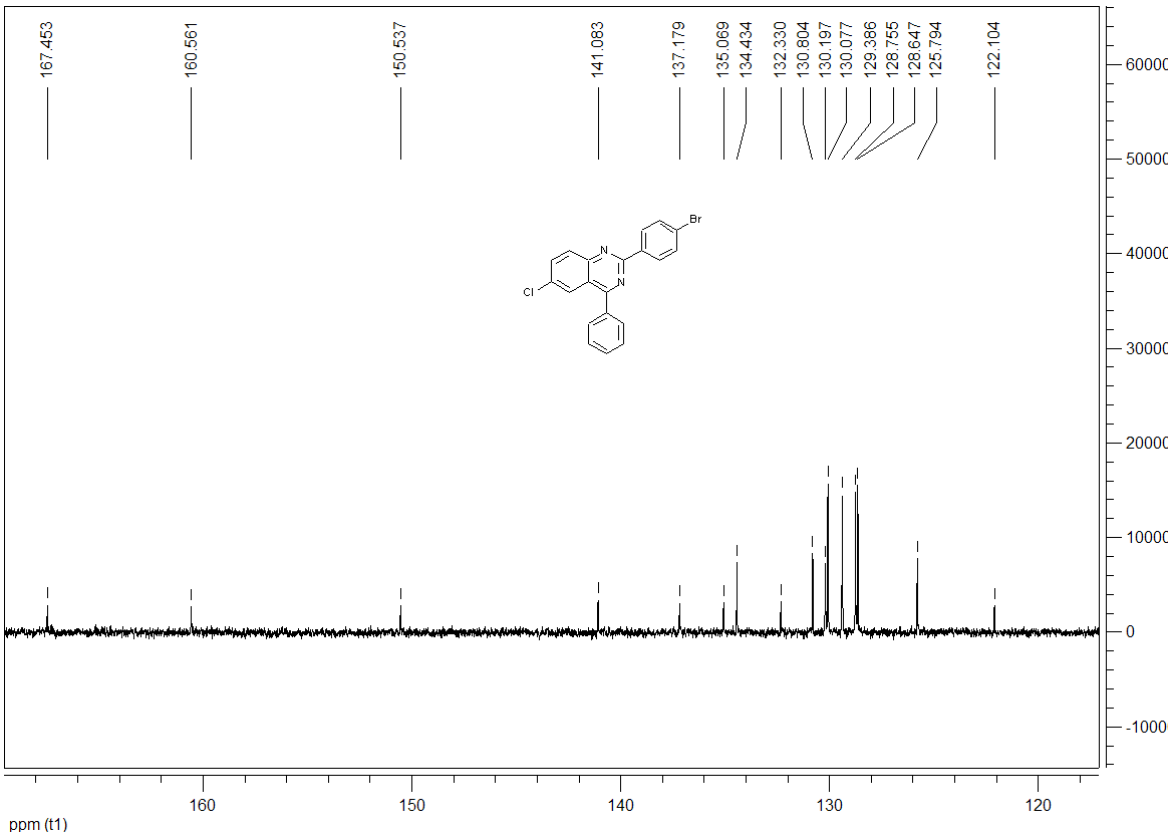
^{1}H NMR and ^{13}C NMR of compound **4l**



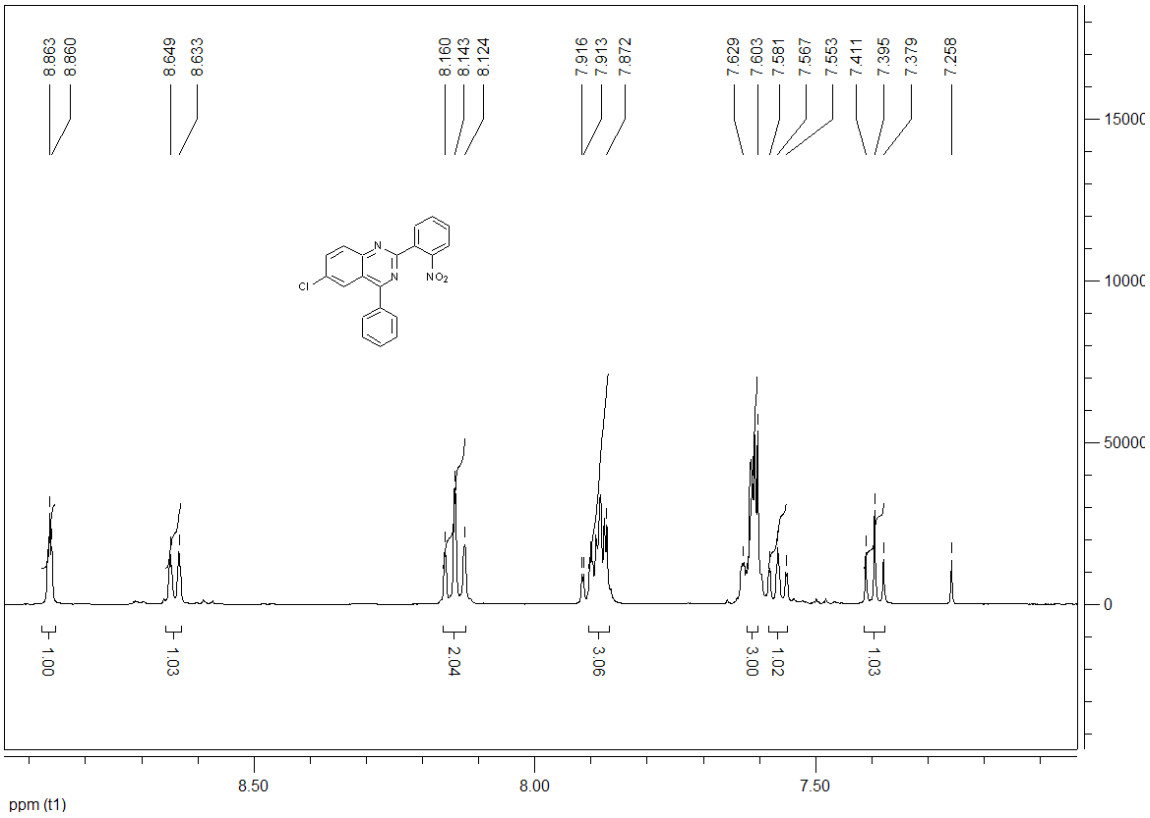


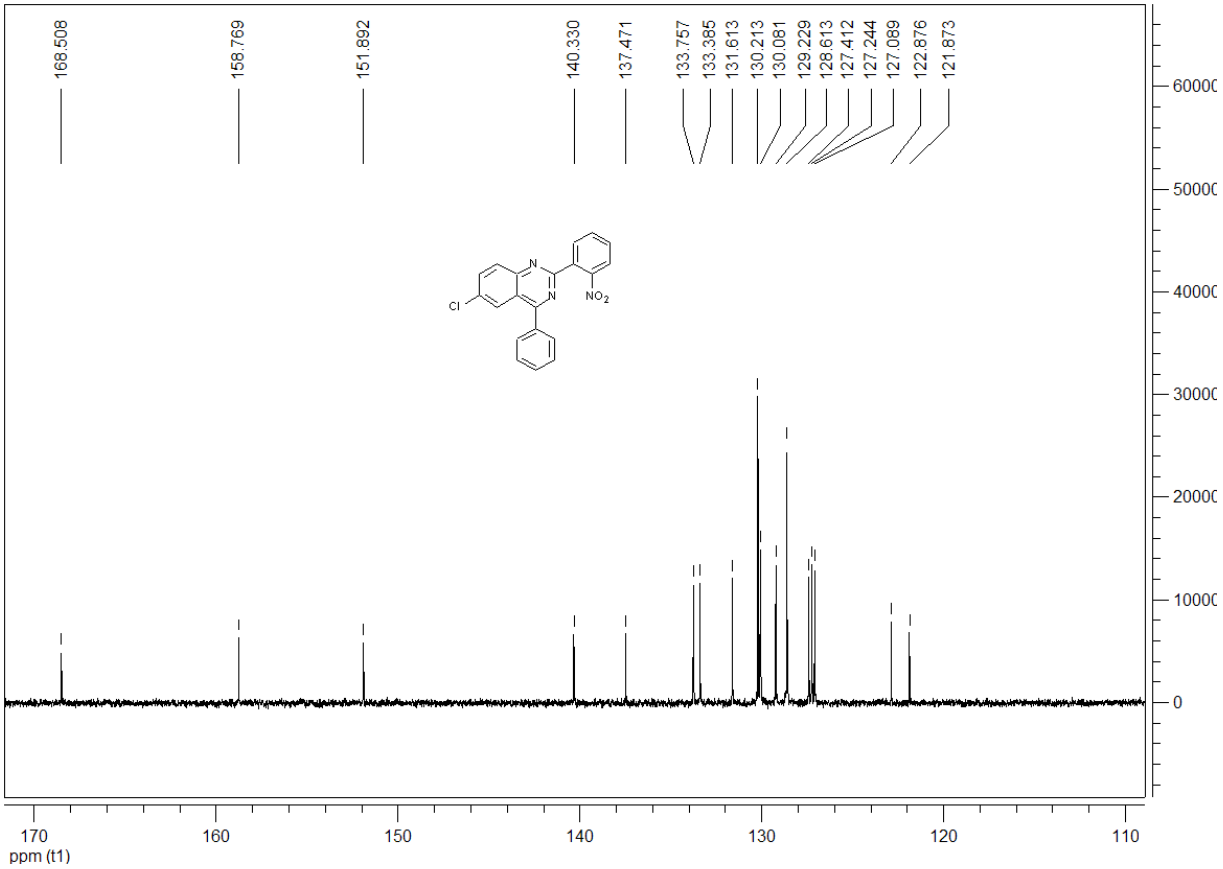
^{1}H NMR and ^{13}C NMR of compound **4m**



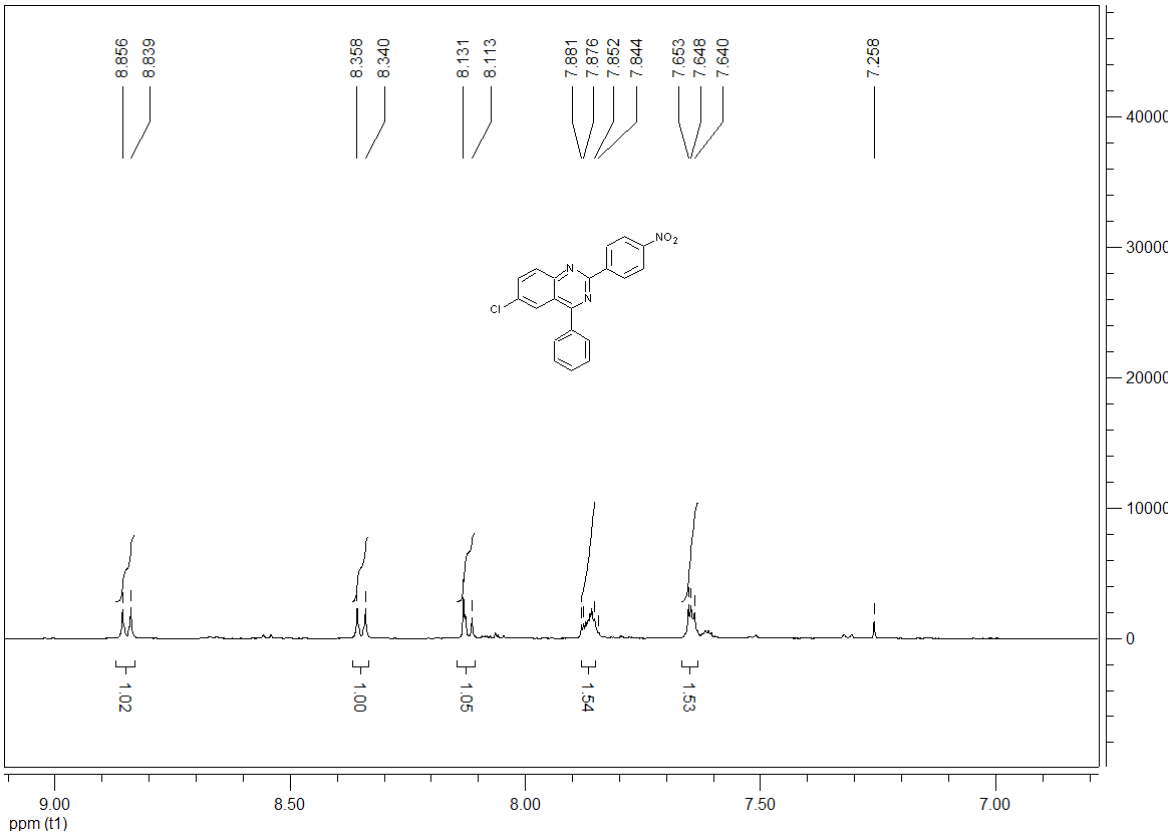


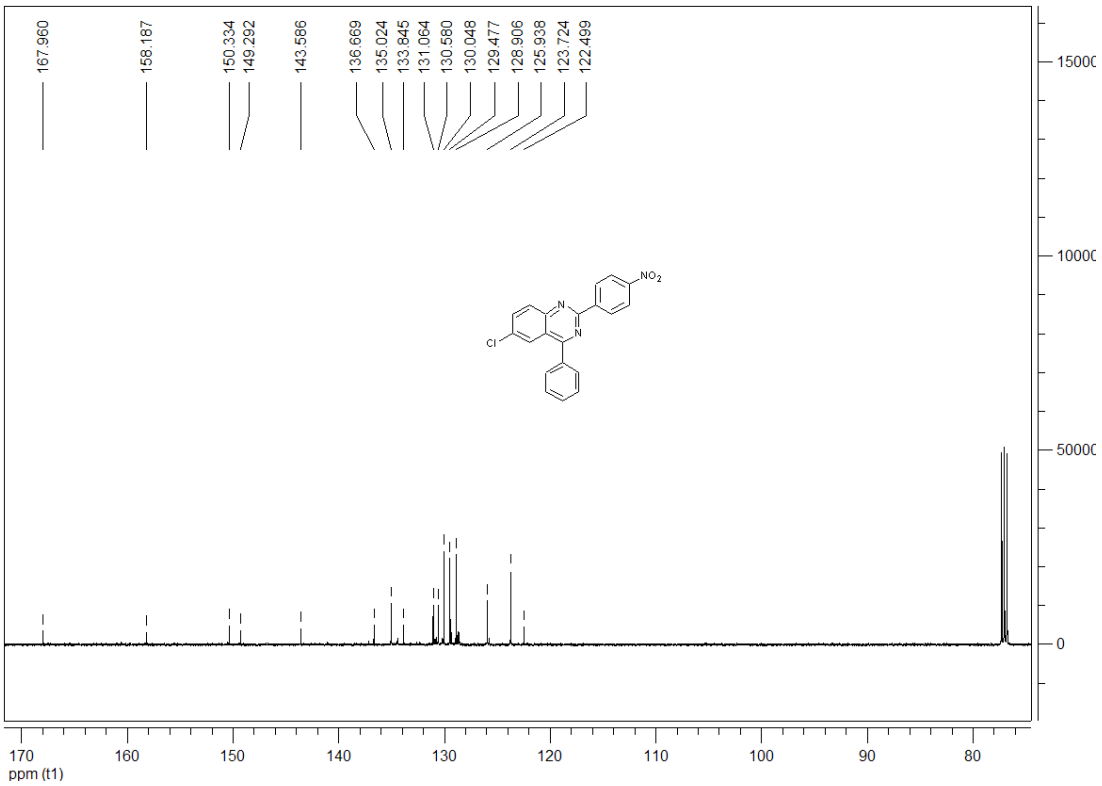
^{1}H NMR and ^{13}C NMR of compound **4n**



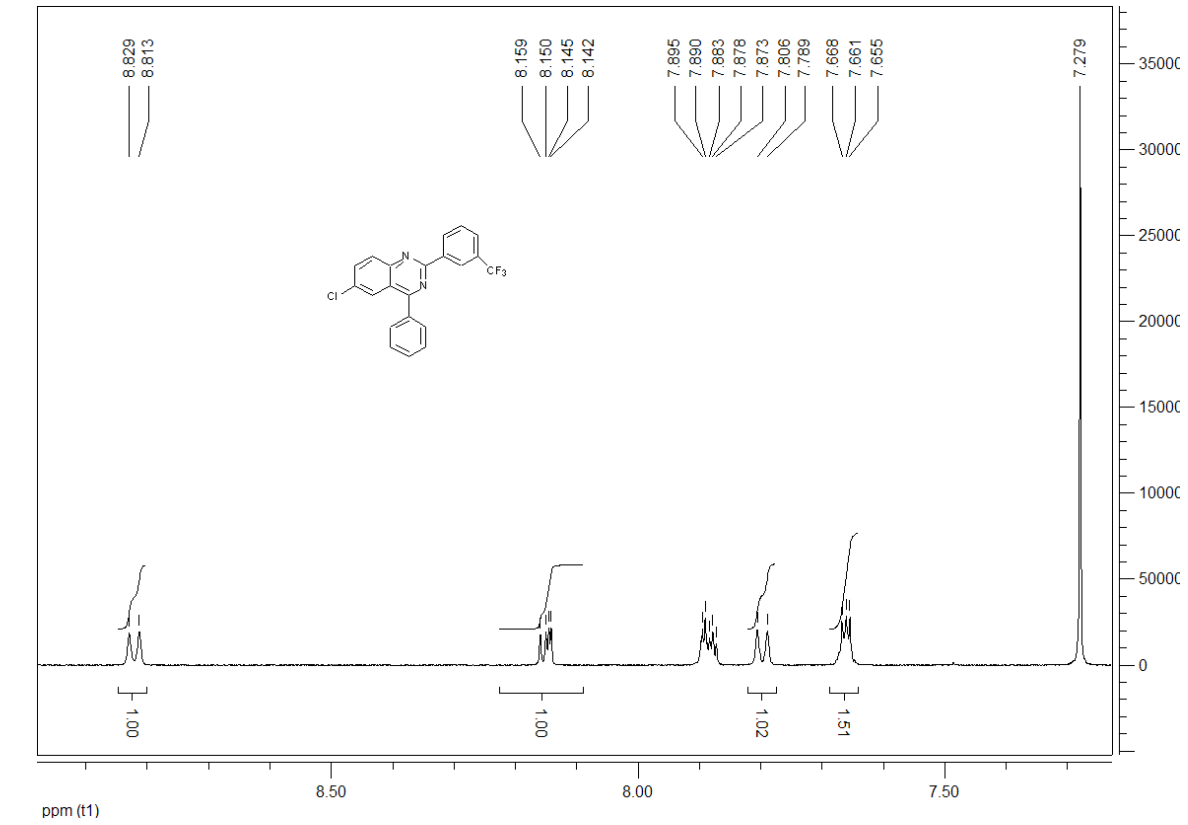


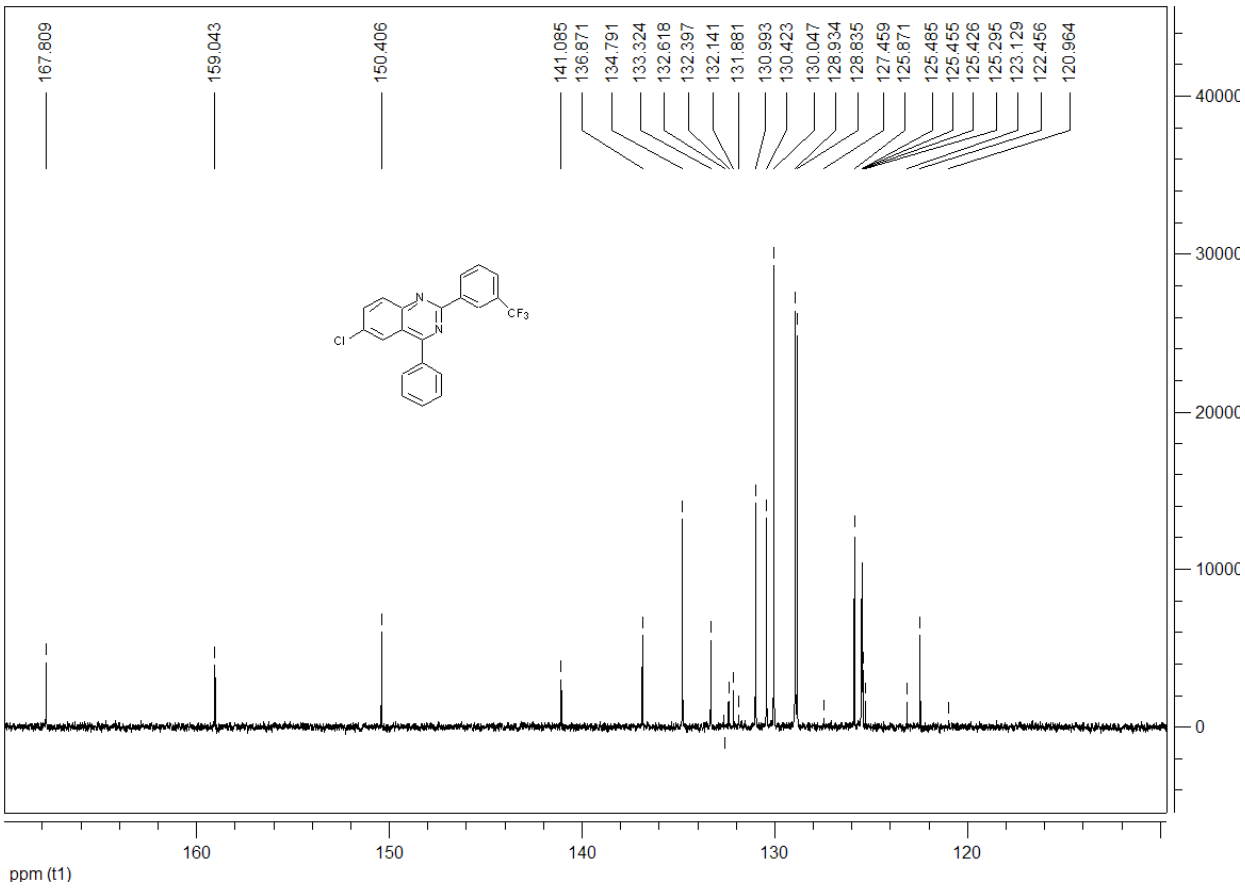
^{1}H NMR and ^{13}C NMR of compound **4o**



