Electronic Supporting Information

Synthesis of polysubstituted quinolines through promoter-regulated selective annulation and C−C bond cleavage from 2-styrylanilines and β-keto esters

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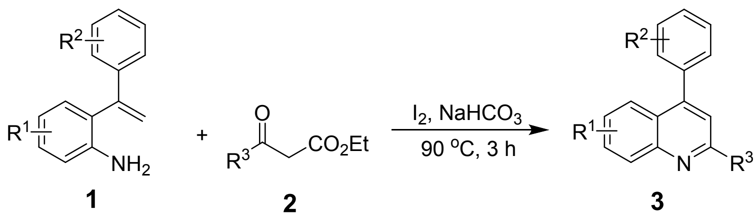
1. General experimental information

All reagents were obtained from commercial sources and used without further purification. NMR spectra were recorded on a 400, 500 or 600 MHz NMR spectrometer (400, 500 or 600 MHz for ^{1}H NMR; 100, 125 or 150 MHz for ^{13}C NMR). ^{1}H NMR chemical shifts were determined relative to internal TMS at δ 0.0 ppm. ^{13}C NMR chemical shifts were determined relative to $CDCl_3$ at δ 77.16 ppm. Data for ^{1}H NMR and ^{13}C NMR are reported as follows: chemical shift (δ, ppm), multiplicity (s = singlet, d = doublet, t = triplet, m = multiplet). High-resolution mass spectra (HRMS) were measured with ESI-TOF in a positive mode.

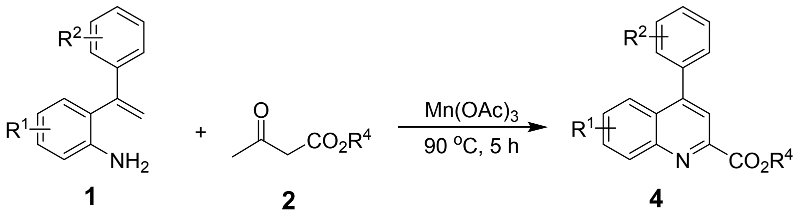
2. Synthetic procedures for 3 and 4

(1) General procedure for the I_2-promoted synthesis of 2-alkylquinolines 3



A mixture of 2-styrylaniline **1** (1.0 mmol), β-carbonyl ester **2** (1.0 mmol), I_2 (1.2 mmol) and $NaHCO_3$ (1.0 mmol) in chlorobenzene (4 mL) were stirred at 90 °C for 3 h. After completion of the reaction, the mixture was washed with aqueous sodium thiosulfate and extracted with ethyl acetate for three times. Then, the combined organic solution was dried over anhydrous Na_2SO_4, and concentrated under reduced pressure. The residue was separated by column chromatography on silica gel with ethyl acetate/petroleum ether as the eluent to afford quinoline **3**.

(2) General procedure for the Mn(OAc)$_3$-promoted synthesis of quinoline-2-carboxylates 4



A mixture of 2-styrylaniline **1** (1.0 mmol), β-carbonyl ester **2** (1.2 mmol) and $Mn(OAc)_3 \cdot 2H_2O$ (2.0 mmol) in chlorobenzene (4 mL) were stirred at 90 °C for 5 h. After completion of the reaction, the mixture was washed with water and extracted with ethyl acetate for three times. Then, the combined organic solution was dried over anhydrous Na_2SO_4, and concentrated under reduced pressure. The residue was separated by column chromatography on silica gel with ethyl acetate/petroleum ether as the eluent to afford quinoline **4**.

3. Characterization data for 3 and 4

2,6-Dimethyl-4-phenyl-quinoline (3a)

Yield: 92%; white solid, mp 72−74 °C (70−72 °C[1]); ^{1}H NMR (400 MHz, $CDCl_3$) *δ* (ppm) 8.01 (d, *J* = 8.4 Hz, 1H, ArH), 7.63 (s, 1H, ArH), 7.58–7.48 (m, 6H, ArH), 7.21 (s, 1H, ArH), 2.78 (s, 3H, 2-CH_3), 2.47 (s, 3H, 6-CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) *δ* (ppm) 157.5, 147.9, 147.0, 138.4, 135.5, 131.5, 129.5 (2C), 128.8, 128.5 (2C), 128.2, 125.0, 124.4, 122.3, 25.3, 21.7.

6-Methoxy-2-methyl-4-phenyl-quinoline (3b)

Yield: 89%; pale yellow solid, mp 67−69 °C (76 °C[2]); ^{1}H NMR (500 MHz, DMSO-d_6) *δ* (ppm) 7.93 (d, *J* = 9.2 Hz, 1H, ArH), 7.62–7.52 (m, 5H, ArH), 7.41 (dd, *J* = 9.2, 2.8 Hz, 1H, ArH), 7.31 (s, 1H, ArH), 7.13 (d, *J* = 2.0 Hz, 1H, ArH), 3.74 (s, 3H, 6-OCH_3), 2.65 (s, 3H, 2-CH_3); ^{13}C NMR (125 MHz, DMSO-d_6) *δ* (ppm) 157.3, 156.2, 146.7, 144.3, 138.2, 130.9, 129.7 (2C), 129.3 (2C), 128.9, 125.5, 122.9, 121.6, 103.9, 55.6, 24.9.

6,7-Dimethoxy-2-methyl-4-phenylquinoline (3c)

Yield: 91%; pale yellow solid, mp 136−138 °C (142 °C[3]); ^{1}H NMR (400 MHz, $CDCl_3$) *δ* (ppm) 7.55–7.45 (m, 5H, ArH), 7.44 (s, 1H, ArH), 7.13 (s, 1H, ArH), 7.10 (s, 1H, ArH), 4.04 (s, 3H, 6-OCH_3), 3.83 (s, 3H, 7-OCH_3), 2.72 (s, 3H, 2-CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) *δ* (ppm) 156.2, 152.1, 149.1, 147.0, 145.5, 138.7, 129.2 (2C), 128.6 (2C), 128.2, 120.6, 120.0, 107.9, 103.4, 56.1, 55.9, 25.0.

2-Methyl-4-phenyl-quinoline (3d)

Yield: 89%; white solid, mp 93−95 °C (96−97 °C[1]); ^{1}H NMR (600 MHz, $CDCl_3$) *δ* (ppm) 8.09 (d, *J* = 8.1 Hz, 1H, ArH), 7.85 (d, *J* = 7.9 Hz, 1H, ArH), 7.68 (t, *J* = 7.0 Hz, 1H, ArH), 7.55–7.39 (m, 6H, ArH), 7.23 (s, 1H, ArH), 2.78 (s, 3H, 2-CH_3); ^{13}C NMR (150 MHz, $CDCl_3$) *δ* (ppm) 158.4, 148.5, 148.4, 138.2, 129.5 (2C), 129.2, 129.0, 128.5 (2C), 128.3, 125.7, 125.6, 125.1, 122.2, 25.3.

6-Chloro-2-methyl-4-phenyl-quinoline (3e)

Yield: 84%; white solid, mp 85−87 °C (86−88 °C[4]); ^{1}H NMR (400 MHz, $CDCl_3$) *δ* (ppm) 8.04 (d, *J* = 8.8 Hz, 1H, ArH), 7.84 (d, *J* = 2.4 Hz, 1H, ArH), 7.64 (dd, *J* = 9.0, 2.3 Hz, 1H, ArH), 7.58–7.46 (m, 5H, ArH), 7.27 (s, 1H, ArH), 2.78 (s, 3H, 2-CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 158.9, 147.8, 146.8, 137.5, 131.6, 130.7, 130.2, 129.4 (2C), 128.7 (2C), 128.6, 125.8, 124.5, 123.0, 25.3.

6-Bromo-2-methyl-4-phenyl-quinoline (3f)

Yield: 78%; pale yellow solid, mp 97−99 °C; ^{1}H NMR (500 MHz, DMSO-d_6) δ (ppm) 7.96 (d, J = 9.5 Hz, 1H, ArH), 7.89–7.86 (m, 2H, ArH), 7.63–7.53 (m, 3H, ArH), 7.43 (s, 1H, ArH), 2.70 (s, 3H, 2-CH_3); ^{13}C NMR (125 MHz, DMSO-d_6) δ (ppm) 159.8, 147.1, 146.9, 137.2, 132.9, 131.6, 129.8 (2C), 129.35 (2C), 129.26, 127.5, 126.2, 123.6, 119.5, 25.3; HRMS (ESI) *m/z* calcd for $C_{16}H_{13}BrN$ [M+H]$^+$: 298.0231, found: 298.0251.

2,6-Dimethyl-4-*p*-tolyl-quinoline (3g)[5]

Yield: 88%; white solid, mp 93−95 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.00 (d, J = 8.4 Hz, 1H, ArH), 7.66 (s, 1H, ArH), 7.53 (dd, J = 8.6, 1.9 Hz, 1H, ArH), 7.42 (d, J = 8.0 Hz, 2H, ArH), 7.36 (d, J = 8.0 Hz, 2H, ArH), 7.20 (s, 1H, ArH), 2.77 (s, 3H, 2-CH_3), 2.49 (s, 3H, CH_3), 2.47 (s, 3H, CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 157.5, 147.9, 147.0, 138.1, 135.5, 135.4, 131.4, 129.4 (2C), 129.2 (2C), 128.7, 125.1, 124.5, 122.2, 25.3, 21.7, 21.3.

4-(4-Fluoro-phenyl)-2,6-dimethyl-quinoline (3h)

Yield: 87%; white solid, mp 75−77 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.98 (d, J = 8.4 Hz, 1H, ArH), 7.55–7.50 (m, 2H, ArH), 7.46 (dd, J = 8.5, 5.4 Hz, 2H, ArH), 7.22 (t, J = 8.6 Hz, 2H, ArH), 7.17 (s, 1H, ArH), 2.75 (s, 3H, 2-CH_3), 2.45 (s, 3H, 6-CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 162.8 (d, J = 247.7 Hz), 157.4, 146.9 146.8, 135.7, 134.3 (d, J = 3.4 Hz), 131.6, 131.1 (d, J = 8.1 Hz, 2C), 128.8, 125.0, 124.1, 122.3, 115.5 (d, J = 21.5 Hz, 2C), 25.1, 21.7; HRMS (ESI) *m/z* calcd for $C_{17}H_{15}FN$ [M+H]$^+$: 252.1189, found: 252.1171.

4-(4-Chloro-phenyl)-2,6-dimethyl-quinoline (3i)

Yield: 86%; white solid, mp 77−79 °C (80−81 °C[1]); ^{1}H NMR (600 MHz, $CDCl_3$) δ (ppm) 7.97 (d, J = 8.4 Hz, 1H, ArH), 7.54–7.46 (m, 4H, ArH), 7.43–7.38 (m, 2H, ArH), 7.14 (s, 1H, ArH), 2.74 (s, 3H, 2-CH_3), 2.44 (s, 3H, 6-CH_3); ^{13}C NMR (100

MHz, $CDCl_3$) δ (ppm) 157.4, 146.9, 146.6, 136.8, 135.8, 134.4, 131.7, 130.8 (2C), 128.8, 128.8 (2C), 124.8, 124.1, 122.2, 25.2, 21.7.

2-Ethyl-6-methyl-4-phenyl-quinoline (3j)

Yield: 94%; white solid, mp 55−57 °C; ^{1}H NMR (500 MHz, DMSO-d_6) δ (ppm) 7.93 (d, *J* = 8.0 Hz, 1H, ArH), 7.60–7.56 (m, 4H, ArH), 7.56–7.52 (m, 3H, ArH), 7.32 (s, 1H), 2.95 (q, *J* = 7.6 Hz, 2H, CH_2CH_3), 2.42 (s, 3H, 6-CH_3), 1.34 (t, *J* = 7.6 Hz, 3H, CH_2CH_3); ^{13}C NMR (125 MHz, DMSO-d_6) δ (ppm) 162.5, 147.5, 146.9, 138.2, 135.8, 131.8, 129.8 (2C), 129.3, 129.1 (2C), 128.8, 125.0, 124.3, 121.7, 31.6, 21.8, 14.0; HRMS (ESI) *m/z* calcd for $C_{18}H_{18}N$ $[M+H]^+$: 248.1439, found: 248.1422.

6-Methyl-4-phenyl-2-trifluoromethyl-quinoline (3k)

Yield: 89%; white solid, mp 38−40 °C (37−39 °C[6]); ^{1}H NMR (600 MHz, $CDCl_3$) δ (ppm) 8.18 (d, *J* = 8.5 Hz, 1H, ArH), 7.72 (s, 1H, ArH), 7.65 (d, *J* = 8.3 Hz, 1H, ArH), 7.63 (s, 1H, ArH), 7.60–7.49 (m, 5H, ArH), 2.50 (s, 3H, 6-CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 150.0, 146.6 (q, *J* = 34.3 Hz), 146.4, 138.9, 137.4, 132.9, 130.2, 129.5 (2C), 128.9, 128.8 (2C), 127.4, 124.5, 121.8 (q, *J* = 275.1 Hz), 117.1 (q, *J* = 2.1 Hz), 22.0.

6-Methyl-2,4-diphenyl-quinoline (3l)

Yield: 85%; pale yellow solid, mp 117−119 °C (117−120 °C[4]); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.20–8.15 (m, 2H, ArH), 8.14 (d, *J* = 8.6 Hz, 1H, ArH), 7.76 (s, 1H, ArH), 7.64 (s, 1H, ArH), 7.58–7.47 (m, 8H, ArH), 7.43 (t, *J* = 7.3 Hz, 1H, ArH), 2.45 (s, 3H, 6-CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 156.1, 148.5, 147.4, 139.8, 138.7, 136.3, 131.8, 129.9, 129.6 (2C), 129.2, 128.9 (2C), 128.6 (2C), 128.3, 127.5 (2C), 125.7, 124.4, 119.5, 21.9.

2-(4-Methoxy-phenyl)-6-methyl-4-phenyl-quinoline (3m)

Yield: 80%; pale yellow solid, mp 139−141 °C (134−136 °C[7]); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.14 (d, *J* = 8.8 Hz, 2H, ArH), 8.10 (d, *J* = 8.6 Hz, 1H, ArH), 7.72 (s, 1H, ArH), 7.62 (s, 1H, ArH), 7.56–7.48 (m, 6H, ArH), 7.03 (d, *J* = 8.8 Hz, 2H, ArH), 3.87 (s, 3H, OCH_3), 2.46 (s, 3H, 6-CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 160.7, 155.6, 148.3, 147.4, 138.8, 135.9, 132.4, 131.7, 129.7, 129.6 (2C), 128.8 (2C), 128.6 (2C), 128.2, 125.5, 124.4, 119.0, 114.2 (2C), 55.4, 21.8.

2-Ethyl-6-methyl-4-*p*-tolyl-quinoline (3n)

Yield: 90%; white solid, mp 56−58 ºC; ^{1}H NMR (600 MHz, $CDCl_3$) δ (ppm) 8.00 (d, J = 8.4 Hz, 1H, ArH), 7.64 (s, 1H, ArH), 7.51 (dd, J = 8.3, 1.1 Hz, 1H, ArH), 7.40 (d, J = 7.6 Hz, 2H, ArH), 7.34 (d, J = 7.6 Hz, 2H, ArH), 7.20 (s, 1H), 3.01 (q, J = 7.6 Hz, 2H, CH_2CH_3), 2.47 (s, 3H, CH_3), 2.44 (s, 3H, CH_3), 1.41 (t, J = 7.6 Hz, 3H, CH_2CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 162.5, 148.1, 147.0, 138.0, 135.7, 135.4, 131.3, 129.4 (2C), 129.2 (2C), 128.9, 125.4, 124.5, 121.1, 32.2, 21.7, 21.3, 14.1; HRMS (ESI) *m/z* calcd for $C_{19}H_{20}N$ $[M+H]^+$: 262.1596, found: 262.1588.

6-Methyl-4-*p*-tolyl-2-trifluoromethyl-quinoline (3o)

Yield: 84%; pale yellow solid, mp 63−65 ºC; ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.17 (d, J = 8.6 Hz, 1H, ArH), 7.76 (s, 1H, ArH), 7.65 (dd, J = 8.7, 1.5 Hz, 1H, ArH), 7.62 (s, 1H, ArH), 7.42 (d, J = 8.1 Hz, 2H, ArH), 7.37 (d, J = 8.1 Hz, 2H, ArH), 2.50 (s, 3H, CH_3), 2.49 (s, 3H, CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 150.1, 146.6 (q, J = 34.3 Hz), 146.4 138.9, 138.8, 134.5, 132.8, 130.1, 129.5 (2C), 129.4 (2C), 127.5, 124.6, 121.8 (q, J = 275.1 Hz), 117.0 (q, J = 2.1 Hz), 21.9, 21.3; HRMS (ESI) *m/z* calcd for $C_{18}H_{15}F_3N$ $[M+H]^+$: 302.1157, found: 302.1136.

6-Methyl-2-phenyl-4-*p*-tolyl-quinoline (3p)

Yield: 81%; pale yellow solid, mp 122−124 ºC (123.8−124.6 ºC[8]); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.19 (d, J = 7.6 Hz, 2H, ArH), 8.16 (d, J = 8.7 Hz, 1H, ArH) 7.78 (s, 1H, ArH), 7.71 (s, 1H, ArH), 7.58 (dd, J = 8.6, 1.5 Hz, 1H, ArH), 7.54 (t, J = 7.5 Hz, 2H, ArH), 7.50–7.44 (m, 3H, ArH), 7.38 (d, J = 7.9 Hz, 2H, ArH), 2.50 (s, 3H, CH_3), 2.49 (s, 3H, CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 156.1, 148.5, 147.4, 139.9, 138.2, 136.2, 135.7, 131.8, 129.9, 129.5 (2C), 129.4 (2C), 129.2, 128.9 (2C), 127.5 (2C), 125.9, 124.5, 119.5, 21.9, 21.4.

4-(4-Chloro-phenyl)-2-ethyl-6-methyl-quinoline (3q)

Yield: 90%; white solid, mp 60−63 ºC; ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.00 (d, J = 8.4 Hz, 1H, ArH), 7.56–7.47 (m, 4H, ArH), 7.42 (d, J = 8.4 Hz, 2H, ArH), 7.17 (s, 1H, ArH), 3.01 (q, J = 7.6 Hz, 2H, CH_2CH_3), 2.44 (s, 3H, 6-CH_3), 1.41 (t, J = 7.6 Hz, 3H, CH_2CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 162.5, 146.9, 146.7, 137.0, 135.8, 134.4, 131.6, 130.8 (2C), 129.0, 128.8 (2C), 125.0, 124.0, 121.0, 32.2, 21.7, 14.0; HRMS (ESI) *m/z* calcd for $C_{18}H_{17}ClN$ $[M+H]^+$: 282.1050, found: 282.1063.

2-Ethyl-6-methoxy-4-phenyl-quinoline (3r)

Yield: 87%; pale yellow solid, mp 47−49 °C; ^1H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.02 (d, J = 9.2 Hz, 1H, ArH), 7.55–7.45 (m, 5H, ArH), 7.35 (dd, J = 9.2, 2.8 Hz, 1H, ArH), 7.21 (s, 1H, ArH), 7.16 (d, J = 2.8 Hz, 1H, ArH), 3.76 (s, 3H, 6-OCH_3), 3.00 (q, J = 7.6 Hz, 2H, CH_2CH_3), 1.41 (t, J = 7.6 Hz, 3H, CH_2CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 161.0, 157.3, 147.5, 144.4, 138.7, 130.6, 129.3 (2C), 128.6 (2C), 128.2, 126.1, 121.4, 121.3, 103.9, 55.4, 32.0, 14.1; HRMS (ESI) *m/z* calcd for $C_{18}H_{18}NO$ $[M+H]^+$: 264.1388, found: 264.1396.

6-Methoxy-4-phenyl-2-trifluoromethyl-quinoline (3s)

Yield: 86%; pale yellow solid, mp 66−68 °C (68−70 °C[6]); ^1H NMR (600 MHz, $CDCl_3$) δ (ppm) 8.18 (d, J = 9.1 Hz, 1H, ArH), 7.62 (s, 1H, ArH), 7.59–7.50 (m, 5H, ArH), 7.47 (d, J = 9.1, 1H, ArH), 7.22 (s, 1H, ArH), 3.81 (s, 3H, 6-OCH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 159.4, 149.0, 145.1 (q, J = 34.5 Hz), 143.9, 137.5, 131.9, 129.2 (2C), 128.90, 128.87 (2C), 128.7, 123.3, 121.8 (q, J = 274.8 Hz), 117.4 (q, J = 2.2 Hz), 103.4, 55.5.

6-Methoxy-2,4-diphenyl-quinoline (3t)

Yield: 83%; pale yellow solid, mp 116−118 °C (119−120 °C[7]); ^1H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.17–8.12 (m, 3H, ArH), 7.77 (s, 1H, ArH), 7.60–7.47 (m, 7H, ArH), 7.45–7.37 (m, 2H, ArH), 7.19 (d, J = 2.8 Hz, 1H, ArH), 3.79 (s, 3H, 6-OCH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 157.8, 154.7, 147.8, 144.9, 139.8, 138.8, 131.6, 129.4 (2C), 129.0, 128.8 (2C), 128.7 (2C), 128.4, 127.3 (2C), 126.7, 121.8, 119.7, 103.7, 55.5.

2,4-Diphenyl-quinoline (3u)

Yield: 83%; pale yellow solid, mp 123−125 °C (120−122 °C[9]); ^1H NMR (600 MHz, $CDCl_3$) δ (ppm) 8.27 (d, J = 8.2 Hz, 1H, ArH), 8.22 (d, J = 7.0 Hz, 2H, ArH), 7.92 (d, J = 8.2 Hz, 1H, ArH), 7.84 (s, 1H, ArH), 7.77–7.72 (m, 1H, ArH), 7.61–7.45 (m, 9H, ArH); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 156.9, 149.2, 148.8, 139.7, 138.4, 130.1, 129.6 (2C), 129.5, 129.3, 128.8 (2C), 128.6 (2C), 128.4, 127.6 (2C), 126.3, 125.8, 125.6, 119.4.

2-Methyl-4-*p*-tolyl-quinoline (3v)

Yield: 91%; white solid, mp 64−66 ºC (60−61 ºC[10]); ^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 8.10 (d, J = 8.5 Hz, 1H, ArH), 7.91 (d, J = 8.5 Hz, 1H, ArH), 7.70 (t, J = 7.8 Hz, 1H, ArH), 7.45 (t, J = 7.5 Hz, 1H, ArH), 7.42 (d, J = 8.0 Hz, 2H, ArH), 7.35 (d, J = 8.0 Hz, 2H, ArH), 7.24 (s, 1H, ArH), 2.79 (s, 3H, 2-CH_3), 2.48 (s, 3H, CH_3); ^{13}C NMR (125 MHz, $CDCl_3$) δ (ppm) 158.5, 148.6, 148.4, 138.2, 135.2, 129.4 (2C), 129.2 (3C), 129.0, 125.7, 125.6, 125.2, 122.2, 25.4, 21.3.

2-Ethyl-4-*p*-tolyl-quinoline (3w)

Yield: 93%; white solid, mp 52−54 ºC; ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.11 (d, J = 8.1 Hz, 1H, ArH), 7.88 (dd, J = 8.4, 0.9 Hz, 1H, ArH), 7.66 (ddd, J = 8.3, 6.9, 1.4 Hz, 1H, ArH), 7.43−7.36 (m, 3H, ArH), 7.30 (d, J = 7.9 Hz, 2H, ArH), 7.23 (s, 1H, ArH), 3.02 (q, J = 7.6 Hz, 2H, CH_2CH_3), 2.44 (s, 3H, CH_3) 1.42 (t, J = 7.6 Hz, 3H, CH_2CH_3); ^{13}C NMR (125 MHz, $CDCl_3$) δ (ppm) 163.5, 148.7, 148.4, 138.2, 135.4, 129.5 (2C), 129.2 (2C), 129.2 (2C), 125.7, 125.6, 125.4, 121.0, 32.4, 21.3, 14.1; HRMS (ESI) *m/z* calcd for $C_{18}H_{18}N$ $[M+H]^+$: 248.1439, found: 248.1422.

2-Ethy-4-(4-chloro-phenyl)-quinoline (3x)

Yield: 89%; white solid, mp 70−72 ºC; ^{1}H NMR (600 MHz, $CDCl_3$) δ (ppm) 8.11 (d, J = 8.1 Hz, 1H, ArH), 7.80 (d, J = 8.0 Hz, 1H, ArH), 7.69 (t, J = 7.0 Hz, 1H, ArH), 7.50 (d, J = 8.0 Hz, 2H, ArH), 7.46−7.41 (m, 3H, ArH), 7.22 (s, 1H, ArH), 3.04 (q, J = 7.5 Hz, 2H, CH_2CH_3), 1.43 (t, J = 7.5 Hz, 3H, CH_2CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 163.5, 148.7, 148.4, 138.4, 129.5 (2C), 129.22, 129.19, 128.5(2C), 128.3, 125.7, 125.6, 125.3, 121.1, 32.3, 14.0; HRMS (ESI) *m/z* calcd for $C_{17}H_{15}ClN$ $[M+H]^+$: 268.0893, found: 268.0891.

6-Chloro-4-phenyl-2-trifluoromethyl-quinoline (3y)

Yield: 81%; white solid, mp 83−85 ºC (85−87 ºC[6]); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.23 (d, J = 9.0 Hz, 1H, ArH), 7.96 (d, J = 2.2 Hz, 1H, ArH), 7.77 (dd, J = 9.0, 2.2 Hz, 1H, ArH), 7.70 (s, 1H, ArH), 7.62–7.56 (m, 3H, ArH), 7.55–7.49 (m, 2H, ArH); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 150.2, 147.8 (d, J = 34.8 Hz), 146.2, 136.5, 134.9, 132.1, 131.6, 129.4 (2C), 129.3, 129.0 (2C), 128.1, 124.7, 121.5 (d, J = 275.3 Hz), 117.8 (d, J = 2.1 Hz).

6-Chloro-2,4-diphenyl-quinoline (3z)

Yield: 80%; white solid, mp 121−123 °C (120−123 °C[4]); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.20–8.15 (m, 3H, ArH), 7.86 (d, J = 2.0 Hz, 1H, ArH), 7.83 (s, 1H, ArH), 7.66 (dd, J = 9.0, 2.3 Hz, 1H, ArH), 7.60–7.44 (m, 8H, ArH); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 157.1, 148.5, 147.2, 139.2, 137.8, 132.2, 131.7, 130.4, 129.6, 129.4 (2C), 128.9 (2C), 128.8 (2C), 128.7, 127.5 (2C), 126.5, 124.5, 120.0.

6-Bromo-2,4-diphenyl-quinoline (3z′)

Yield: 75%; pale yellow solid, mp 150−152 °C (152.1−153.9 °C[8]); ^{1}H NMR (600 MHz, $CDCl_3$) δ (ppm) 8.21–8.16 (m, 2H, ArH), 8.10 (d, J = 8.9 Hz, 1H, ArH), 8.04 (d, J = 1.8 Hz, 1H, ArH), 7.83 (s, 1H, ArH), 7.80 (dd, J = 8.9, 2.0 Hz, 1H, ArH), 7.60–7.45 (m, 8H, ArH); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 157.2, 148.4, 147.4, 139.2, 137.7, 133.0, 131.9, 129.6, 129.5 (2C), 128.9 (2C), 128.8 (2C), 128.7, 127.8, 127.6 (2C), 127.0, 120.4, 120.0.

6-Methyl-4-phenyl-quinoline-2-carboxylic acid ethyl ester (4a)

Yield: 86%; white solid, mp 115−117 °C (115.4−116.1 °C[11]); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.27 (d, J = 8.7 Hz, 1H, ArH), 8.10 (s, 1H, ArH), 7.71 (s, 1H, ArH), 7.62 (dd, J = 8.7, 1.7 Hz, 1H, ArH), 7.59–7.49 (m, 5H, ArH), 4.56 (q, J = 7.1 Hz, 2H, OCH_2CH_3), 2.49 (s, 3H, 6-CH_3), 1.49 (t, J = 7.1 Hz, 3H, OCH_2CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 165.6, 149.0, 146.9, 146.8, 139.0, 137.8, 132.3, 130.9, 129.6 (2C), 128.7 (2C), 128.6, 127.8, 124.4, 121.4, 62.2, 22.1, 14.4.

6-Methoxy-4-phenyl-quinoline-2-carboxylic acid ethyl ester (4b)

Yield: 84%; pale yellow solid, mp 151−153 °C (153−155 °C[12]); ^{1}H NMR (400 MHz, DMSO-d_6) δ (ppm) 8.18 (d, J = 9.3 Hz, 1H, ArH), 7.94 (s, 1H, ArH), 7.69–7.55 (m, 6H, ArH), 7.22 (d, J = 2.8 Hz, 1H, ArH), 4.42 (q, J = 7.0 Hz, 2H, OCH_2CH_3), 3.80 (s, 3H, 6-OCH_3), 1.38 (t, J = 7.2 Hz, 3H, OCH_2CH_3); ^{13}C NMR (100 MHz, DMSO-d_6) δ (ppm) 164.8, 159.2, 147.3, 145.0, 143.6, 137.1, 132.2, 129.2 (2C), 128.9 (2C), 128.8, 128.2, 122.9, 121.1, 103.3, 61.3, 55.4, 14.2.

4-Phenyl-quinoline-2-carboxylic acid ethyl ester (4c)

Yield: 87%; white solid, mp 117−119 °C (115−119 °C[13]); ^{1}H NMR (400 MHz, DMSO-d_6) δ (ppm) 8.27 (d, J = 8.4 Hz, 1H, ArH), 7.98 (s, 1H, ArH), 7.96–7.88 (m, 2H, ArH), 7.74 (t, J = 8.2 Hz, 1H, ArH), 7.64–7.58 (m, 5H, ArH), 4.45 (q, J = 7.2 Hz, 2H, OCH_2CH_3), 1.39 (t, J = 7.1 Hz, 3H, OCH_2CH_3); ^{13}C NMR (100 MHz, DMSO-d_6) δ (ppm) 167.7, 164.7, 149.0, 147.5, 136.8, 130.5, 130.4, 129.4 (2C), 129.1, 128.9, 128.8 (2C), 126.8, 125.4, 120.6, 61.6, 14.1.