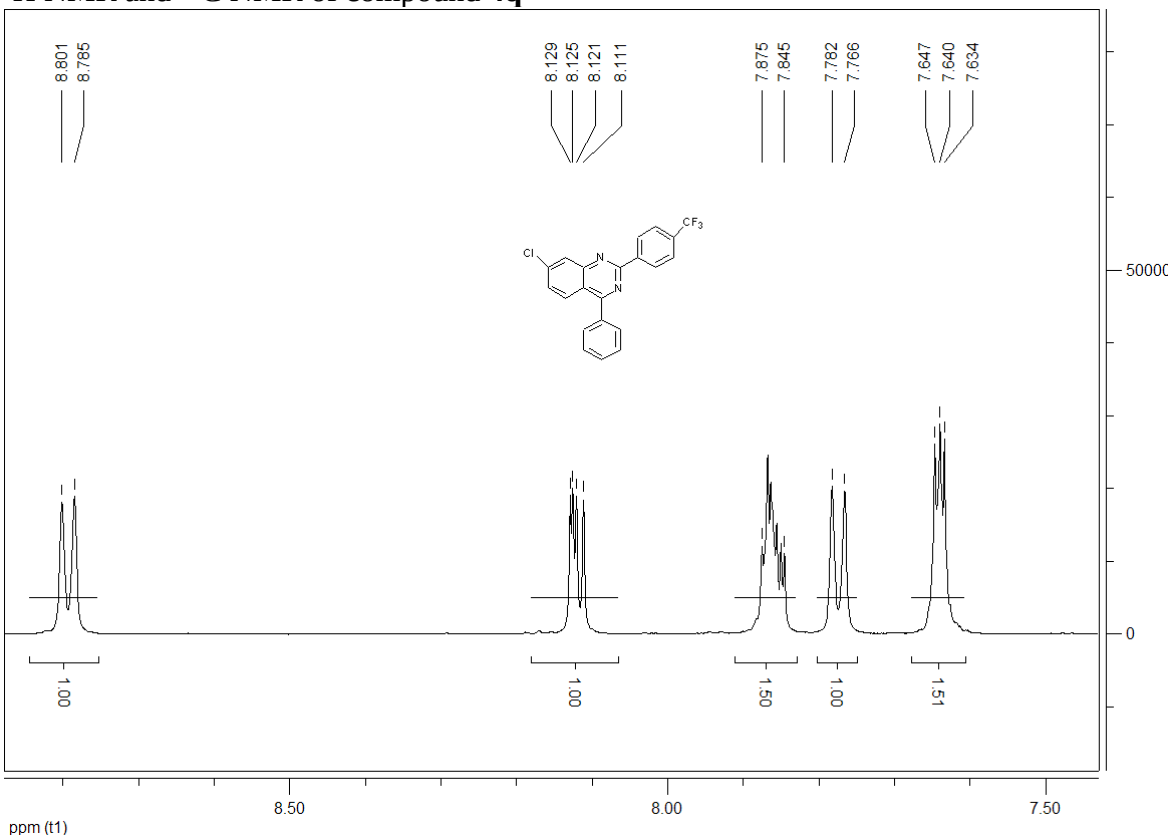


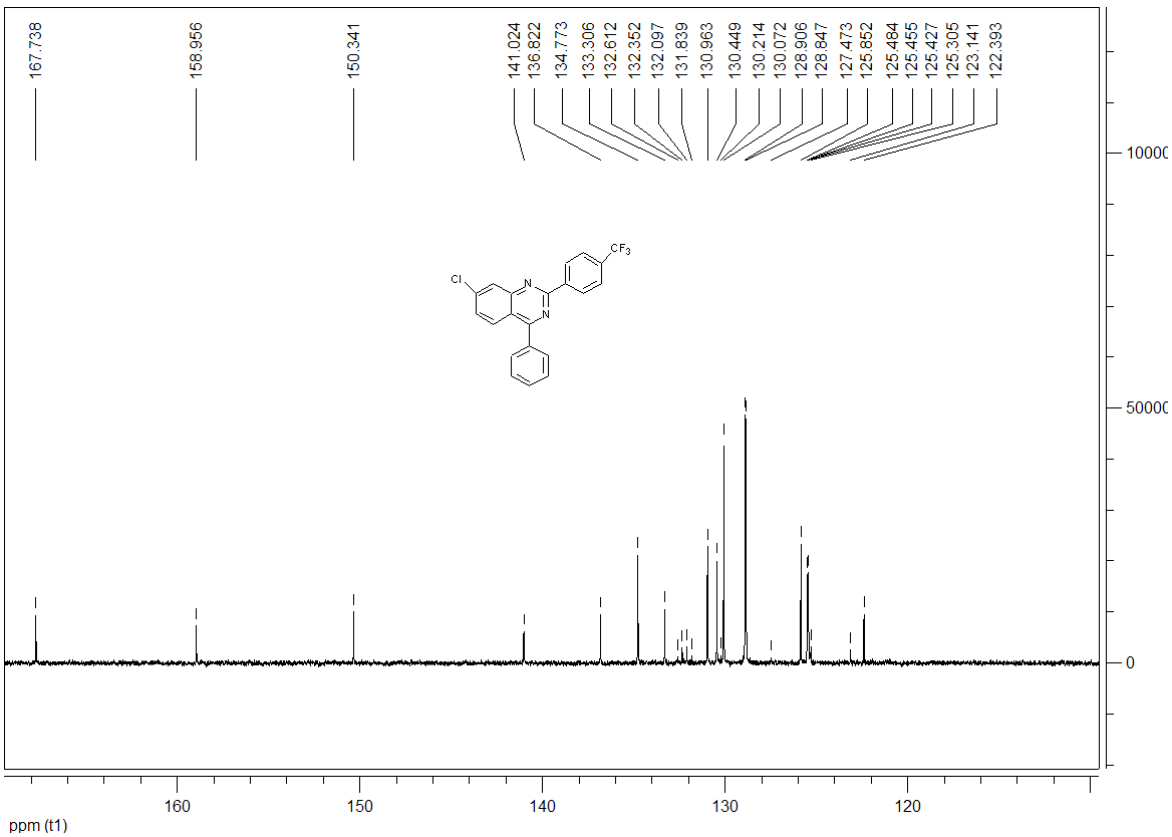
^{1}H NMR and ^{13}C NMR of compound **4p**



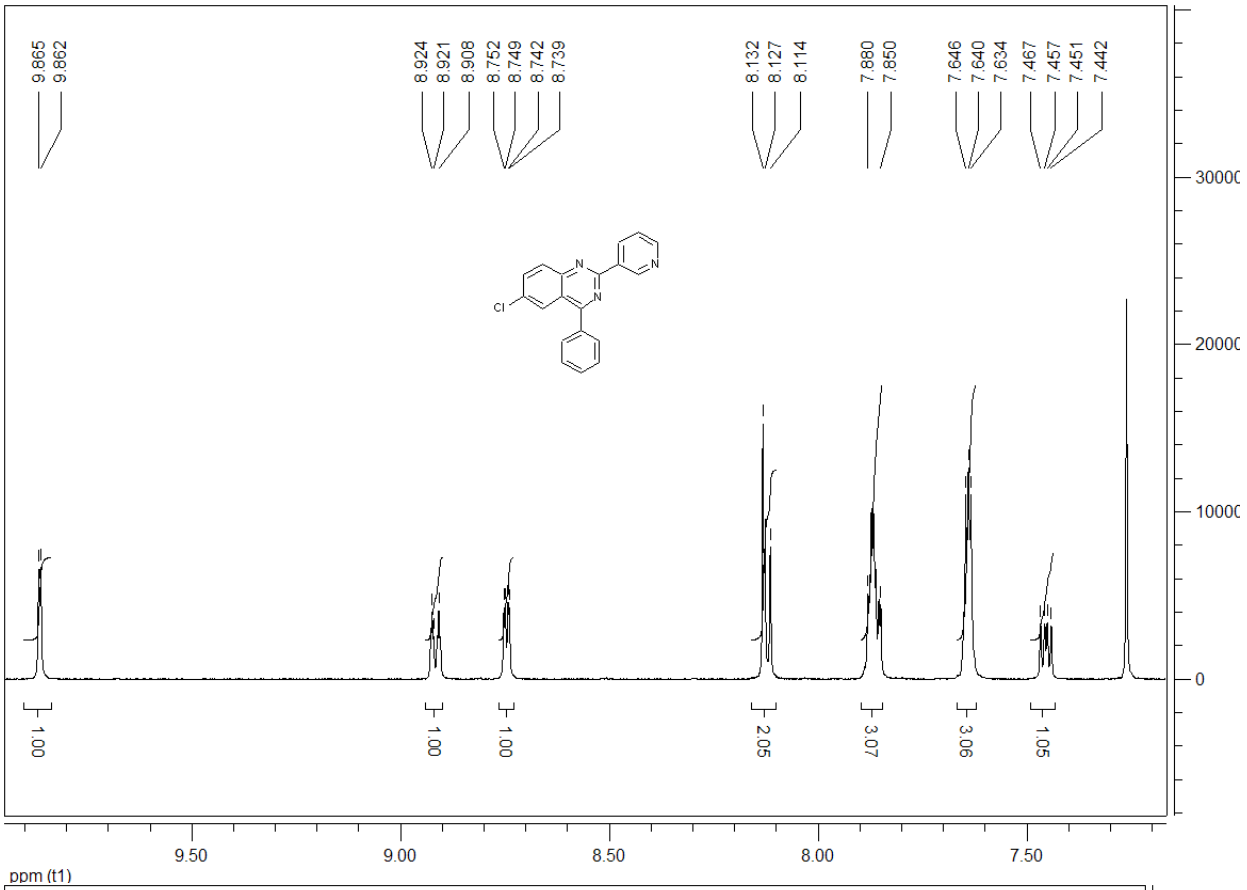


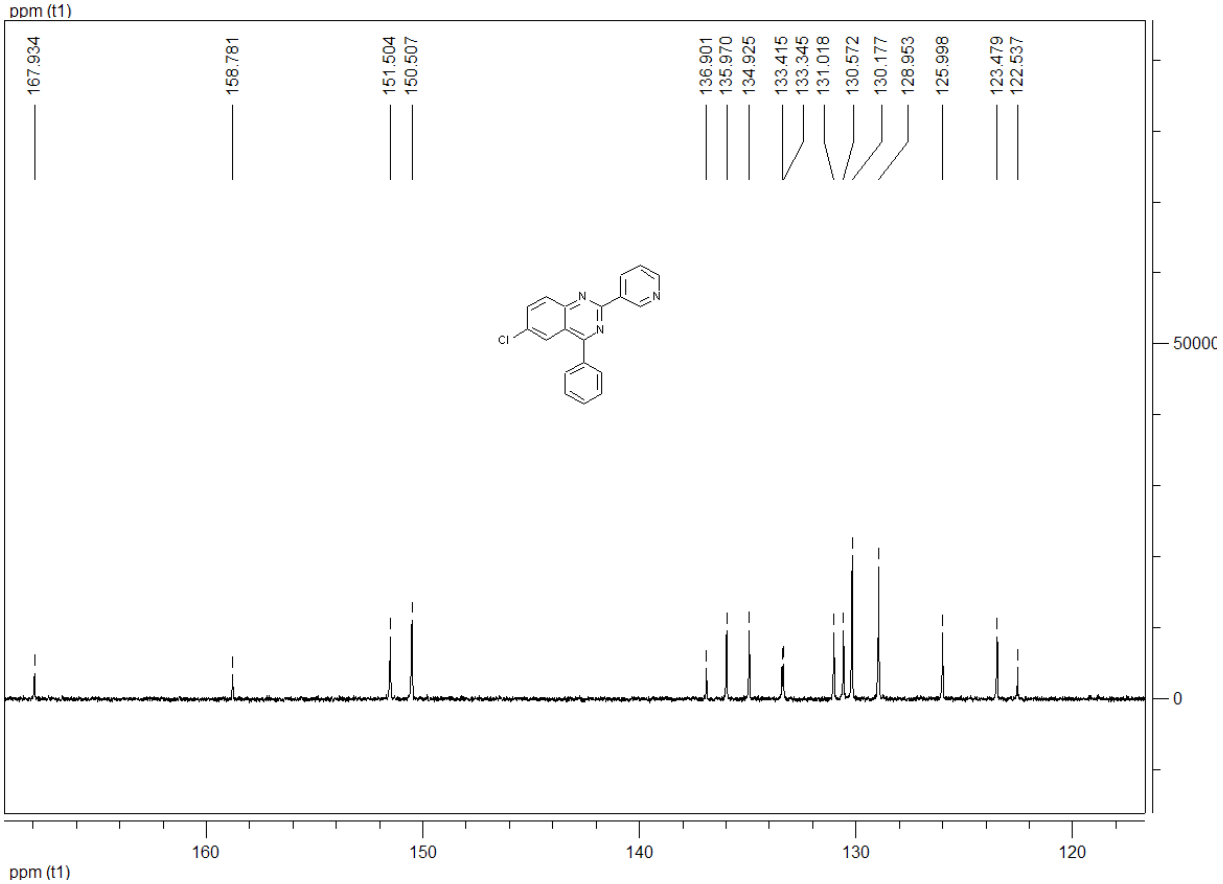
^{1}H NMR and ^{13}C NMR of compound **4q**



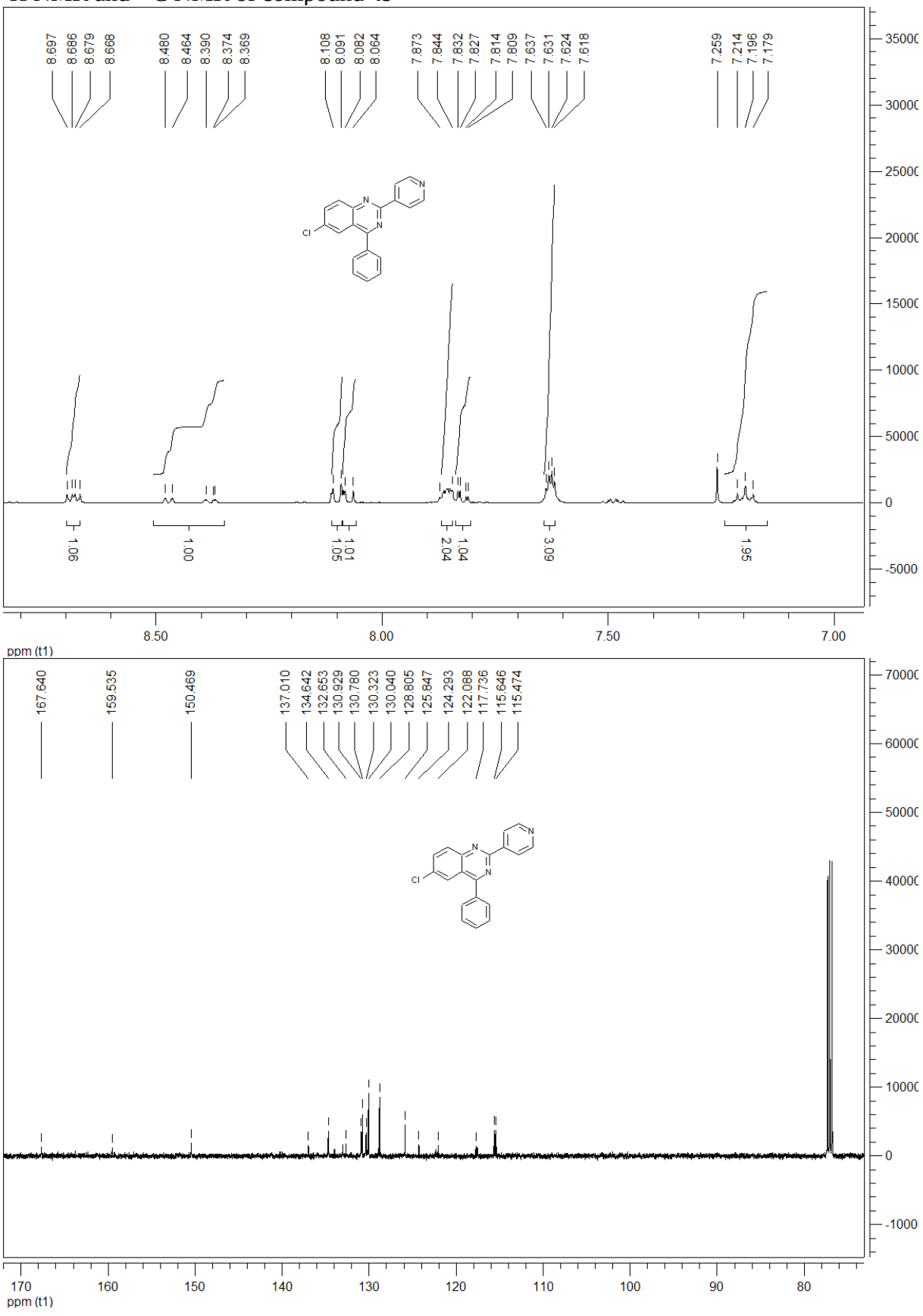


^{1}H NMR and ^{13}C NMR of compound **4r**

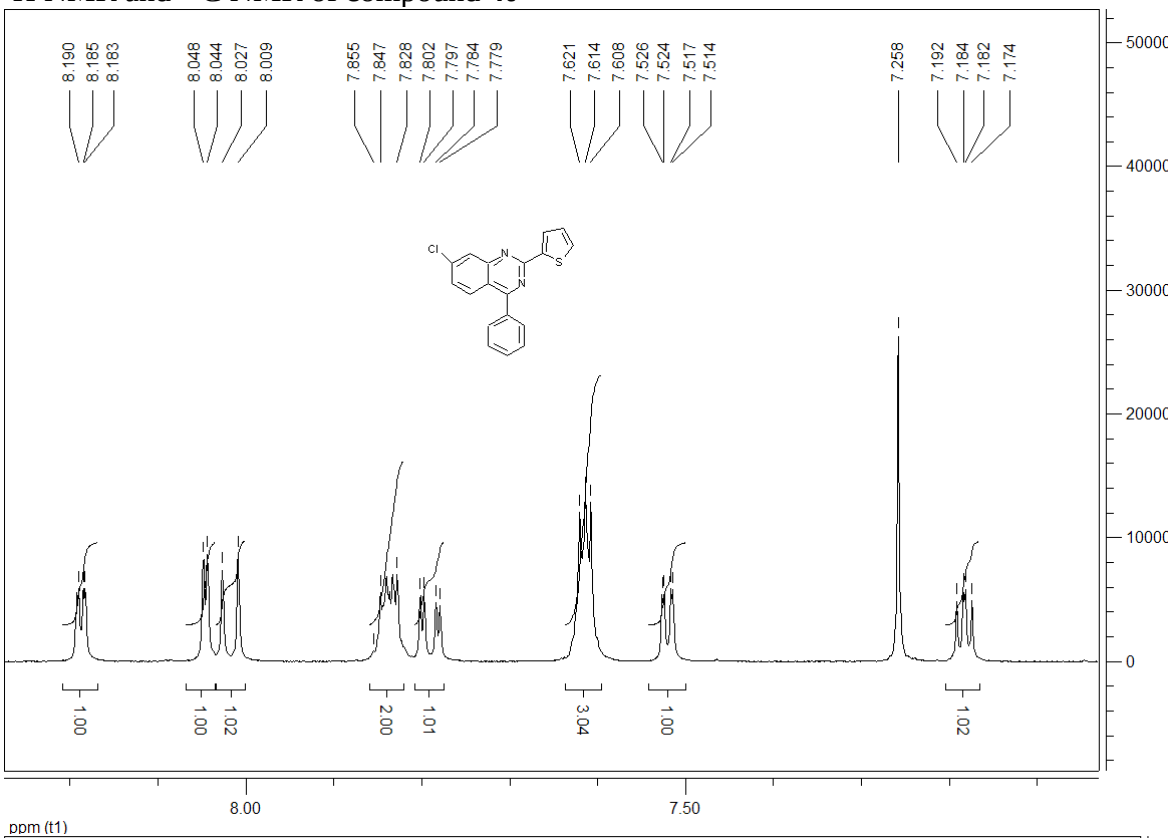


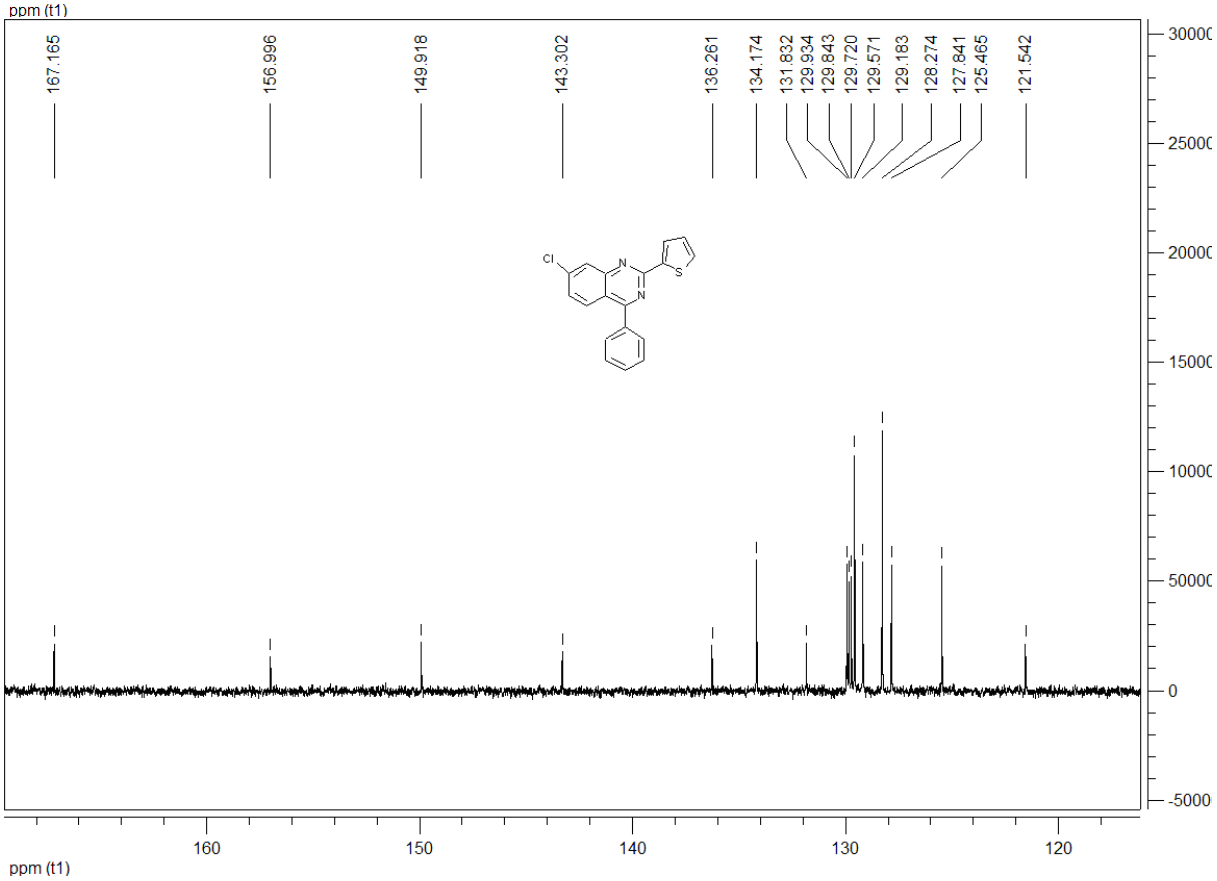


^{1}H NMR and ^{13}C NMR of compound **4s**

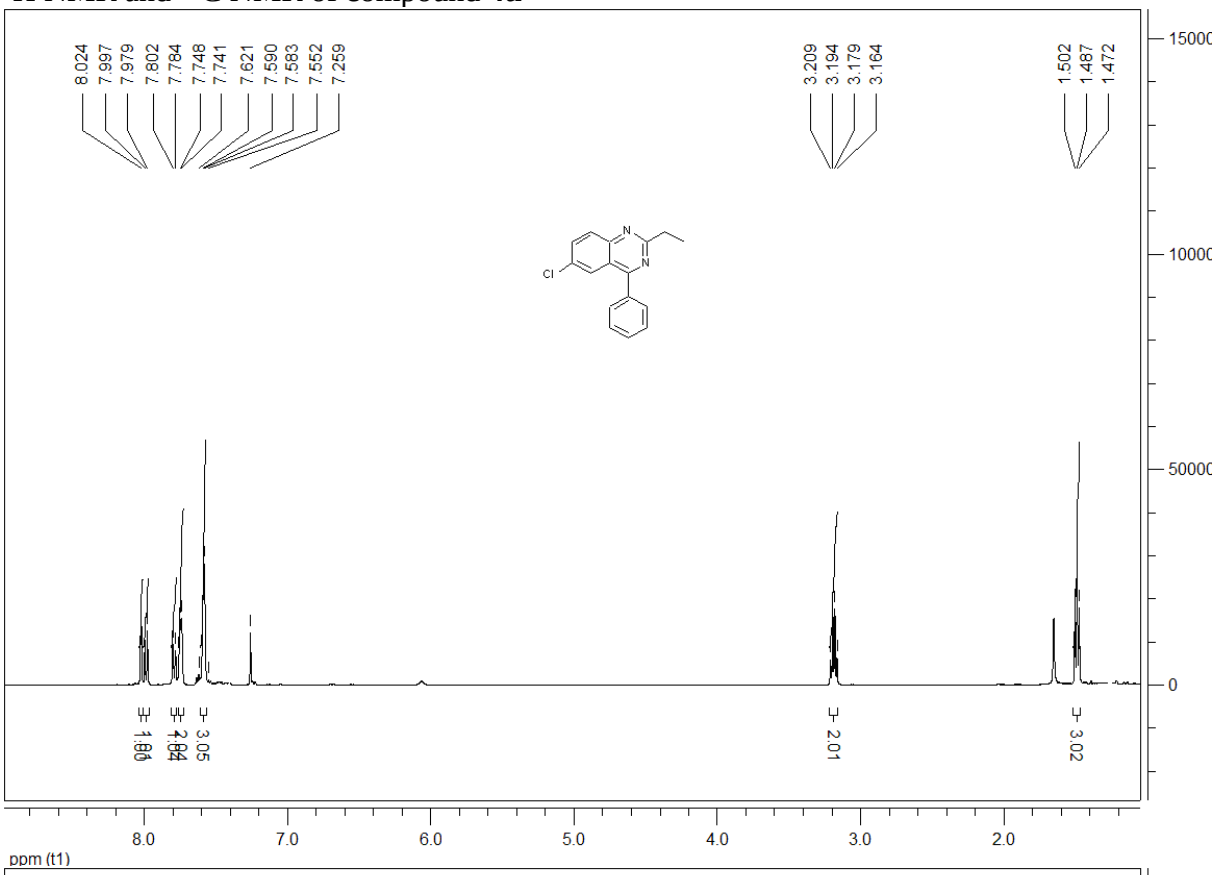


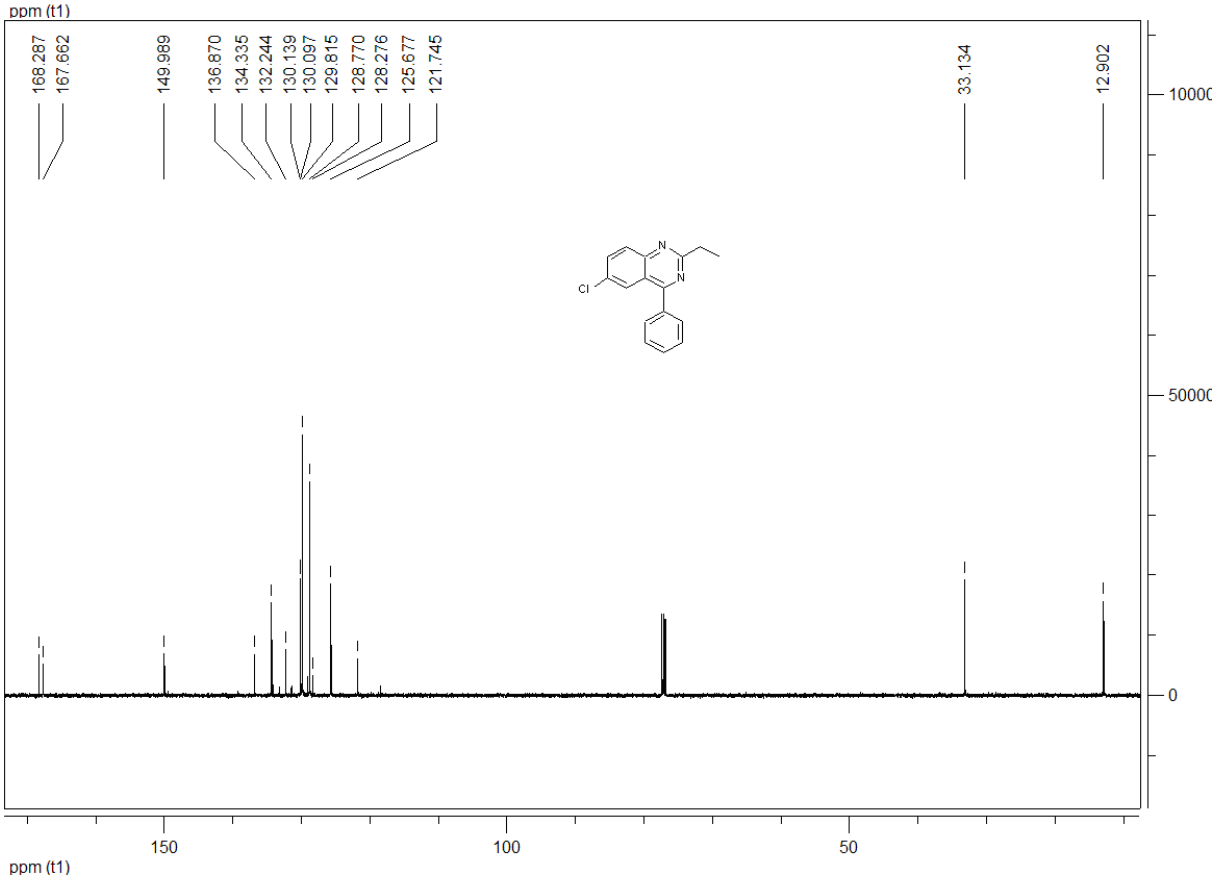
^{1}H NMR and ^{13}C NMR of compound **4t**



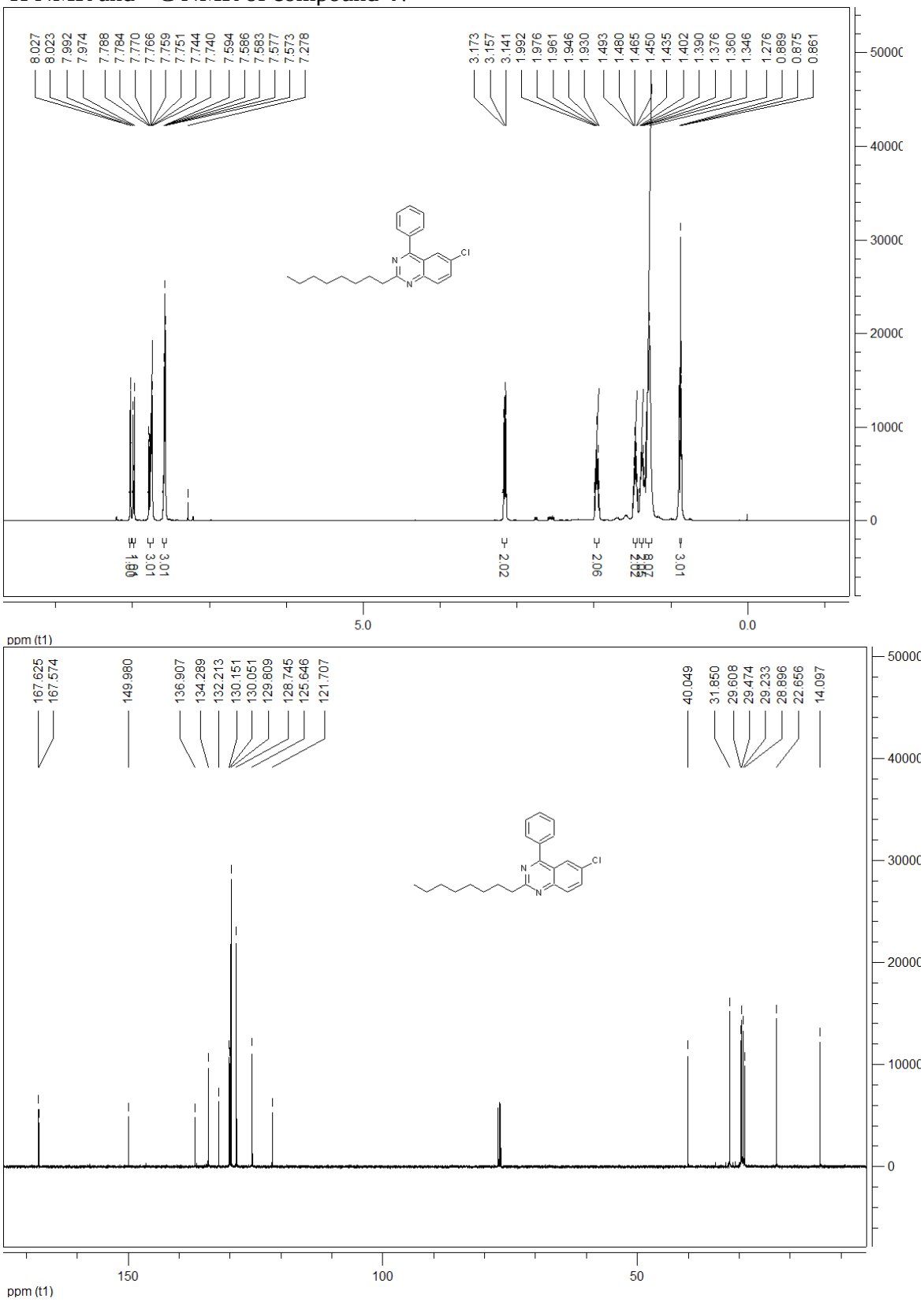


^{1}H NMR and ^{13}C NMR of compound **4u**

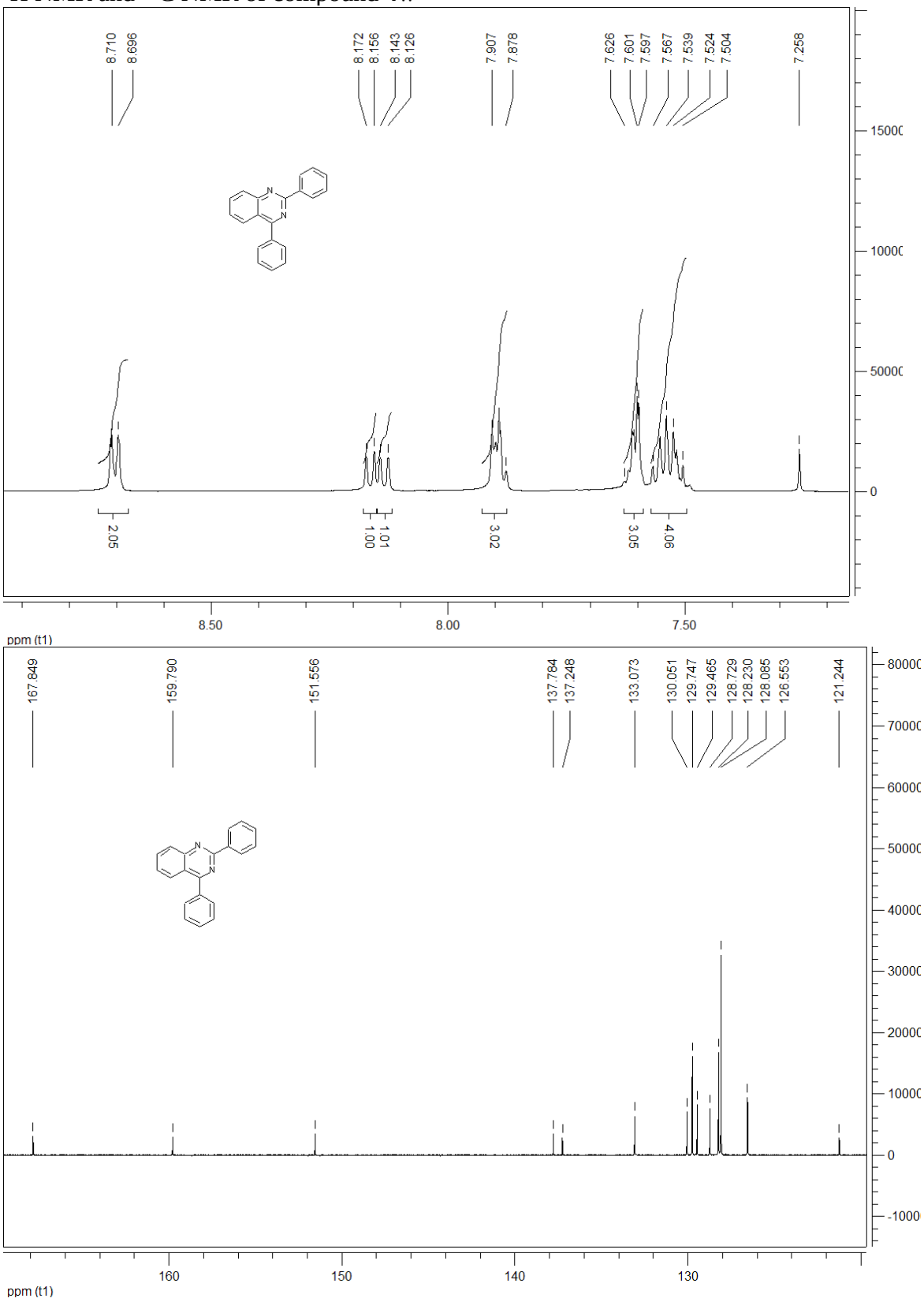




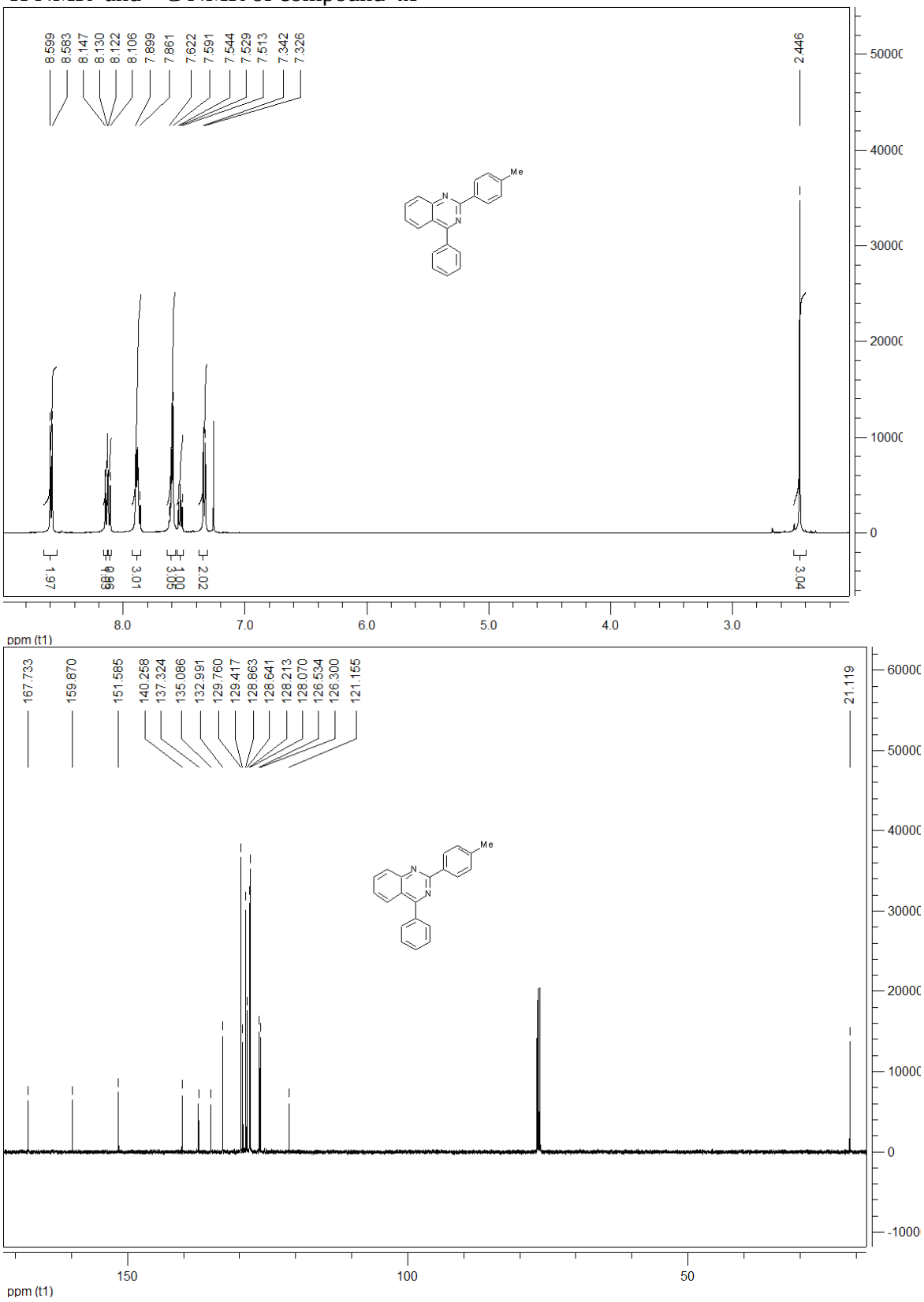
^{1}H NMR and ^{13}C NMR of compound **4v**



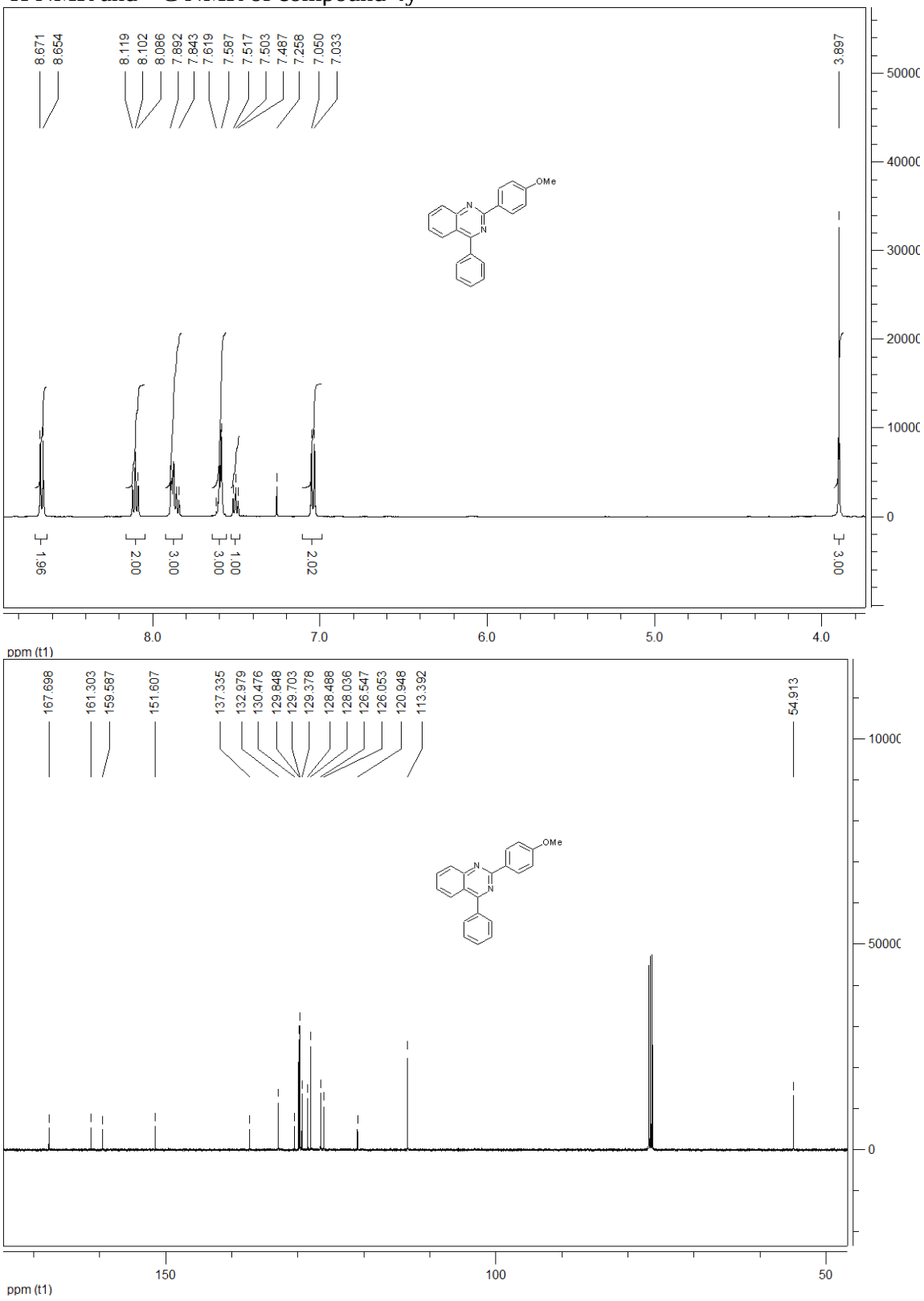
^{1}H NMR and ^{13}C NMR of compound **4w**



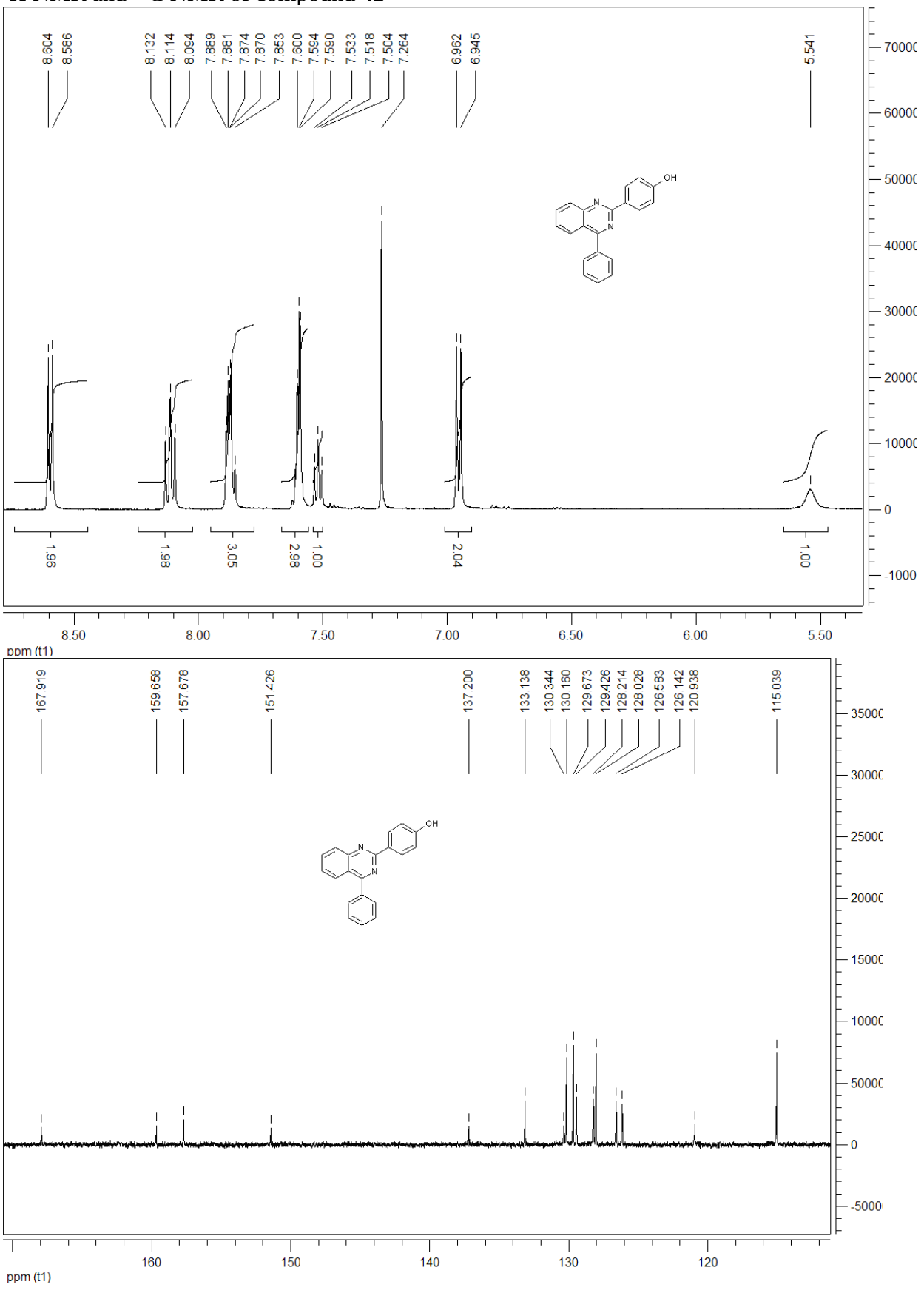
^{1}H NMR and ^{13}C NMR of compound **4x**