6-Bromo-4-phenyl-quinoline-2-carboxylic acid ethyl ester (4d)[14]

Yield: 82%; pale yellow solid, mp 134−136 °C; ^{1}H NMR (500 MHz, DMSO-d_6) δ (ppm) 8.22 (d, J = 9.0 Hz, 1H, ArH), 8.05 (dd, J = 9.0, 2.0 Hz, 1H, ArH), 8.02 (s, 1H, ArH), 8.01 (d, J = 2.0 Hz, 1H, ArH), 7.67–7.59 (m, 5H, ArH), 4.45 (q, J = 7.0 Hz, 2H, OCH_2CH_3), 1.39 (t, J = 7.0 Hz, 3H, OCH_2CH_3); ^{13}C NMR (125 MHz, DMSO-d_6) δ (ppm) 165.0, 148.8, 148.5, 146.6, 136.6, 134.2, 133.2, 129.9 (2C), 129.7, 129.5 (2C), 128.6, 127.8, 123.2, 122.0, 62.2, 14.6.

6-Methyl-4-*p*-tolyl-quinoline-2-carboxylic acid ethyl ester (4e)[15]

Yield: 88%; white solid, mp 96−98 °C; ^{1}H NMR (400 MHz, DMSO-d_6) δ (ppm) 8.14 (d, J = 8.4 Hz, 1H, ArH), 7.91 (s, 1H, ArH), 7.73 (d, J = 8.8 Hz, 1H, ArH), 7.70 (s, 1H, ArH), 7.47 (d, J = 8.0 Hz, 2H, ArH), 7.41 (d, J = 8.0 Hz, 2H, ArH), 4.43 (q, J = 7.2 Hz, 2H, OCH_2CH_3), 2.48 (s, 3H, 6-CH_3), 2.43 (s, 3H, CH_3), 1.38 (t, J = 7.0 Hz, 3H, OCH_2CH_3); ^{13}C NMR (100 MHz, DMSO-d_6) δ (ppm) 164.8, 148.2, 146.6, 146.1, 139.0, 138.3, 134.1, 132.6, 130.2, 129.4 (2C), 129.2 (2C), 126.9, 124.0, 120.7, 61.4, 21.5, 20.8, 14.2.

4-(4-Fluoro-phenyl)-6-methyl-quinoline-2-carboxylic acid ethyl ester (4f)

Yield: 81%; white solid, mp 166−168 °C (174−175 °C[16]); ^{1}H NMR (400 MHz, DMSO-d_6) δ (ppm) 8.16 (d, J = 8.6 Hz, 1H, ArH), 7.93 (s, 1H, ArH), 7.75 (dd, J = 8.7, 1.4 Hz, 1H, ArH), 7.68–7.62 (m, 3H, ArH), 7.45 (t, J = 8.8 Hz, 2H, ArH), 4.43 (q, J = 7.1 Hz, 2H, OCH_2CH_3), 2.49 (s, 3H, 6-CH_3) 1.39 (t, J = 7.1 Hz, 3H, OCH_2CH_3); ^{13}C NMR (100 MHz, DMSO-d_6) δ (ppm) 164.8, 147.2, 146.6, 146.1, 139.3, 132.8, 131.6 (2C), 131.5 (2C), 130.2, 126.9, 123.8, 120.9, 115.9, 115.7, 61.5, 21.5, 14.2.

6-Methyl-4-phenyl-quinoline-2-carboxylic acid methyl ester (4g)

Yield: 76%; white solid, mp 124−126 °C (127−129 °C[12]); ^{1}H NMR (600 MHz, DMSO-d_6) δ (ppm) 8.16 (d, J = 8.4 Hz, 1H, ArH), 7.94 (s, 1H, ArH), 7.76 (d, J = 9.0 Hz, 1H, ArH), 7.70 (s, 1H, ArH), 7.63–7.58 (m, 5H, ArH), 3.97 (s, 3H, OCH_3), 2.49 (s, 3H, 6-CH_3); ^{13}C NMR (150 MHz, DMSO-d_6) δ (ppm) 165.8, 148.7, 146.8, 146.6, 139.7, 137.4, 133.3, 130.7, 129.8 (2C), 129.4 (2C), 129.3, 127.4, 124.4, 121.3, 53.1, 22.1.

6-Methyl-4-phenyl-quinoline-2-carboxylic acid isopropyl ester (4h)[15]

Yield: 83%; white solid, mp 97−99 °C; ^{1}H NMR (600 MHz, DMSO-d_6) δ (ppm) 8.16 (d, J = 8.4 Hz, 1H, ArH), 7.92 (s, 1H, ArH), 7.74 (d, J = 9.0 Hz, 1H, ArH), 7.67 (s, 1H, ArH), 7.64–7.57 (m, 5H, ArH), 5.~~25~~ 28–5.22 (~~p, J = 6.3 Hz~~m, 1H, O$CH(CH_3)_2$), 2.48 (s, 3H, 6-CH_3), ~~1.40 (s, 3H, CH3),~~ 1.39 (~~s~~d, J = 6.6 Hz, ~~3H~~6H, $OCH(CH_3)_2$); ^{13}C NMR (150 MHz, DMSO-d_6) δ (ppm) 164.8, 148.7, 147.3, 146.6, 139.6, 137.5, 133.2, 130.7, 129.8, 129.4, 129.3, 127.3, 124.4, 121.3, 69.7, 22.1, 22.0(2C).

6-Methyl-4-phenyl-quinoline-2-carboxylic acid isobutyl ester (4i)[15]

Yield: 78%; white solid, mp 91−93 °C; ^{1}H NMR (400 MHz, DMSO-d_6) δ (ppm) 8.16 (d, J = 8.4 Hz, 1H, ArH), 7.93 (s, 1H, ArH), 7.75 (d, J = 7.0 Hz, 1H, ArH), 7.68 (s, 1H, ArH), 7.62–7.57 (m, 5H, ArH), 4.19 (d, J = 6.8 Hz, 2H, OCH_2), 2.48 (s, 3H, 6-CH_3), 2.12–2.18 (m, 1H, $CH(CH_3)_2$), 1.00 (d, J = 6.8 Hz, 6H, $CH(CH_3)_2$); ^{13}C NMR (100 MHz, DMSO-d_6) δ (ppm) 164.7, 148.3, 146.6, 146.2, 139.0, 138.3, 134.1, 132.6, 130.3, 129.4 (2C), 129.2 (2C), 127.0, 124.0, 120.7, 71.1, 27.4, 21.5, 18.9 (2C).

6-Methyl-4-*p*-tolyl-quinoline-2-carboxylic acid methyl ester (4j)[17]

Yield: 77%; white solid, mp 77−79 °C; ^{1}H NMR (400 MHz, DMSO-d_6) δ (ppm) 8.14 (d, J = 8.6 Hz, 1H, ArH), 7.92 (s, 1H, ArH), 7.75 (dd, J = 8.7, 1.8 Hz, 1H, ArH), 7.72 (s, 1H, ArH), 7.48 (d, J = 8.1 Hz, 2H, ArH), 7.42 (d, J = 8.0 Hz, 2H, ArH), 3.96 (s, 3H, OCH_3), 2.49 (s, 3H, 6-CH_3), 2.44 (s, 3H, CH_3); ^{13}C NMR (125 MHz, DMSO-d_6) δ (ppm) 165.9, 148.7, 146.8, 146.7, 139.6, 138.9, 134.5, 133.2, 130.7, 129.9 (2C), 129.8 (2C), 127.5, 124.5, 121.2, 53.1, 22.1, 21.4.

6-Methyl-4-*p*-tolyl-quinoline-2-carboxylic acid isopropyl ester (4k)

Yield: 84%; white solid, mp 90−92 °C; ^{1}H NMR (500 MHz, DMSO-d_6) δ (ppm) 8.16 (d, J = 8.5 Hz, 1H, ArH), 7.91 (s, 1H, ArH), 7.74 (d, J = 8.4 Hz, 1H, ArH), 7.70 (s, 1H, ArH), 7.48 (d, J = 8.0 Hz, 2H, ArH), 7.43 (d, J = 8.0 Hz, 2H, ArH), 5.29–5.22 (m, 1H, O*CH*$(CH_3)_2$), 2.49 (s, 3H, 6-CH_3), 2.45 (s, 3H, CH_3), 1.39 (d, J = 6.5 Hz, 6H, OCH$(CH_3)_2$); ^{13}C NMR (125 MHz, DMSO-d_6) δ (ppm) 164.8, 148.7, 147.4, 146.6, 139.5, 138.8, 134.6, 133.1, 130.7, 129.9 (2C), 129.7 (2C), 127.4, 124.5, 121.2, 69.6, 22.1 (2C), 15.6 (2C); HRMS (ESI) *m/z* calcd for $C_{21}H_{22}NO_2$ $[M+H]^+$: 320.1651, found: 320.1659.

6-Methyl-4-*p*-tolyl-quinoline-2-carboxylic acid isobutyl ester (4l)

Yield: 80%; white solid, mp 84−86 °C; ^{1}H NMR (400 MHz, DMSO-d_6) δ (ppm) 8.14 (d, J = 8.4 Hz, 1H, ArH), 7.90 (s, 1H, ArH), 7.73 (d, J = 8.8 Hz, 1H, ArH), 7.70 (s, 1H, ArH), 7.47 (d, J = 8.0 Hz, 2H, ArH), 7.41 (d, J = 8.0 Hz, 2H, ArH), 4.18 (d, J = 6.8 Hz, 2H, OCH_2), 2.48 (s, 3H, 6-CH_3), 2.44 (s, 3H, CH_3), 2.06–2.15 (m, 1H, *CH*$(CH_3)_2$), 0.99 (d, J = 6.8 Hz, 6H, CH$(CH_3)_2$); ^{13}C NMR (100 MHz, DMSO-d_6) δ (ppm) 164.7, 148.2, 146.6, 146.2, 139.1, 137.0, 132.7, 130.3, 129.3 (2C), 128.9 (2C), 128.8, 126.9, 123.9, 120.8, 71.1, 27.4, 21.5 (2C), 18.9 (2C); HRMS (ESI) *m/z* calcd for $C_{22}H_{24}NO_2$ $[M+H]^+$: 334.1807, found: 334.1805.

4-(4-Fluoro-phenyl)-6-methyl-quinoline-2-carboxylic acid isobutyl ester (4m)

Yield: 77%; white solid, mp 141−143 °C; ^{1}H NMR (600 MHz, DMSO-d_6) δ (ppm) 8.15 (d, J = 8.4 Hz, 1H, ArH), 7.92 (s, 1H, ArH), 7.75 (d, J = 8.4 Hz, 1H, ArH), 7.65 (dd, J = 7.3, 4.0 Hz, 3H, ArH), 7.45 (t, J = 8.8 Hz, 2H, ArH), 4.18 (d, J = 6.6 Hz, 2H, OCH_2), 2.48 (s, 3H, 6-CH_3), 2.09 (~~dt, J = 13.4, 6.7 Hz~~m, 1H, *CH*$(CH_3)_2$), ~~1.00 (s, 3H, CH_3),~~ 0.99 (~~s~~d, J = 6.6 Hz, ~~3H~~6H, CH$(CH_3)_2$); ^{13}C NMR (150 MHz, DMSO-d_6) δ (ppm) 164.7, 147.2, 146.6, 146.2, 139.2, 132.8, 131.6 (2C), 131.5 (2C), 130.3, 126.9, 123.8, 120.9, 115.9, 115.7, 71.1, 27.4, 21.5, 18.9, 15.1; HRMS (ESI) *m/z* calcd for $C_{21}H_{21}FNO_2$ $[M+H]^+$: 338.1556, found: 338.1553.

4-Phenyl-quinoline-2-carboxylic acid isopropyl ester (4n)

Yield: 83%; white solid, mp 103−105 °C (104−107 °C[13]); ^{1}H NMR (400 MHz, DMSO-d_6) δ (ppm) 8.27 (d, J = 8.4 Hz, 1H, ArH), 7.98 (s, 1H, ArH), 7.95–7.89 (m, 2H, ArH), 7.77−7.72 (m, 1H, ArH), 7.65–7.58 (m, 5H, ArH), 5.32–5.22 (m, 1H, O*CH*$(CH_3)_2$), 1.40 (d, *J* = 6.3 Hz, 6H, OCH(CH_3)$_2$); ^{13}C NMR (125 MHz, DMSO-d_6) δ (ppm) 164.7, 149.5, 148.3, 148.0, 137.3, 131.01, 130.95, 129.9 (2C), 129.6, 129.4, 129.3 (2C), 127.3, 125.9, 121.1, 69.8, 22.1 (2C).

4-Phenyl-quinoline-2-carboxylic acid isobutyl ester (4o)

Yield: 79%; white solid, mp 98−100 °C; ^{1}H NMR (400 MHz, DMSO-d_6) δ (ppm) 8.27 (d, *J* = 8.4 Hz, 1H, ArH), 7.97 (s, 1H, ArH), 7.95–7.89 (m, 2H, ArH), 7.75 (t, *J* = 7.2 Hz, 1H, ArH), 7.65–7.58 (m, 5H, ArH), 4.20 (d, *J* = 6.8 Hz, 2H, OCH_2), 2.14–2.08 (m, 1H, *CH*$(CH_3)_2$), 1.00 (d, *J* = 6.4 Hz, 6H, CH(CH_3)$_2$); ^{13}C NMR (100 MHz, DMSO-d_6) δ (ppm) 164.7, 149.1, 147.6, 147.5, 136.9, 136.8, 130.5, 129.4 (2C), 129.1, 128.9, 128.8 (2C), 126.9, 125.4, 120.6, 71.2, 27.4, 18.9 (2C); HRMS (ESI) *m/z* calcd for $C_{20}H_{20}NO_2$ $[M+H]^+$: 306.1494, found: 306.1493.

6-Chloro-4-phenyl-quinoline-2-carboxylic acid isopropyl ester (4p)

Yield: 85%; white solid, mp 129−131 °C; ^{1}H NMR (400 MHz, DMSO-d_6) δ (ppm) 8.28 (d, *J* = 9.0 Hz, 1H, ArH), 7.99 (s, 1H, ArH), 7.92 (dd, *J* = 9.0, 2.3 Hz, 1H, ArH), 7.82 (d, *J* = 2.3 Hz, 1H, ArH), 7.67–7.59 (m, 5H, ArH), 5.32–5.21 (m, 1H, O*CH*$(CH_3)_2$), 1.40 (d, *J* = 6.2 Hz, 6H, OCH(CH_3)$_2$); ^{13}C NMR (125 MHz, DMSO-d_6) δ (ppm) 164.4, 148.9, 148.7, 146.4, 136.7, 134.2, 133.2, 131.6, 129.8 (2C), 129.7, 129.5 (2C), 128.1, 124.5, 122.0, 70.0, 22.1 (2C); HRMS (ESI) *m/z* calcd for $C_{19}H_{17}ClNO_2$ $[M+H]^+$: 326.0948, found: 326.0966.

6-Chloro-4-*p*-tolyl-quinoline-2-carboxylic acid ethyl ester (4q)

Yield: 74%; white solid, mp 163−165 °C; ^{1}H NMR (400 MHz, DMSO-d_6) δ (ppm) 8.27 (d, *J* = 9.0 Hz, 1H, ArH), 7.99 (s, 1H, ArH), 7.92 (dd, *J* = 9.0, 2.2 Hz, 1H, ArH), 7.86 (d, *J* = 2.2 Hz, 1H, ArH), 7.51 (d, *J* = 8.0 Hz, 2H, ArH), 7.44 (d, *J* = 8.0 Hz, 2H, ArH), 4.44 (q, *J* = 7.1 Hz, 2H, O*CH*$_2CH_3$), 2.45 (s, 3H, CH_3), 1.39 (t, *J* = 7.1 Hz, 3H, OCH_2*CH*$_3$); ^{13}C NMR (125 MHz, DMSO-d_6) δ (ppm) 165.0, 149.0, 148.4, 146.5, 139.3, 134.2, 133.7, 133.2, 131.6, 130.1 (2C), 129.8 (2C), 128.2, 124.6, 121.9, 62.2, 21.4, 14.6; HRMS (ESI) *m/z* calcd for $C_{19}H_{17}ClNO_2$ $[M+H]^+$: 326.0948, found: 326.0968.

6-Chloro-4-*p*-tolyl-quinoline-2-carboxylic acid isopropyl ester (4r)

Yield: 72%; white solid, mp 149−151 °C; ^{1}H NMR (600 MHz, DMSO-d_6) δ (ppm) 8.20 (d, J = 9.0 Hz, 1H, ArH), 8.02 (d, J = 8.4 Hz, 2H, ArH), 7.97 (s, 1H, ArH), 7.50 (d, J = 8.0 Hz, 2H, ArH), 7.44 (d, J = 8.4 Hz, 2H, ArH), 5.26 (~~p, J = 6.3 Hz~~m, 1H, O*CH*(CH$_3$)$_2$), 2.45 (s, 3H, CH$_3$), ~~1.40 (s, 3H, CH$_3$),~~ 1.39 (~~s~~d, J = 6.0 Hz, ~~3H~~6H, OCH(*CH$_3$*)$_2$); ^{13}C NMR (150 MHz, DMSO-d_6) δ (ppm) 164.5, 149.0, 148.7, 146.5, 139.3, 134.1, 133.8, 133.2, 131.6, 130.1 (2C), 129.8 (2C), 128.2, 124.6, 121.9, 69.9, 22.1 (2C), 21.4; HRMS (ESI) *m/z* calcd for $C_{20}H_{19}ClNO_2$ $[M+H]^+$: 340.1104, found: 340.1105.

6-Bromo-4-phenyl-quinoline-2-carboxylic acid isopropyl ester (4s)

Yield: 78%; pale yellow solid, mp 122−124 °C; ^{1}H NMR (400 MHz, DMSO-d_6) δ (ppm) 8.20 (d, J = 9.0 Hz, 1H, ArH), 8.02 (dd, J = 9.0, 2.1 Hz, 1H, ArH), 7.99 (s, 1H, ArH), 7.98 (d, J = 2.1 Hz, 1H, ArH), 7.67–7.59 (m, 5H, ArH), 5.31–5.21 (m, 1H, O*CH*(CH$_3$)$_2$), 1.40 (d, J = 6.3 Hz, 6H, OCH(*CH$_3$*)$_2$); ^{13}C NMR (125 MHz, DMSO-d_6) δ (ppm) 164.4, 148.8, 148.8, 146.6, 136.7, 134.2, 133.2, 129.8 (2C), 129.7, 129.5 (2C), 128.6, 127.8, 123.1, 122.0, 70.0, 22.1 (2C); HRMS (ESI) *m/z* calcd for $C_{19}H_{17}BrNO_2$ $[M+H]^+$: 370.0443, found: 370.0440.

6-Bromo-4-*p*-tolyl-quinoline-2-carboxylic acid isopropyl ester (4t)

Yield: 75%; white solid, mp 132−134 °C; ^{1}H NMR (600 MHz, DMSO-d_6) δ (ppm) 8.28 (d, J = 9.0 Hz, 1H, ArH), 7.98 (s, 1H, ArH), 7.92 (dd, J = 9.0, 2.3 Hz, 1H, ArH), 7.86 (s, 1H, ArH), 7.50 (d, J = 8.4 Hz, 2H, ArH), 7.44 (d, J = 7.9 Hz, 2H, ArH), 5.26 (~~p, J = 6.2 Hz~~m, 1H, O*CH*(CH$_3$)$_2$), 2.45 (s, 3H, CH$_3$), ~~1.40 (s, 3H, CH$_3$),~~ 1.39 (~~s~~d, J = 6.0 Hz, ~~3H~~6H, OCH(*CH$_3$*)$_2$); ^{13}C NMR (150 MHz, DMSO-d_6) δ (ppm) 164.5, 148.9, 148.8, 146.6, 139.3, 134.1, 133.8, 133.2, 130.1 (2C), 129.8 (2C), 128.7, 127.9, 123.0, 121.9, 65.4, 22.1 (3C); HRMS (ESI) *m/z* calcd for $C_{20}H_{19}BrNO_2$ $[M+H]^+$: 384.0599, found: 384.0584.

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5. Copies of NMR spectra for 3 and 4

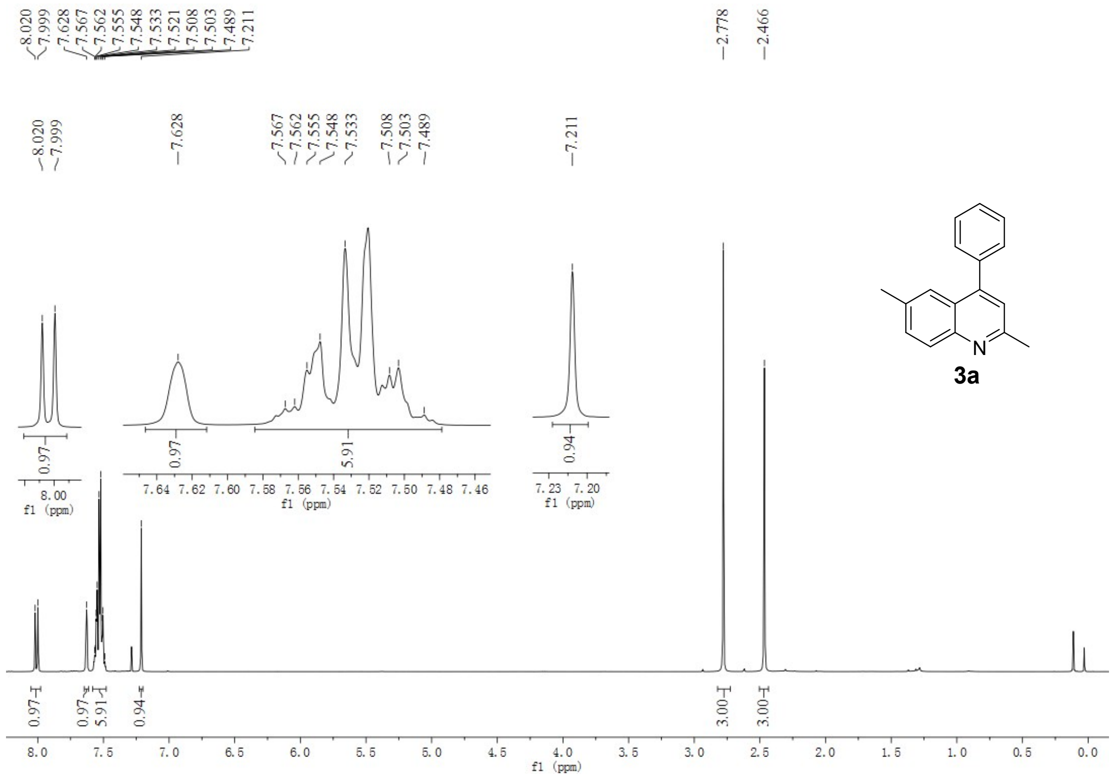

Figure S1. ^{1}H NMR (400 MHz, $CDCl_3$) of compound 3a

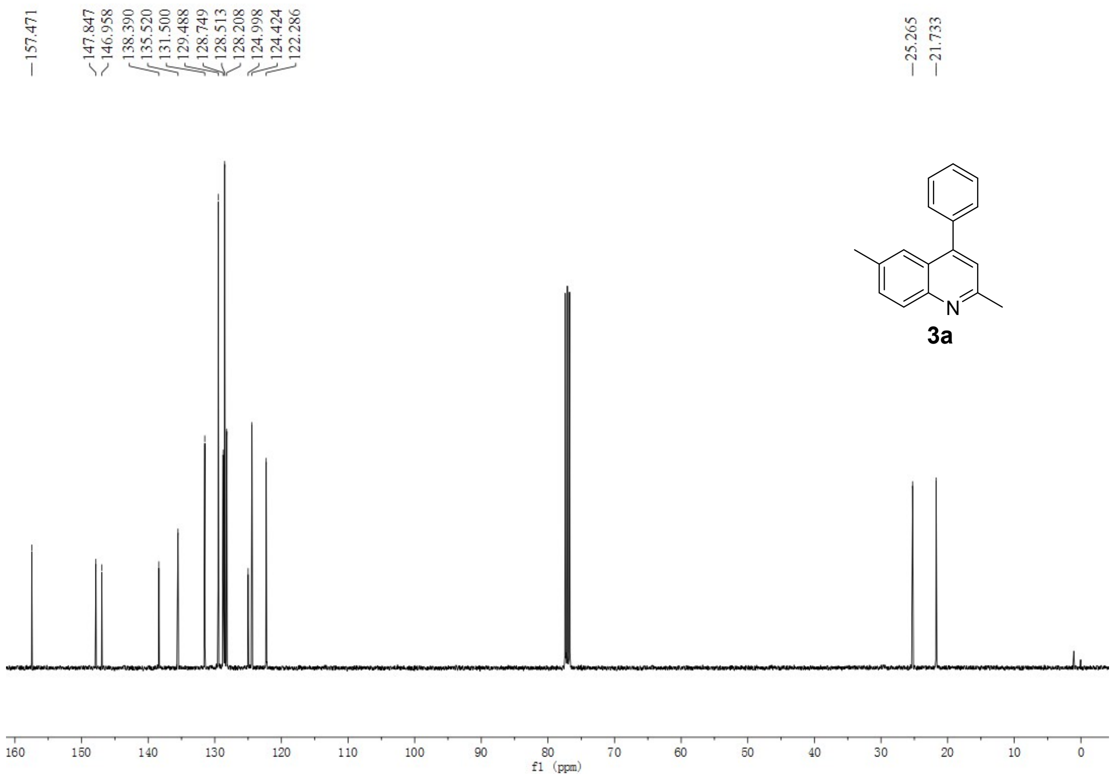

Figure S2. ^{13}C NMR (100 MHz, $CDCl_3$) of compound 3a

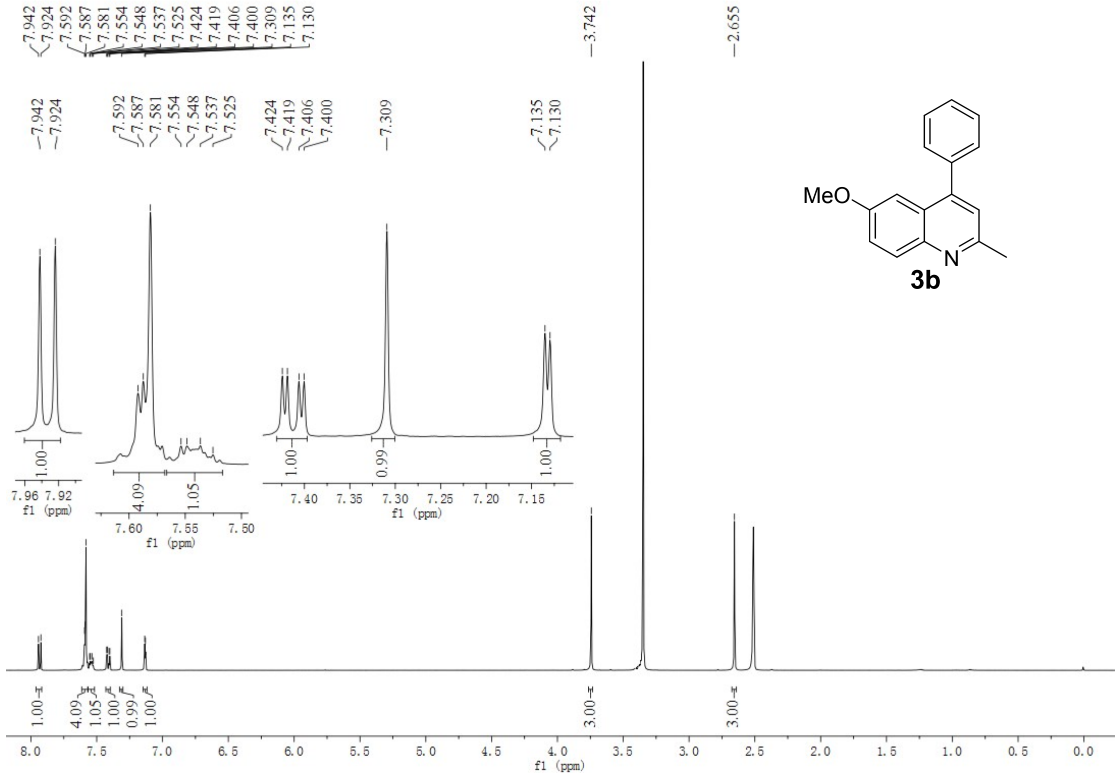

Figure S3. ^{1}H NMR (500 MHz, DMSO-d_6) of compound 3b

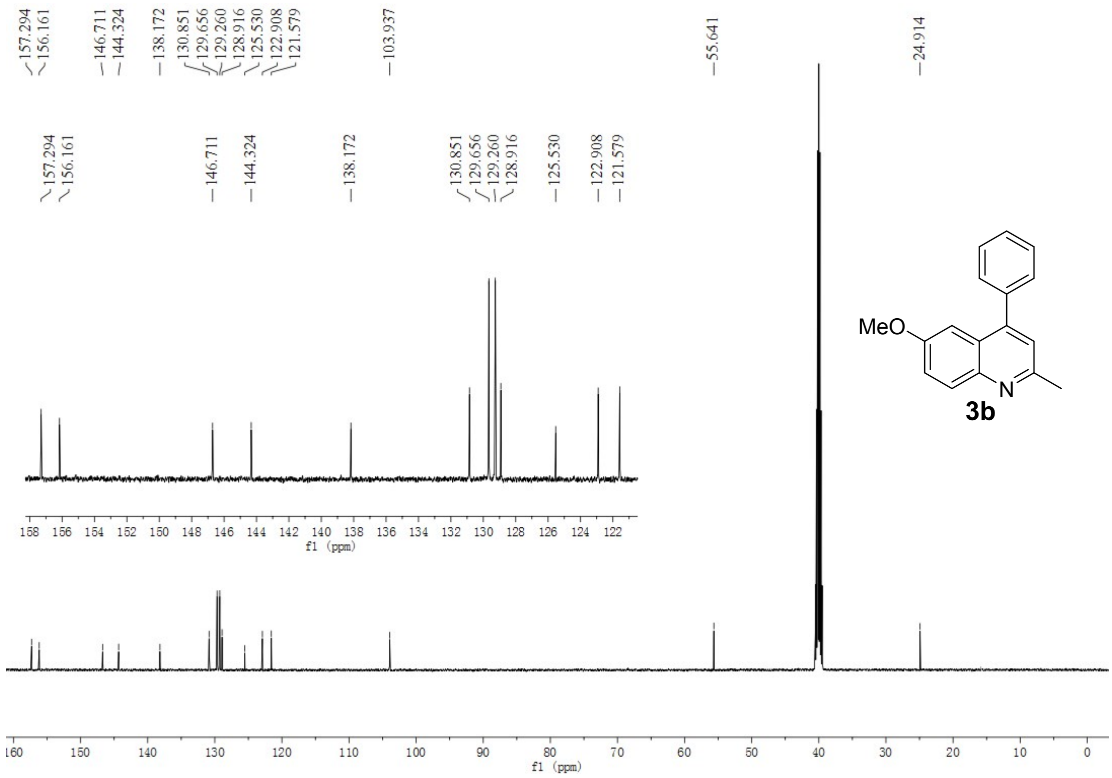

Figure S4. ^{13}C NMR (125 MHz, DMSO-d_6) of compound 3b

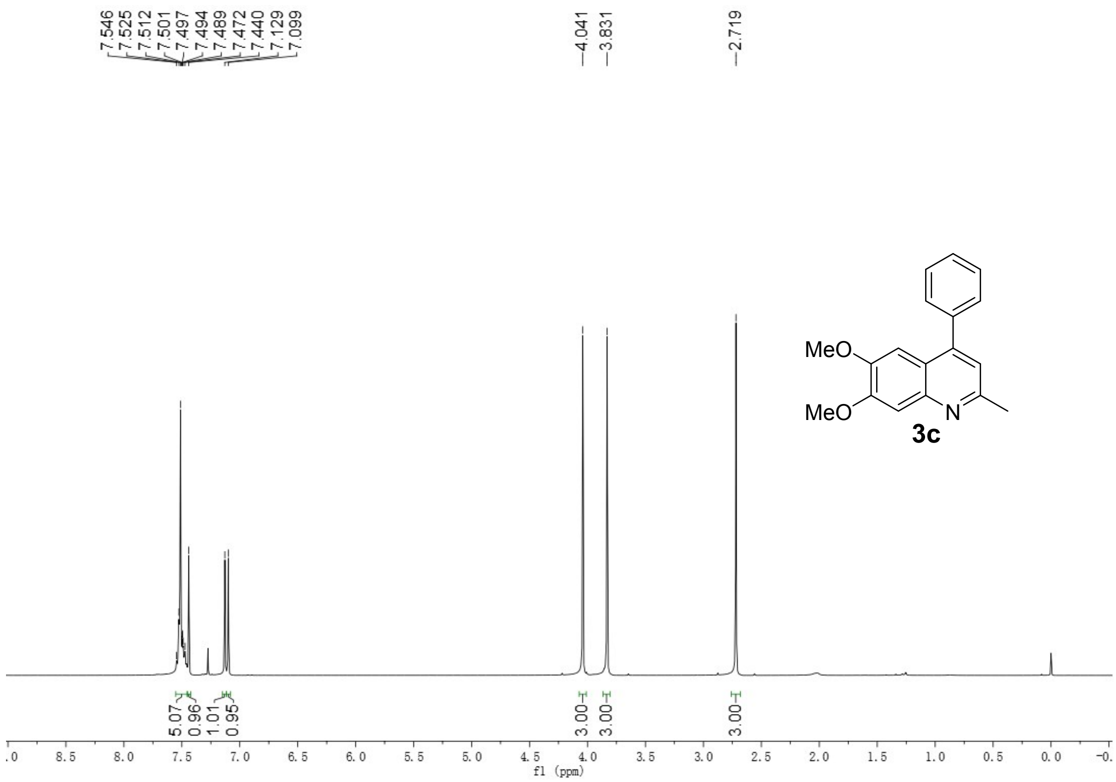

Figure S5. ^{1}H NMR (400 MHz, $CDCl_3$) of compound 3c

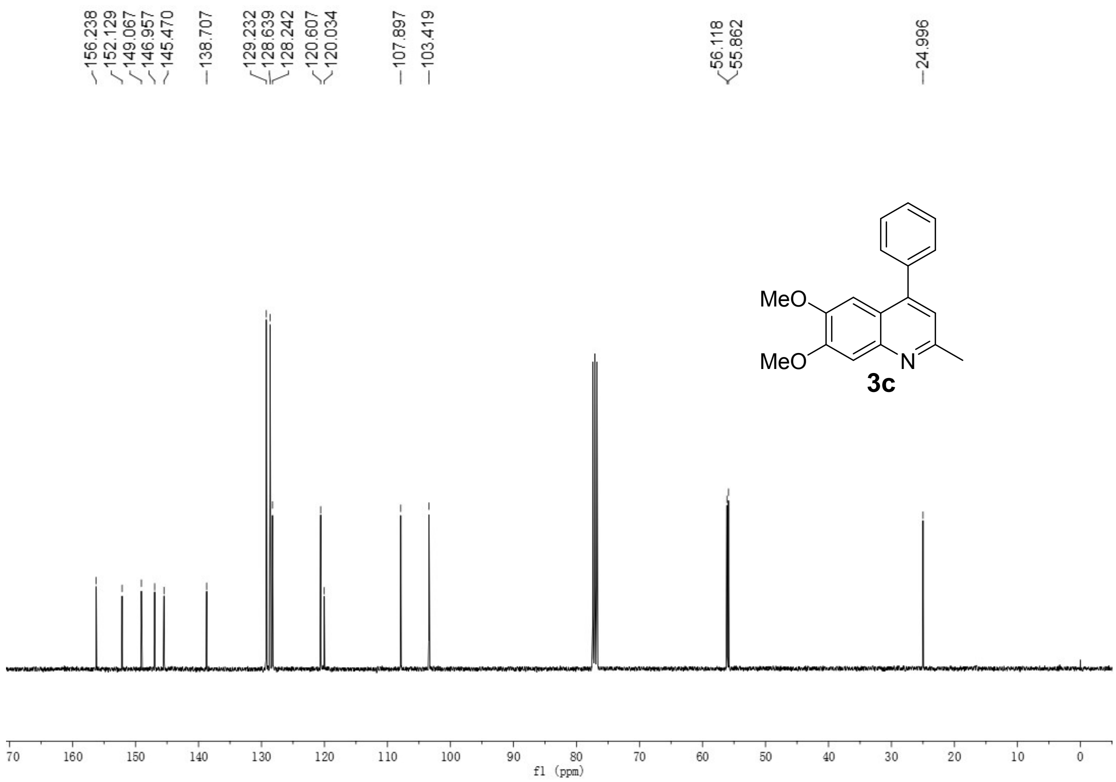

Figure S6. ^{13}C NMR (100 MHz, $CDCl_3$) of compound 3c

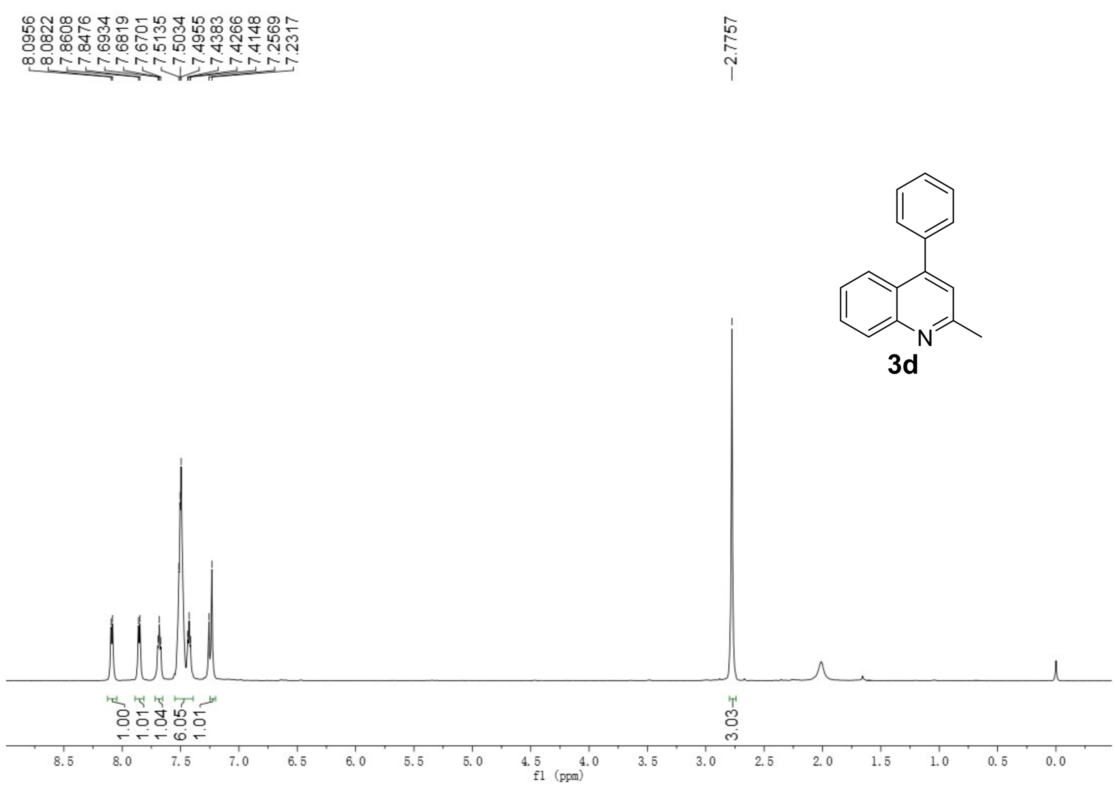

Figure S7. ^{1}H NMR (600 MHz, $CDCl_3$) of compound 3d

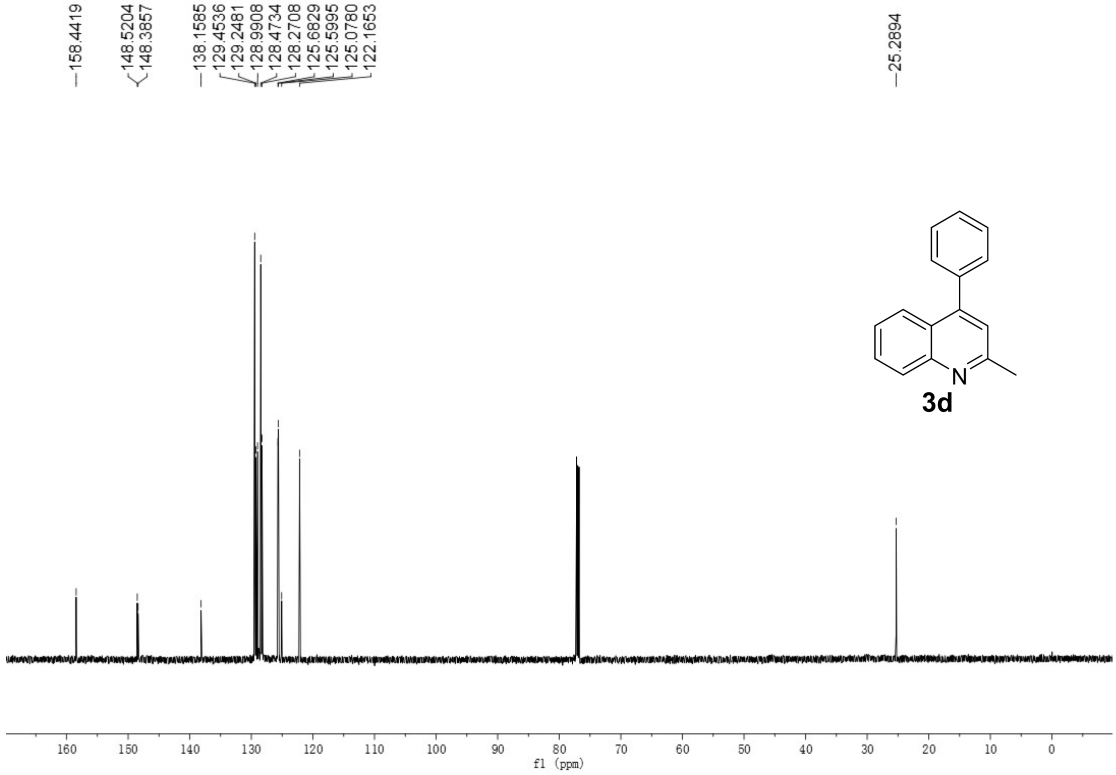

Figure S8. ^{13}C NMR (150 MHz, $CDCl_3$) of compound 3d

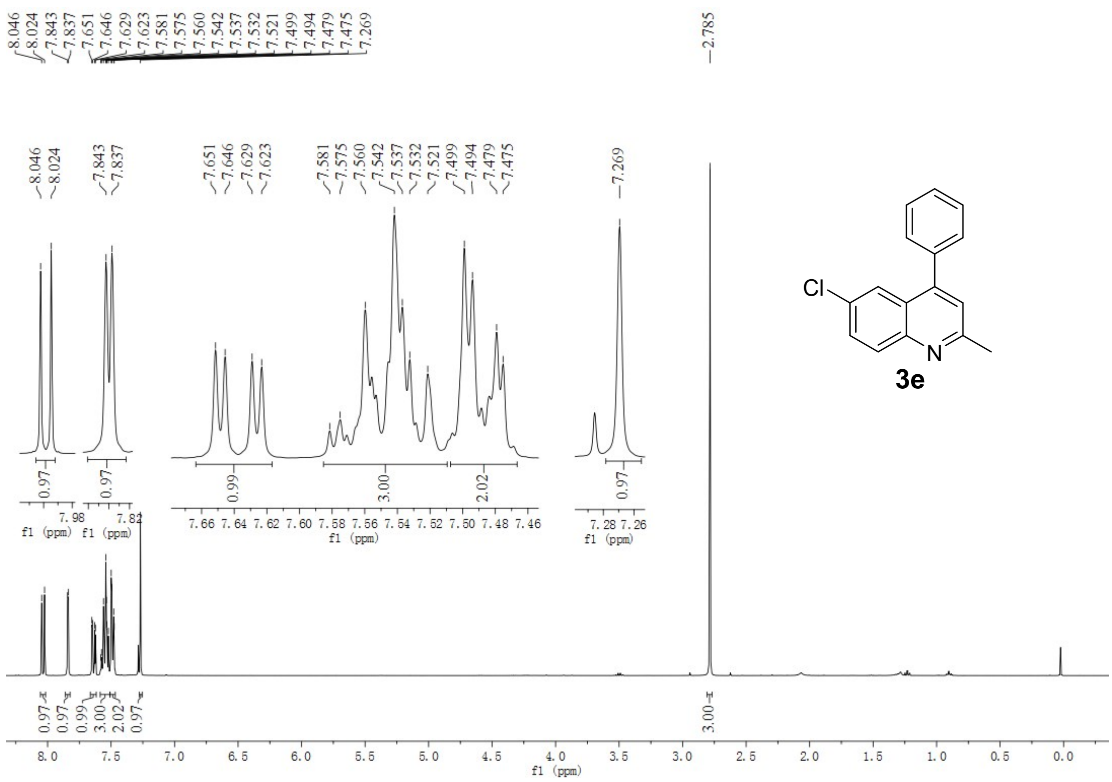

Figure S9. ^{1}H NMR (400 MHz, $CDCl_3$) of compound 3e

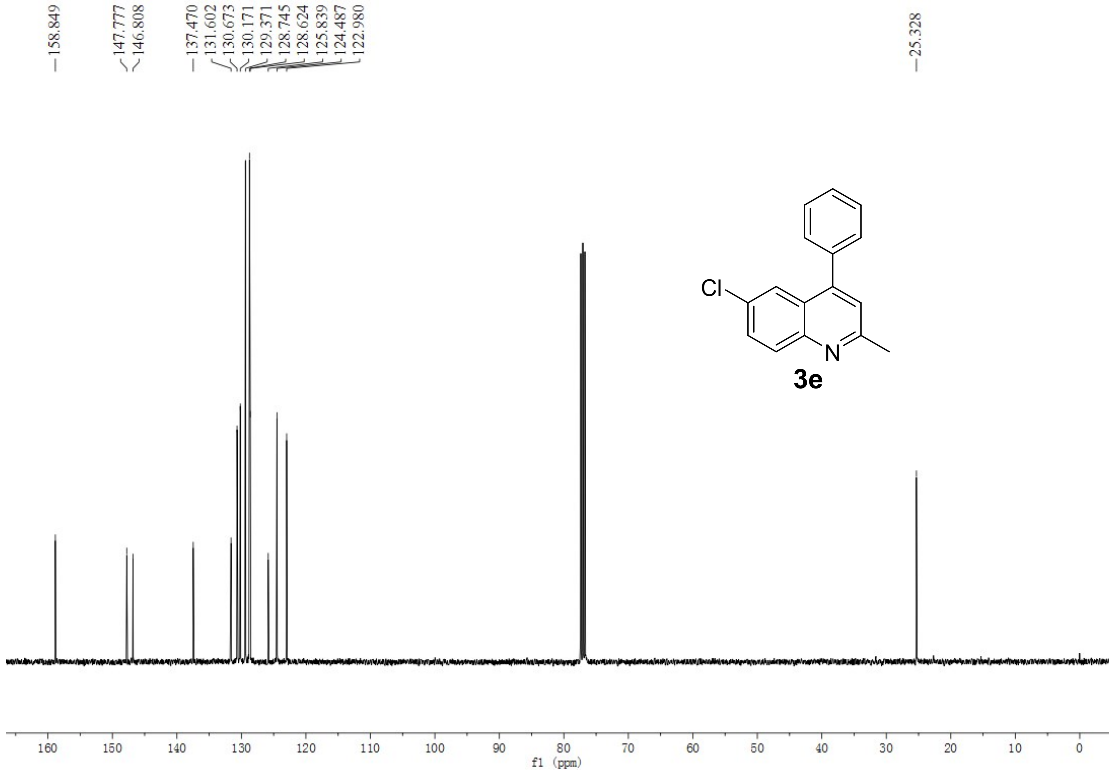

Figure S10. ^{13}C NMR (100 MHz, $CDCl_3$) of compound 3e

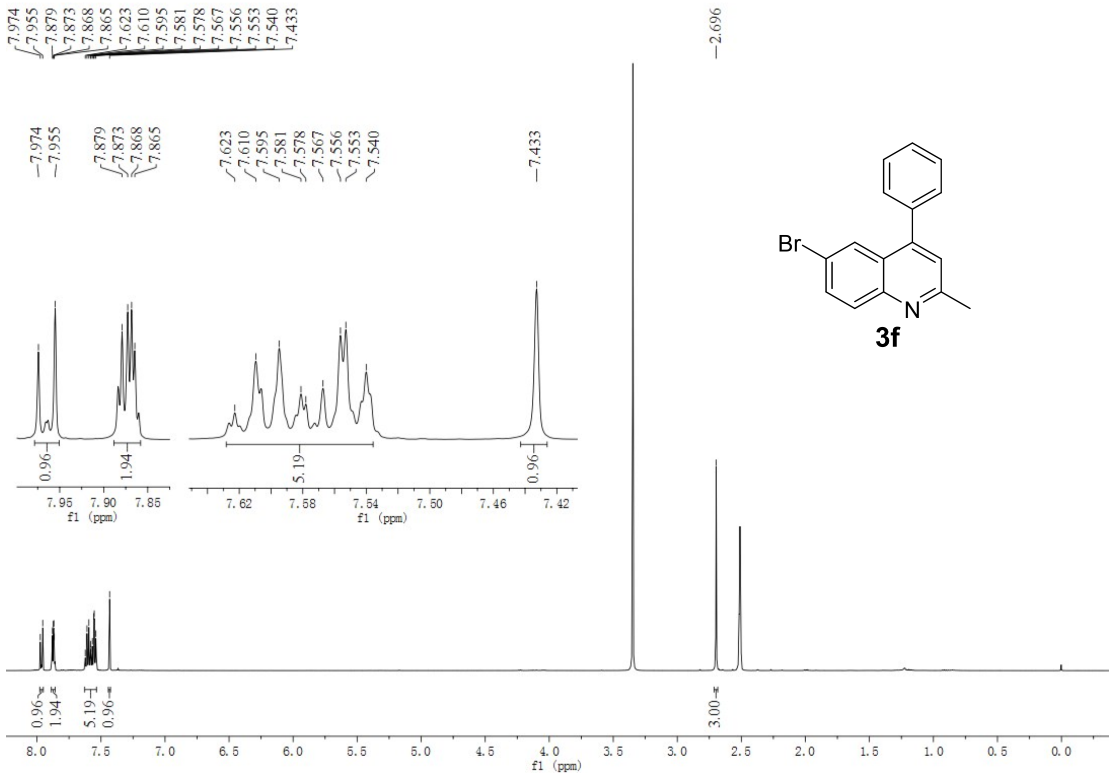

Figure S11. ^{1}H NMR (500 MHz, DMSO-d_6) of compound 3f

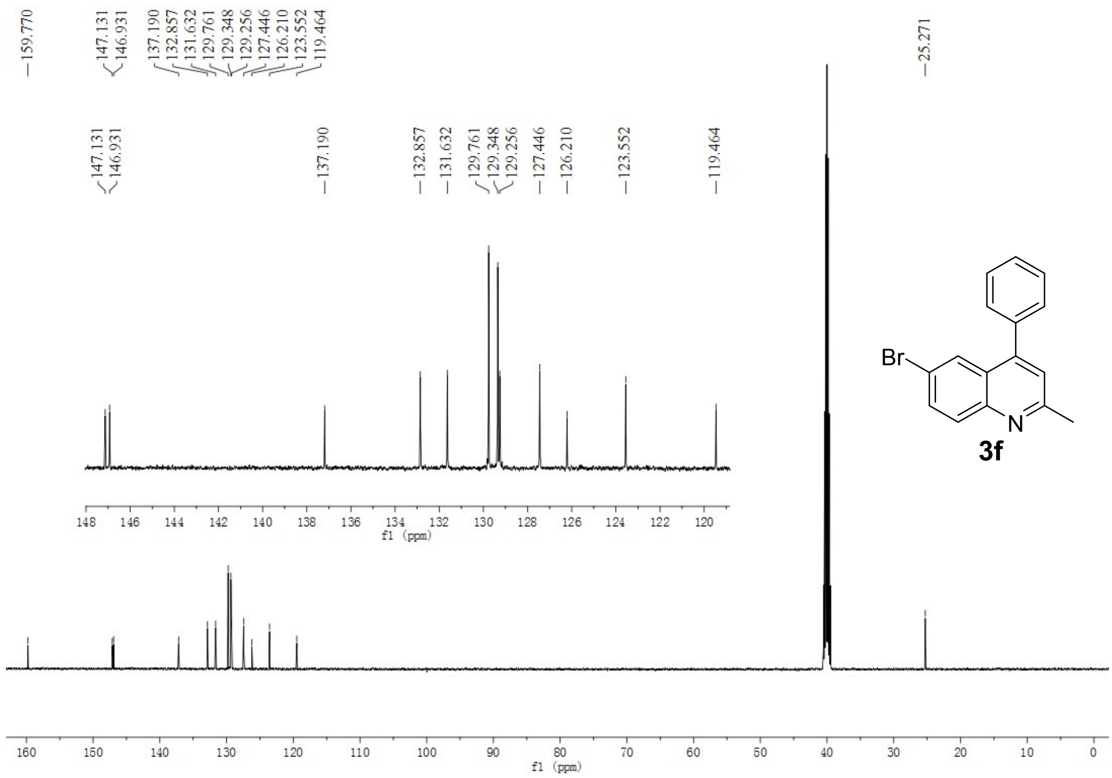