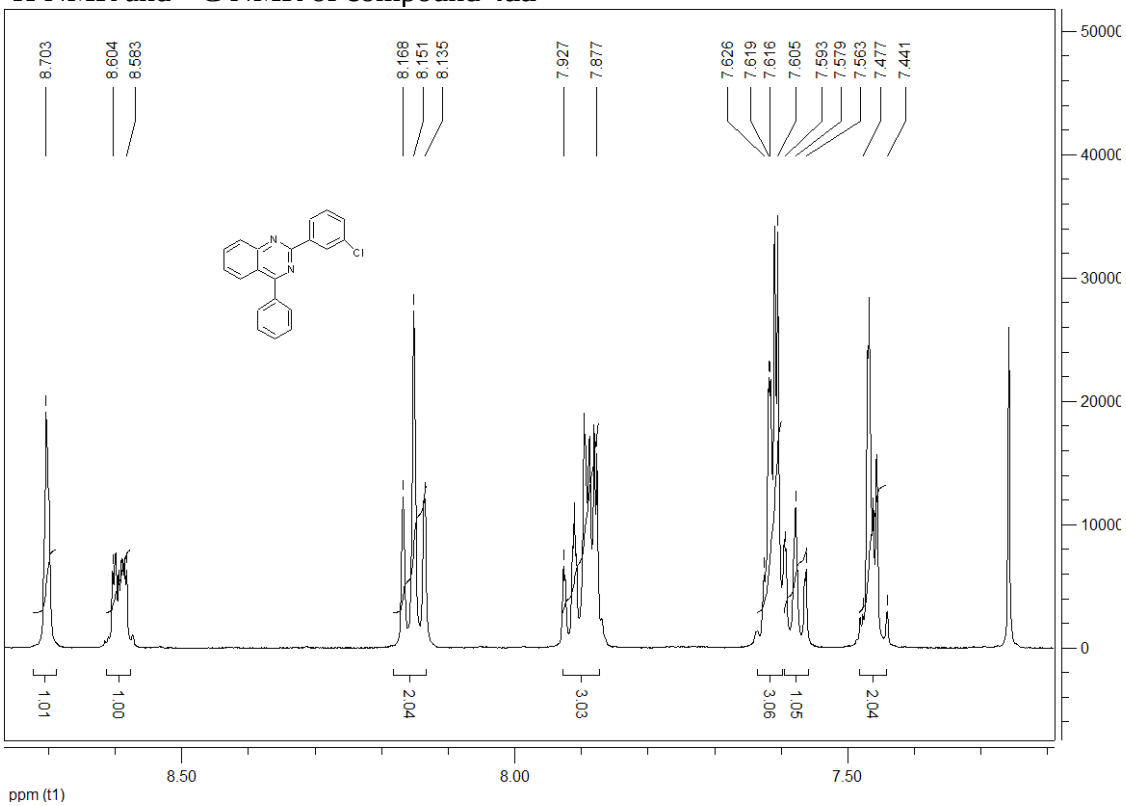
^{1}H NMR and ^{13}C NMR of compound **4y**

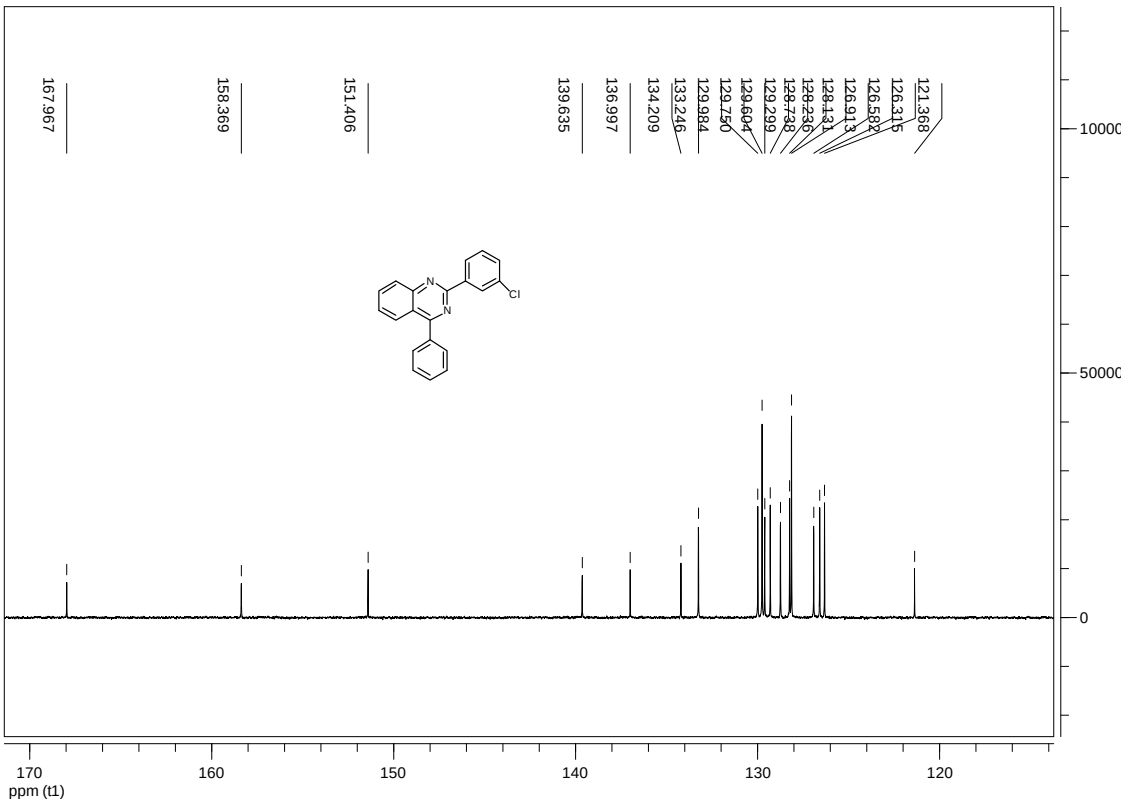


^{1}H NMR and ^{13}C NMR of compound **4z**

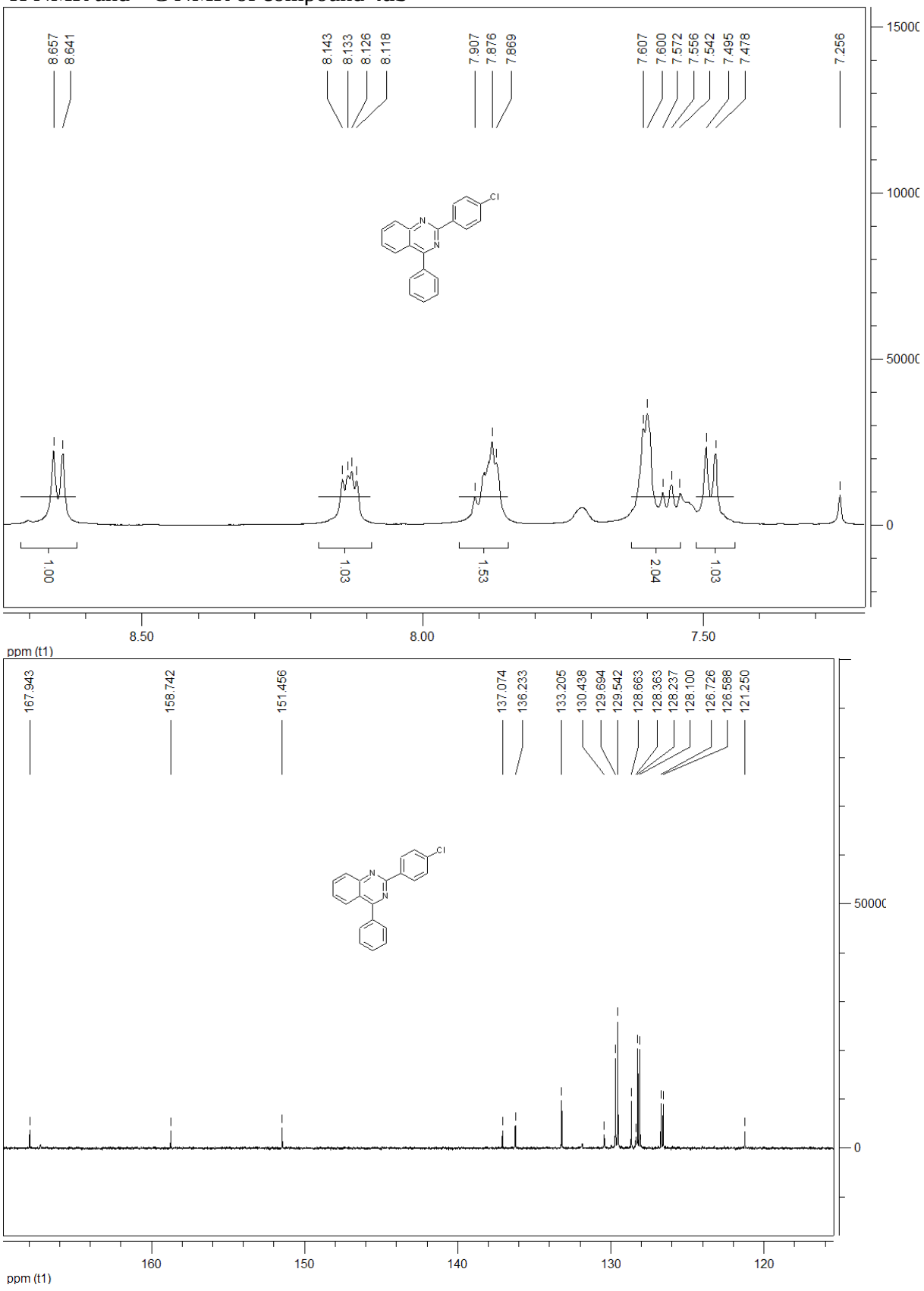


^{1}H NMR and ^{13}C NMR of compound **4aa**

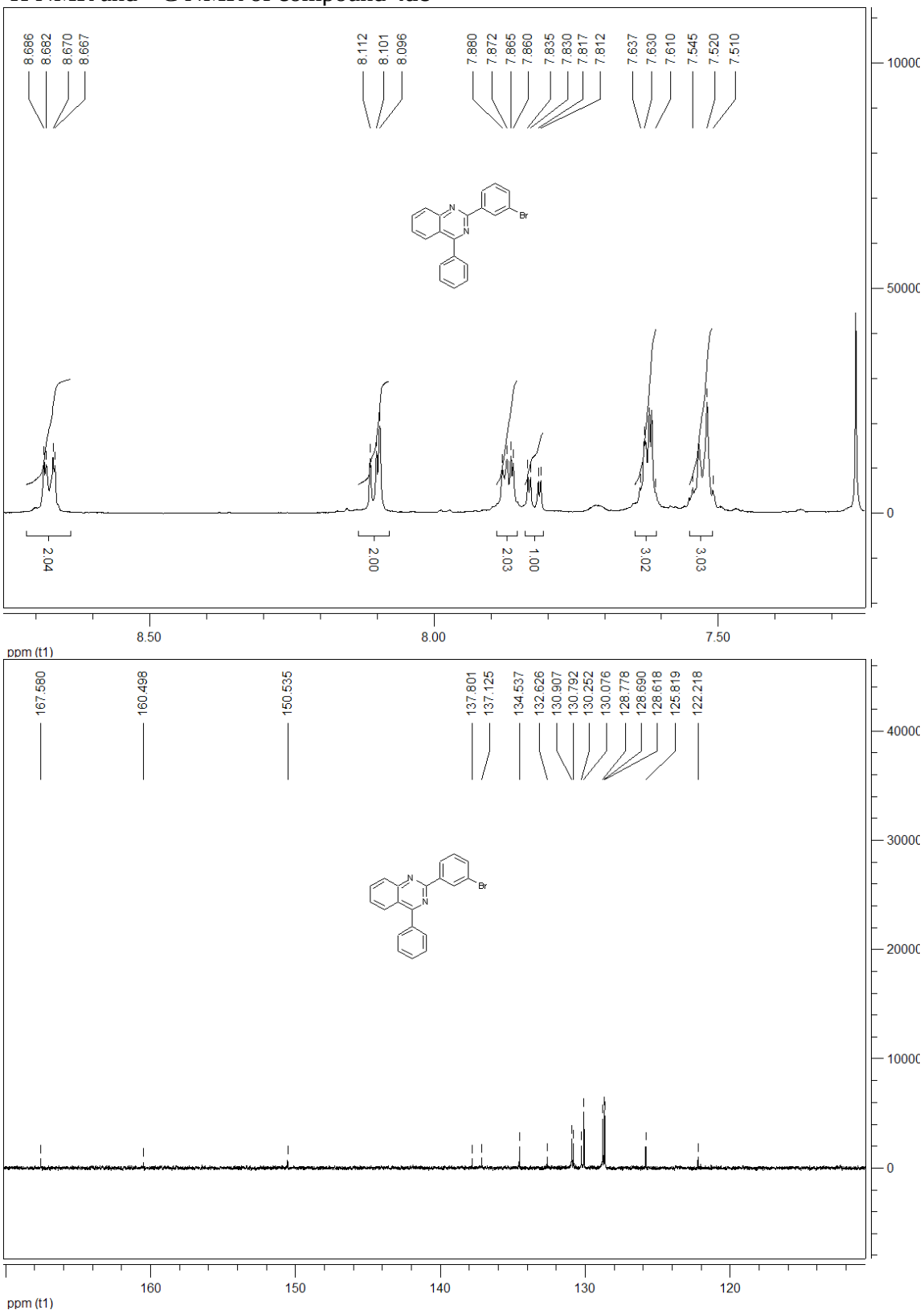




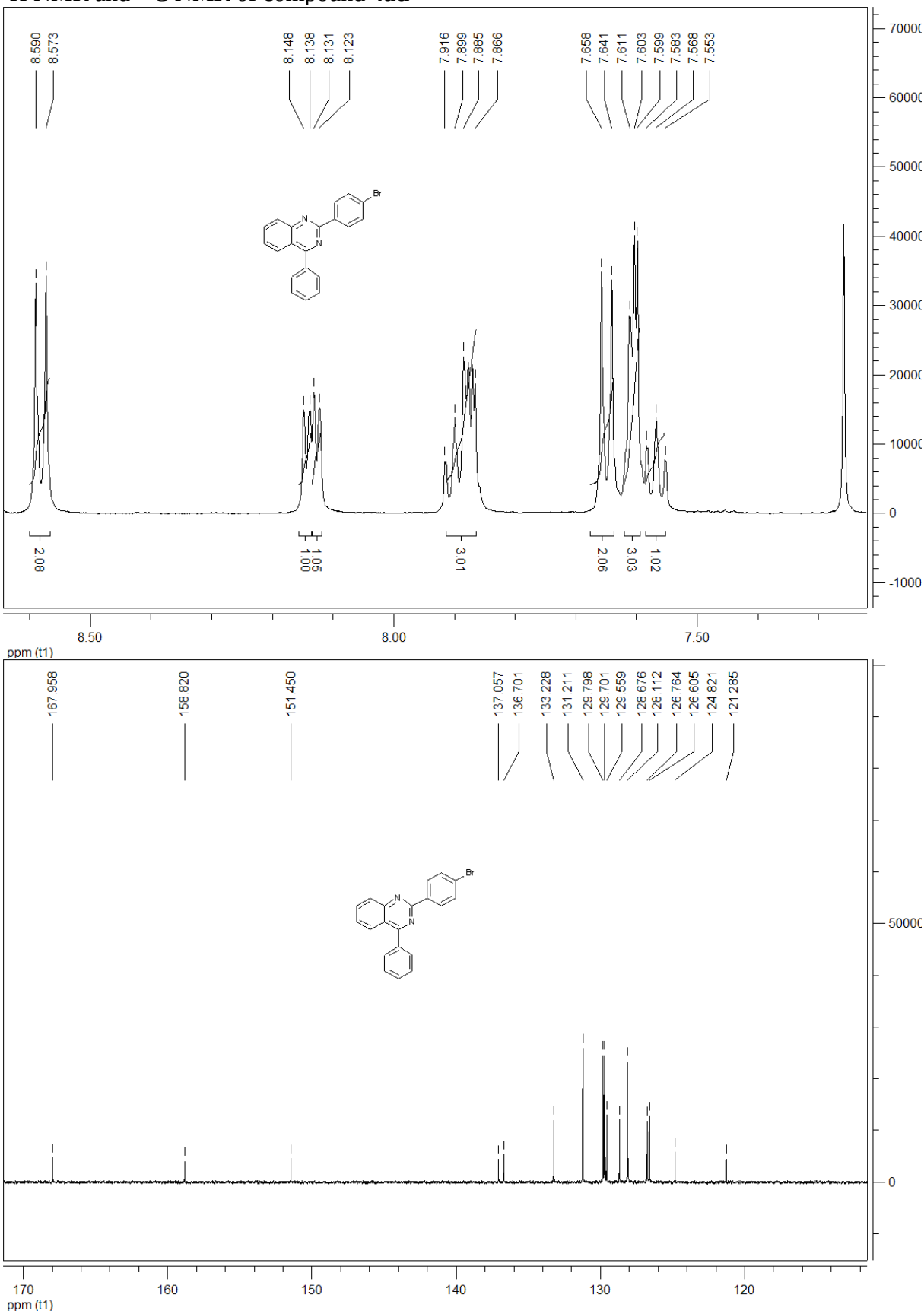
^{1}H NMR and ^{13}C NMR of compound **4ab**



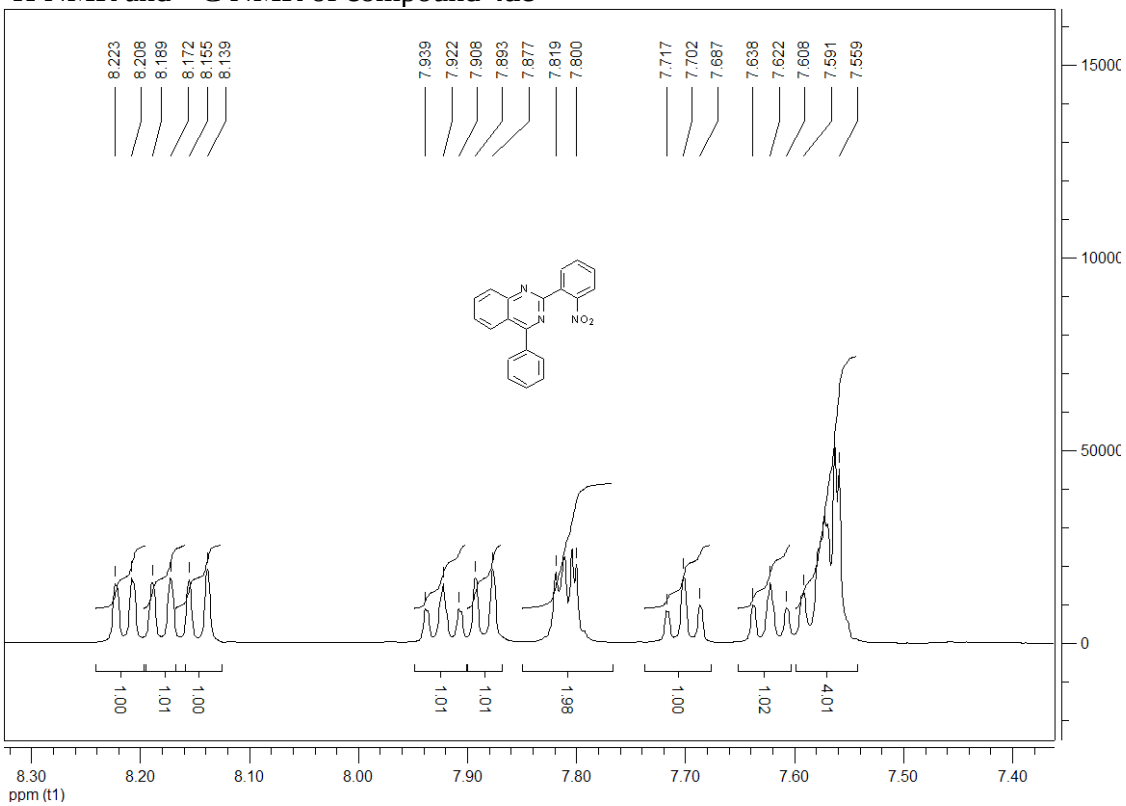
^{1}H NMR and ^{13}C NMR of compound **4ac**