Figure S12. ^{13}C NMR (125 MHz, DMSO-d_6) of compound 3f

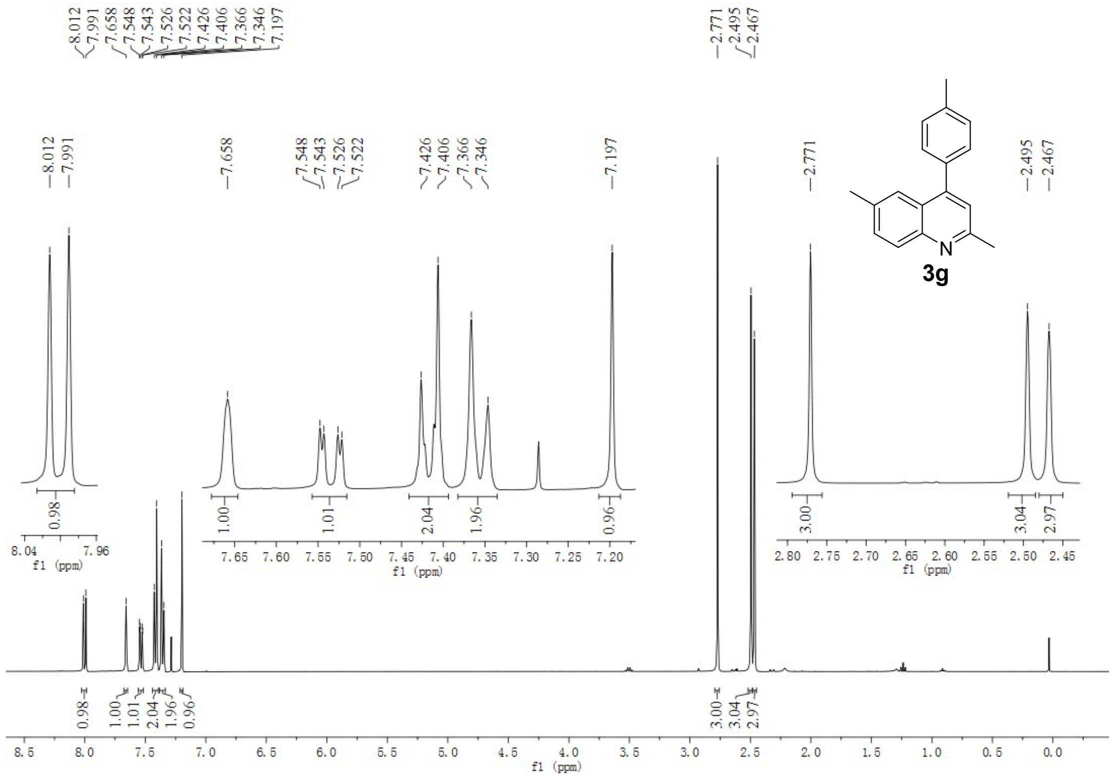

Figure S13. ¹H NMR (400 MHz, $CDCl_3$) of compound 3g

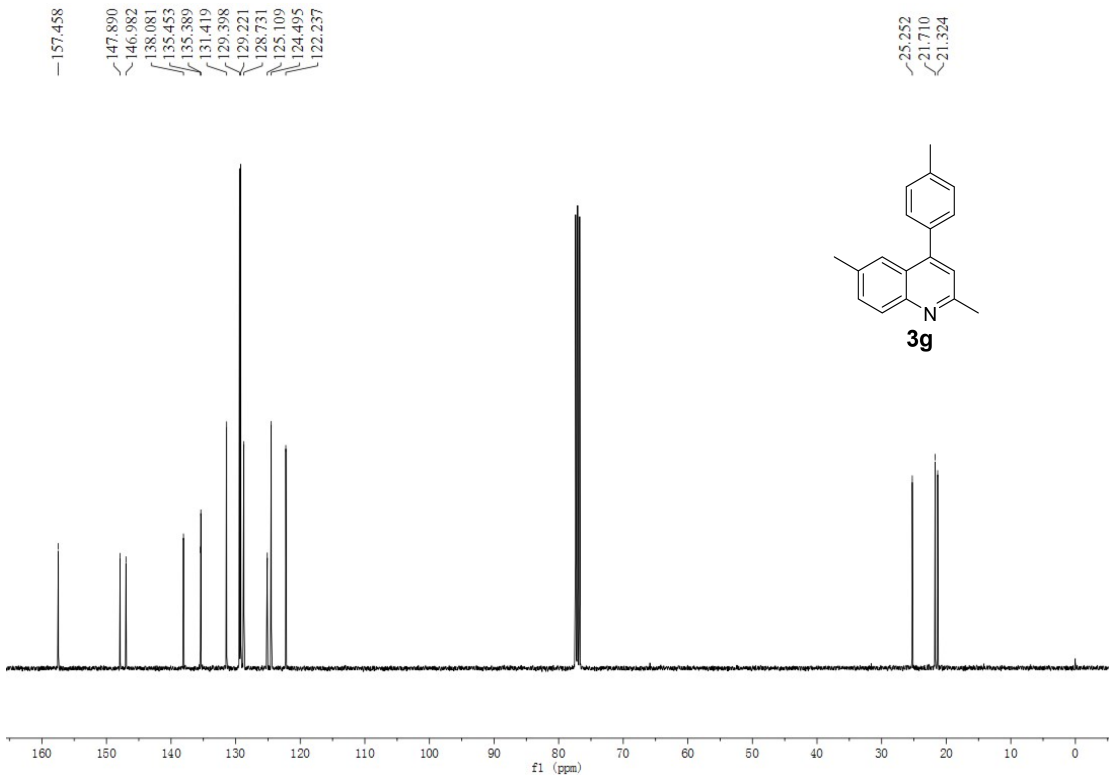

Figure S14. ¹³C NMR (100 MHz, $CDCl_3$) of compound 3g

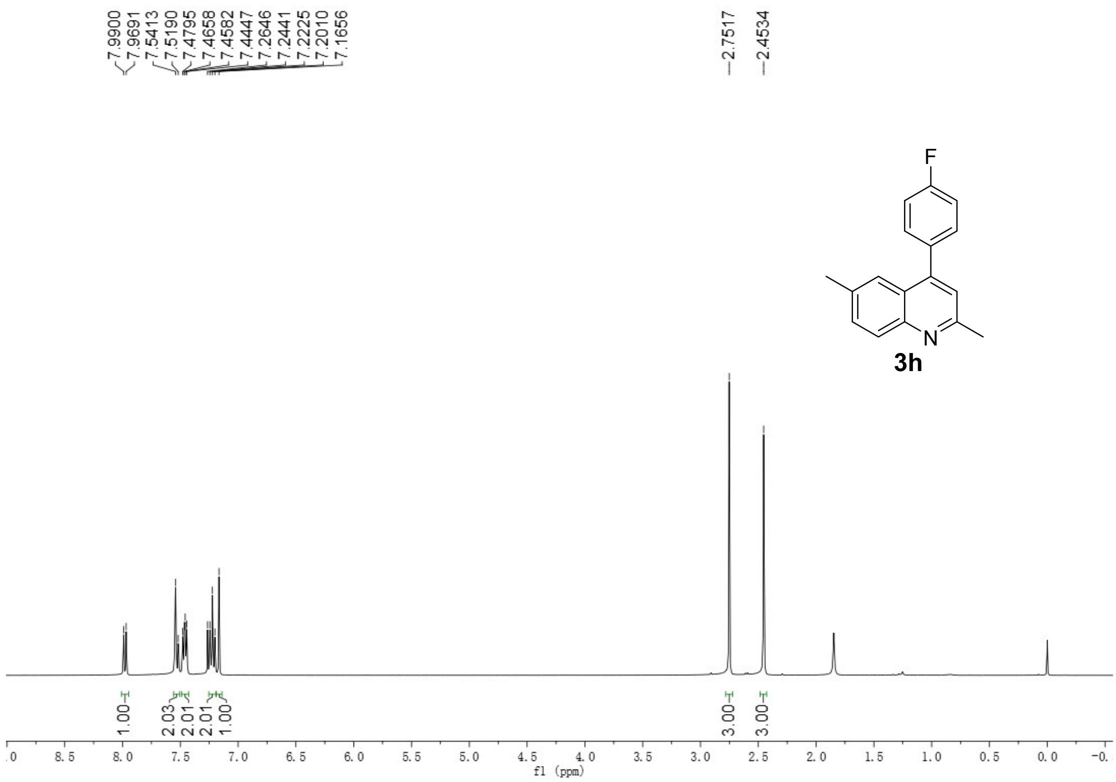

Figure S15. ^{1}H NMR (400 MHz, $CDCl_3$) of compound 3h

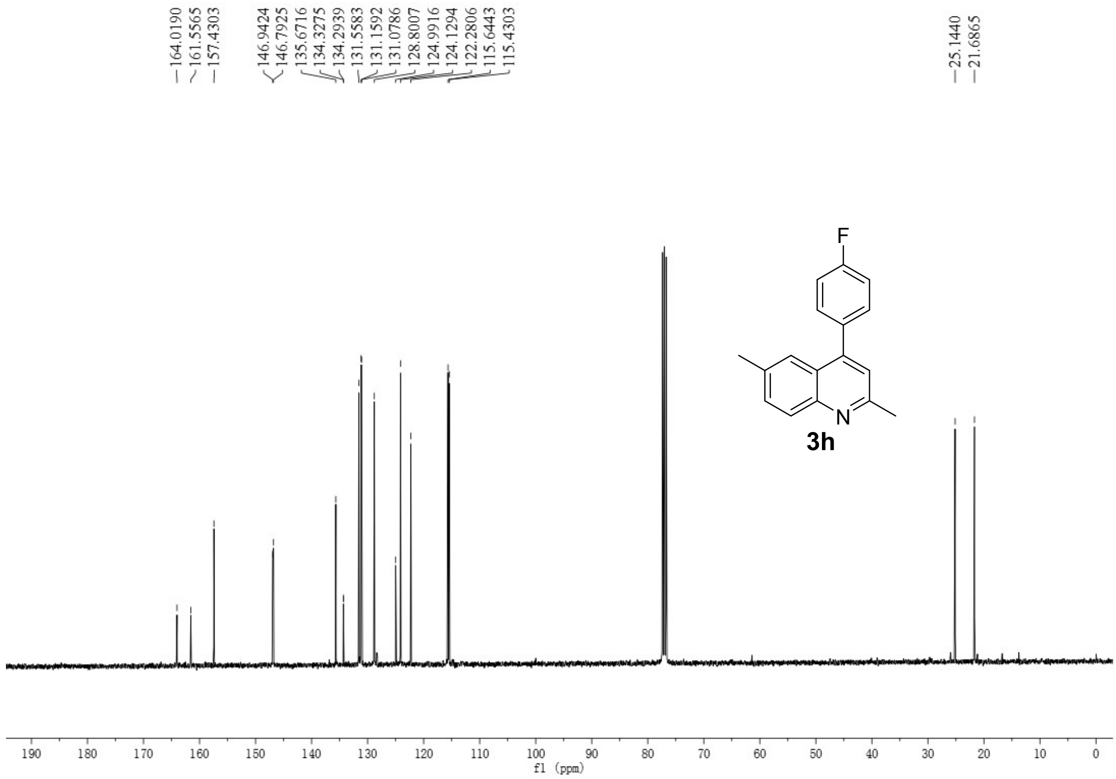

Figure S16. ^{13}C NMR (100 MHz, $CDCl_3$) of compound 3h

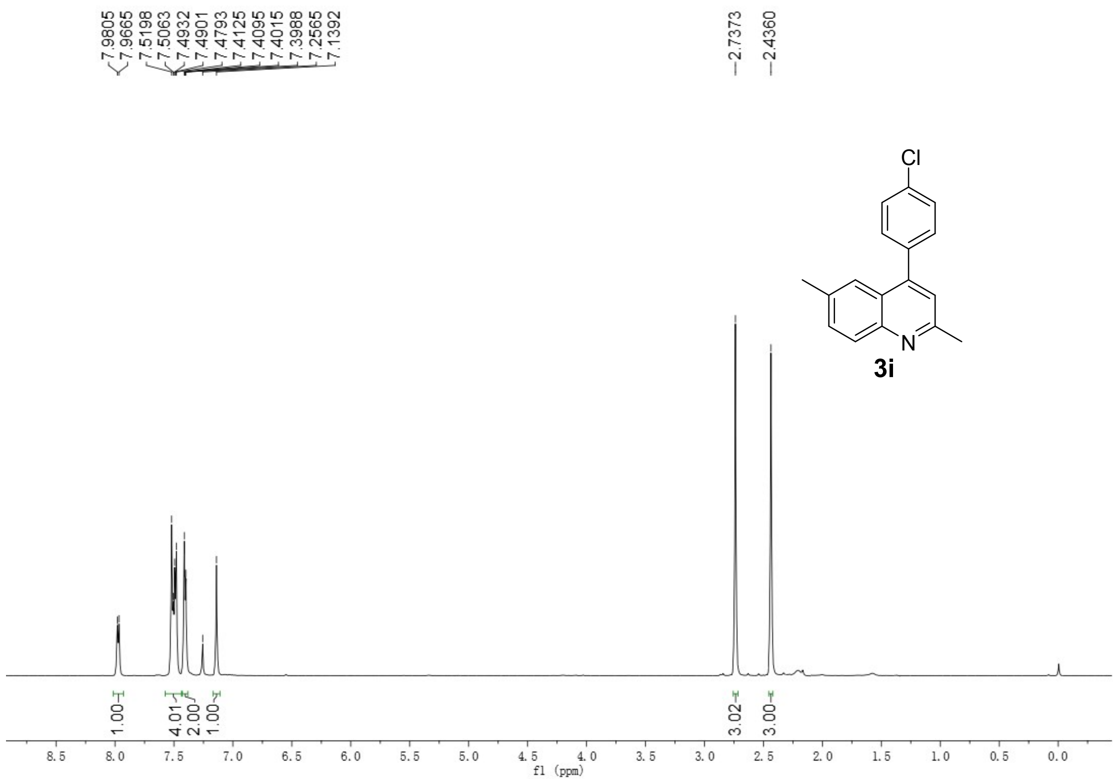

Figure S17. ^{1}H NMR (600 MHz, $CDCl_3$) of compound 3i

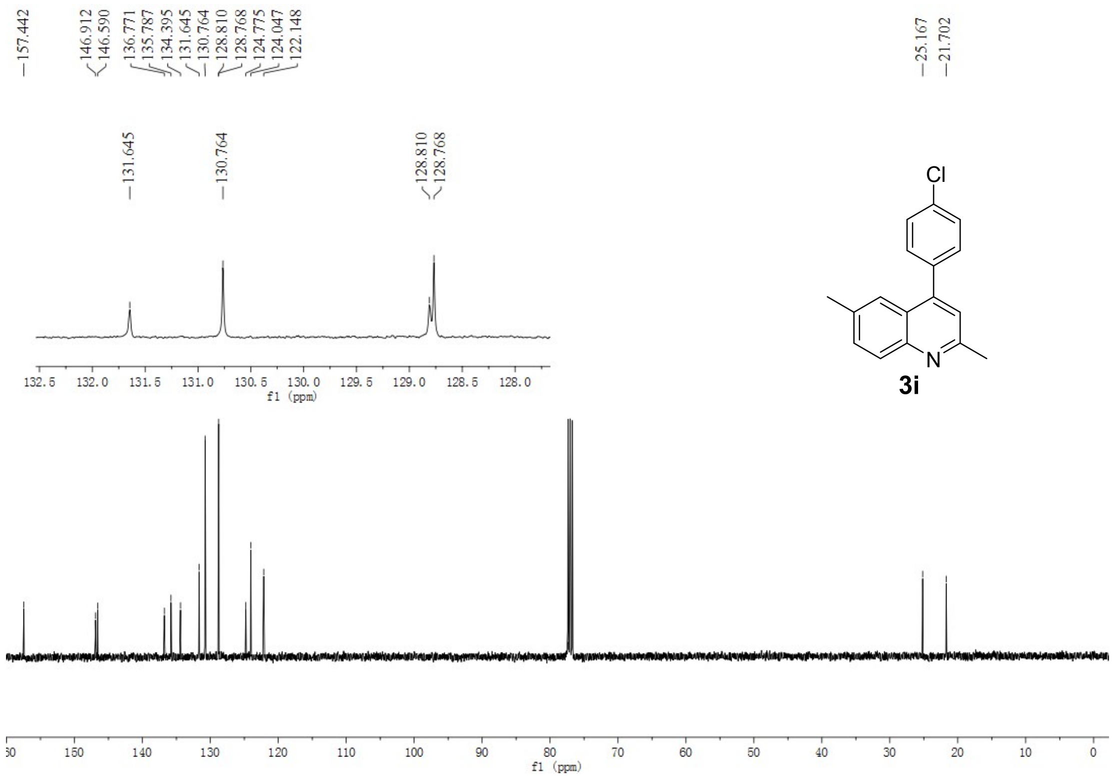

Figure S18. ^{13}C NMR (100 MHz, $CDCl_3$) of compound 3i

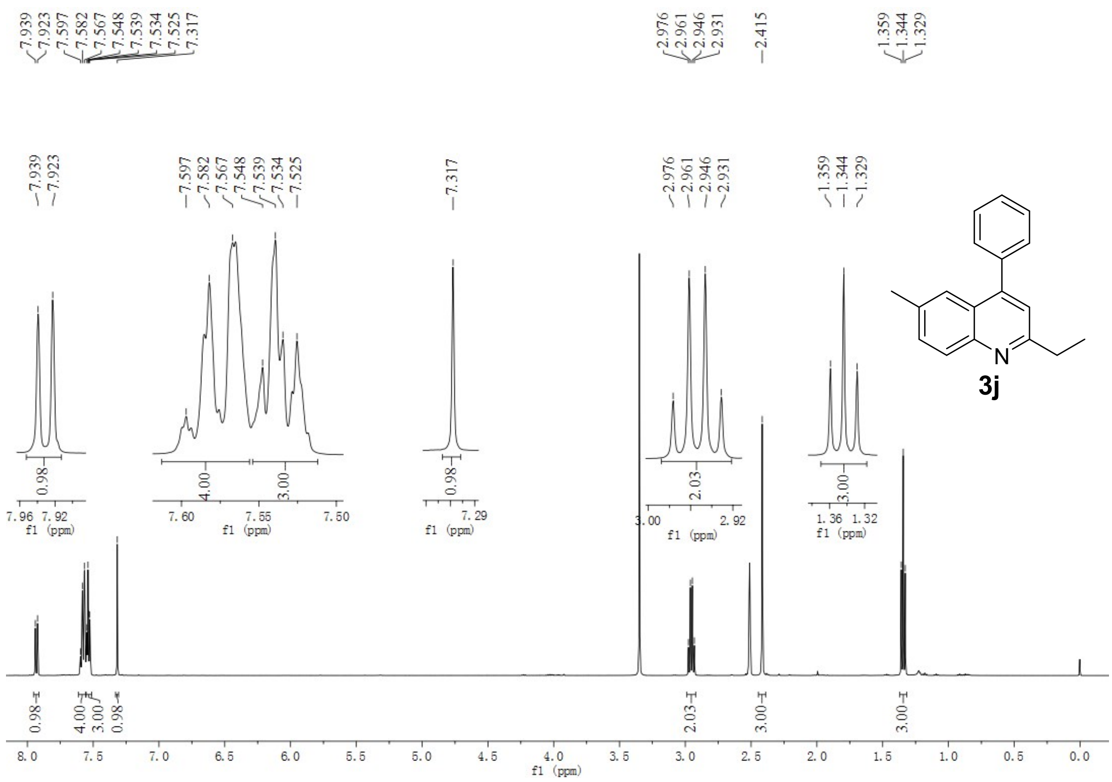

Figure S19. ^{1}H NMR (500 MHz, DMSO-d_6) of compound 3j

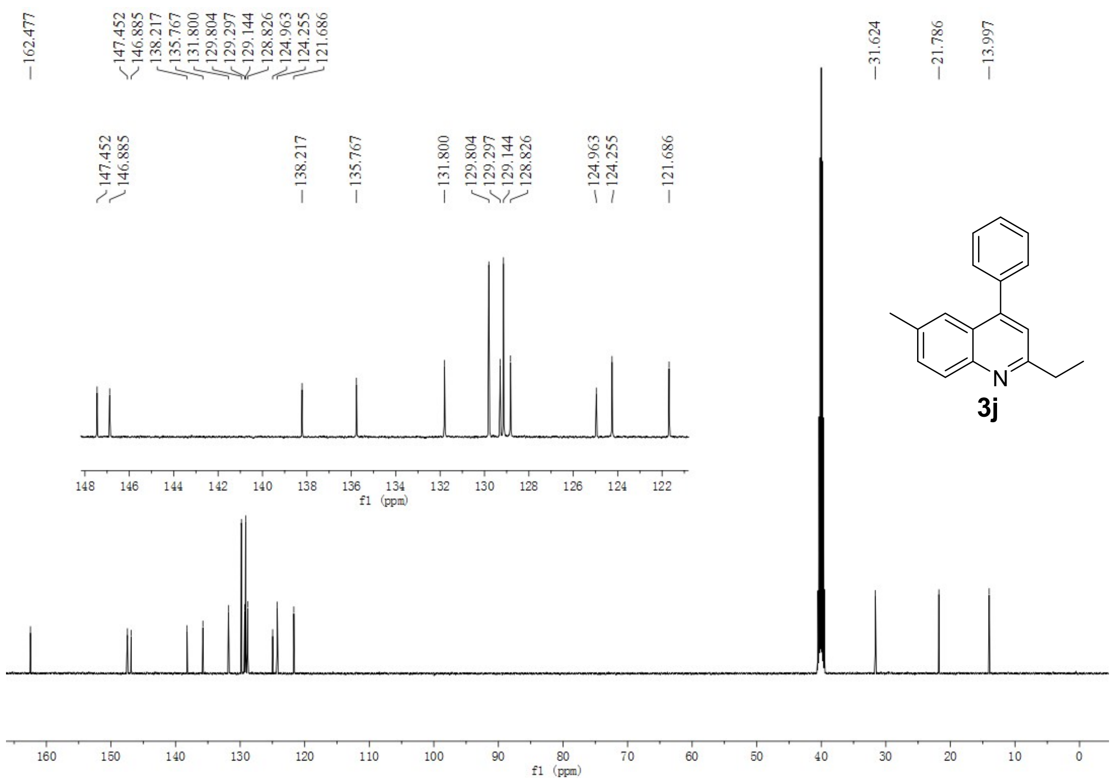

Figure S20. ^{13}C NMR (125 MHz, DMSO-d_6) of compound 3j

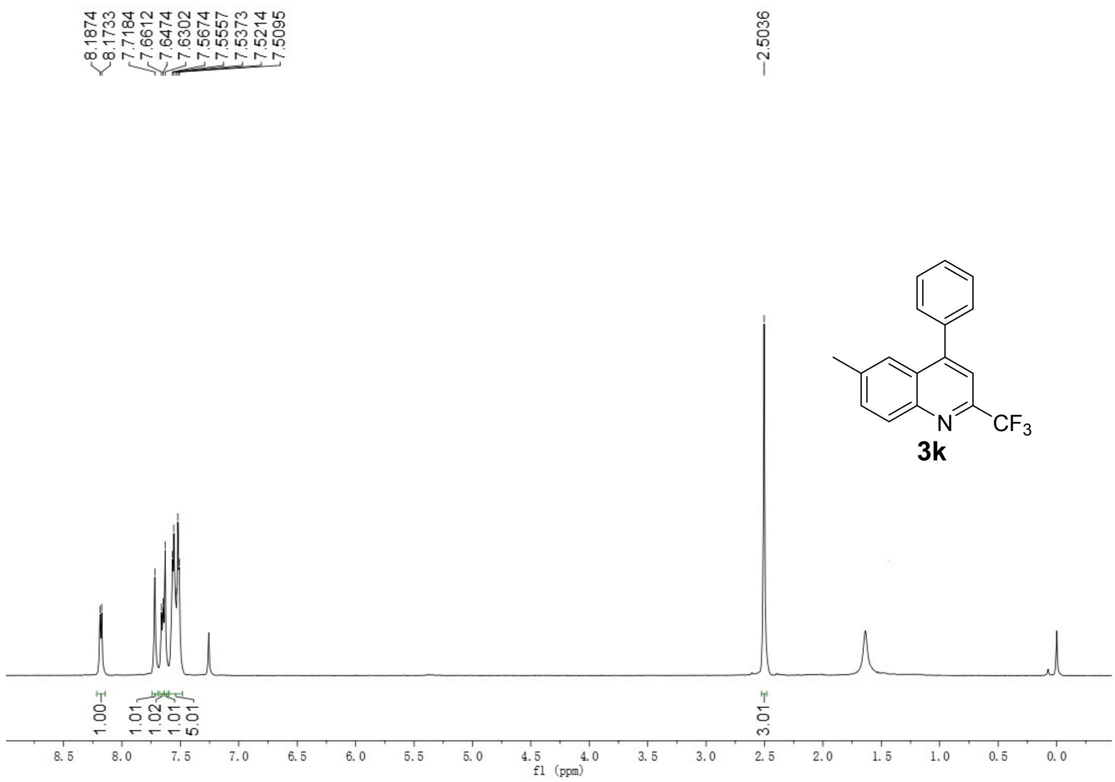

Figure S21. ^{1}H NMR (600 MHz, $CDCl_3$) of compound 3k

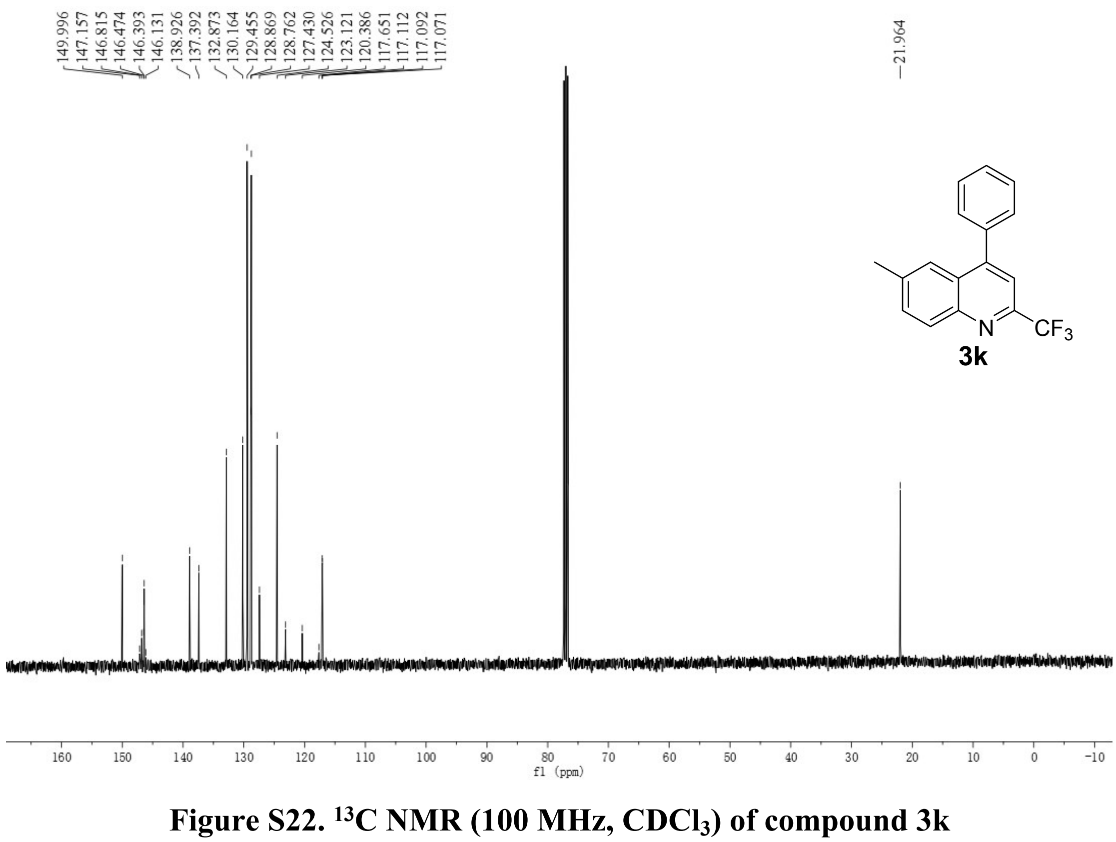

Figure S22. ^{13}C NMR (100 MHz, $CDCl_3$) of compound 3k

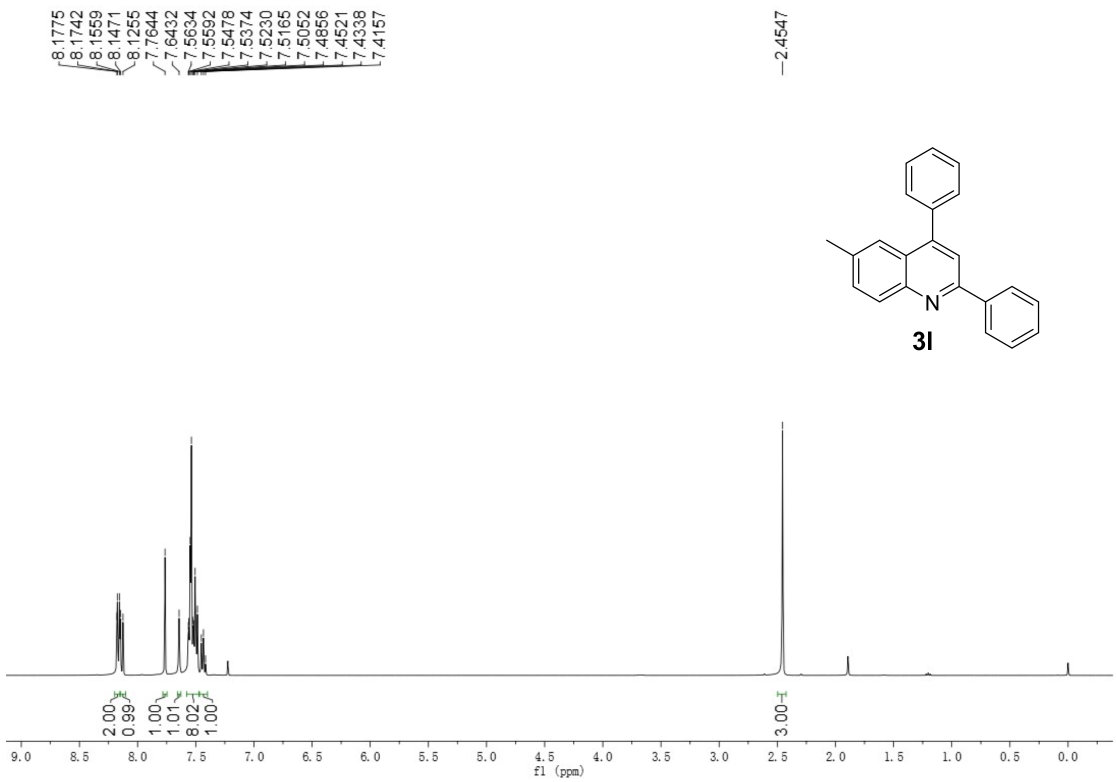

Figure S23. ^{1}H NMR (400 MHz, $CDCl_3$) of compound 3l