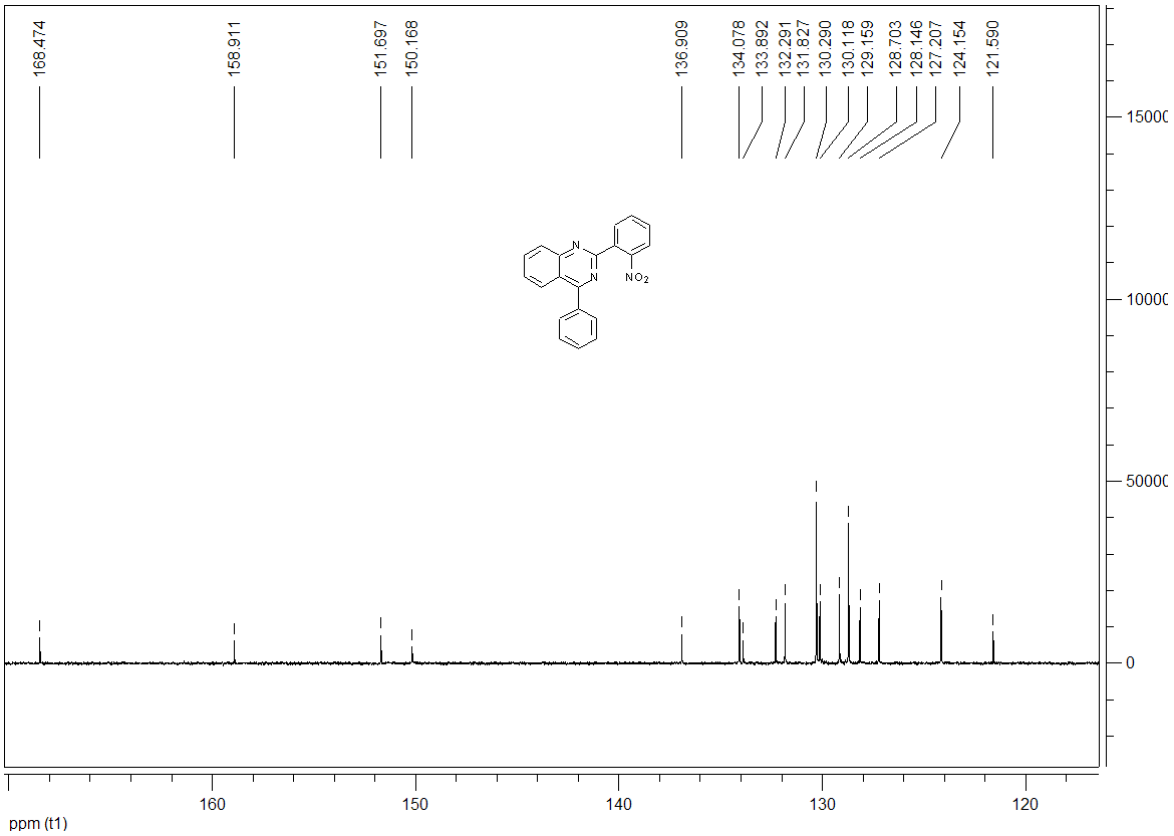


^{1}H NMR and ^{13}C NMR of compound **4ad**

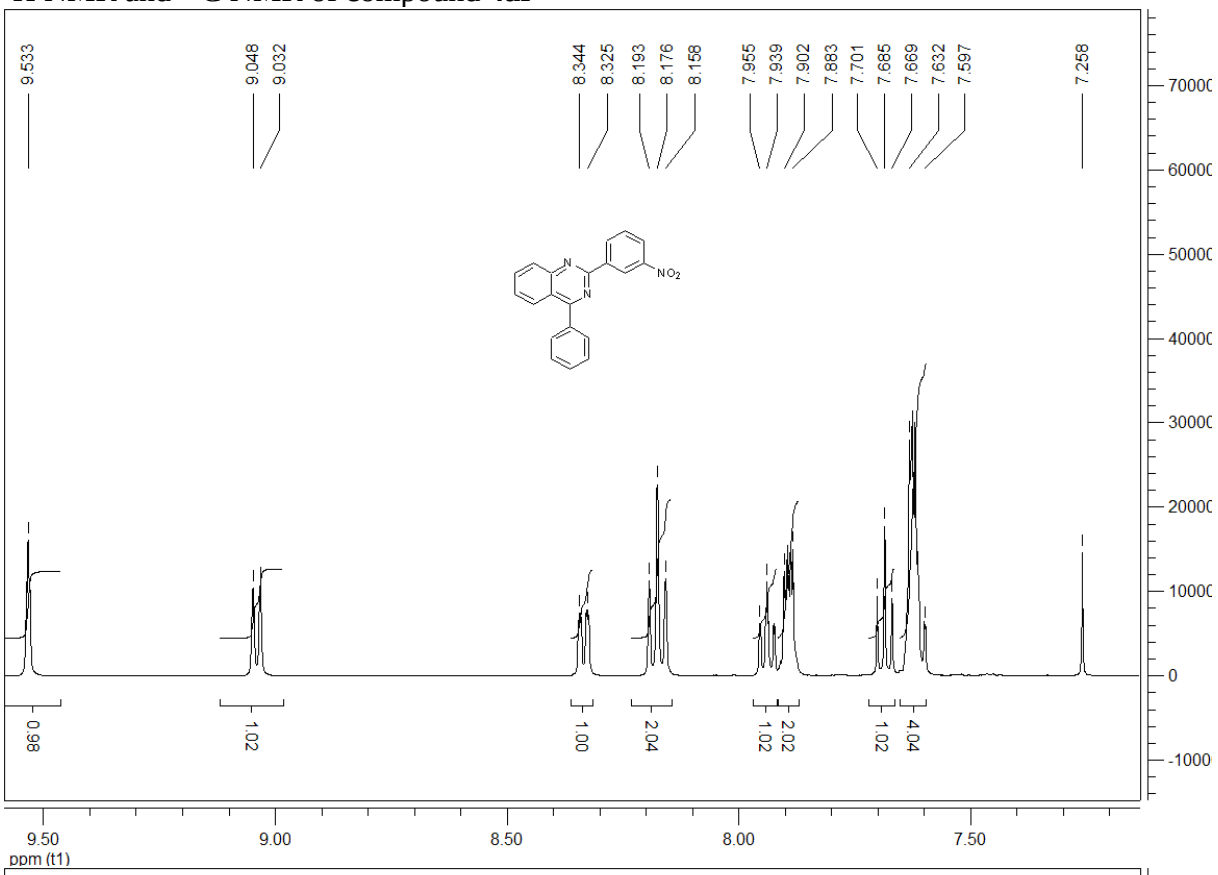


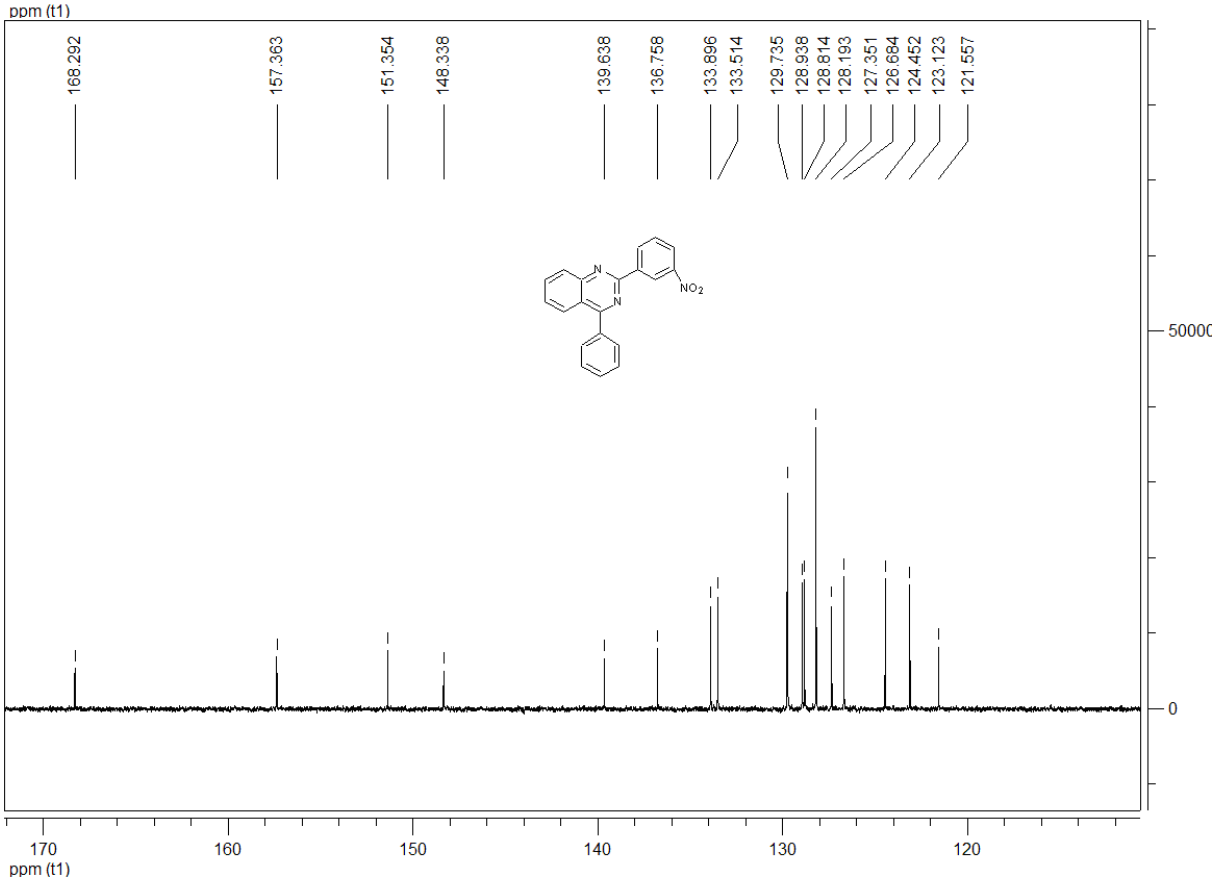
^{1}H NMR and ^{13}C NMR of compound **4ae**



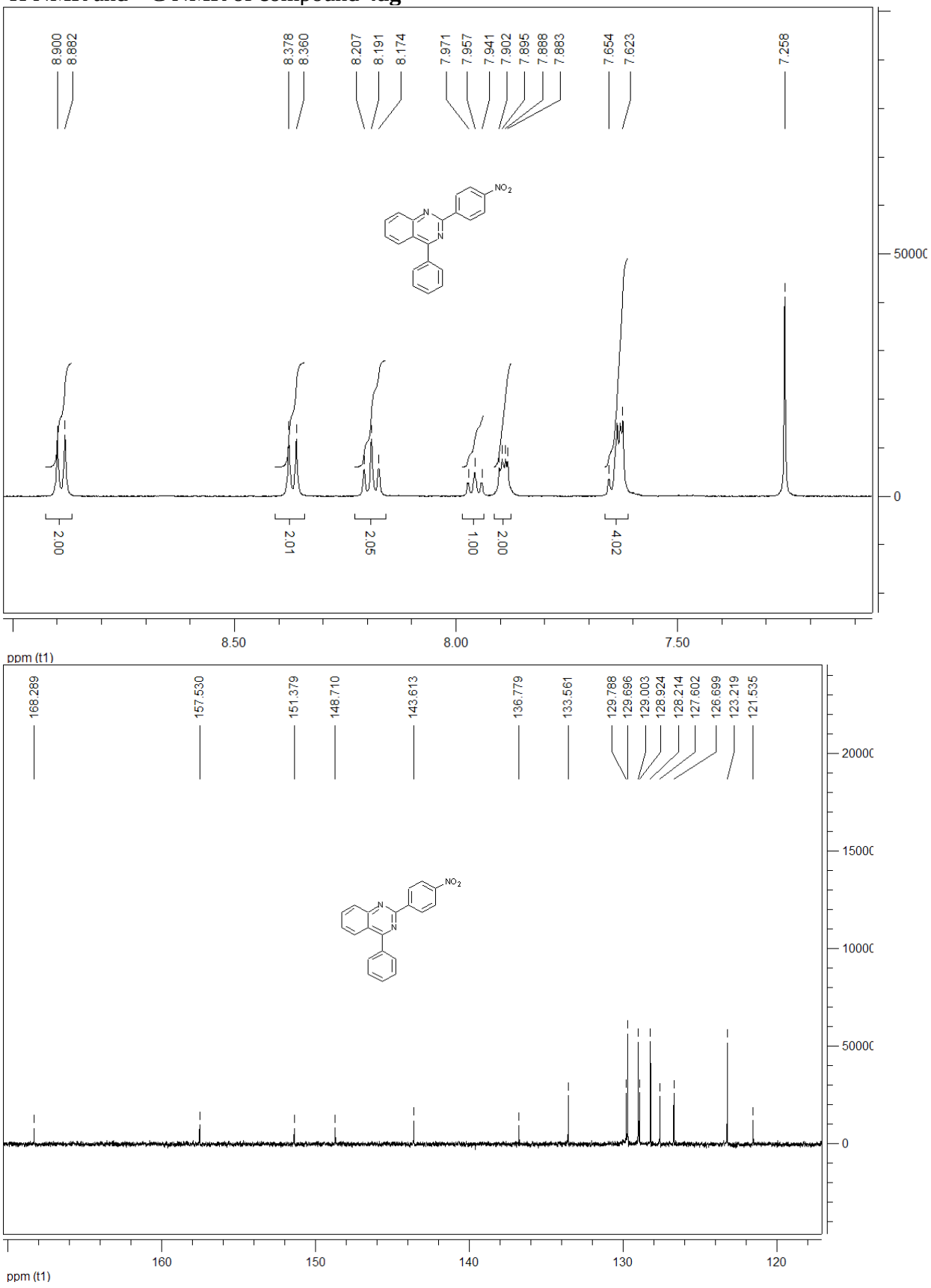


^{1}H NMR and ^{13}C NMR of compound **4af**

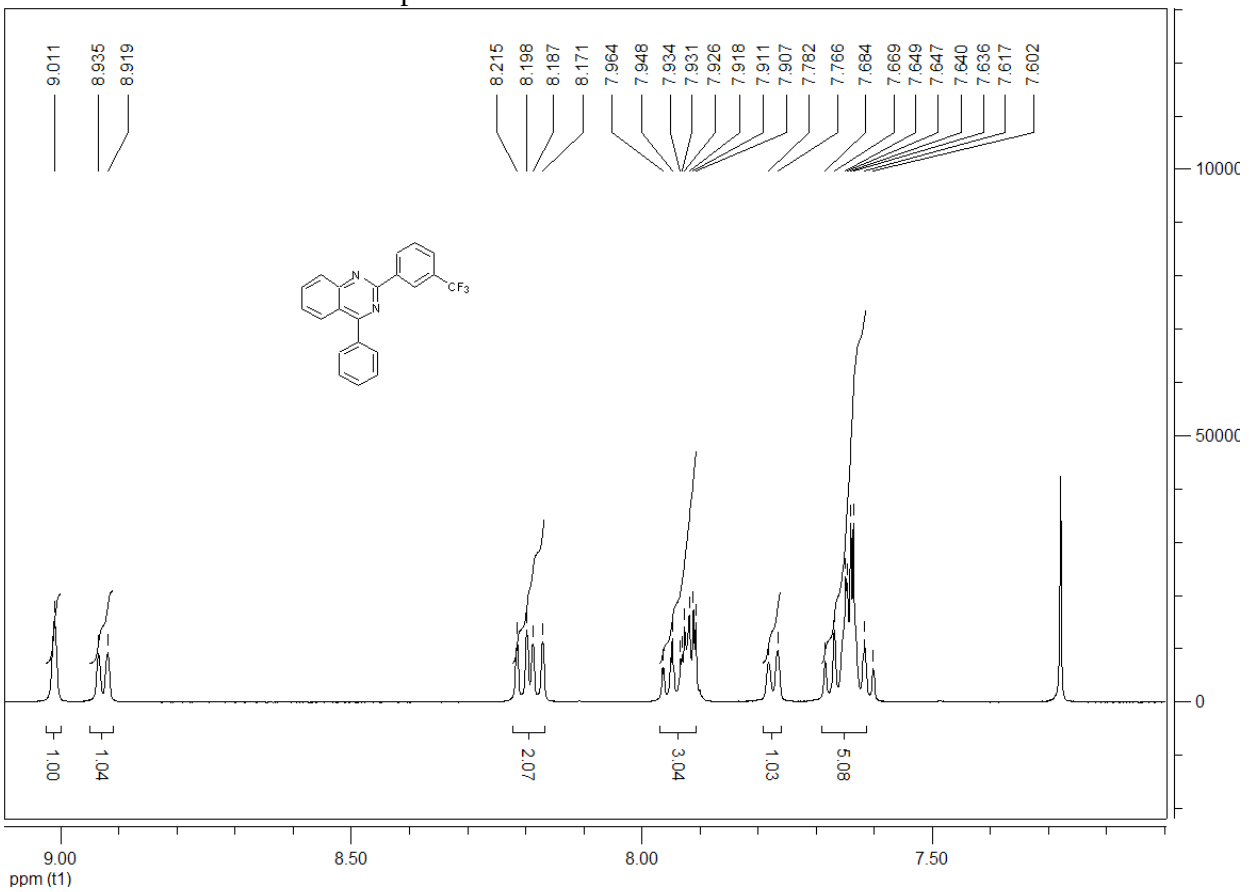


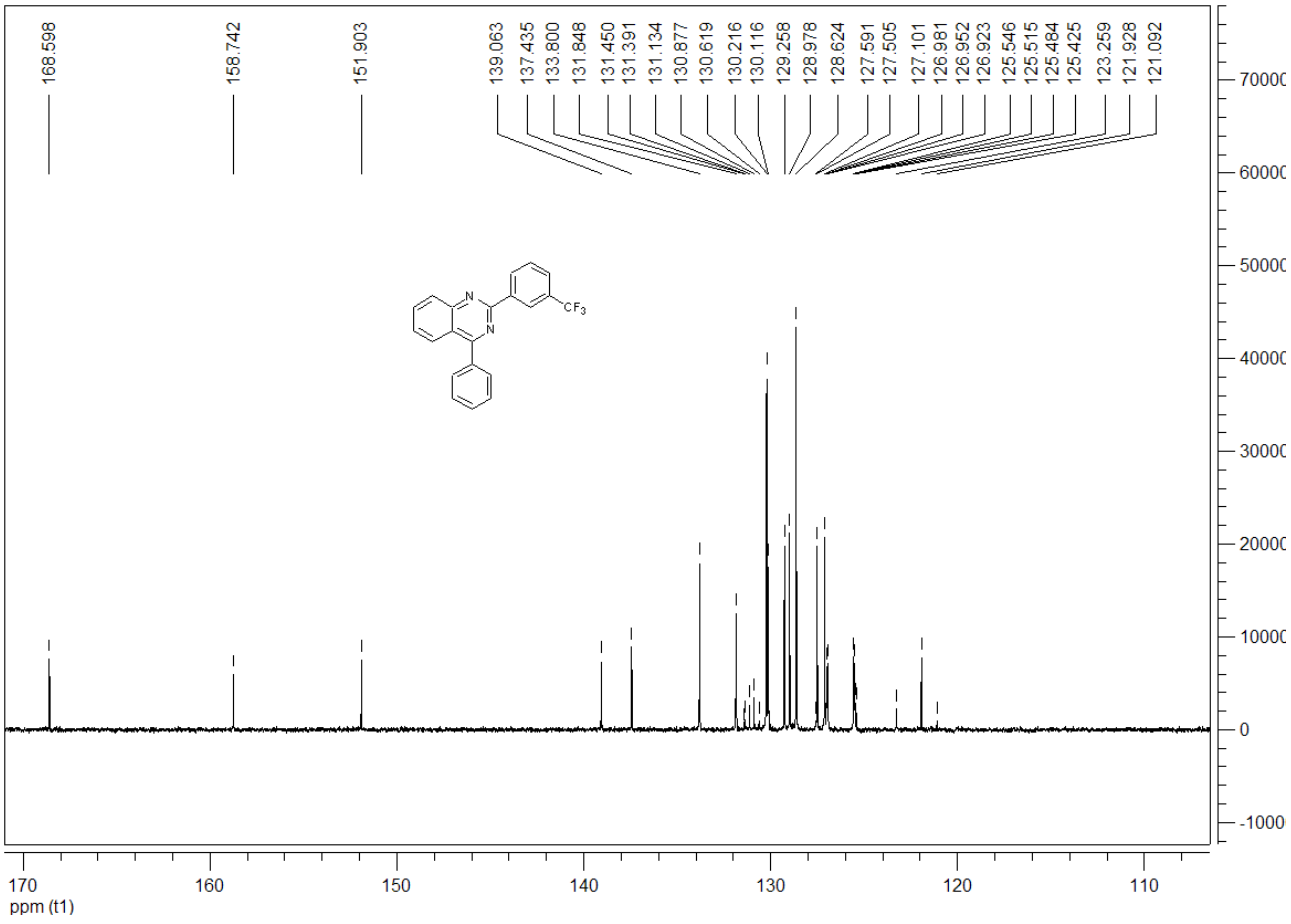


^{1}H NMR and ^{13}C NMR of compound **4ag**

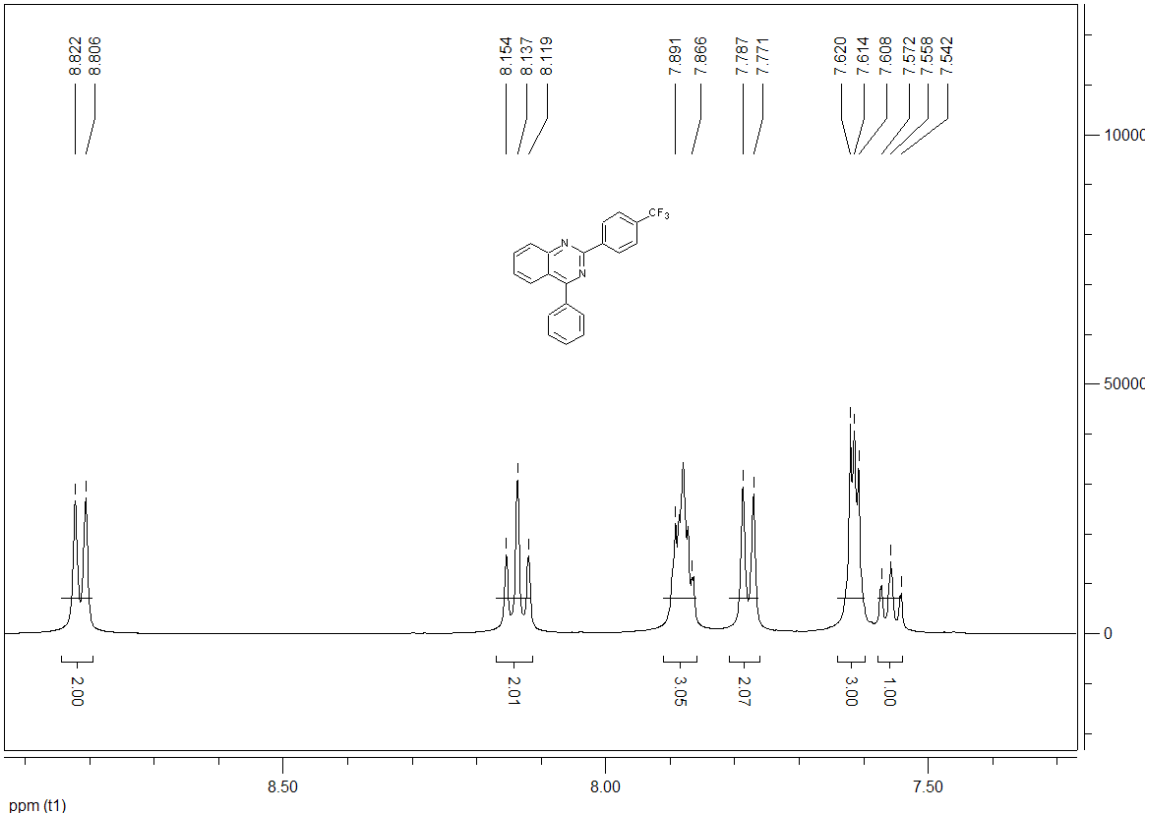


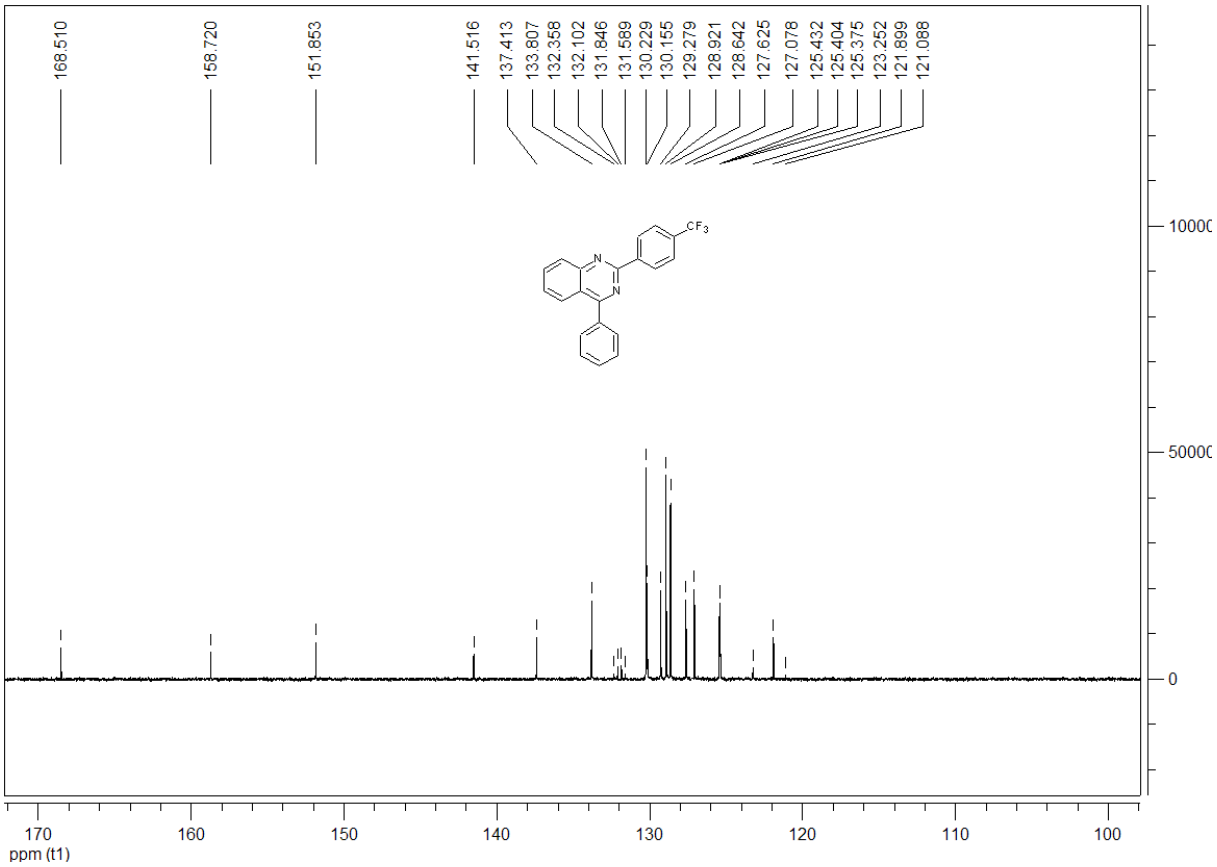
^{1}H NMR and ^{13}C NMR of compound **4ah**



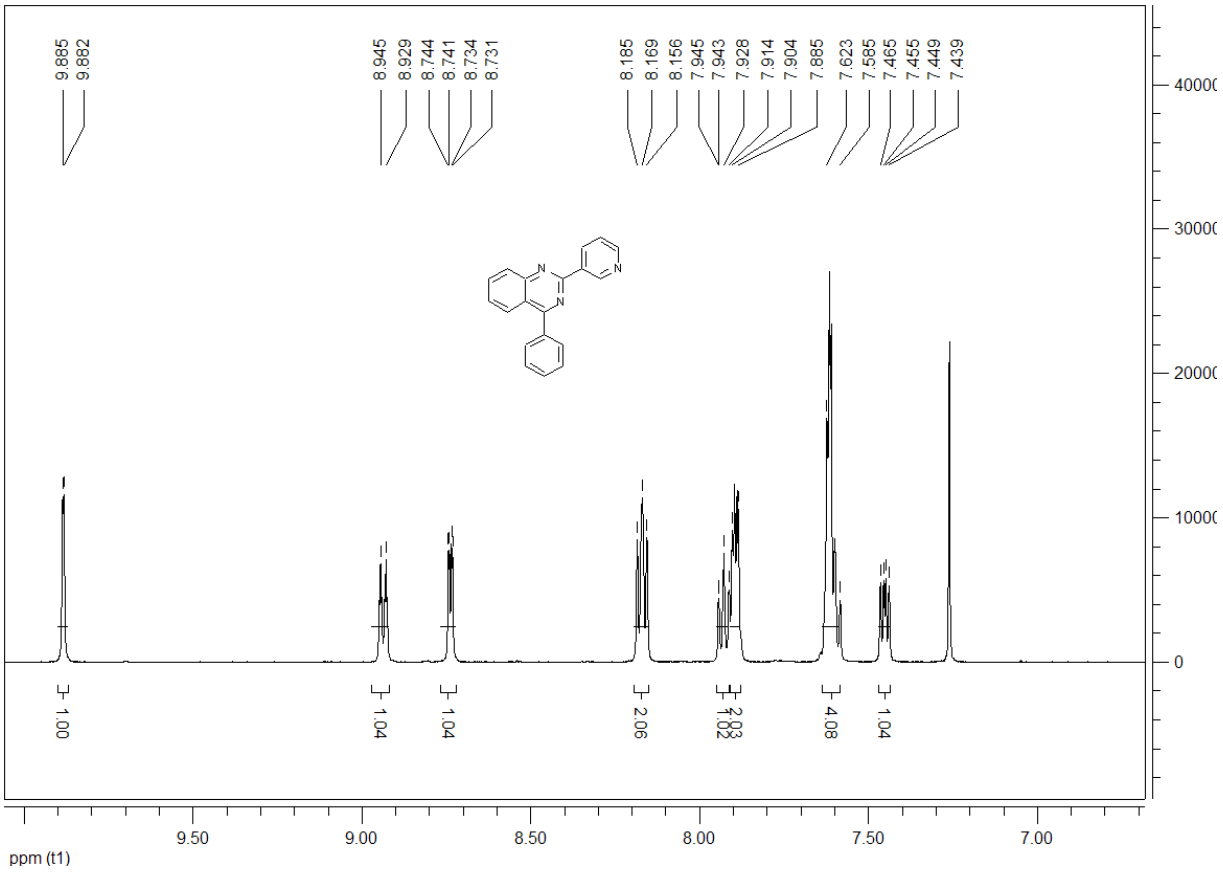


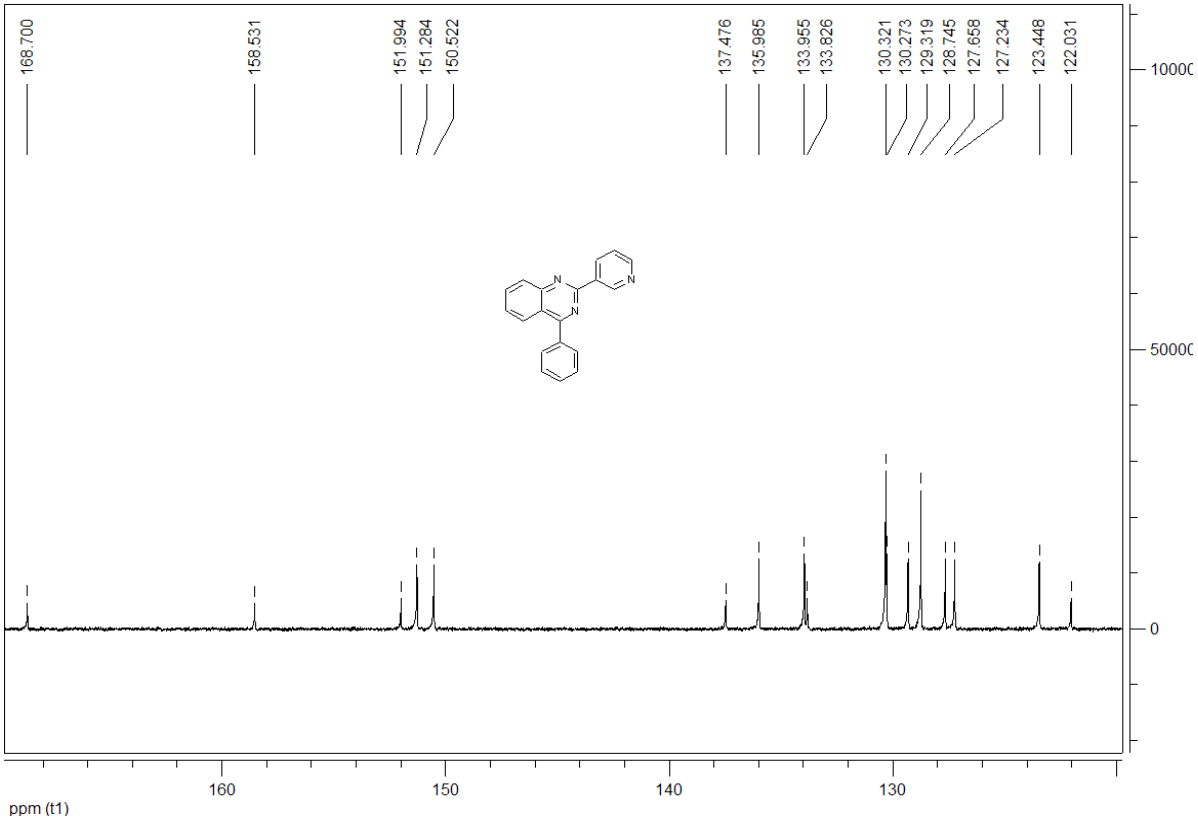
^{1}H NMR and ^{13}C NMR of compound **4ai**



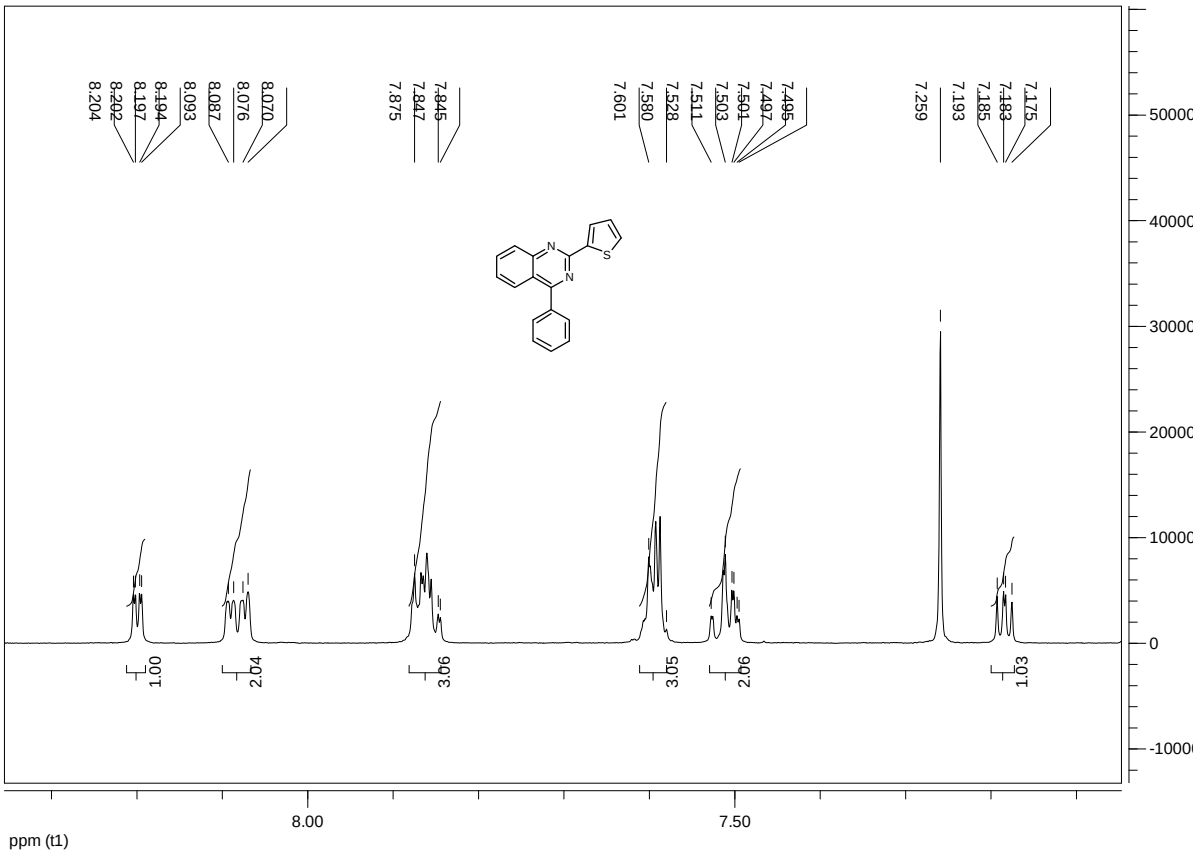


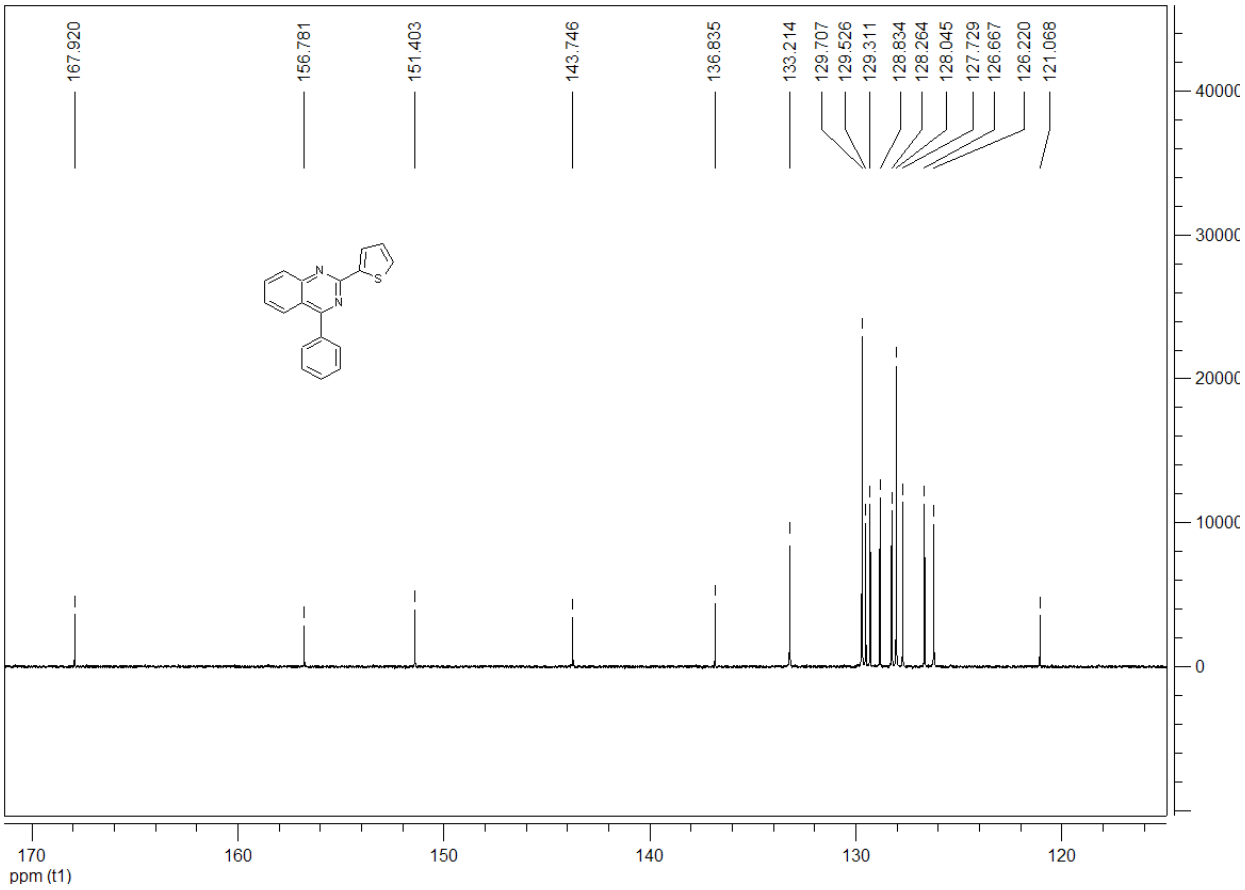
^{1}H NMR and ^{13}C NMR of compound **4aj**