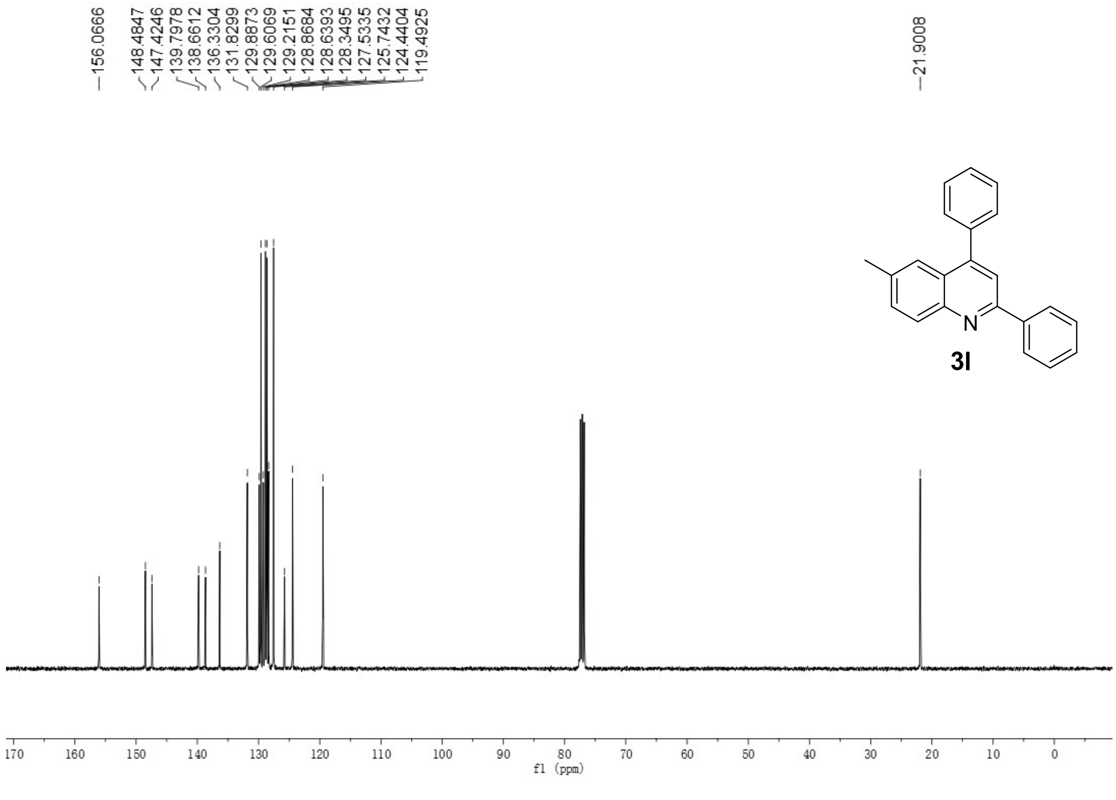

Figure S24. ^{13}C NMR (100 MHz, $CDCl_3$) of compound 3l

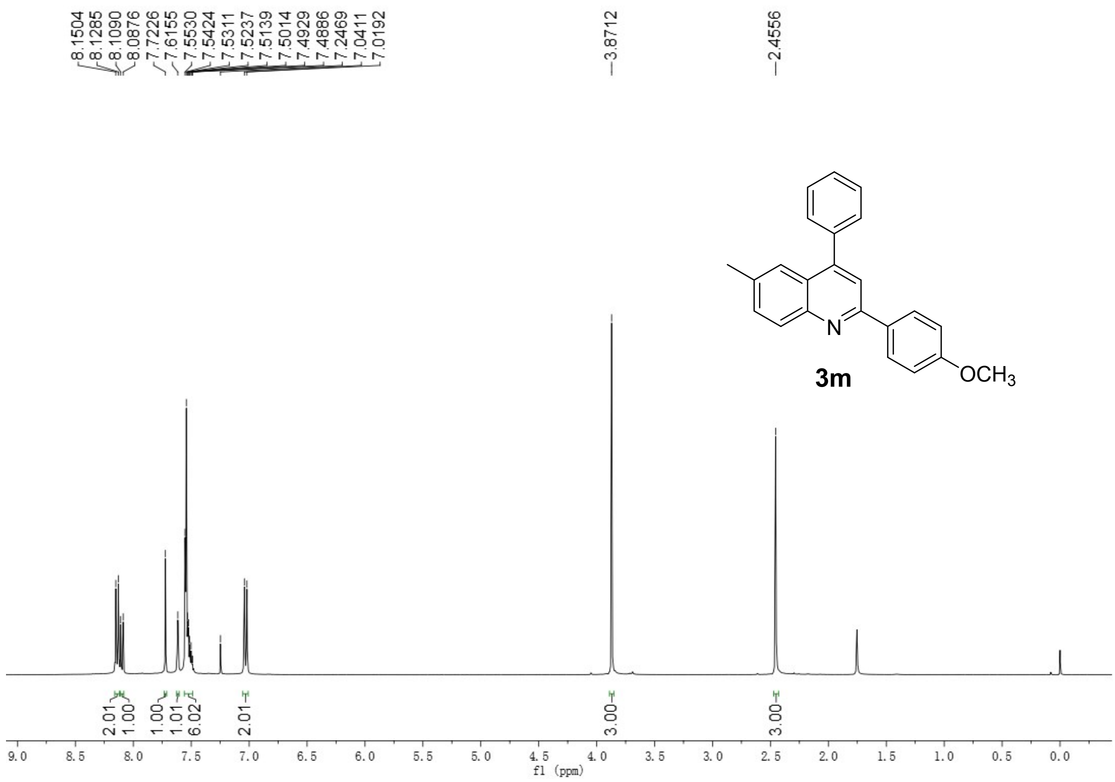

Figure S25. ^{1}H NMR (400 MHz, $CDCl_3$) of compound 3m

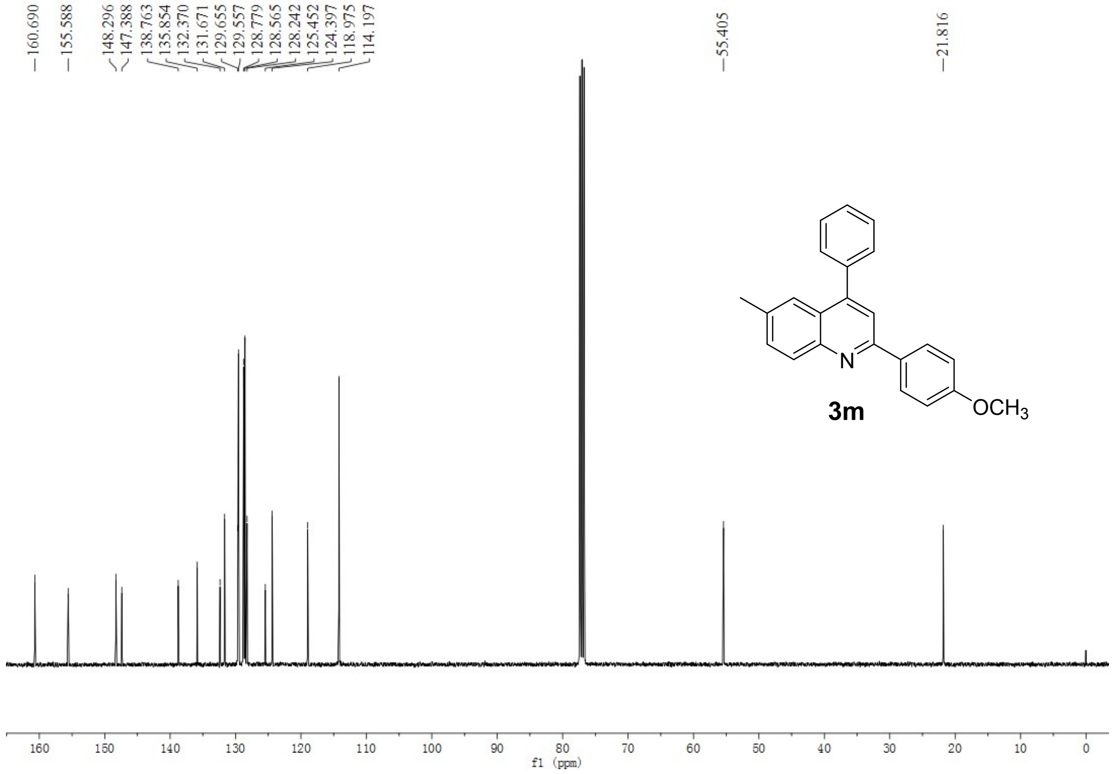

Figure S26. ^{13}C NMR (100 MHz, $CDCl_3$) of compound 3m

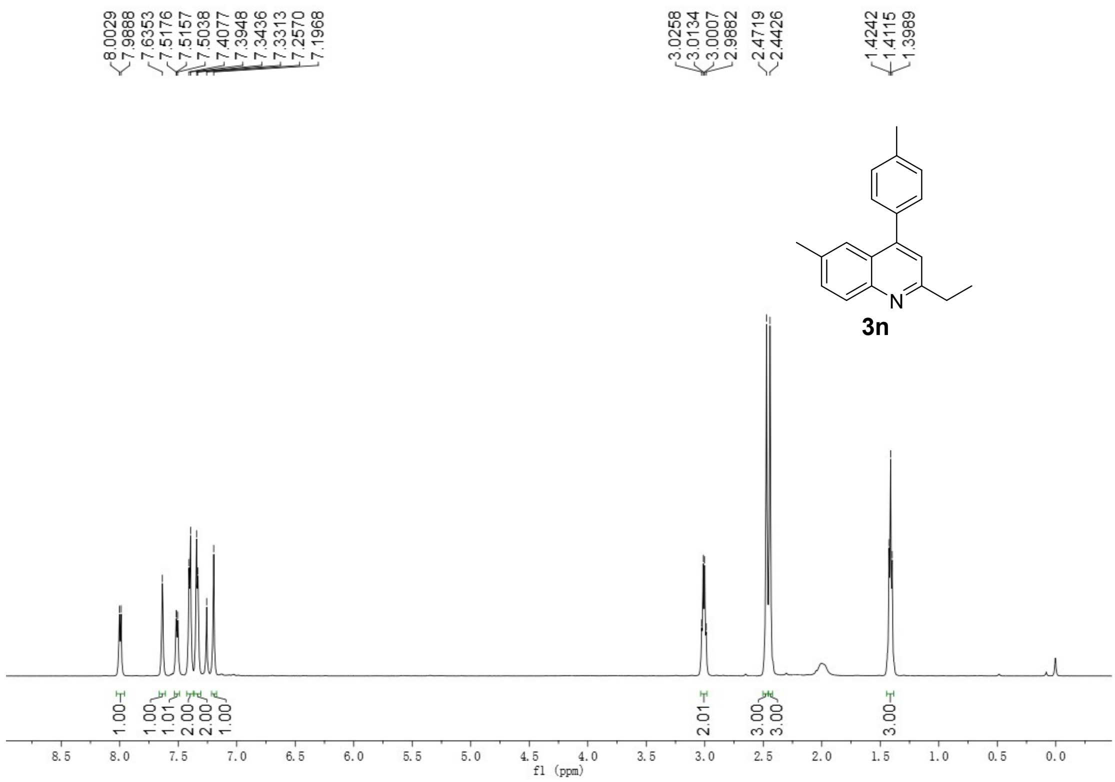

Figure S27. ^{1}H NMR (600 MHz, $CDCl_3$) of compound 3n

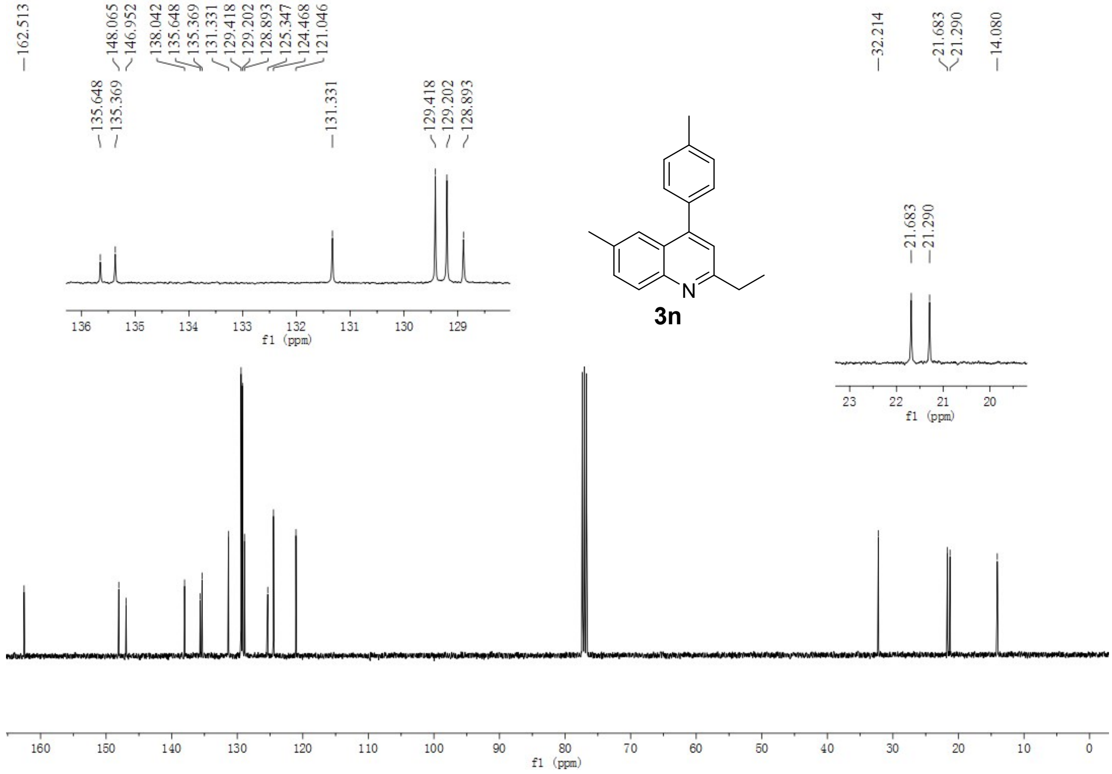

Figure S28. ^{13}C NMR (100 MHz, $CDCl_3$) of compound 3n

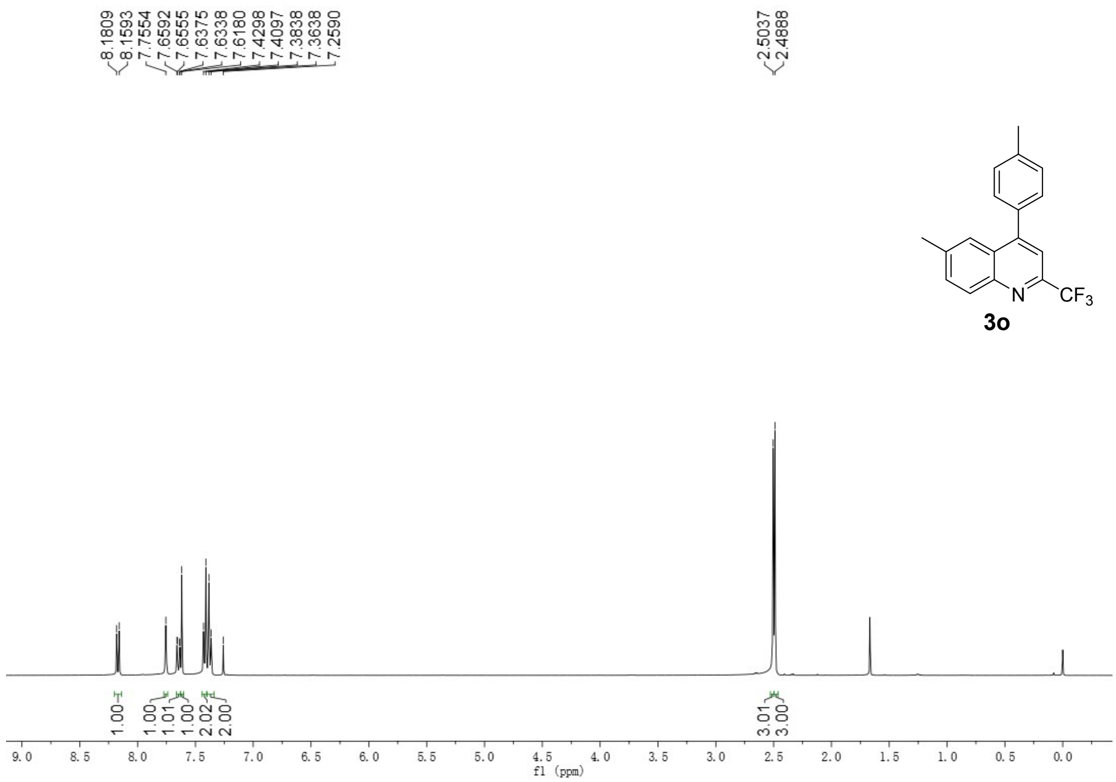

Figure S29. ^{1}H NMR (400 MHz, $CDCl_3$) of compound 3o

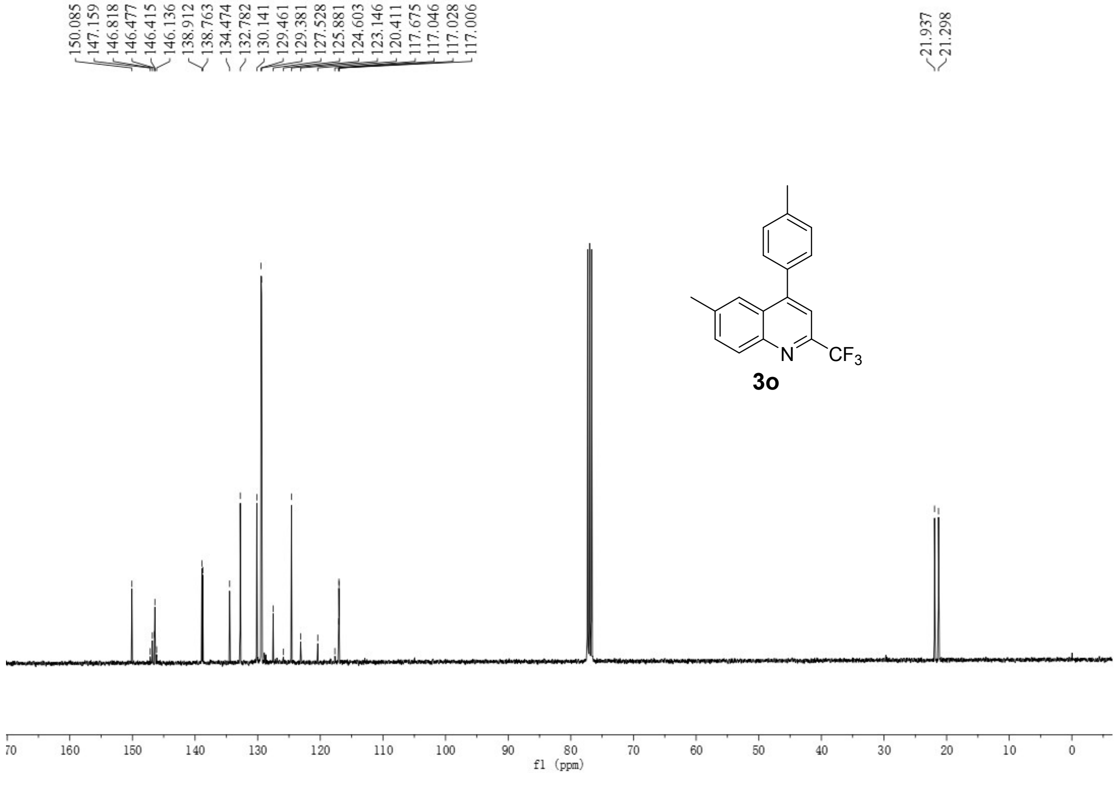

Figure S30. ^{13}C NMR (100 MHz, $CDCl_3$) of compound 3o

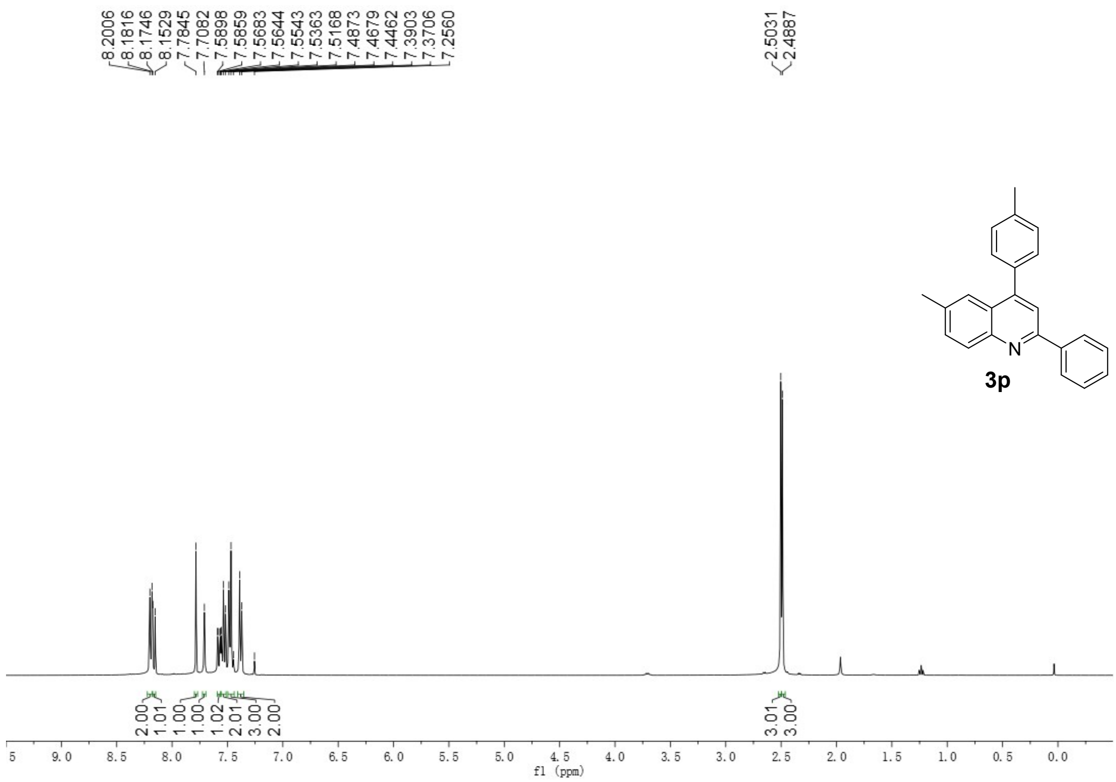

Figure S31. ¹H NMR (400 MHz, CDCl₃) of compound 3p

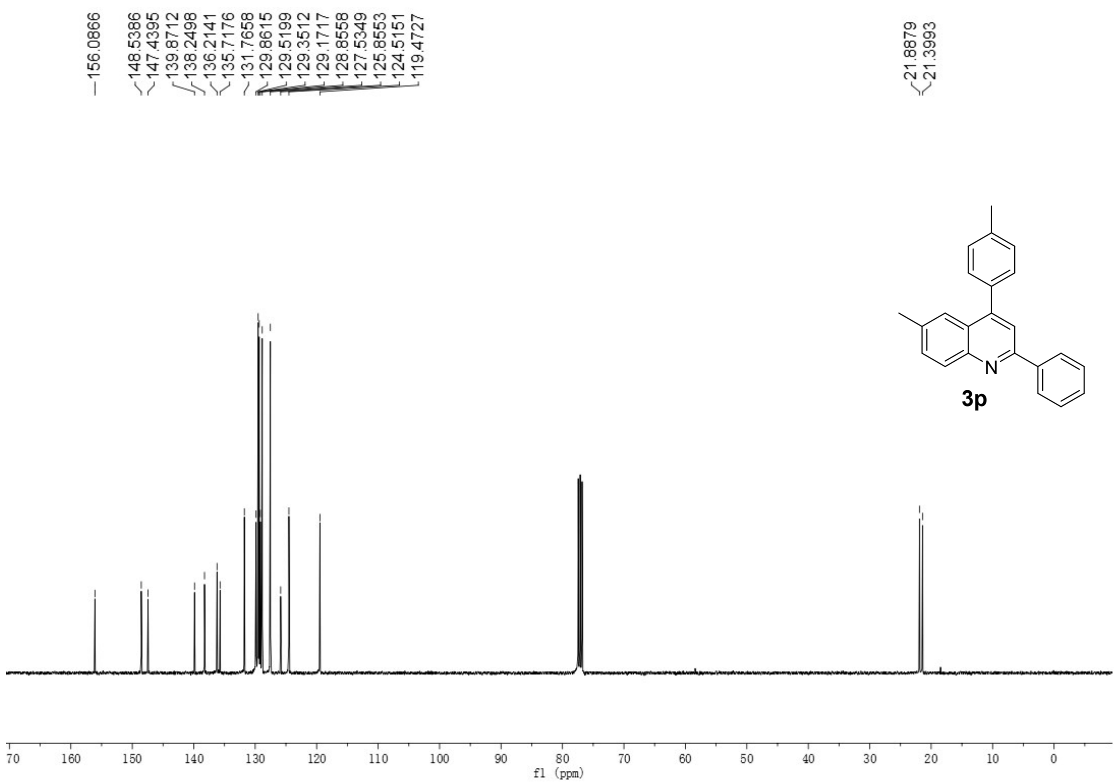

Figure S32. ¹³C NMR (100 MHz, CDCl₃) of compound 3p

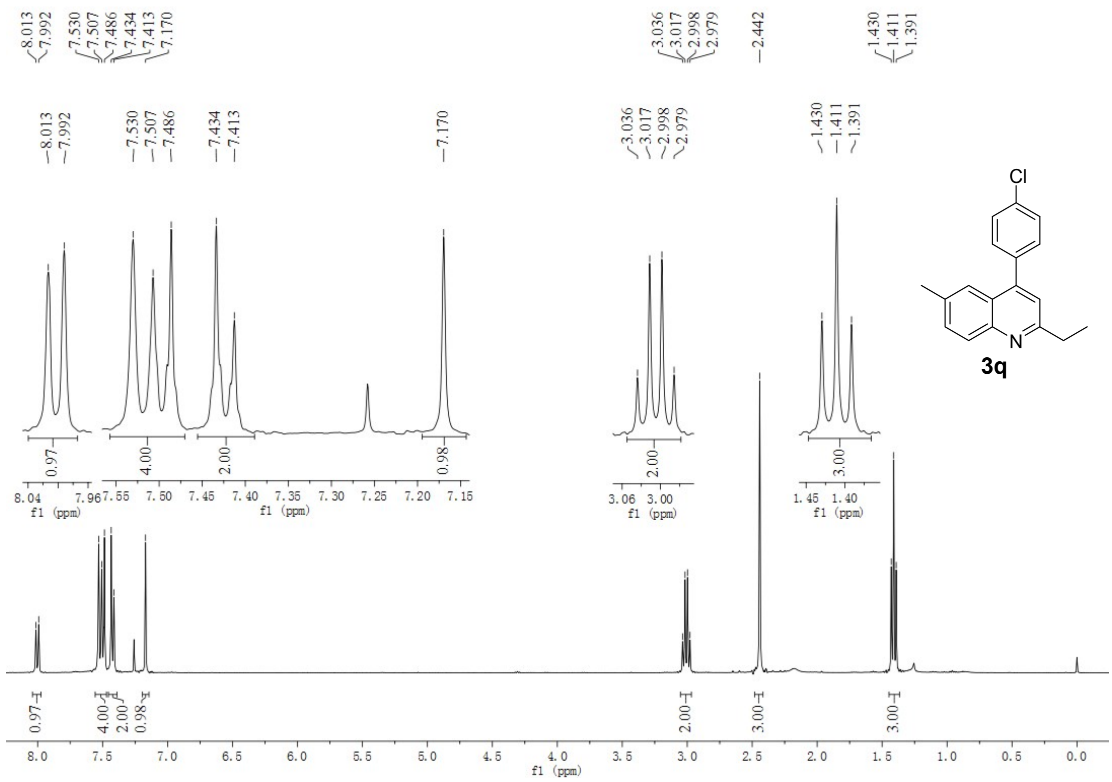

Figure S33. ^{1}H NMR (400 MHz, $CDCl_3$) of compound 3q

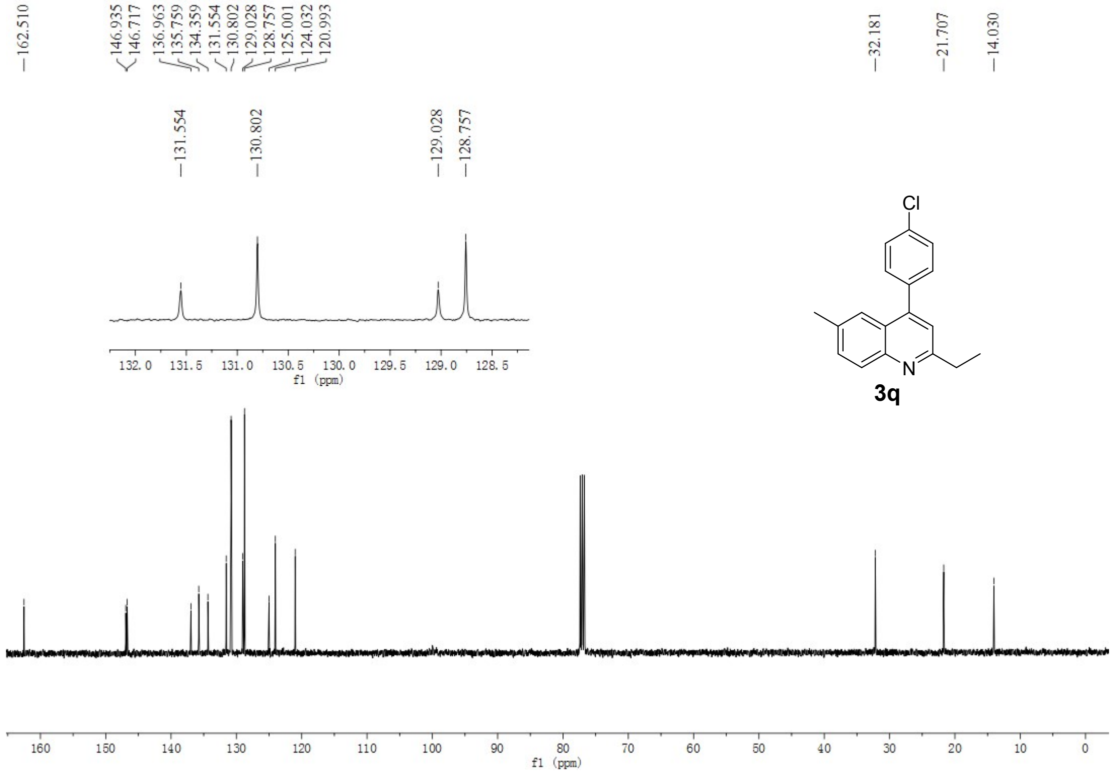

Figure S34. ^{13}C NMR (100 MHz, $CDCl_3$) of compound 3q

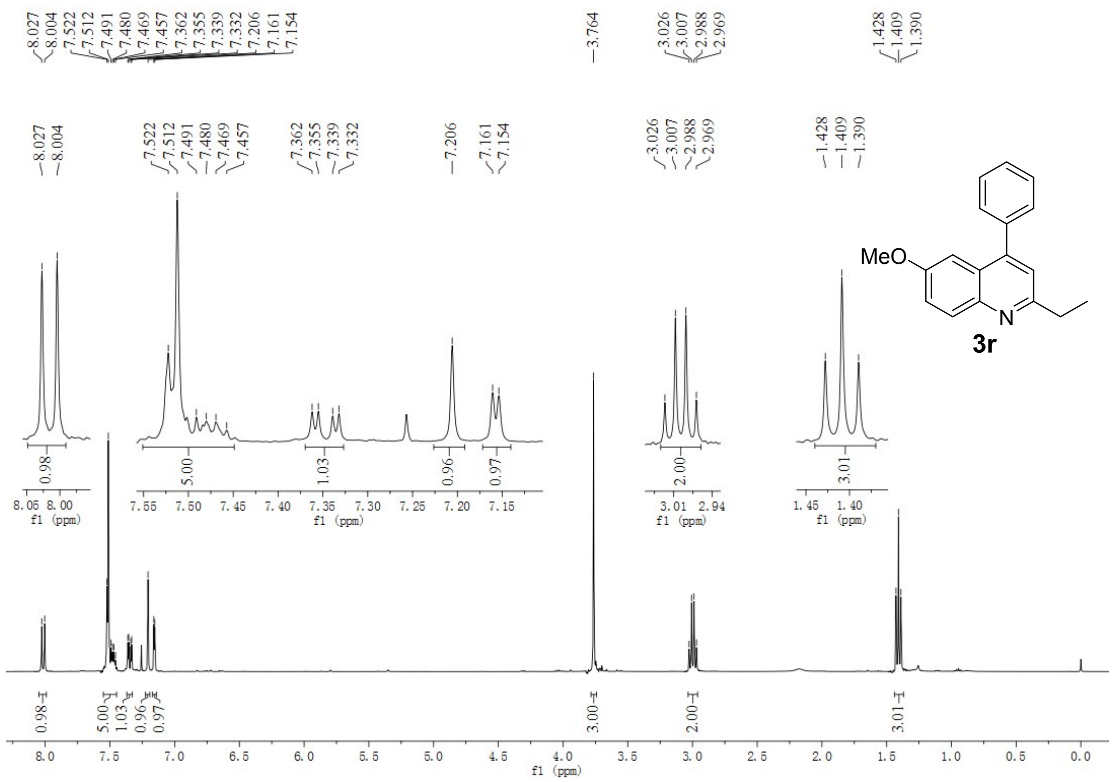

Figure S35. ^{1}H NMR (400 MHz, $CDCl_3$) of compound 3r

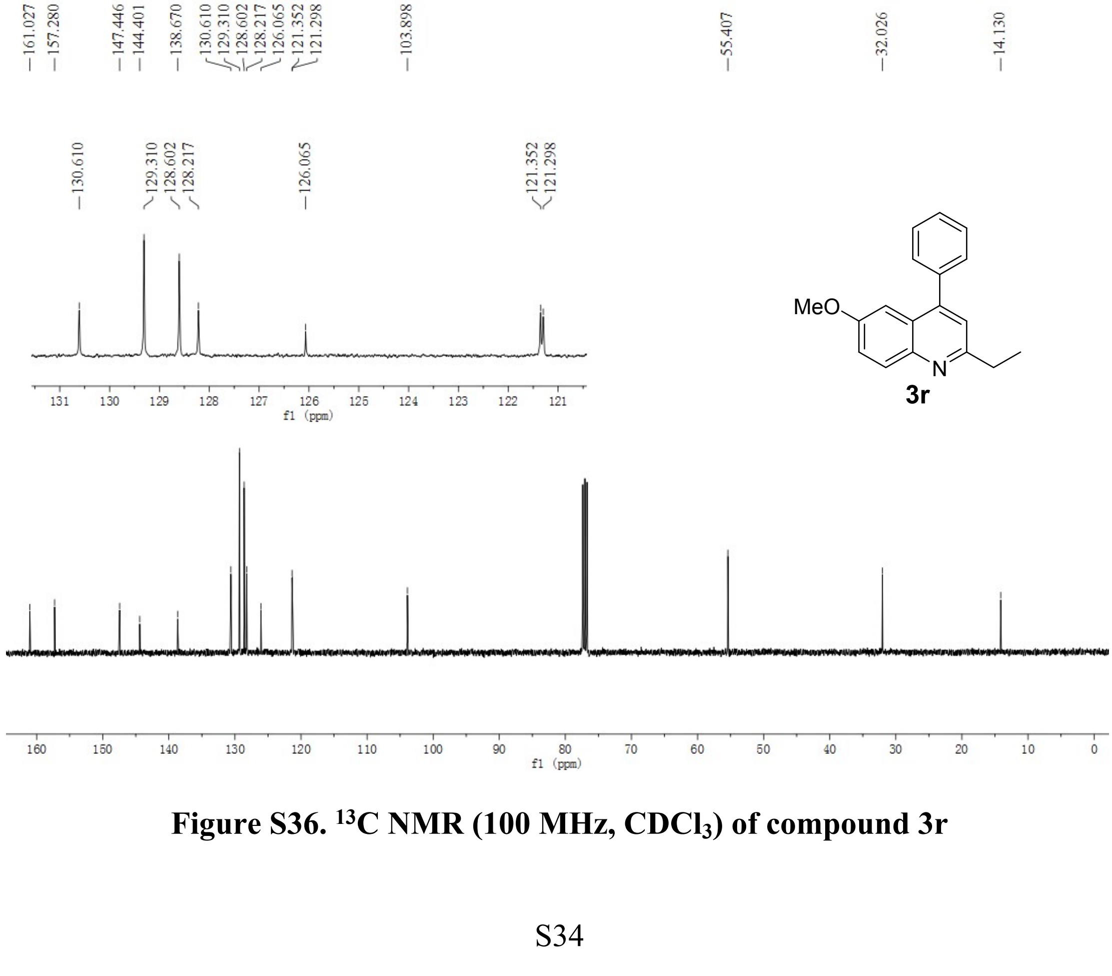

Figure S36. ^{13}C NMR (100 MHz, $CDCl_3$) of compound 3r

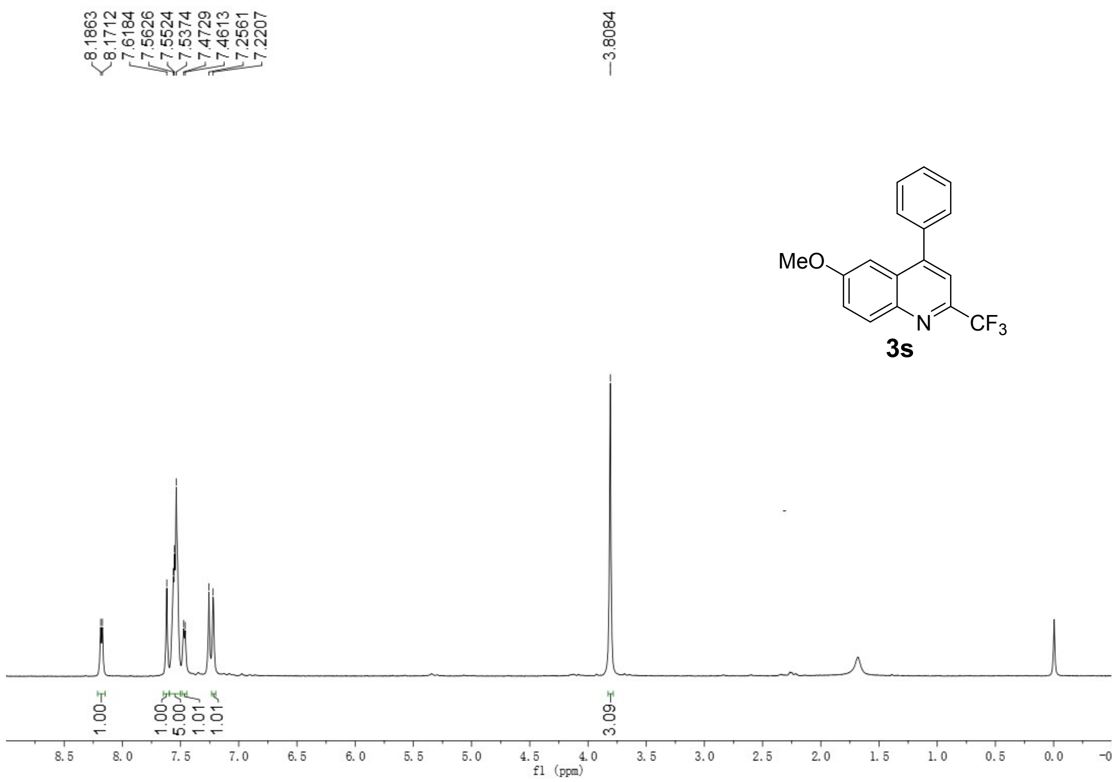

Figure S37. ^{1}H NMR (600 MHz, $CDCl_3$) of compound 3s

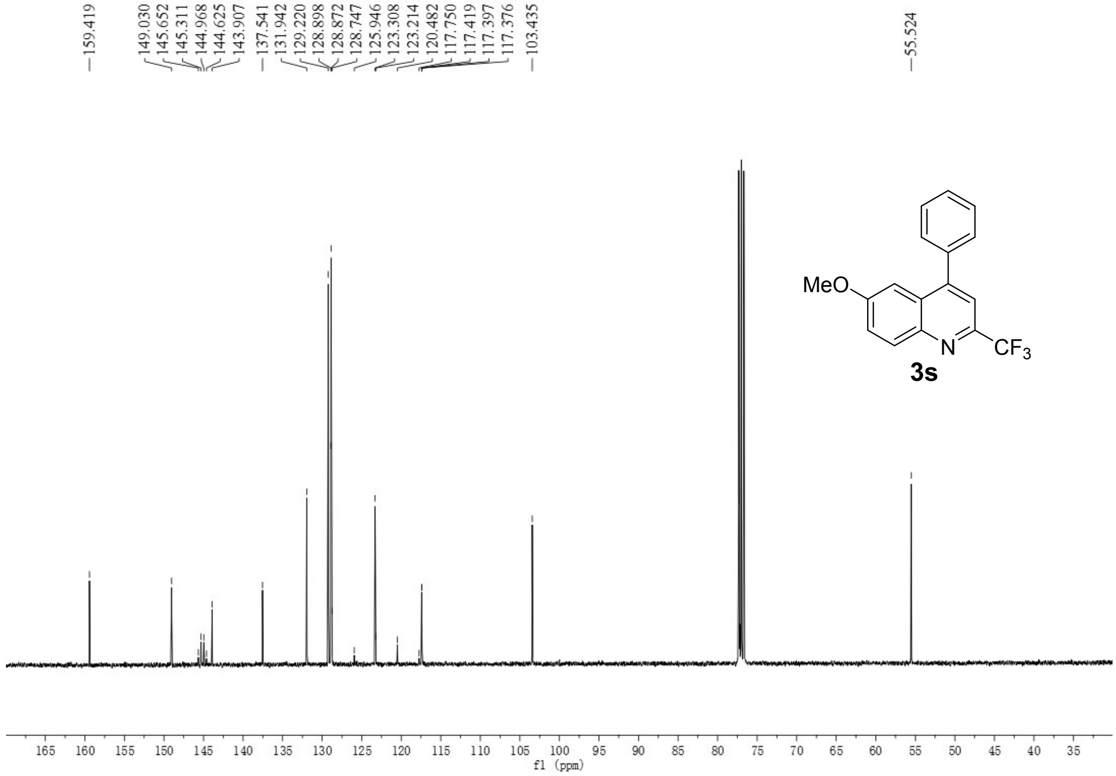

Figure S38. ^{13}C NMR (100 MHz, $CDCl_3$) of compound 3s

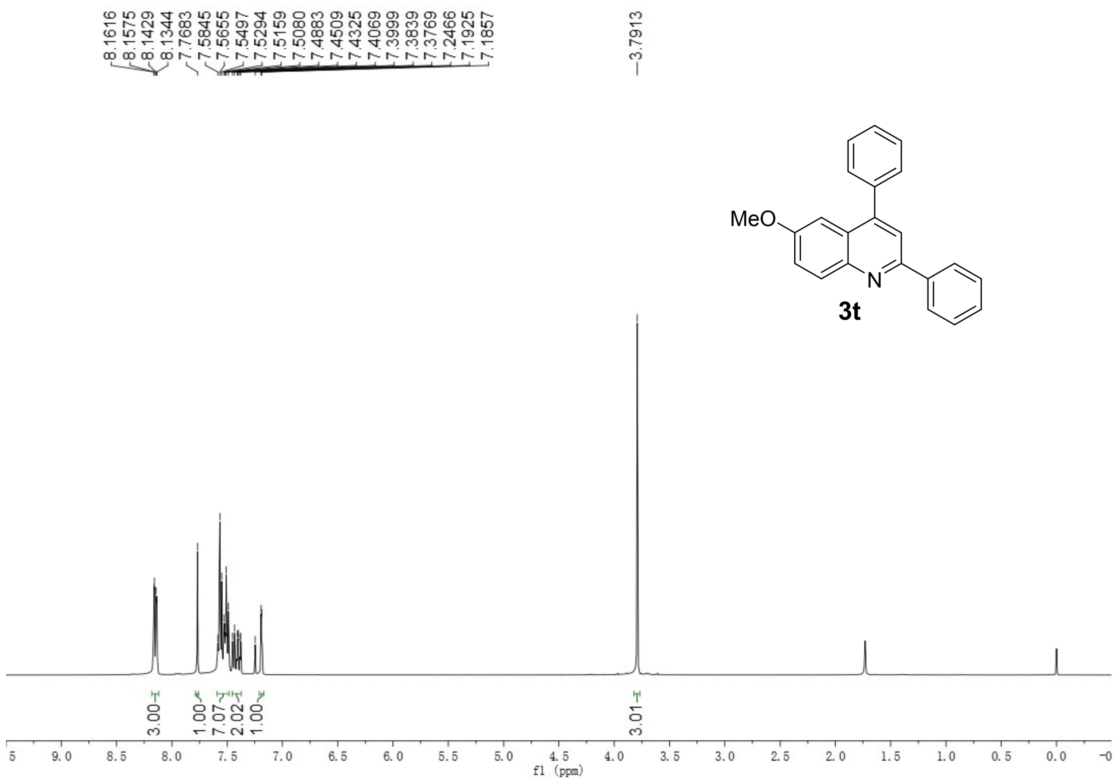

Figure S39. ^{1}H NMR (400 MHz, $CDCl_3$) of compound 3t

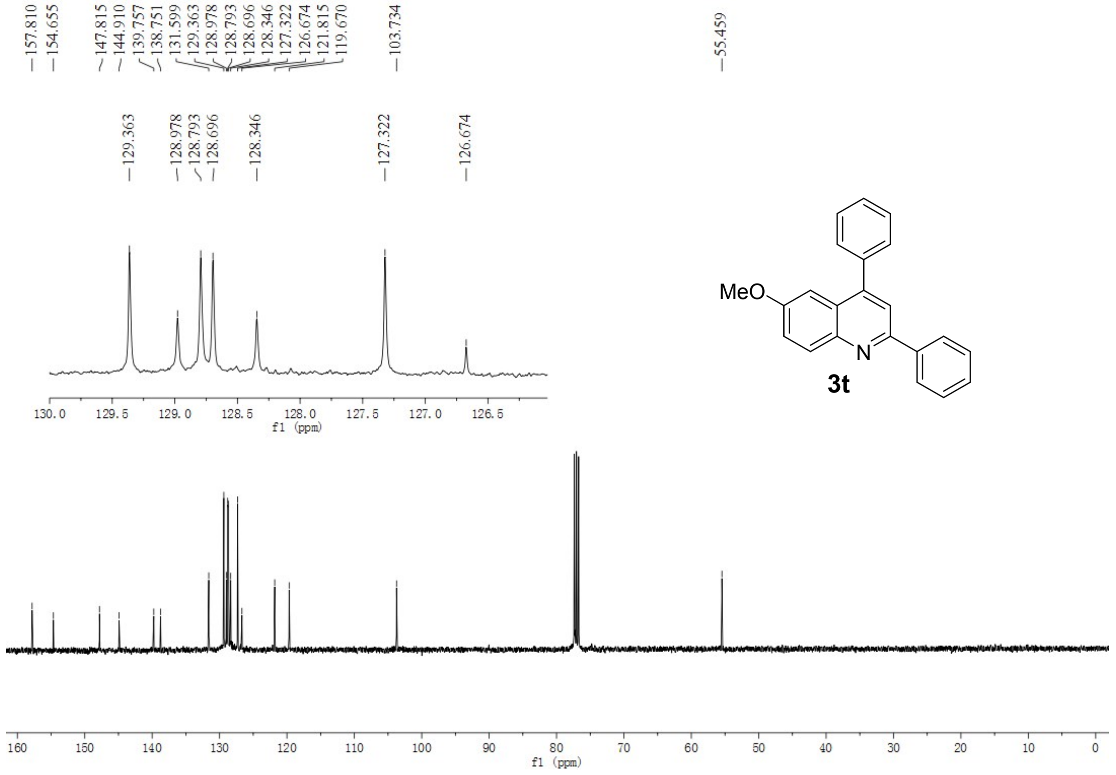

Figure S40. ^{13}C NMR (100 MHz, $CDCl_3$) of compound 3t

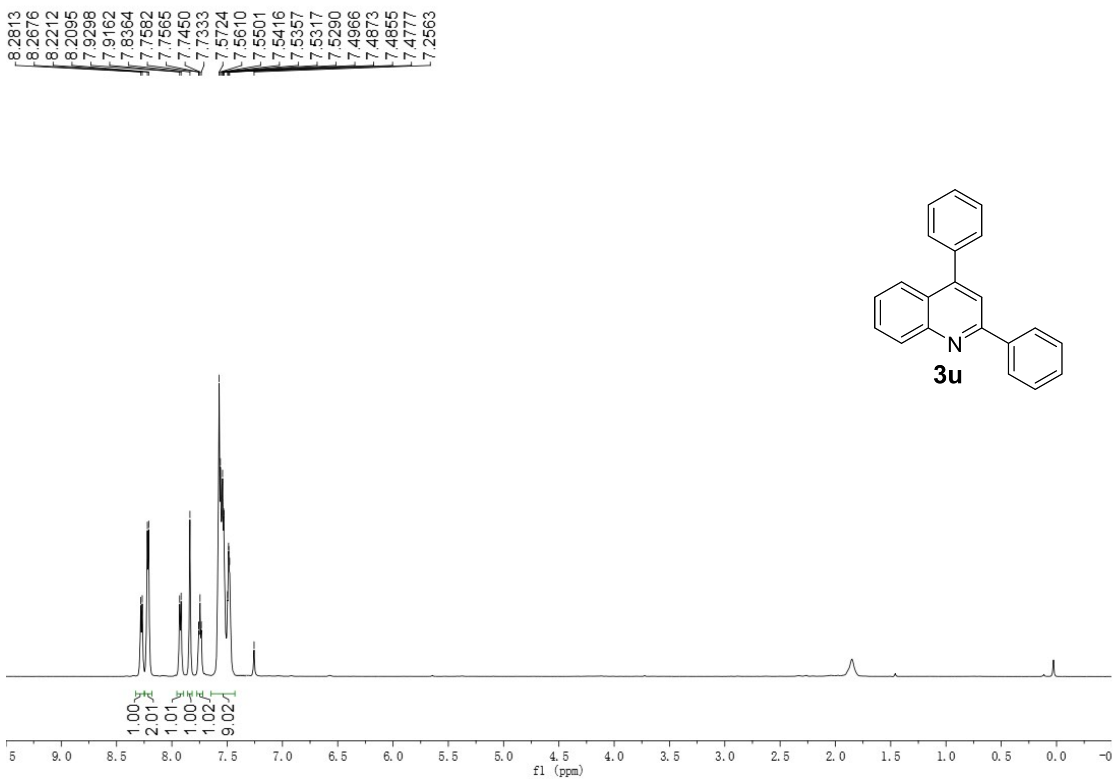

Figure S41. ^{1}H NMR (600 MHz, $CDCl_3$) of compound 3u

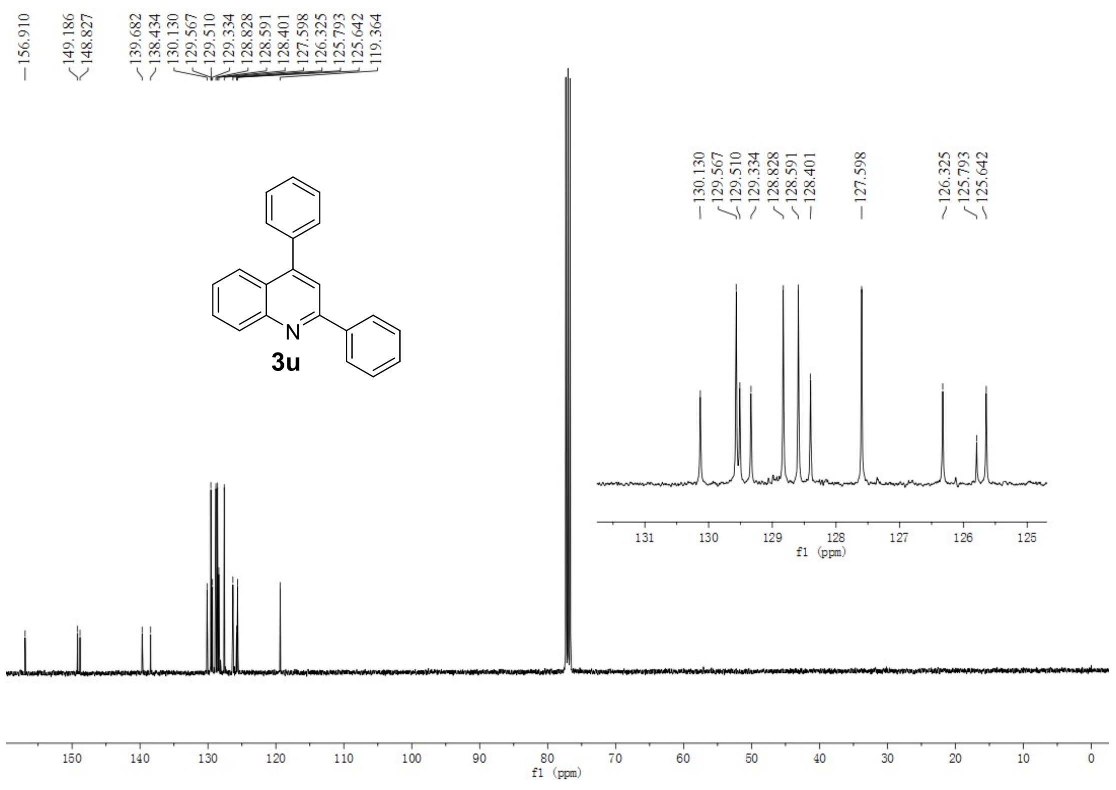

Figure S42. ^{13}C NMR (100 MHz, $CDCl_3$) of compound 3u

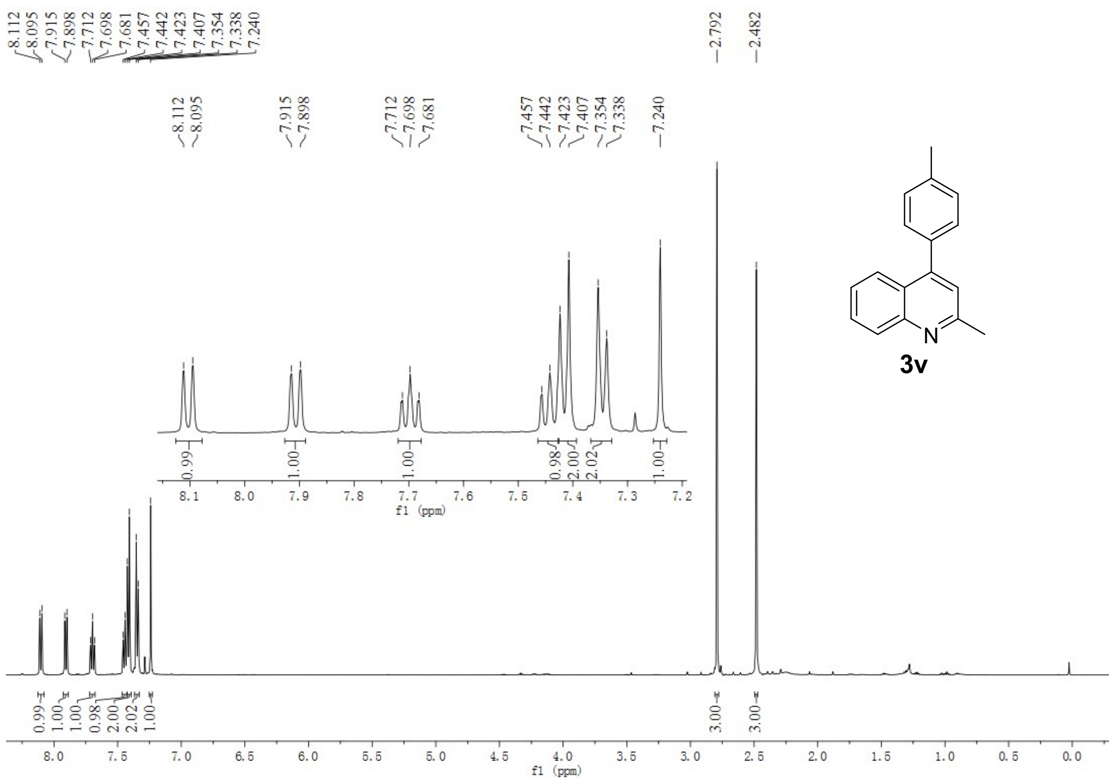

Figure S43. ^{1}H NMR (500 MHz, $CDCl_3$) of compound 3v

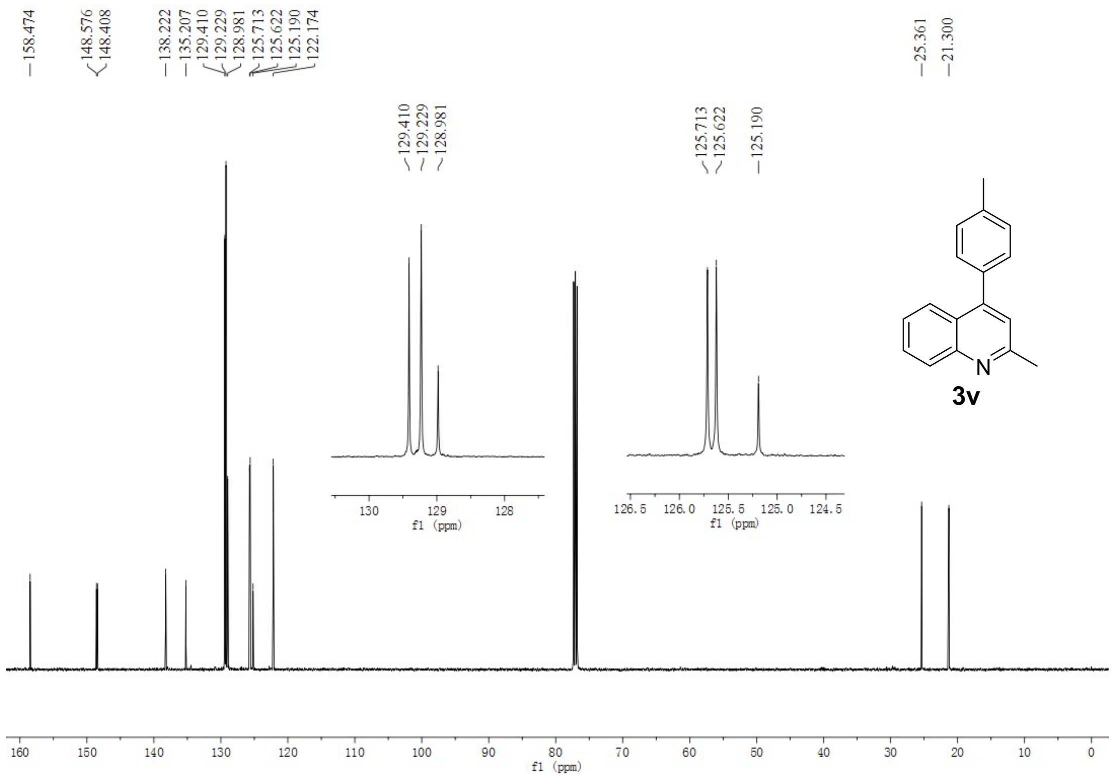

Figure S44. ^{13}C NMR (125 MHz, $CDCl_3$) of compound 3v

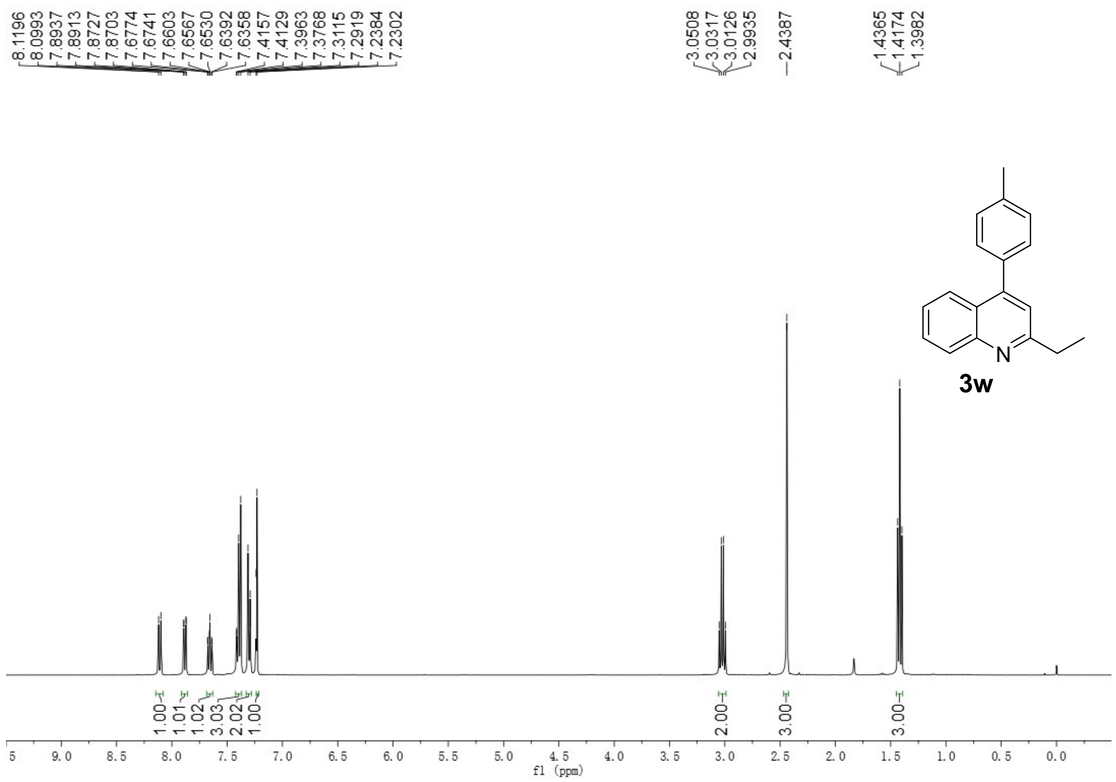

Figure S45. ^{1}H NMR (400 MHz, $CDCl_3$) of compound 3w

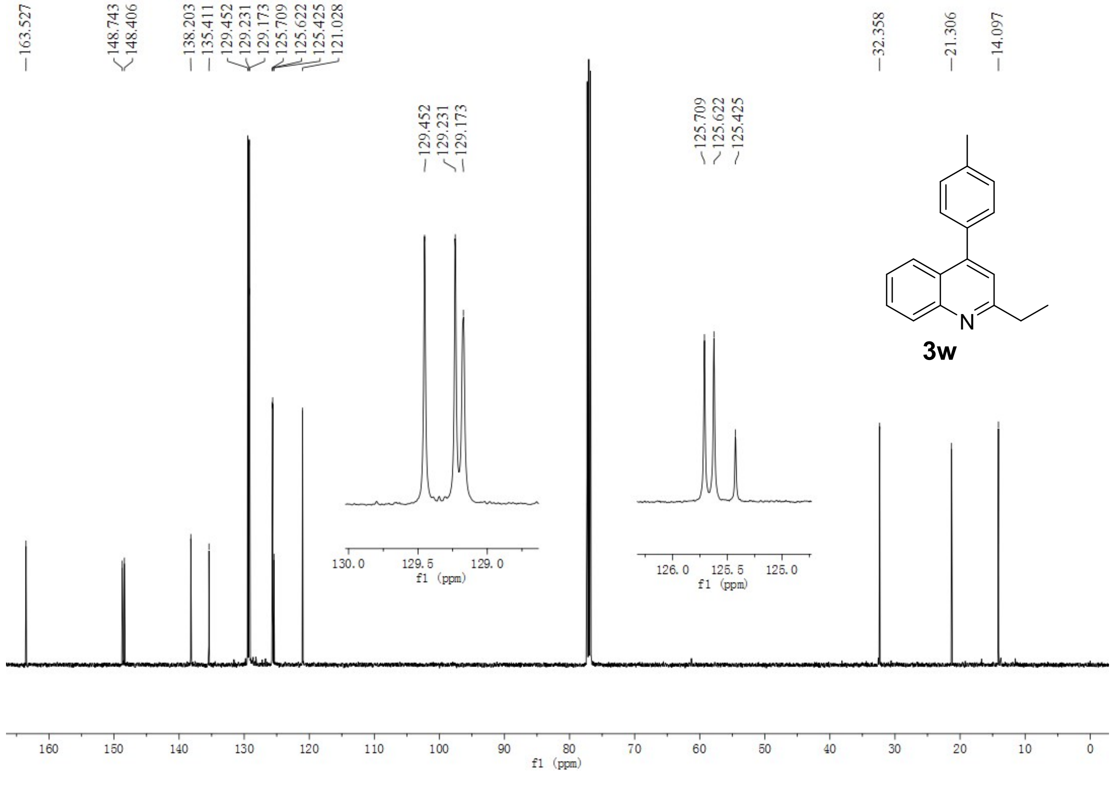