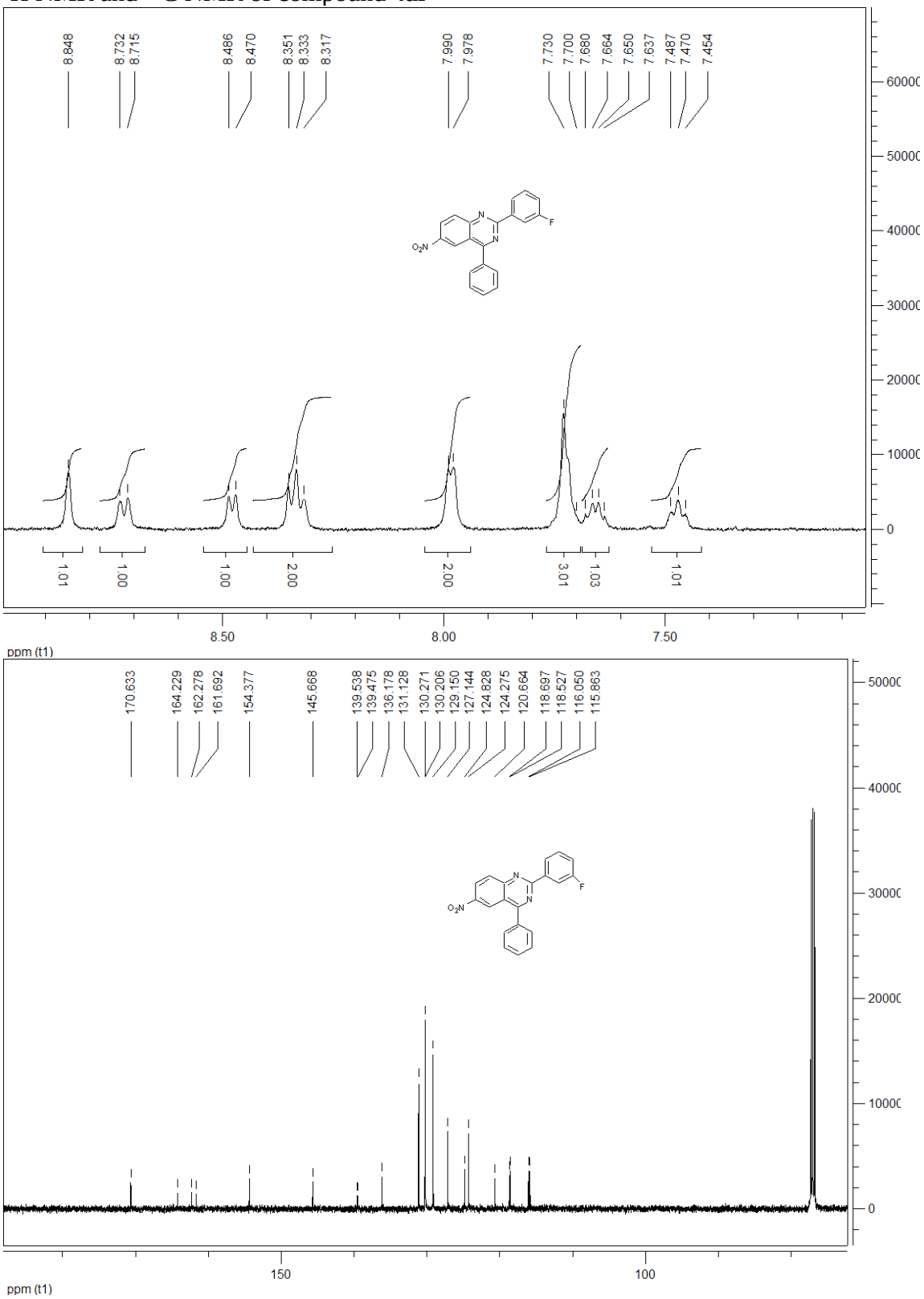


^{1}H NMR and ^{13}C NMR of compound **4ak**

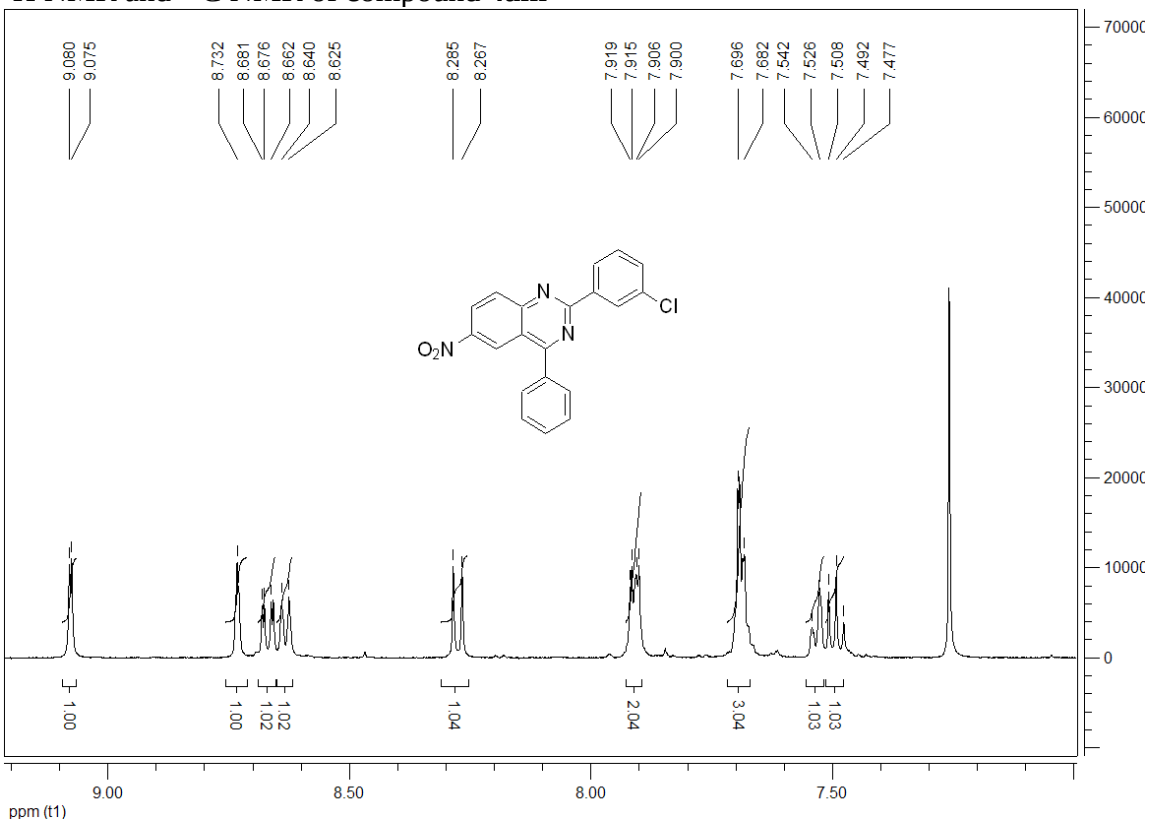


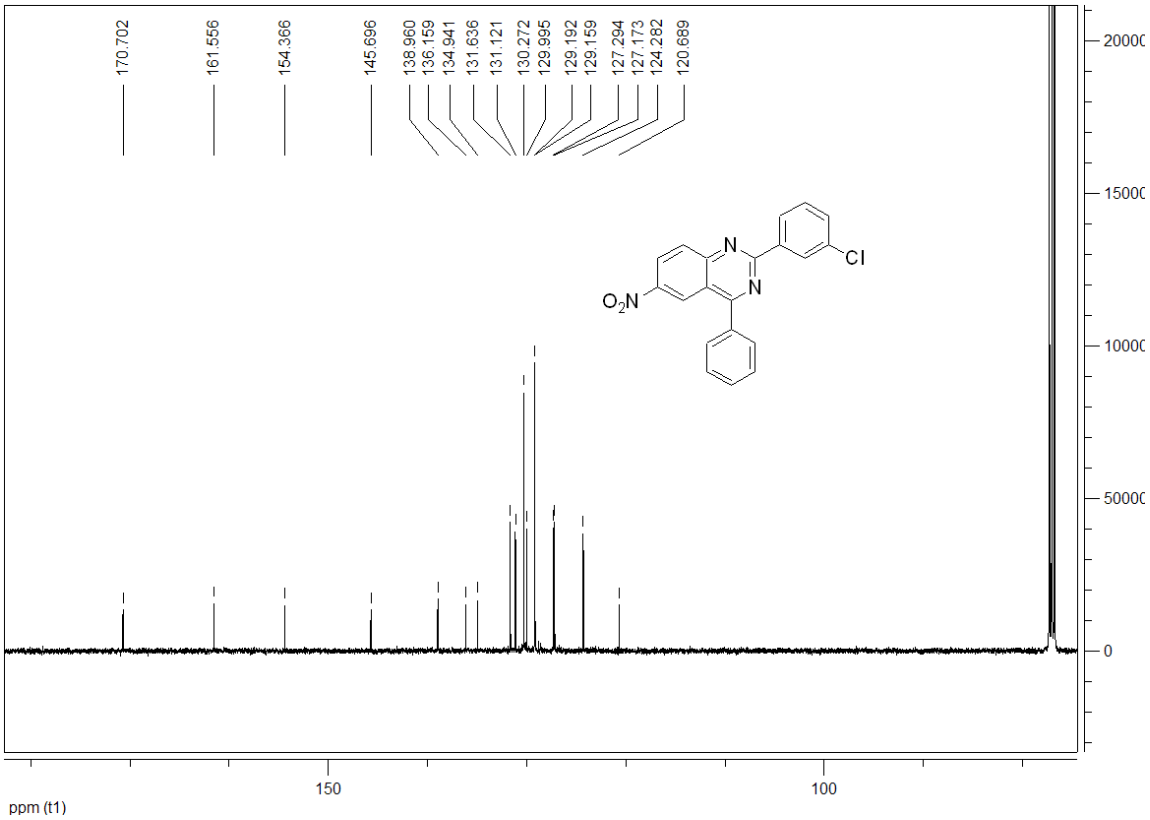


^{1}H NMR and ^{13}C NMR of compound **4al**

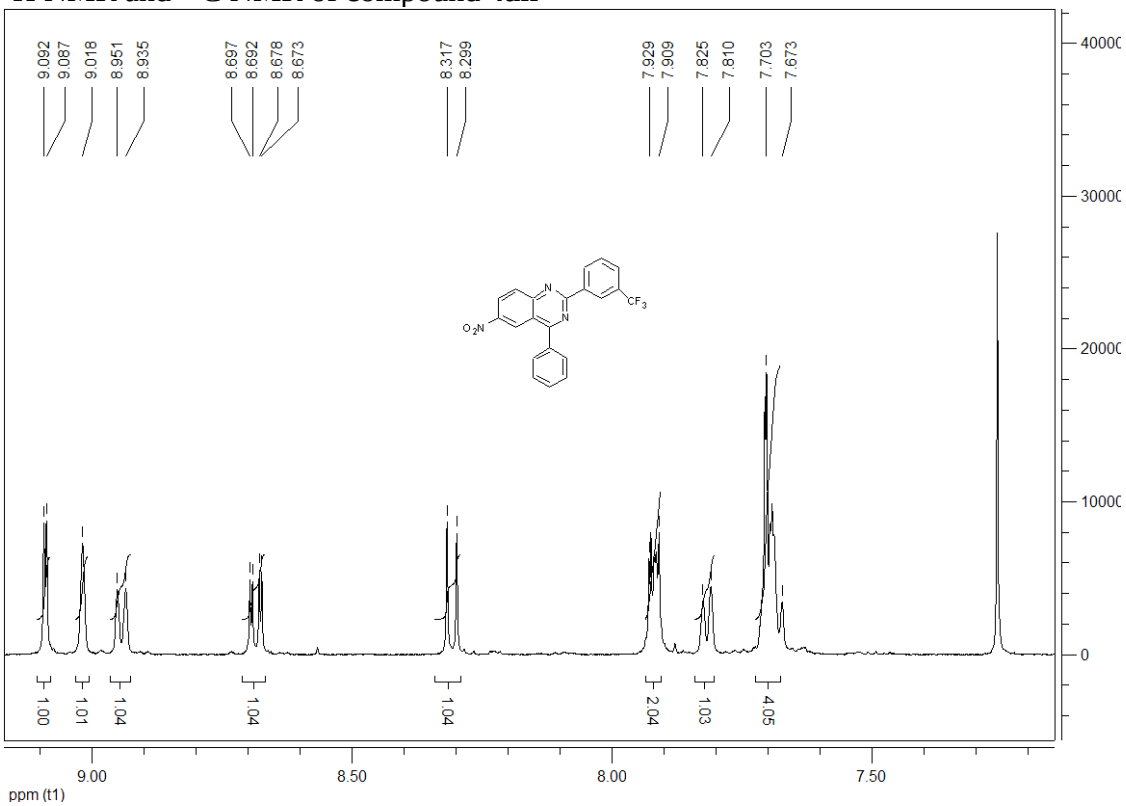


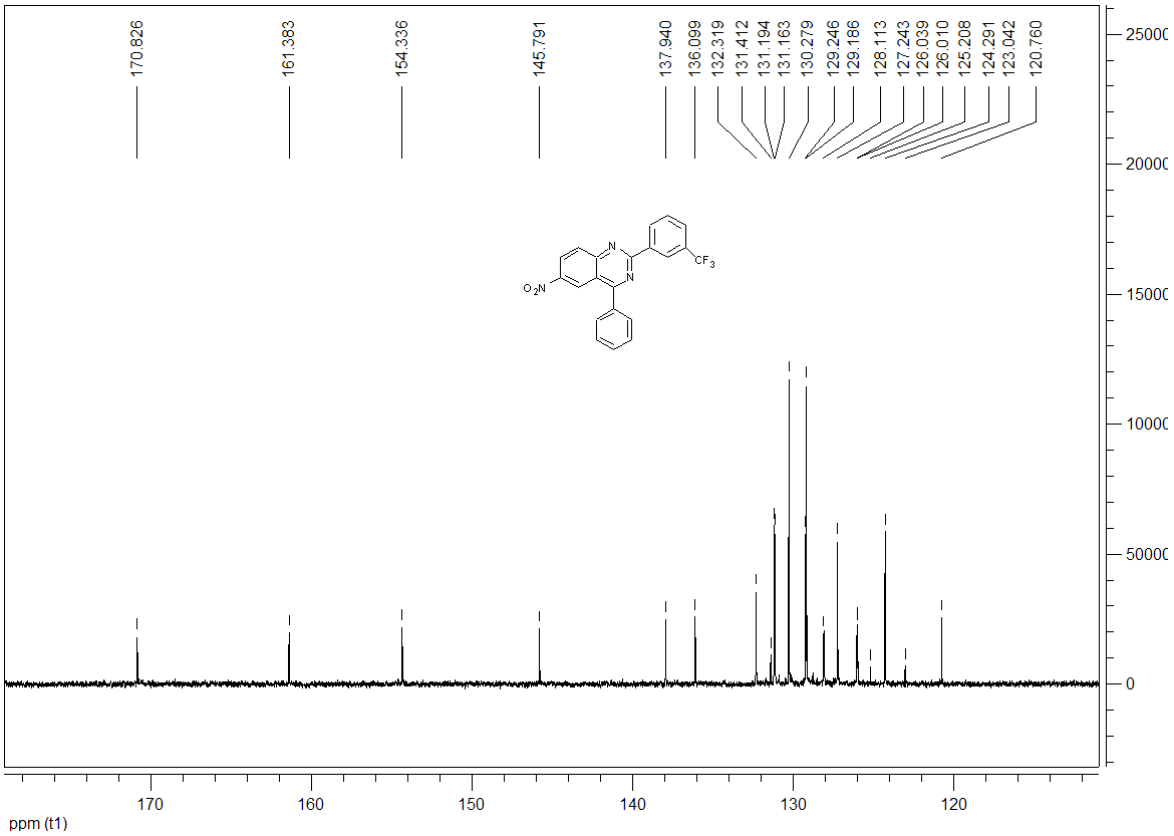
^{1}H NMR and ^{13}C NMR of compound **4am**



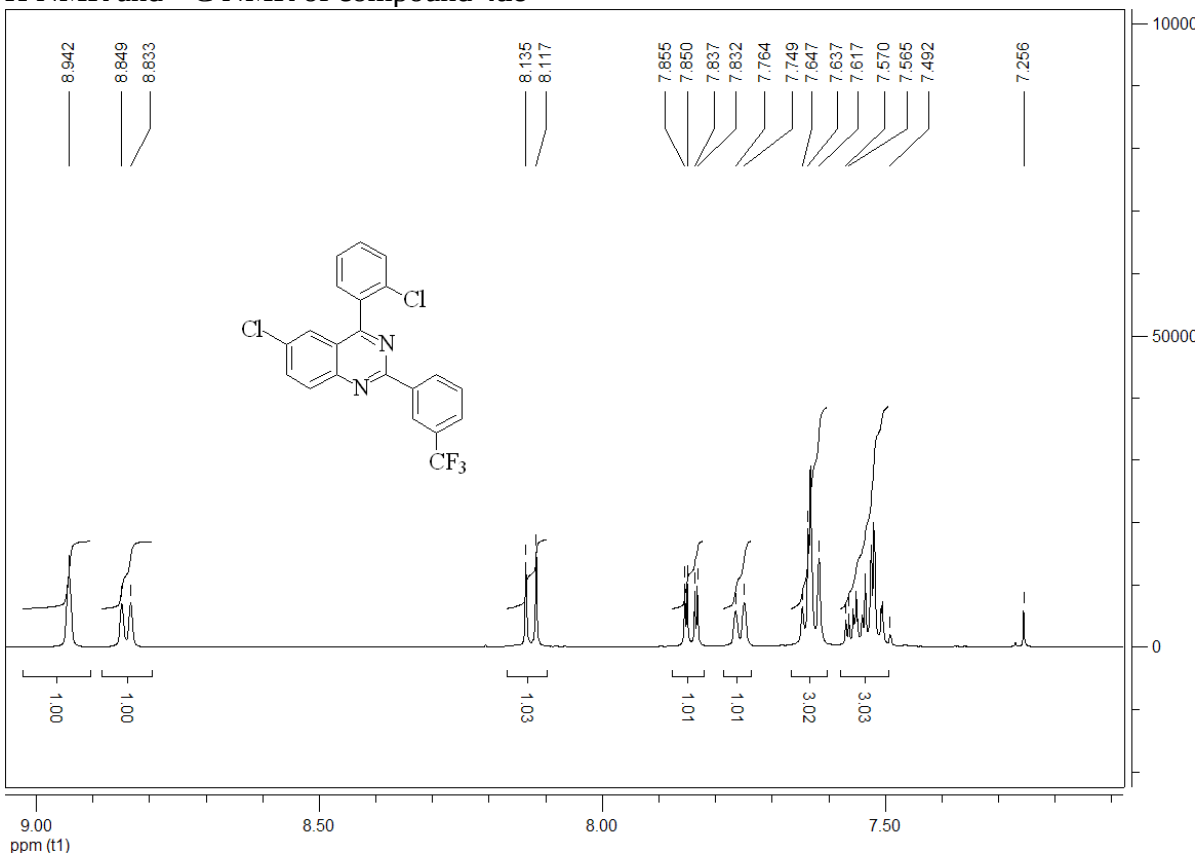


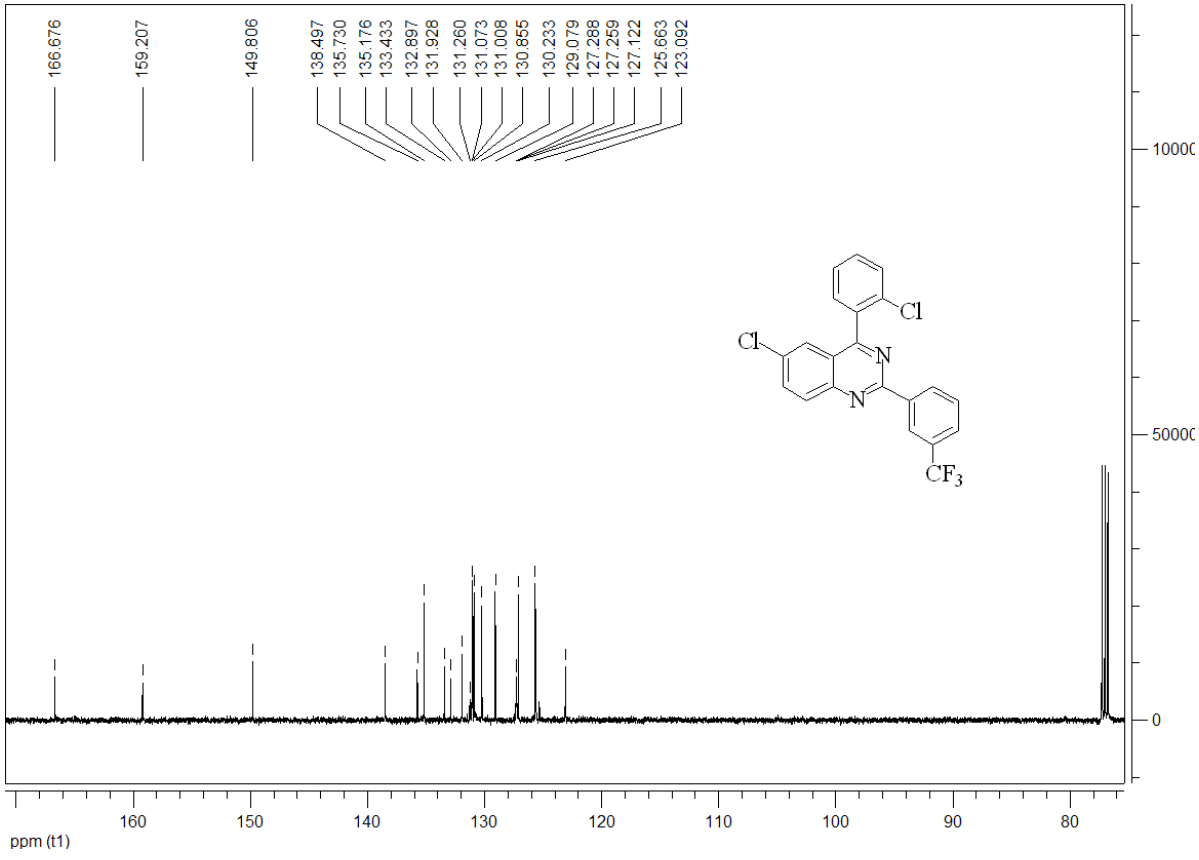
^{1}H NMR and ^{13}C NMR of compound **4an**



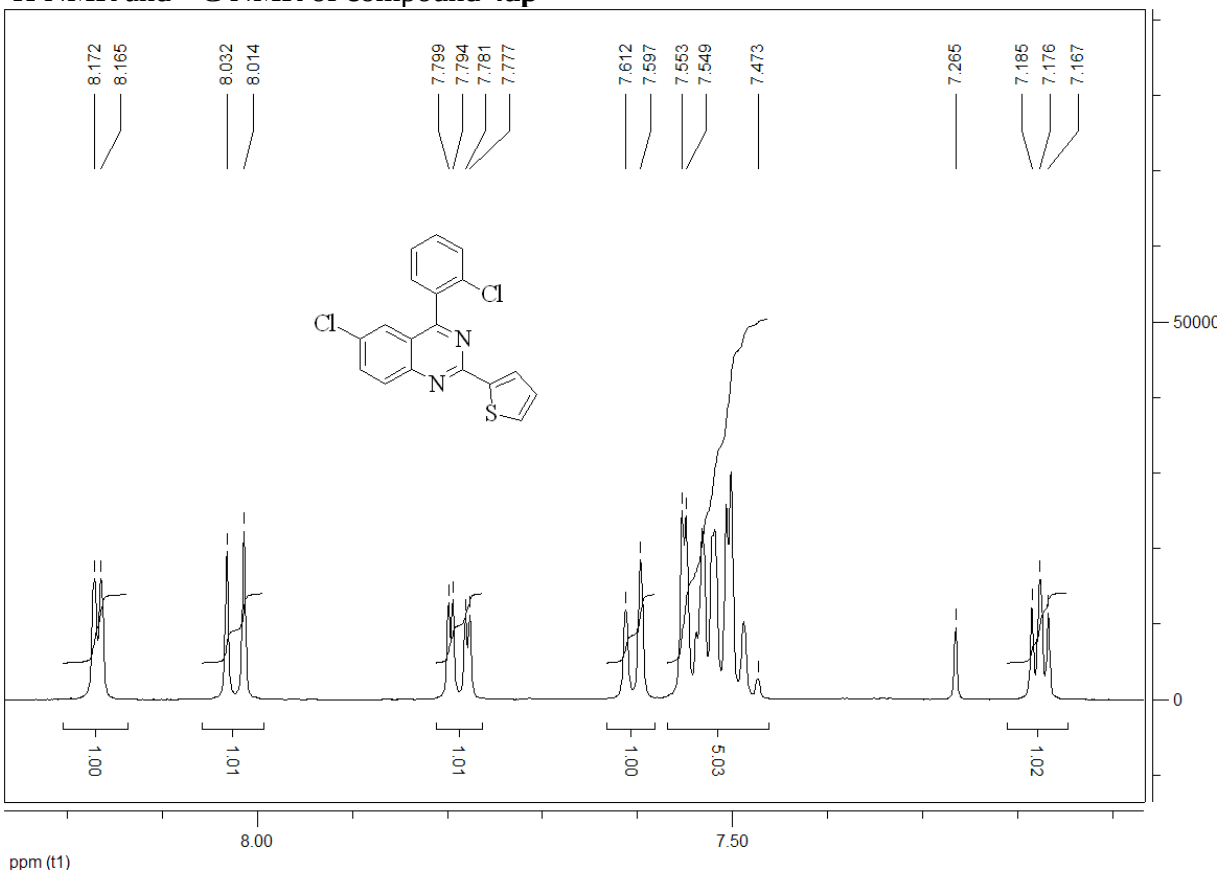


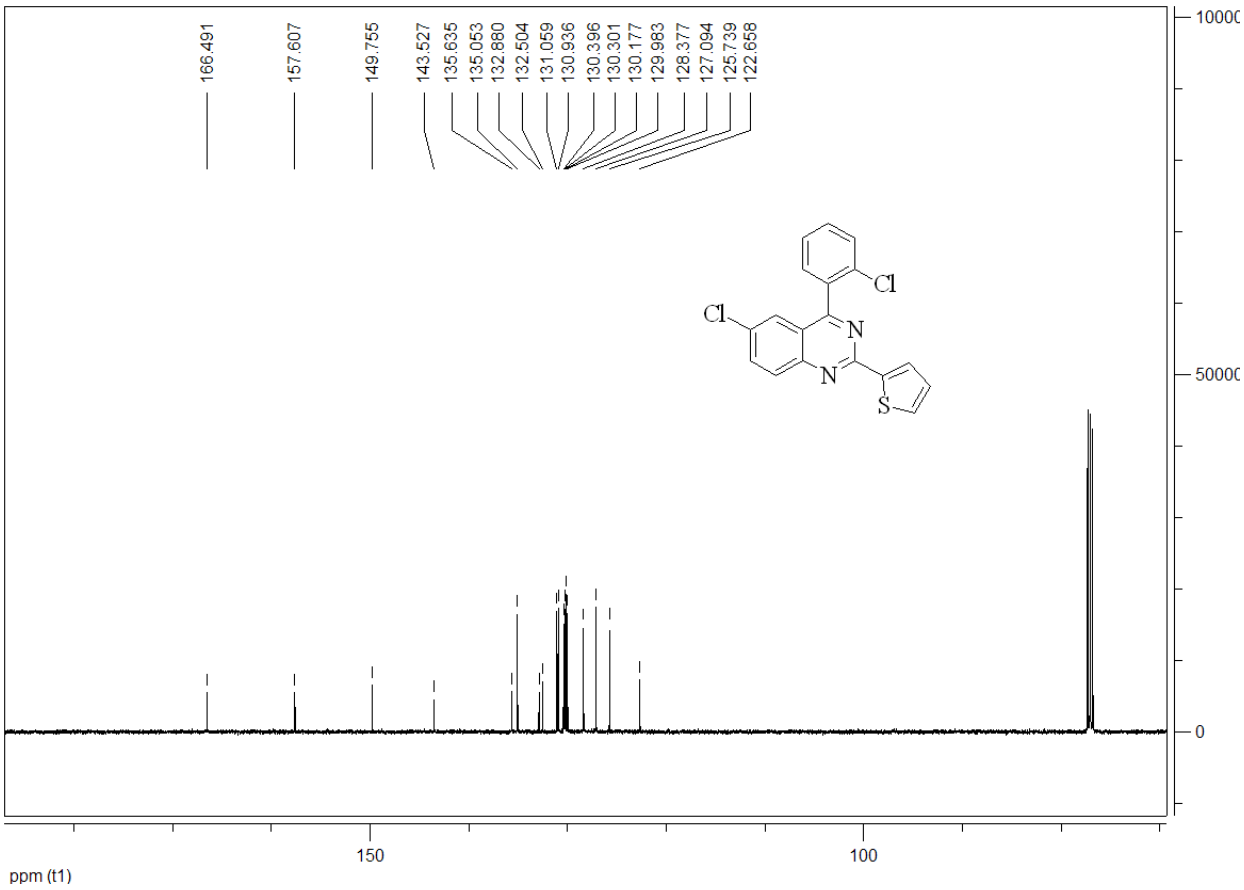
^{1}H NMR and ^{13}C NMR of compound **4ao**



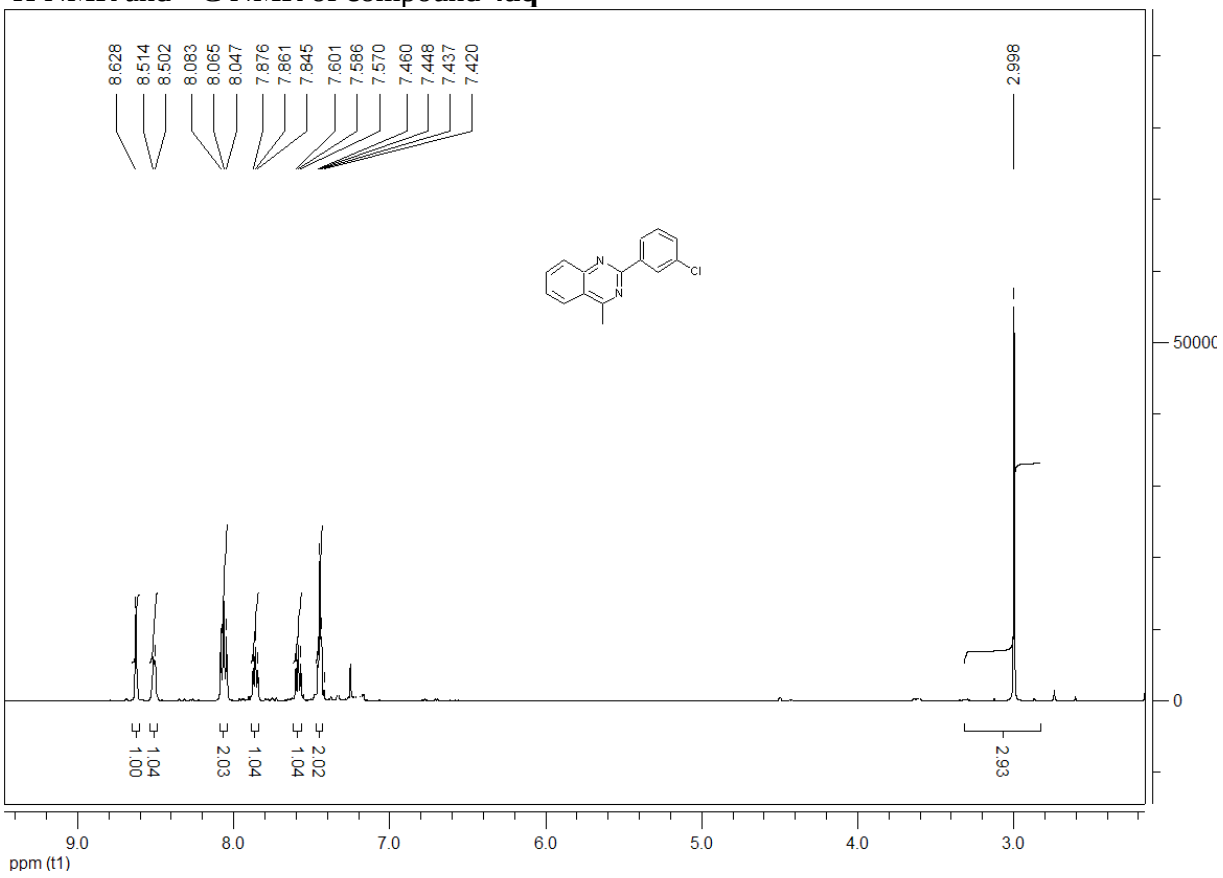


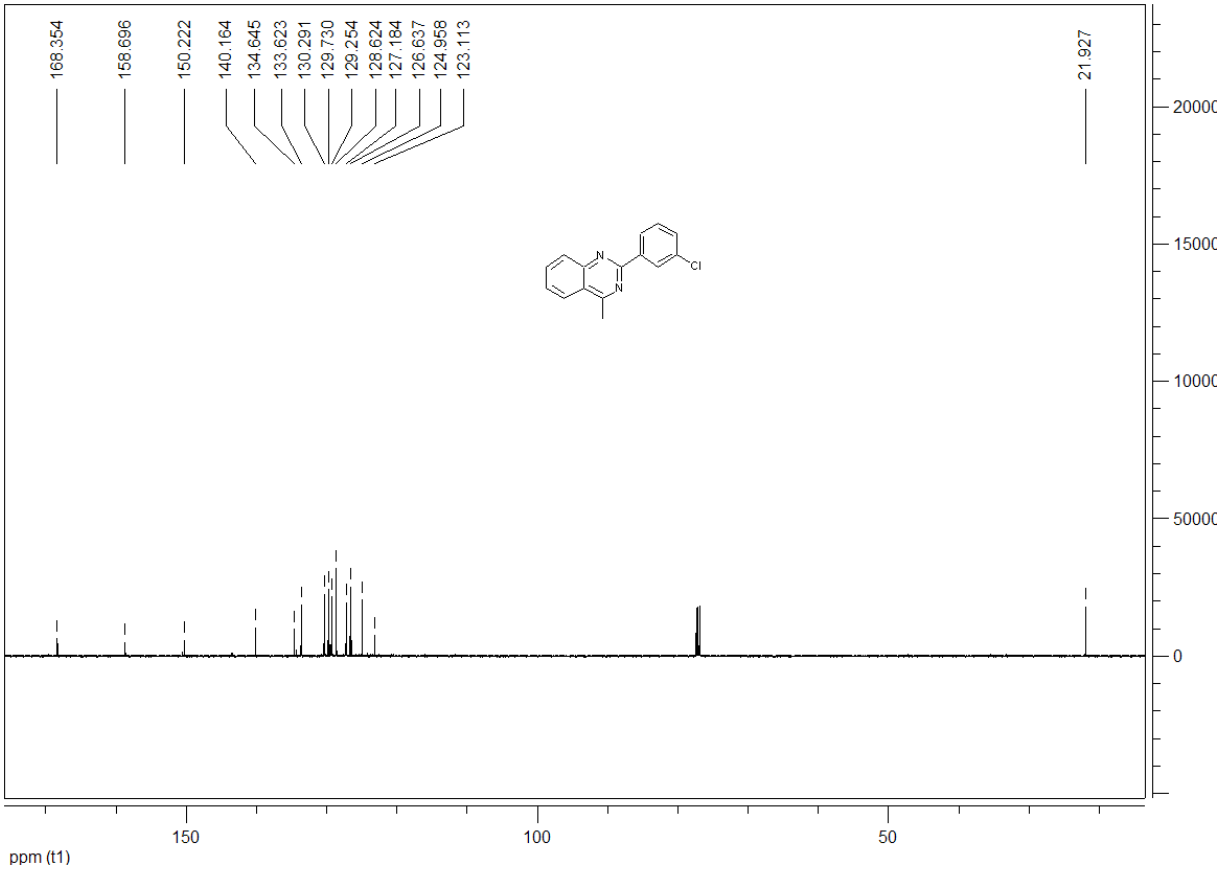
^{1}H NMR and ^{13}C NMR of compound **4ap**



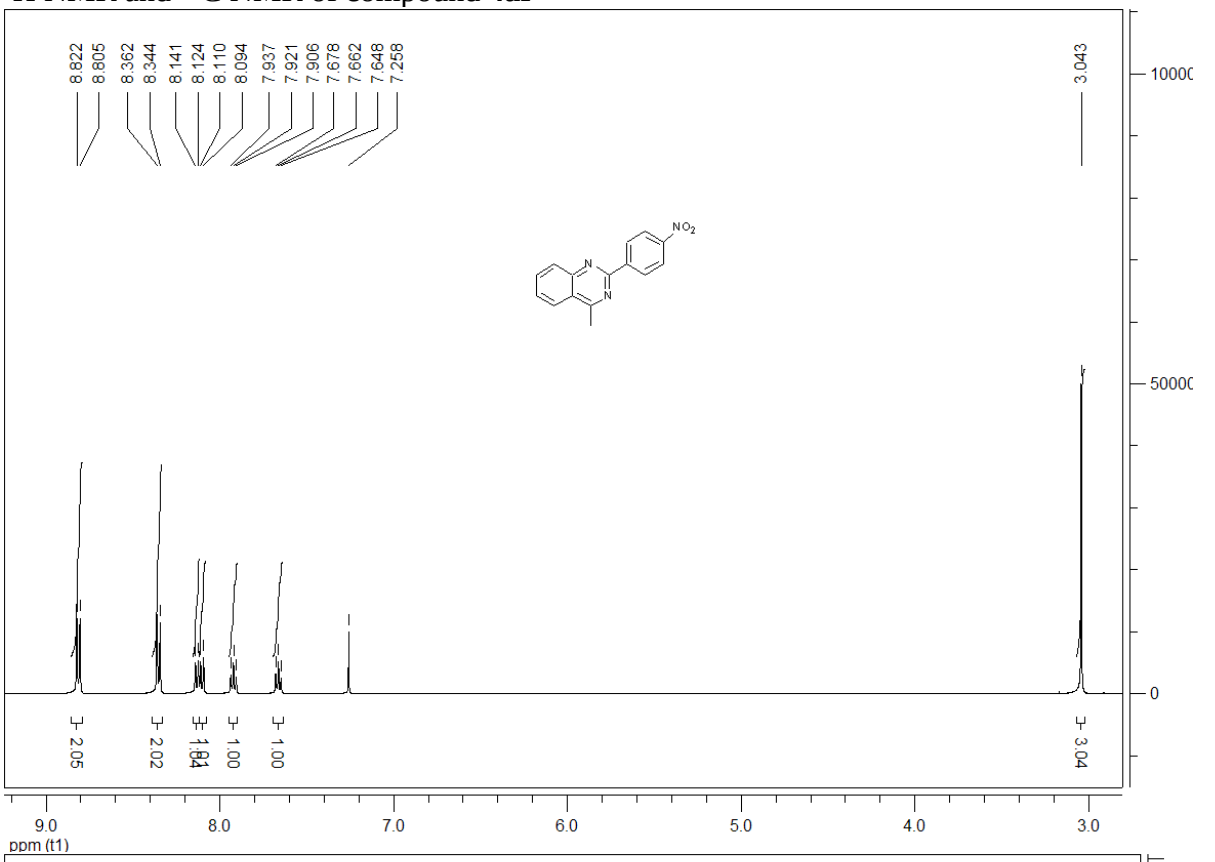


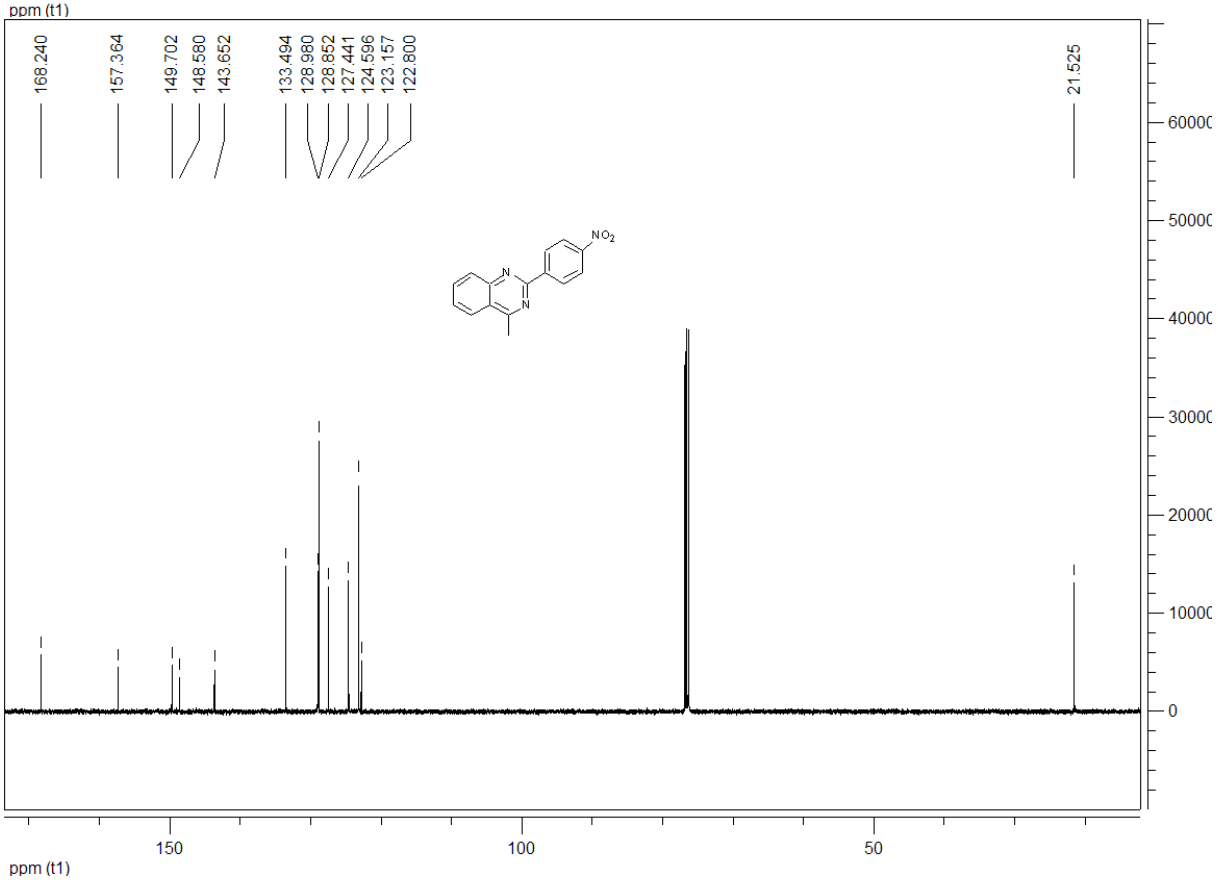
^{1}H NMR and ^{13}C NMR of compound **4aq**



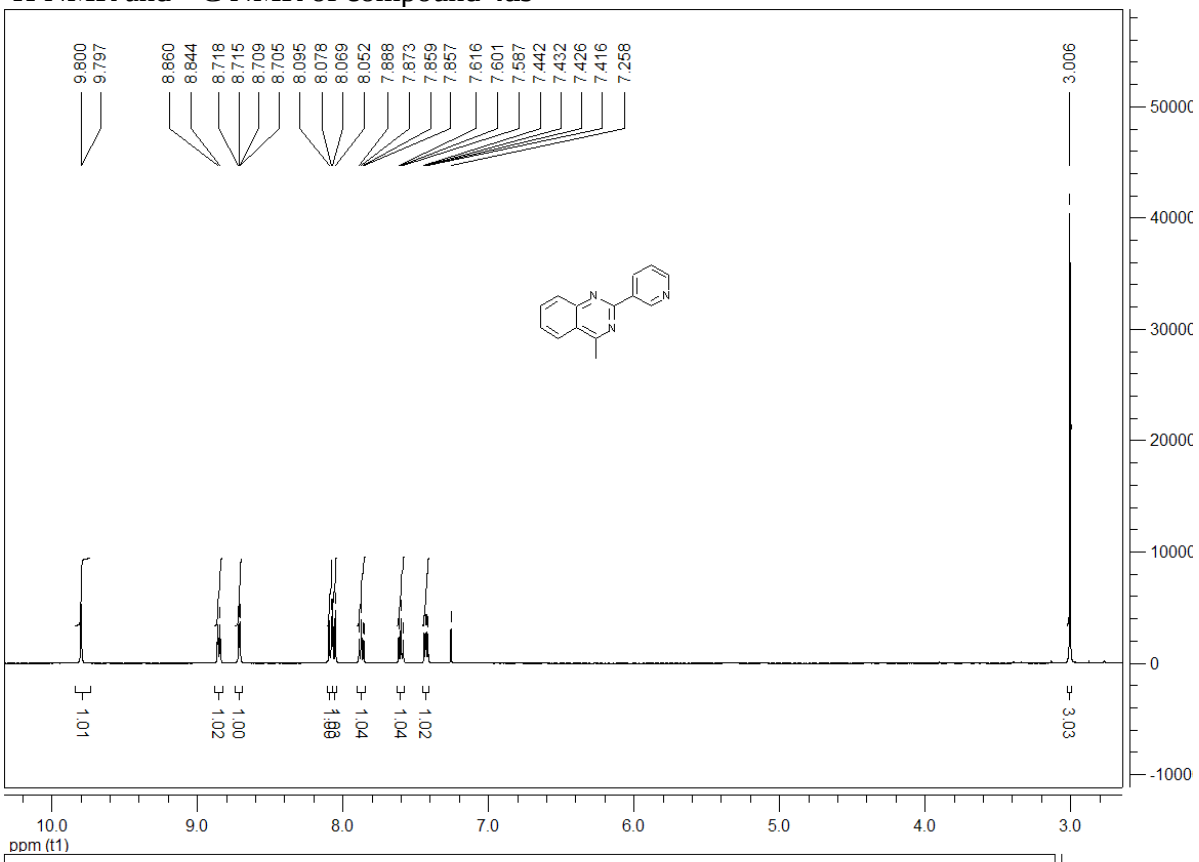


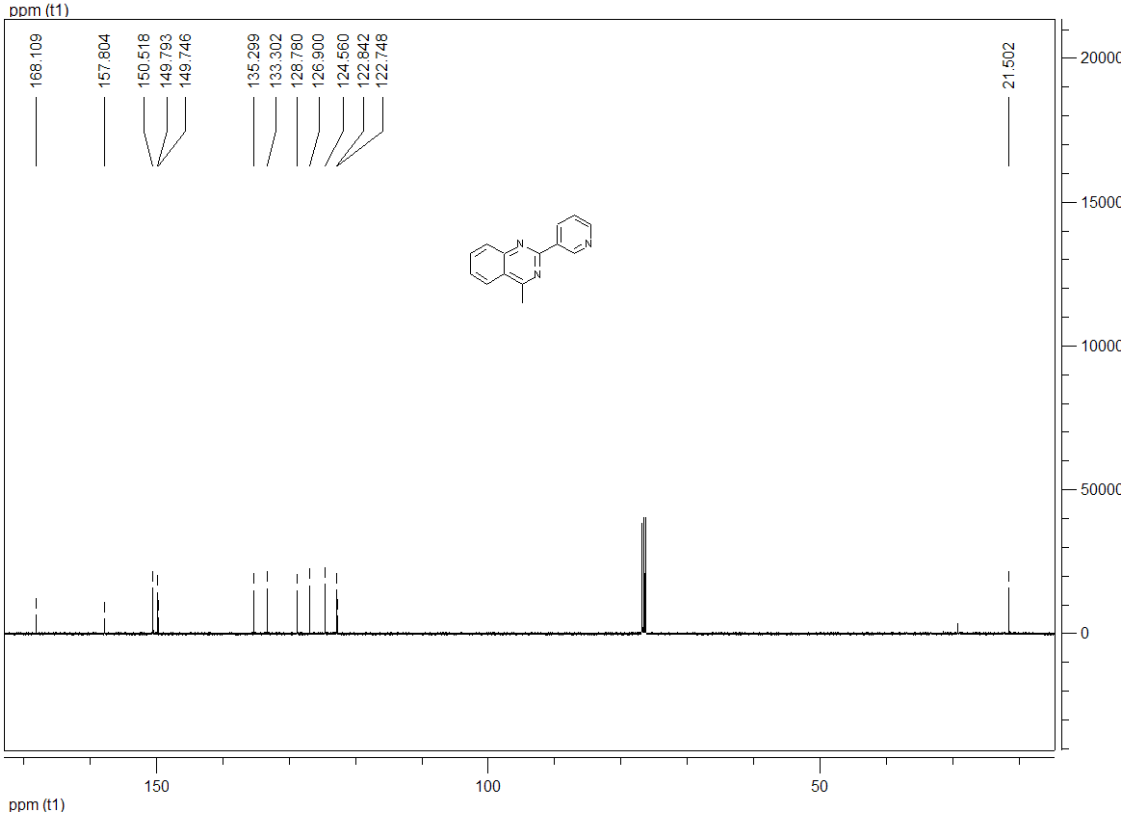
^{1}H NMR and ^{13}C NMR of compound **4ar**



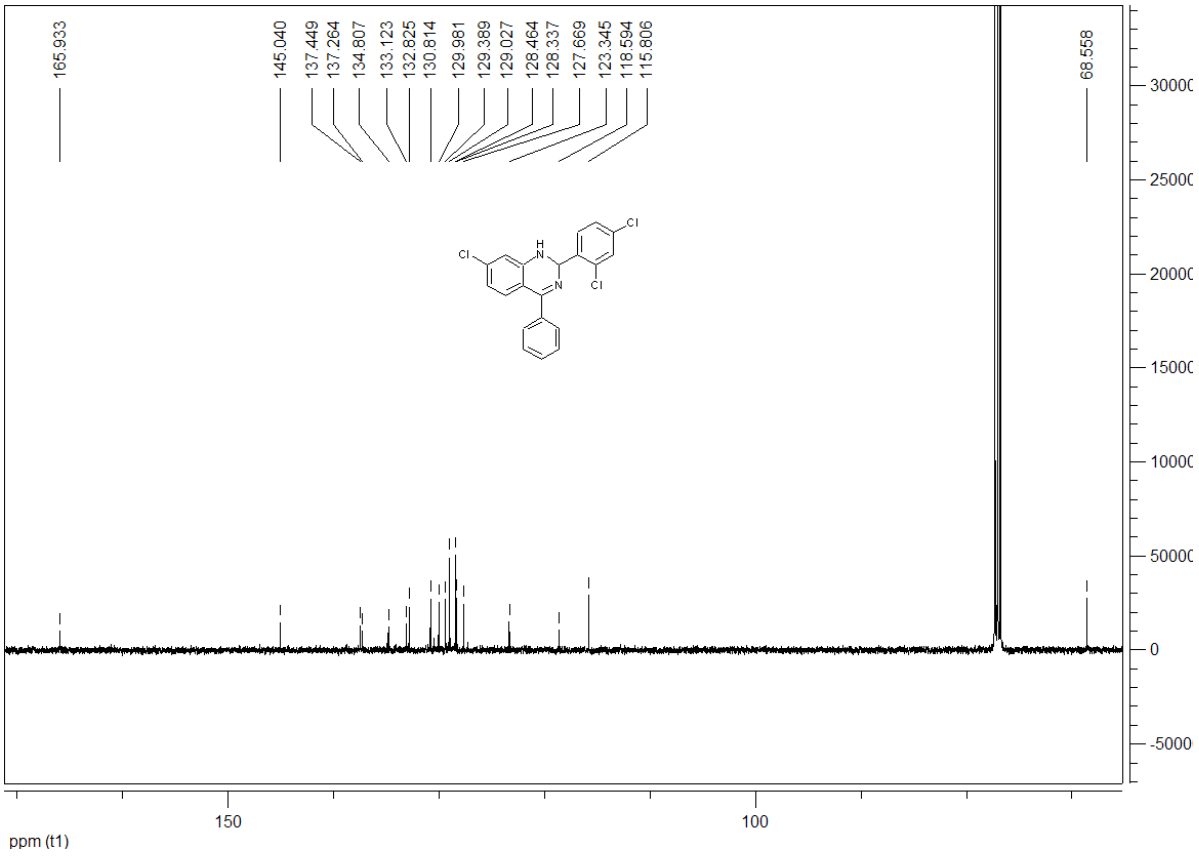


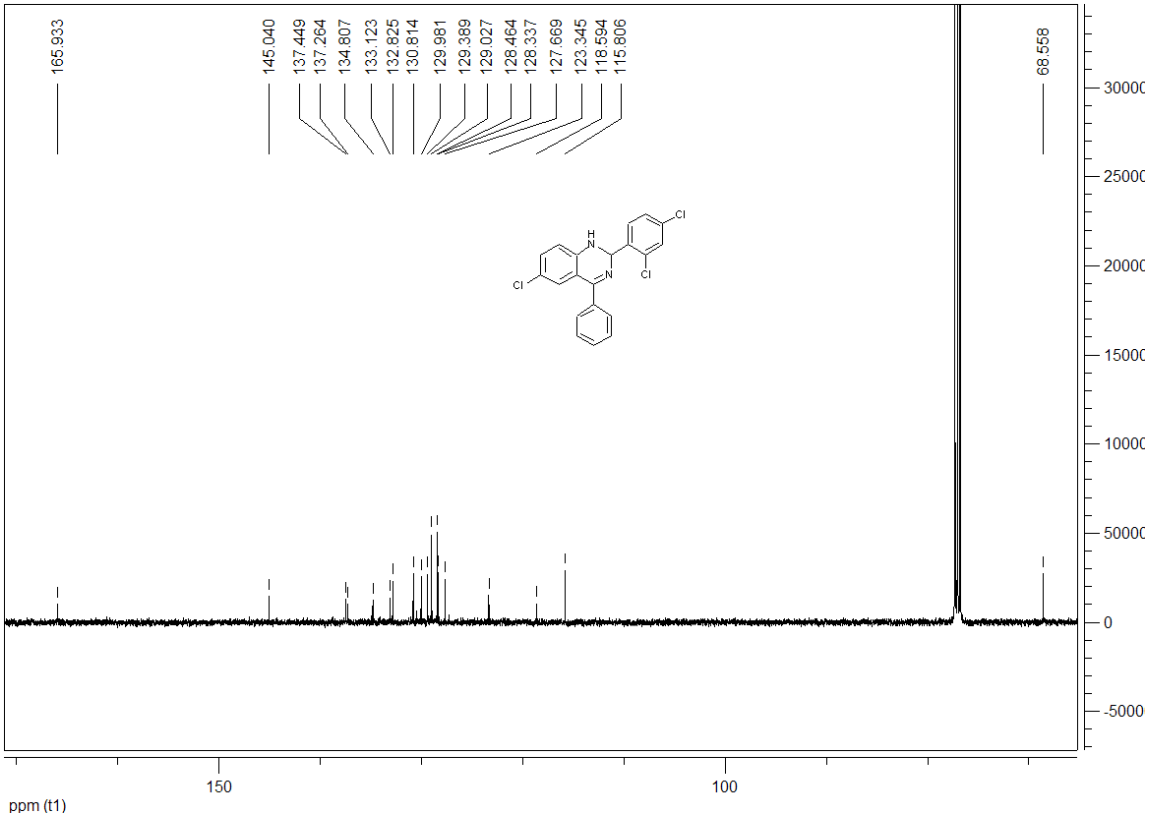
^{1}H NMR and ^{13}C NMR of compound **4as**



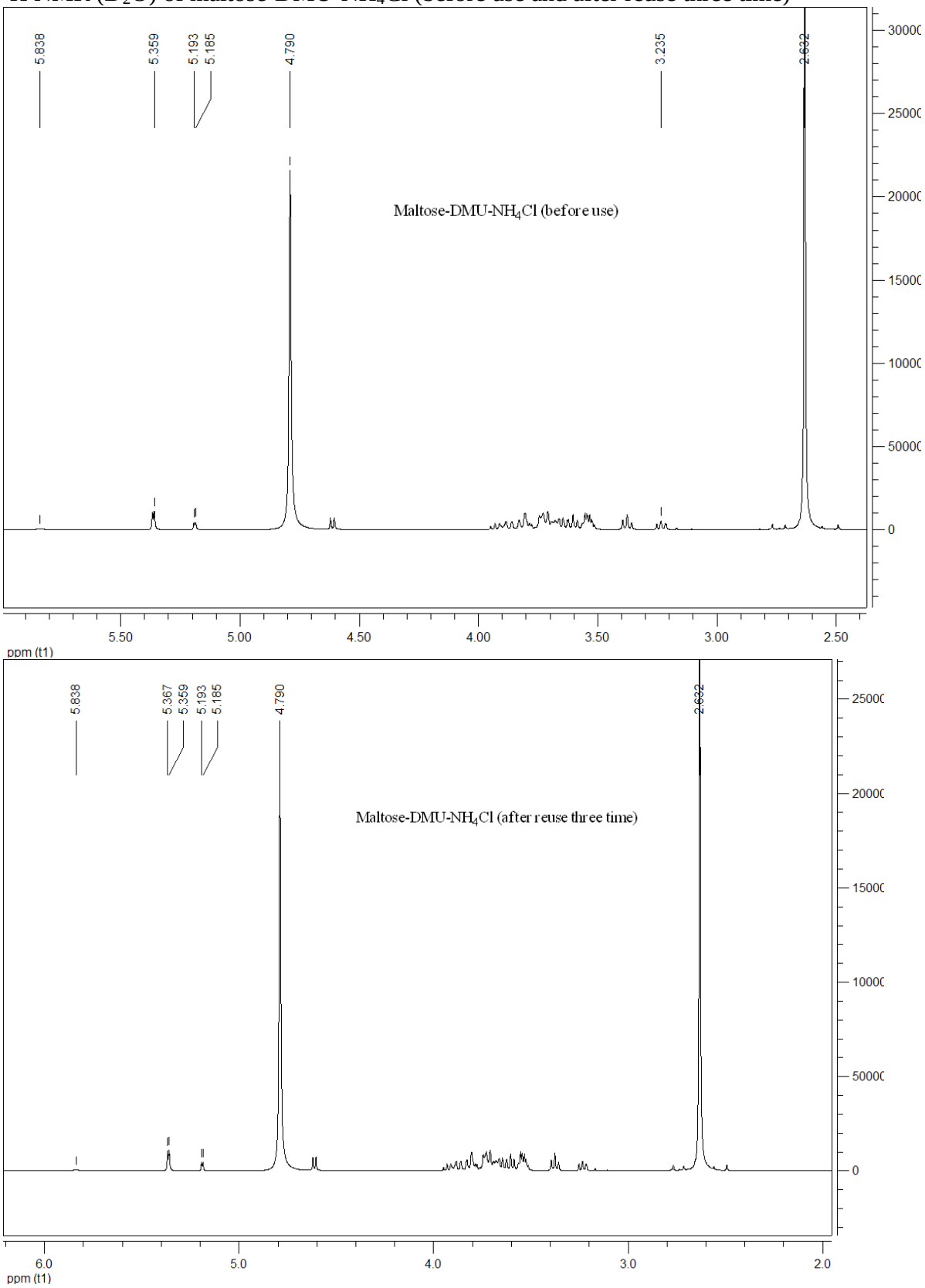


^{1}H NMR and ^{13}C NMR of intermediate **IV**





^{1}H NMR (D_2O) of maltose-DMU-NH_4Cl (before use and after reuse three time)



^{13}C NMR (D_2O) of maltose-DMU-NH_4Cl (before use and after reuse three time)