Figure S46. ^{13}C NMR (125 MHz, $CDCl_3$) of compound 3w

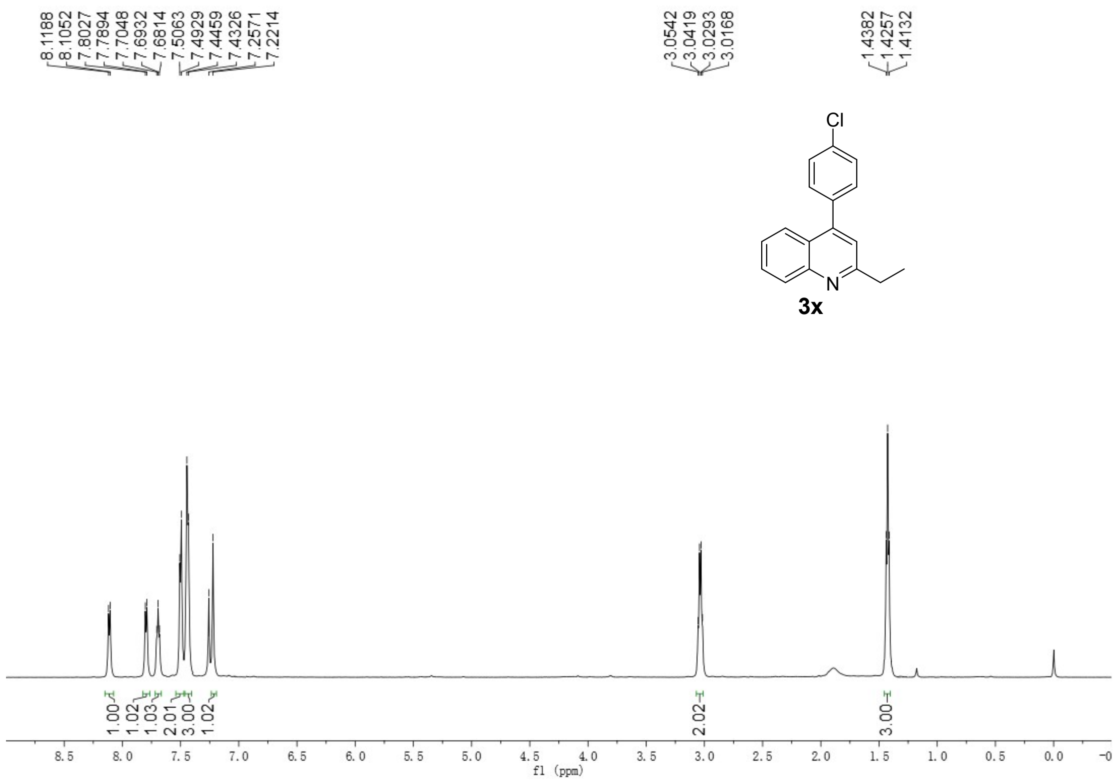

Figure S47. ^{1}H NMR (600 MHz, $CDCl_3$) of compound 3x

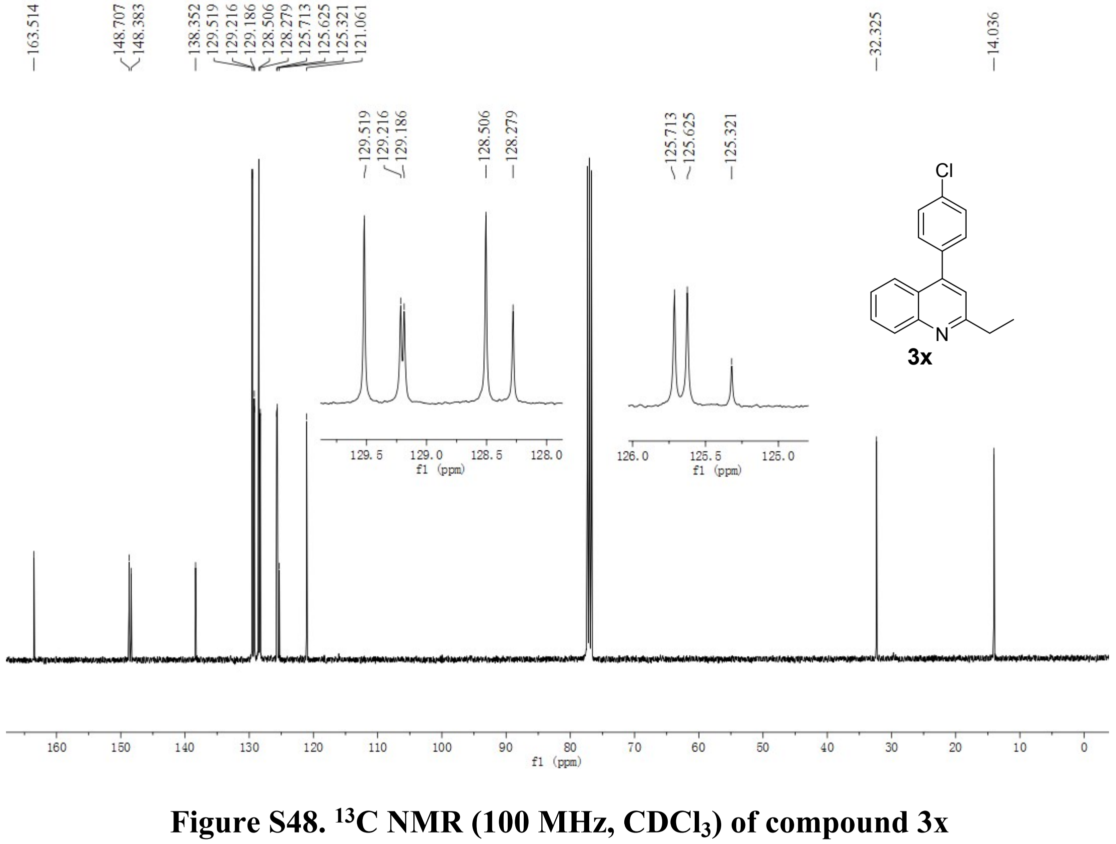

Figure S48. ^{13}C NMR (100 MHz, $CDCl_3$) of compound 3x

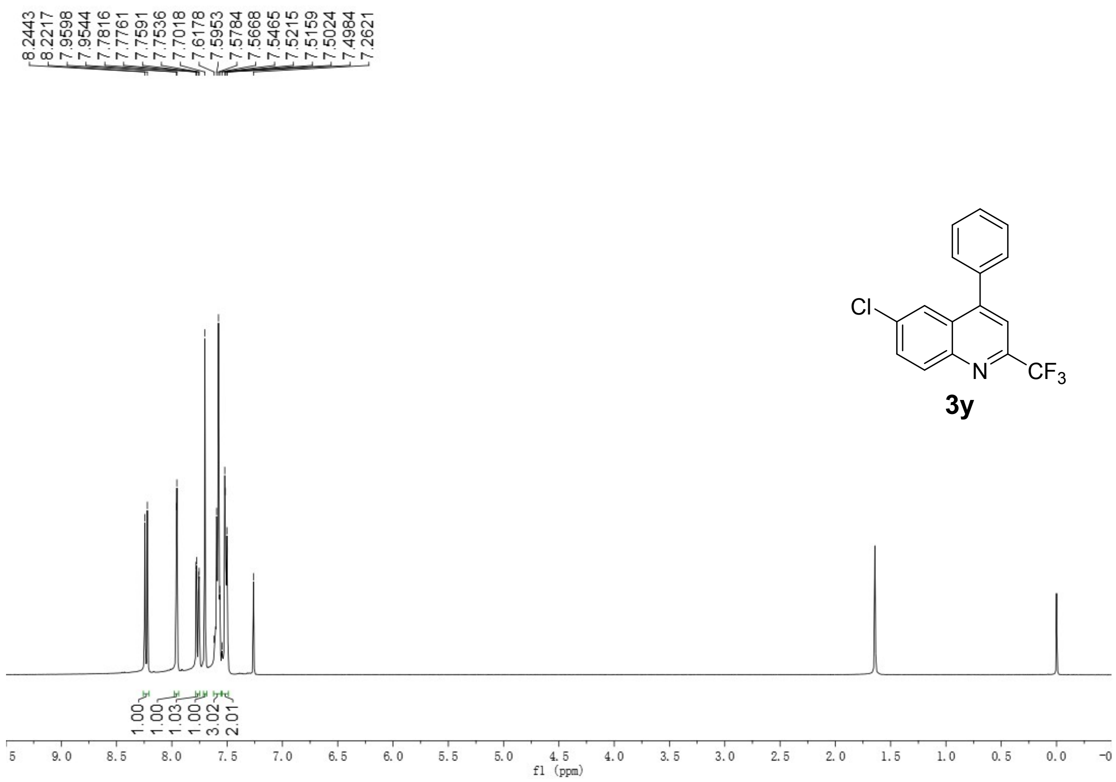

Figure S49. ^{1}H NMR (400 MHz, $CDCl_3$) of compound 3y

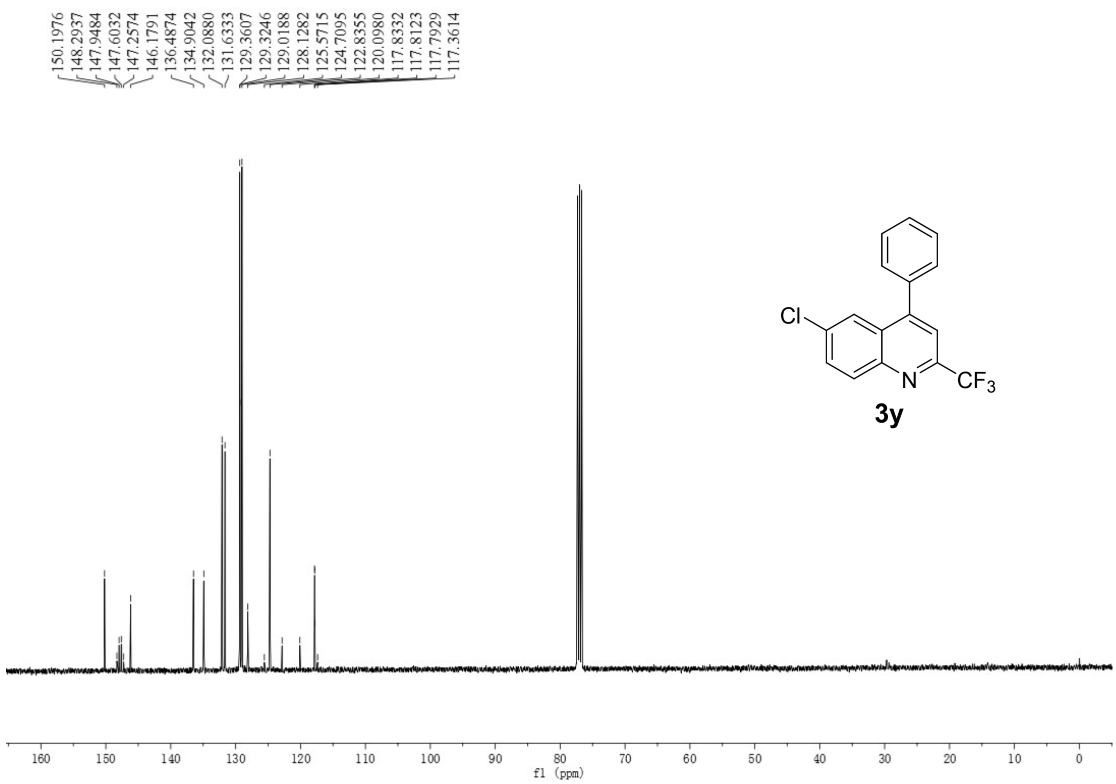

Figure S50. ^{13}C NMR (100 MHz, $CDCl_3$) of compound 3y

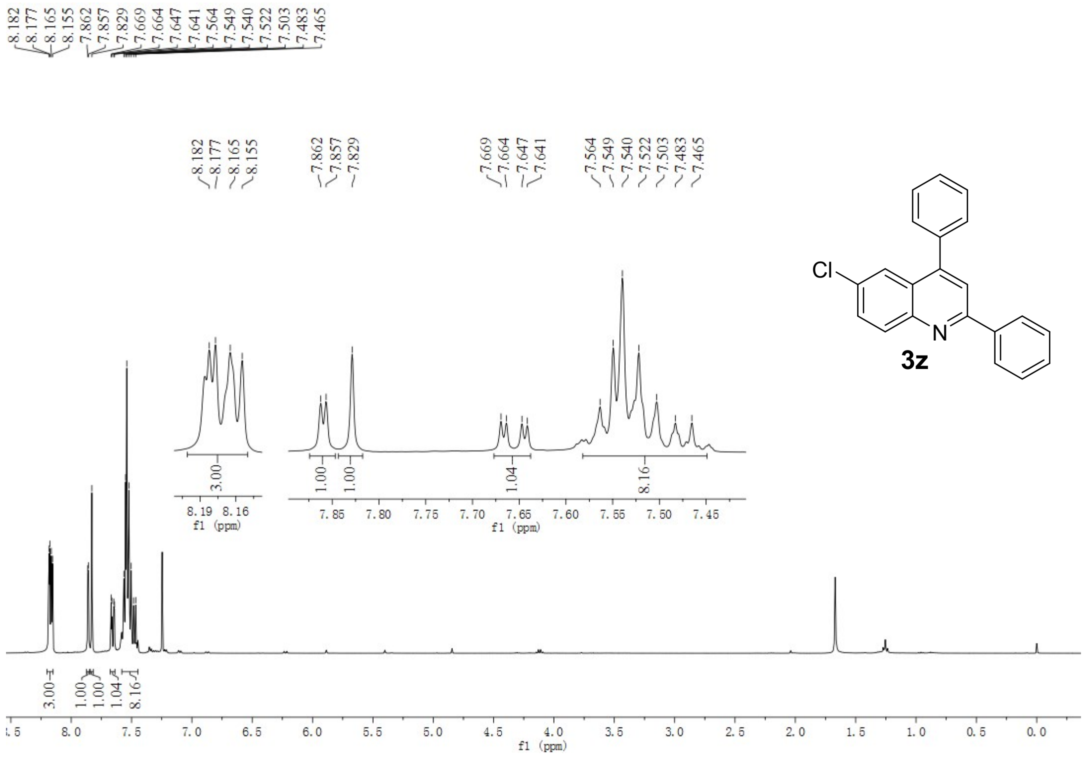

Figure S51. ^{1}H NMR (400 MHz, $CDCl_3$) of compound 3z

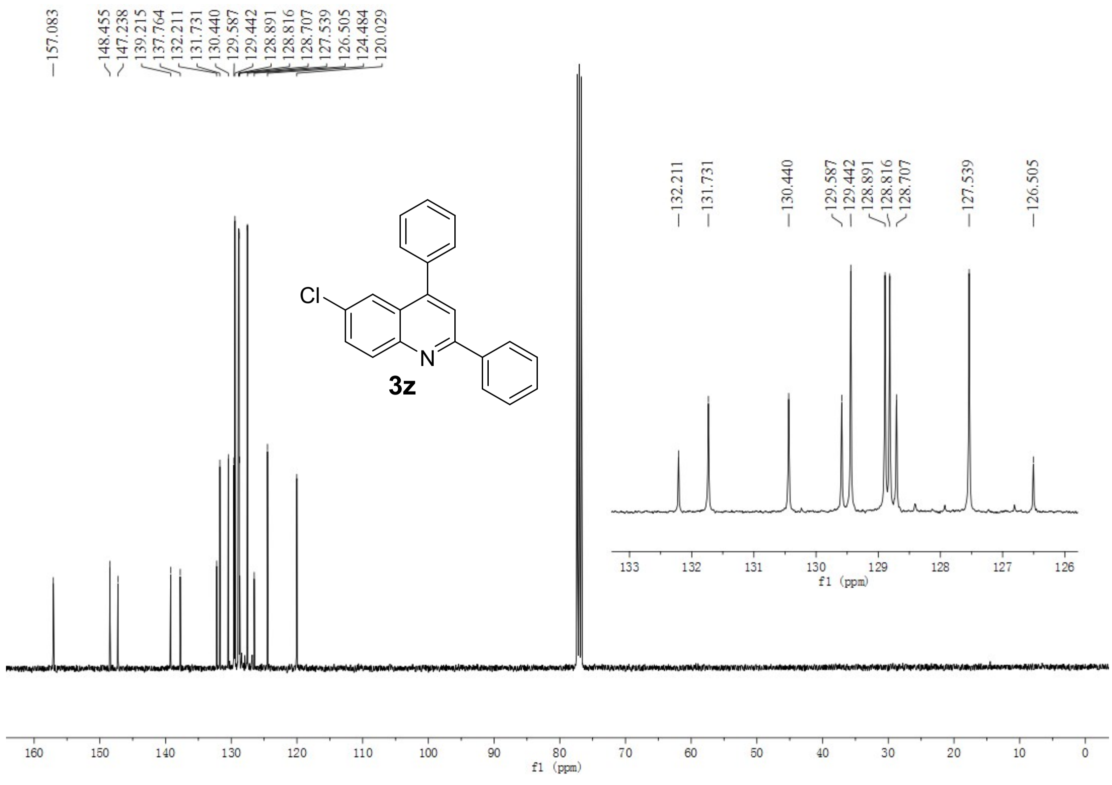

Figure S52. ^{13}C NMR (100 MHz, $CDCl_3$) of compound 3z

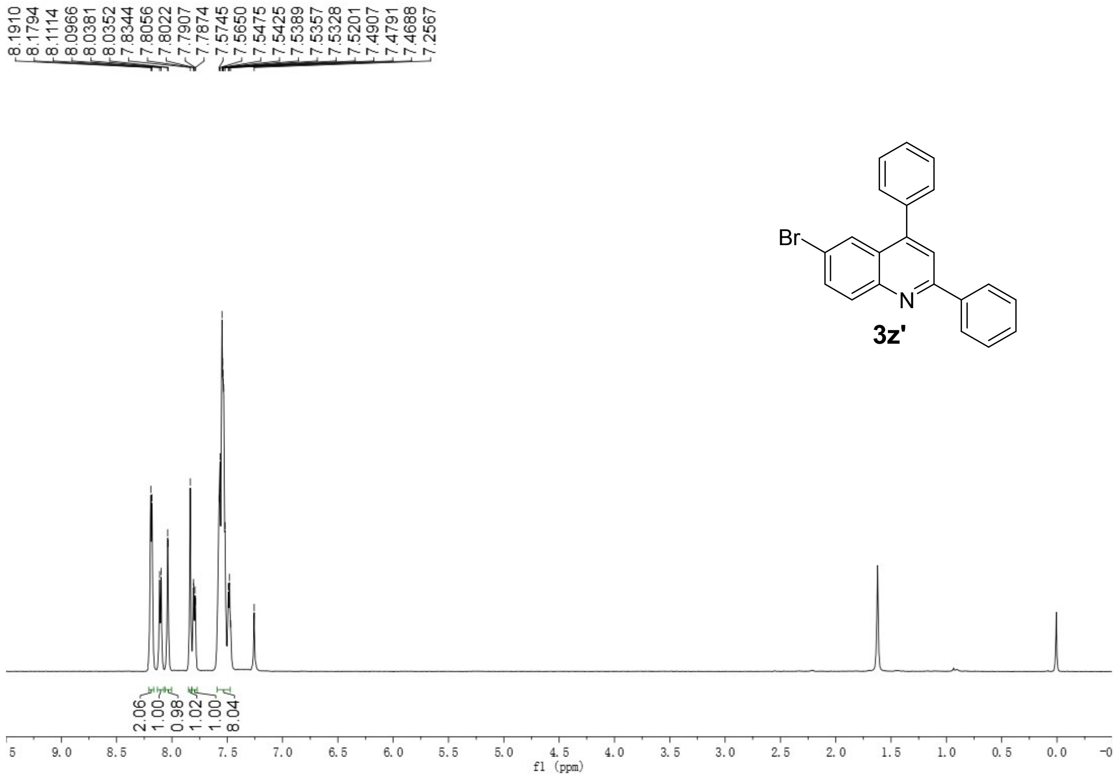

Figure S53. ^{1}H NMR (600 MHz, $CDCl_3$) of compound 3z′

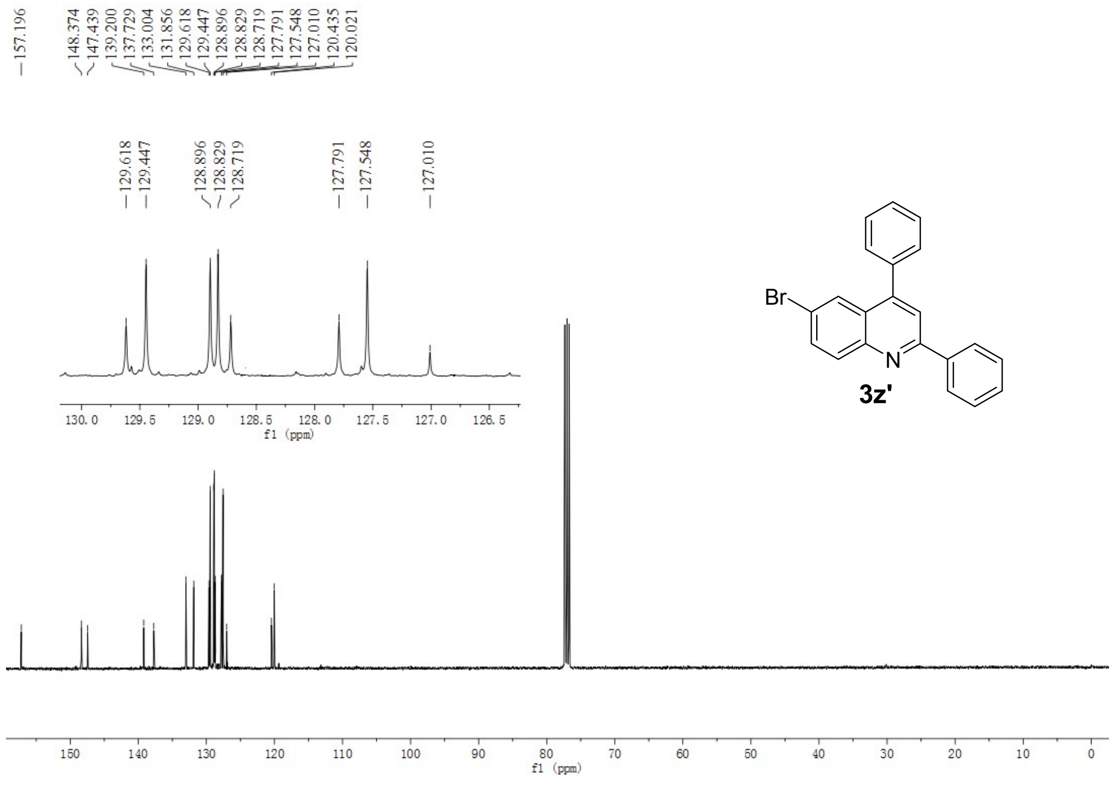

Figure S54. ^{13}C NMR (100 MHz, $CDCl_3$) of compound 3z′

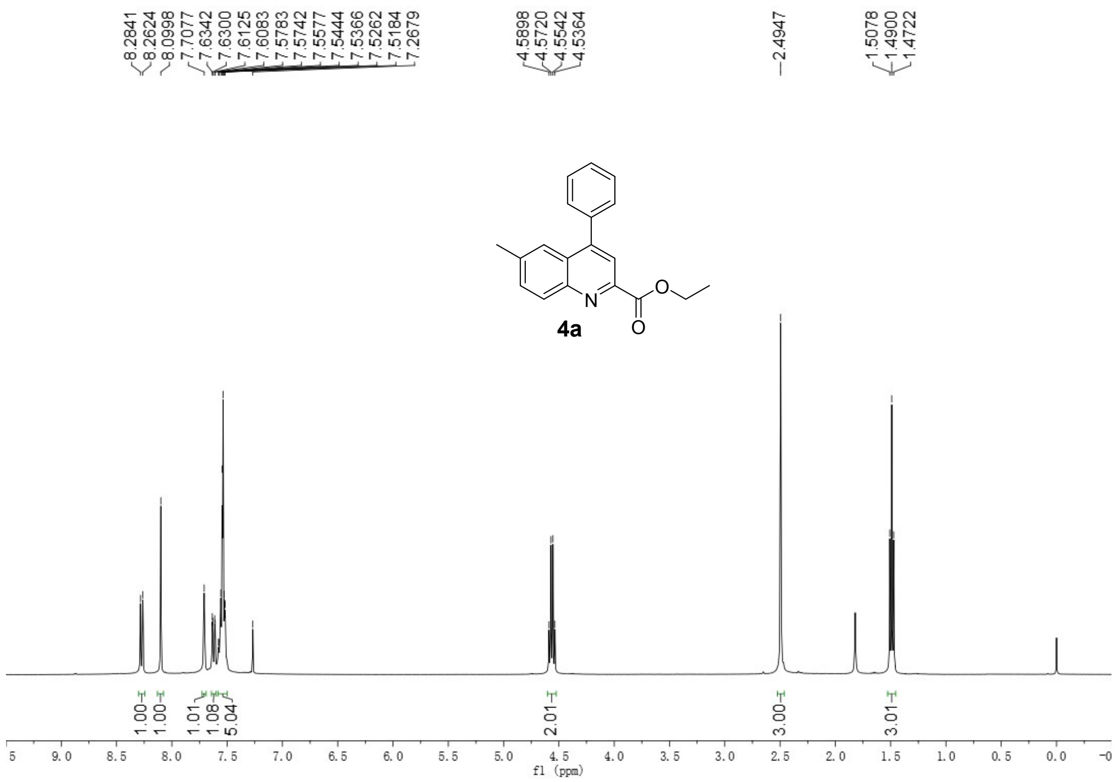

Figure S55. ^{1}H NMR (400 MHz, $CDCl_3$) of compound 4a

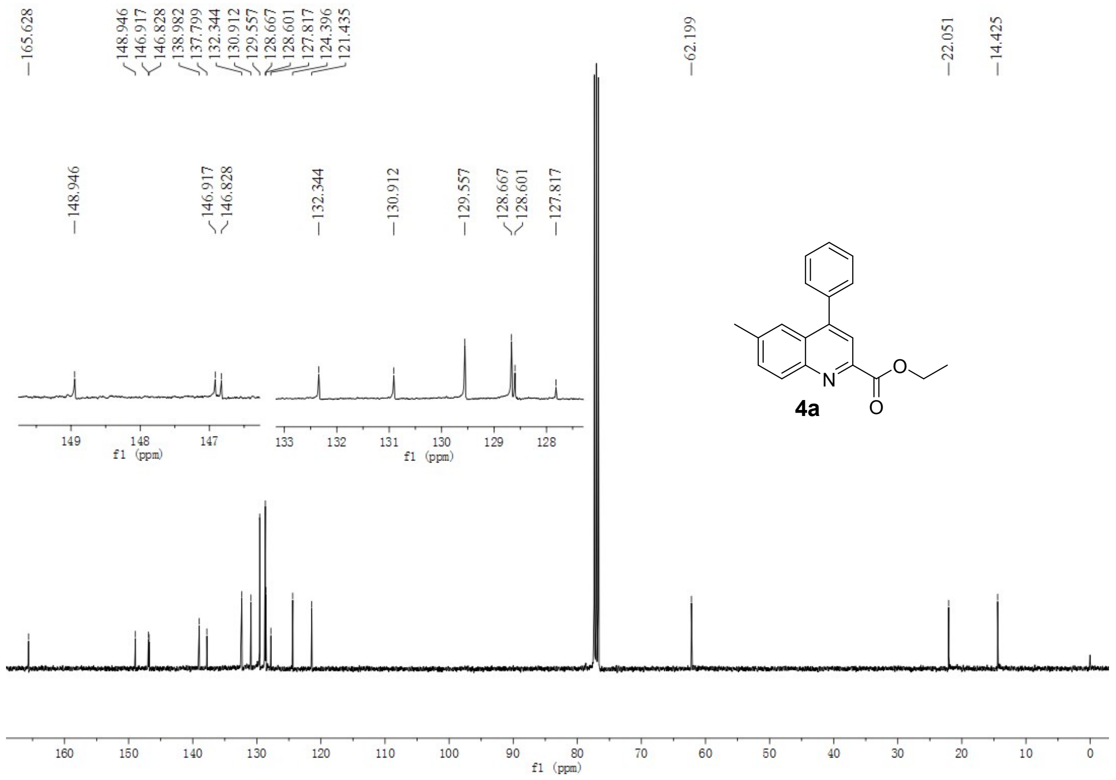

Figure S56. ^{13}C NMR (100 MHz, $CDCl_3$) of compound 4a

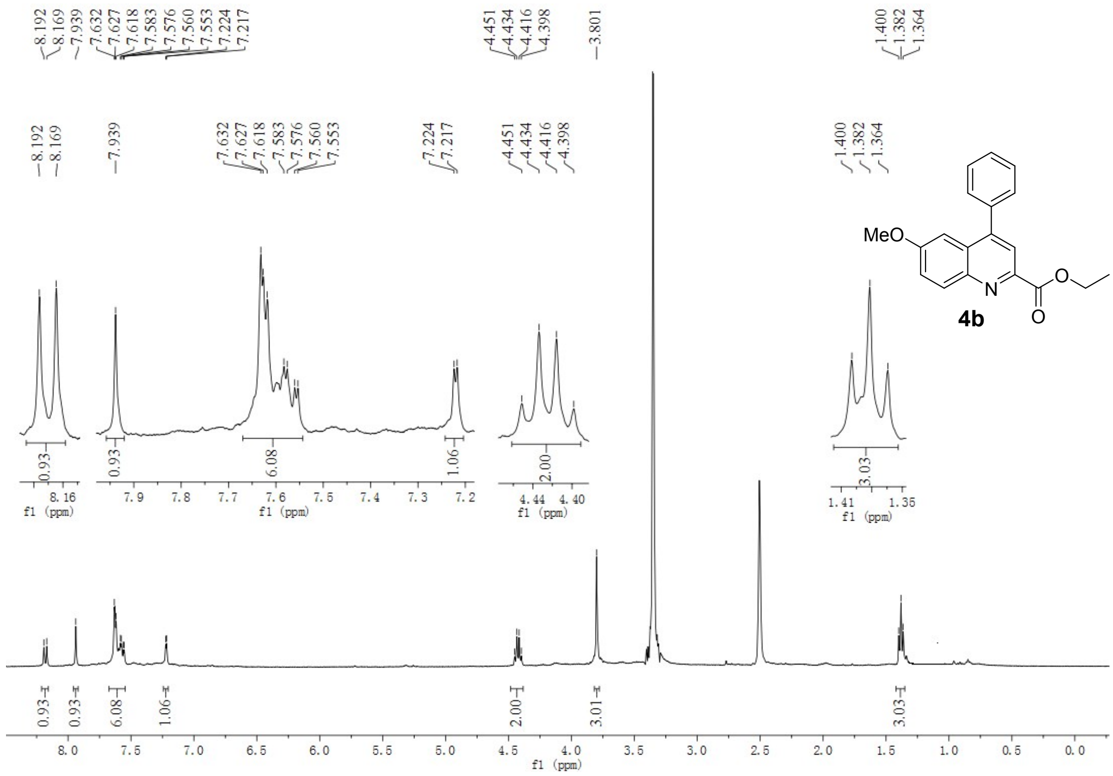

Figure S57. ^{1}H NMR (400 MHz, DMSO-d_6) of compound 4b

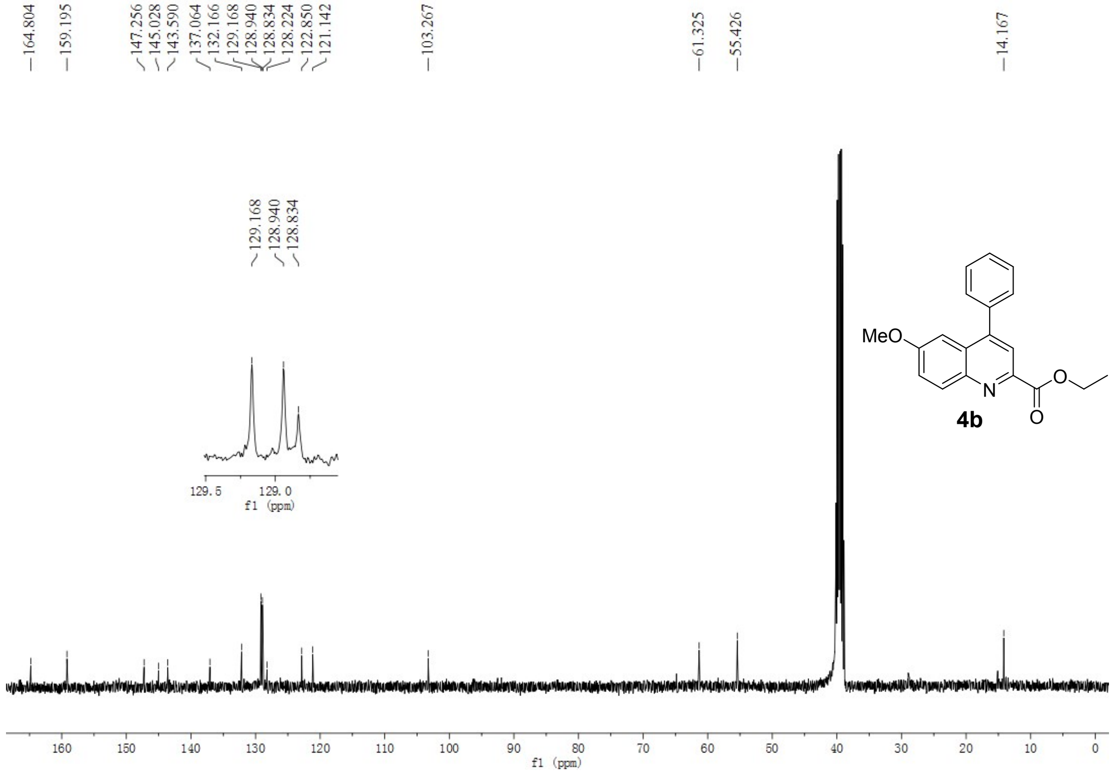

Figure S58. ^{13}C NMR (100 MHz, DMSO-d_6) of compound 4b

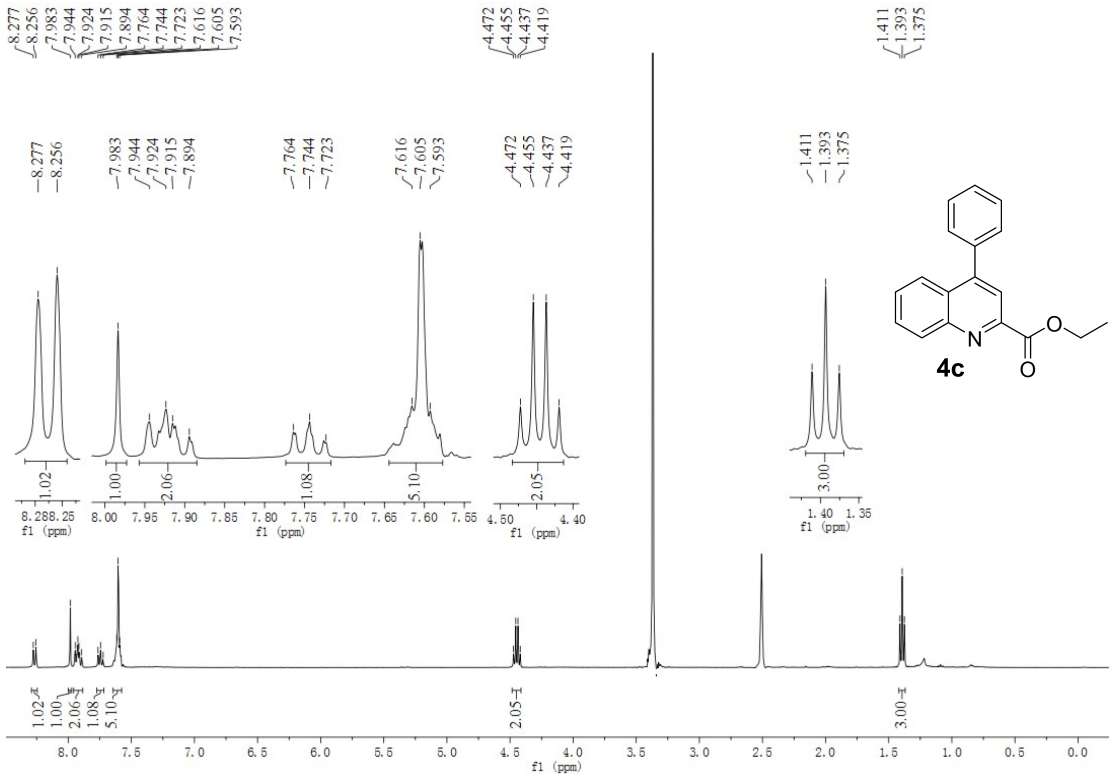

Figure S59. ^{1}H NMR (400 MHz, DMSO-d_6) of compound 4c

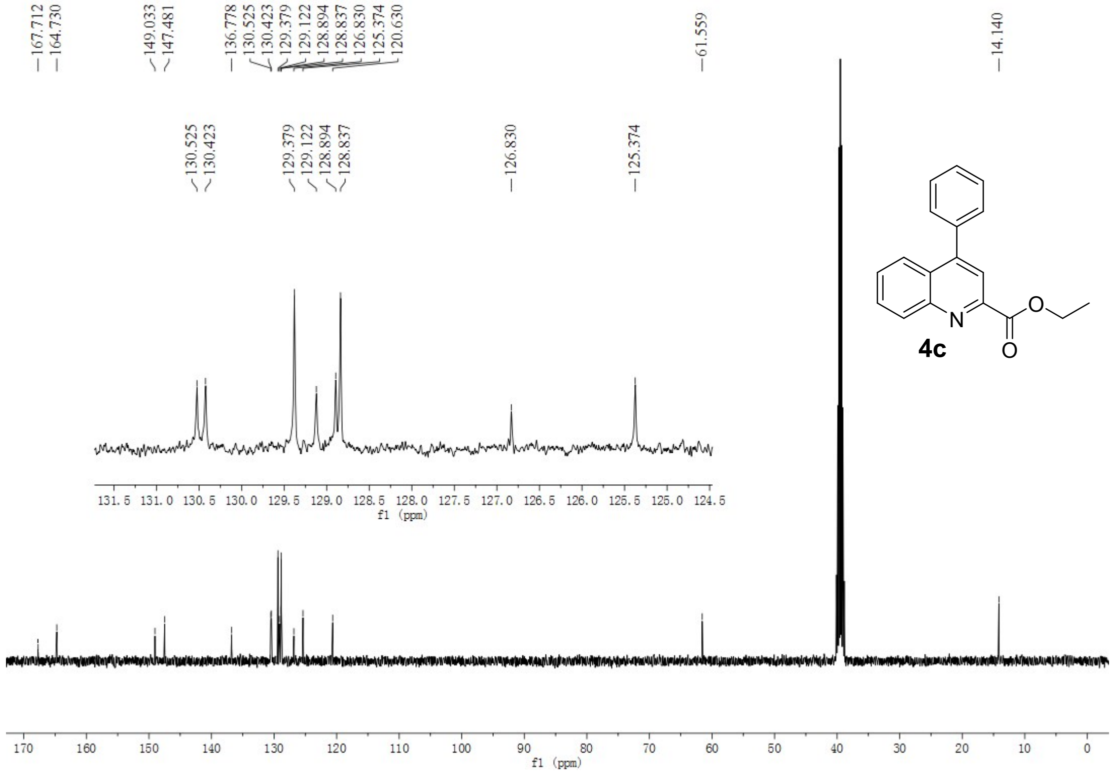

Figure S60. ^{13}C NMR (100 MHz, DMSO-d_6) of compound 4c

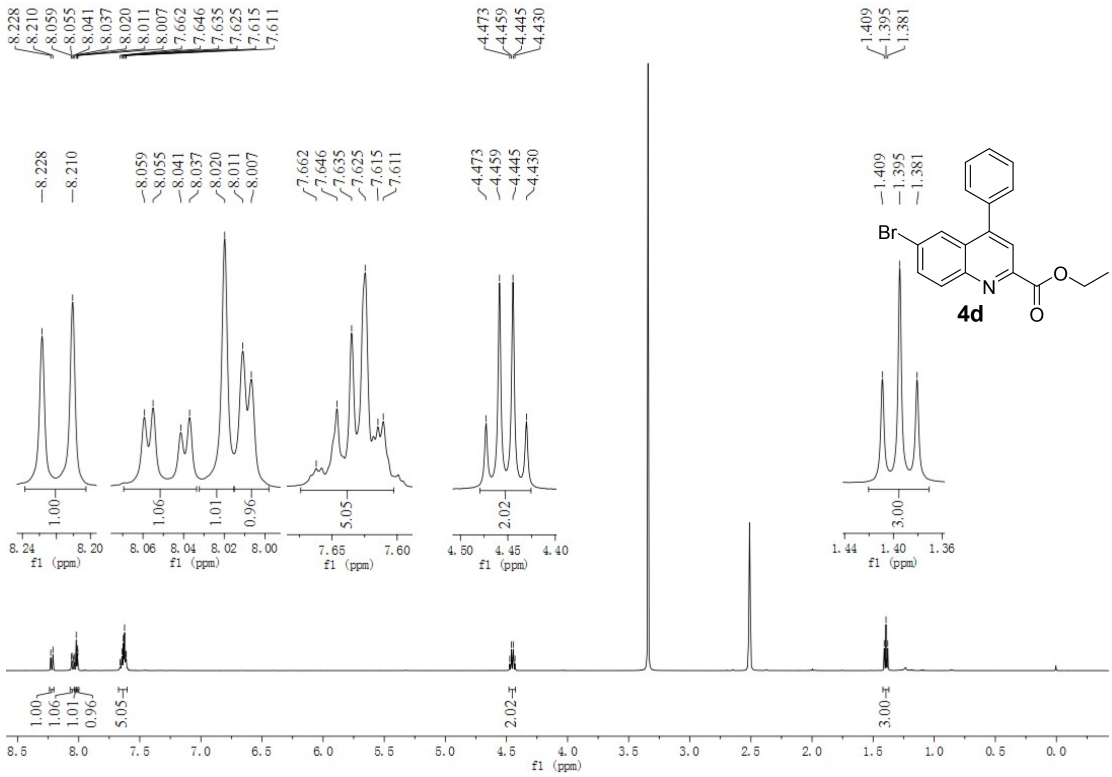

Figure S61. ^{1}H NMR (500 MHz, DMSO-d_6) of compound 4d

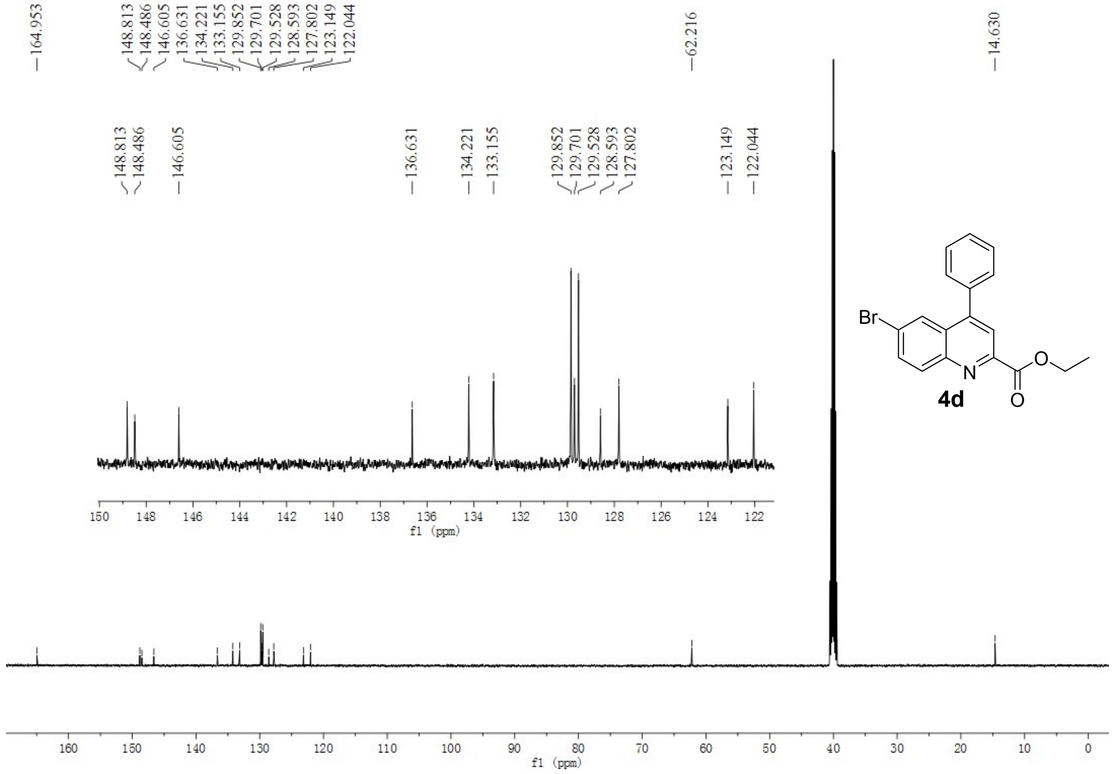

Figure S62. ^{13}C NMR (125 MHz, DMSO-d_6) of compound 4d

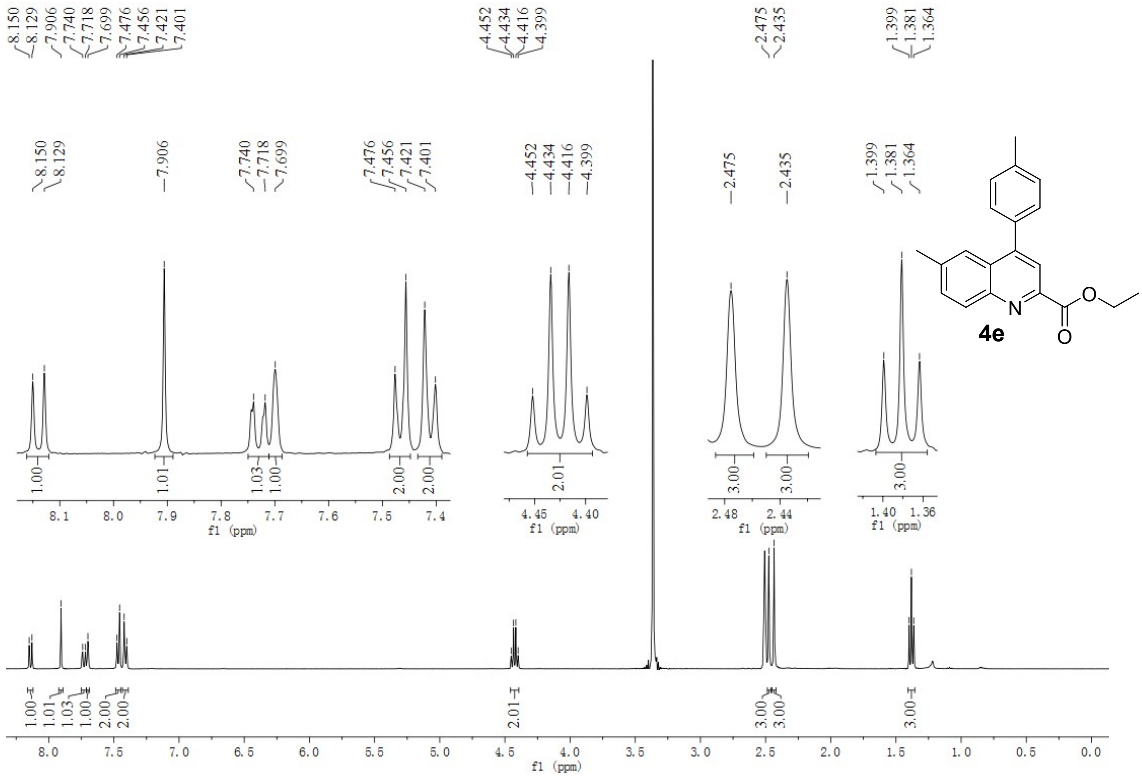

Figure S63. ^{1}H NMR (400 MHz, DMSO-d_6) of compound 4e

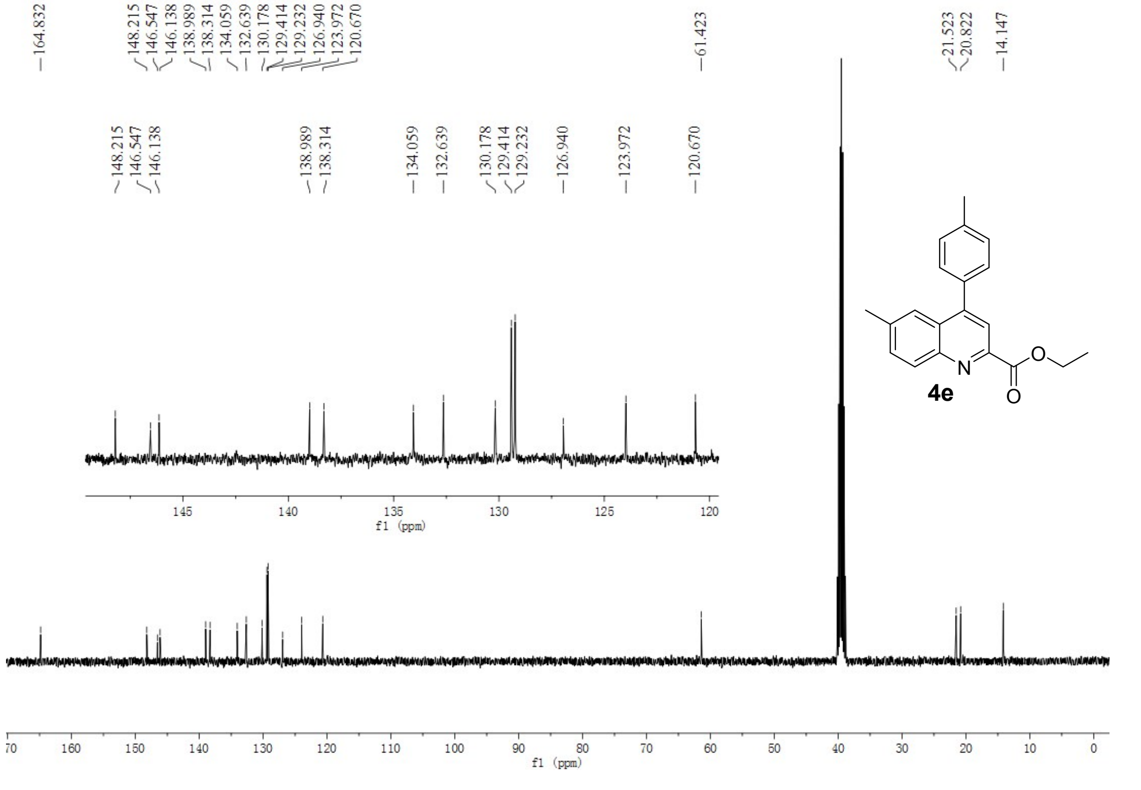

Figure S64. ^{13}C NMR (100 MHz, DMSO-d_6) of compound 4e

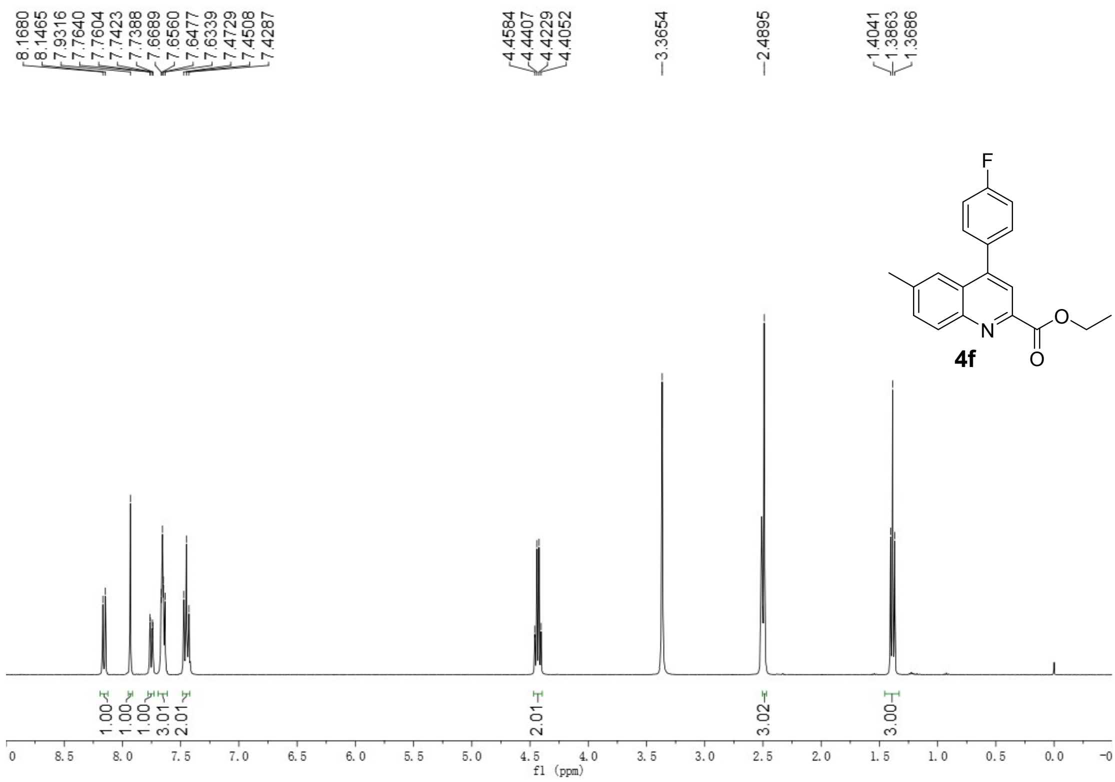

Figure S65. ¹H NMR (400 MHz, DMSO-*d₆*) of compound 4f

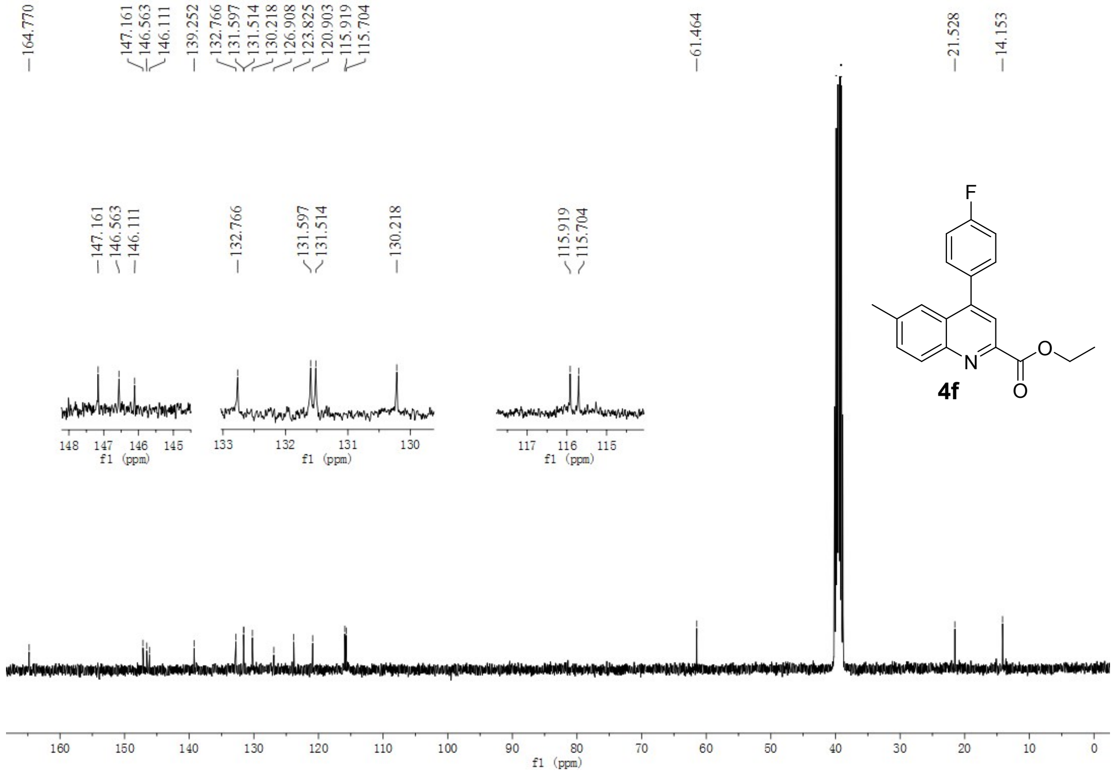

Figure S66. ¹³C NMR (100 MHz, DMSO-*d₆*) of compound 4f

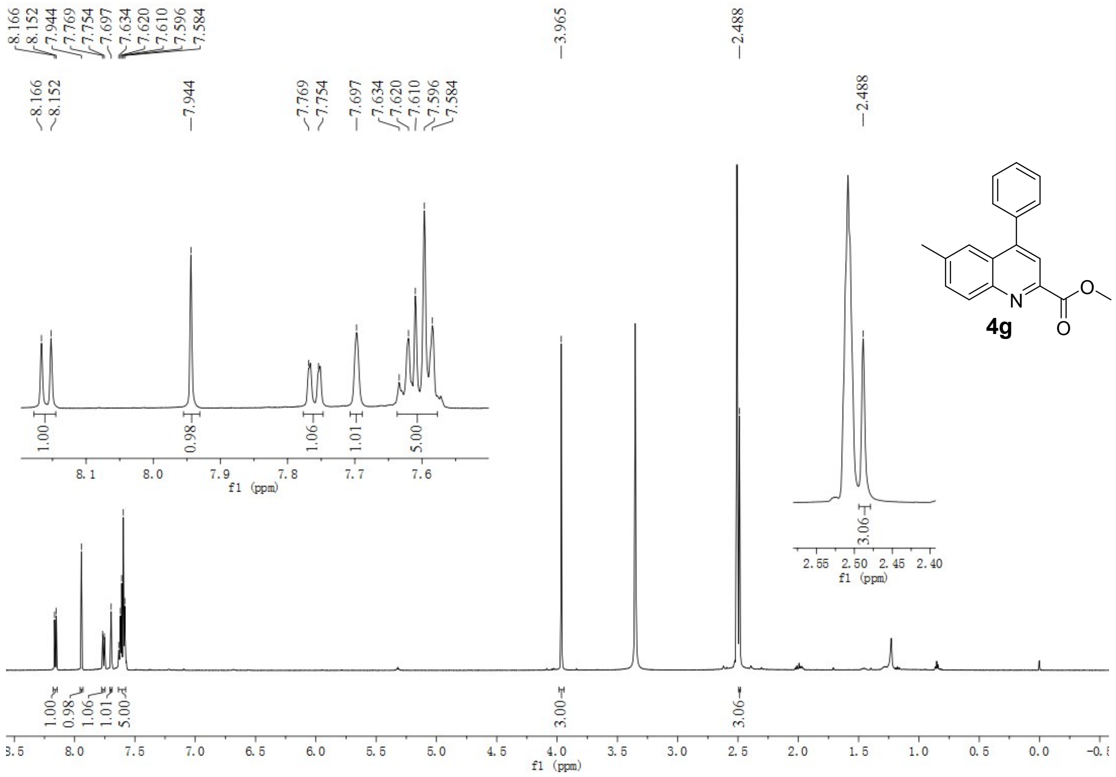

Figure S67. ^{1}H NMR (600 MHz, DMSO-d_6) of compound 4g

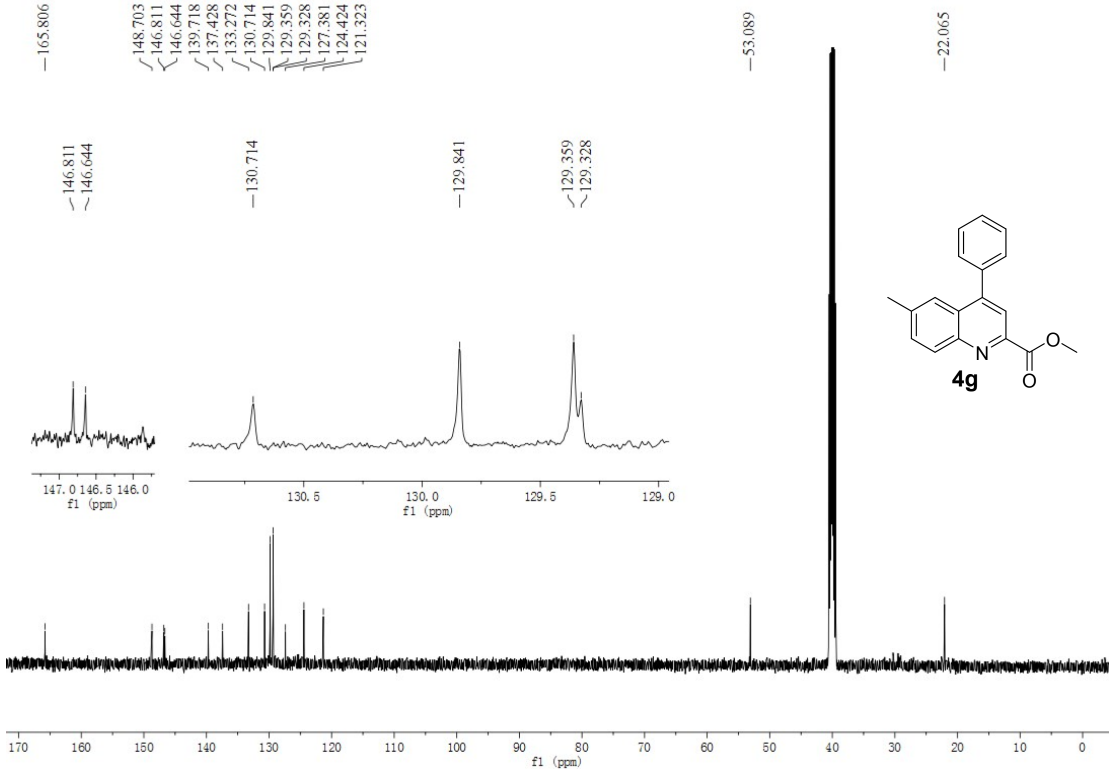

Figure S68. ^{13}C NMR (150 MHz, DMSO-d_6) of compound 4g

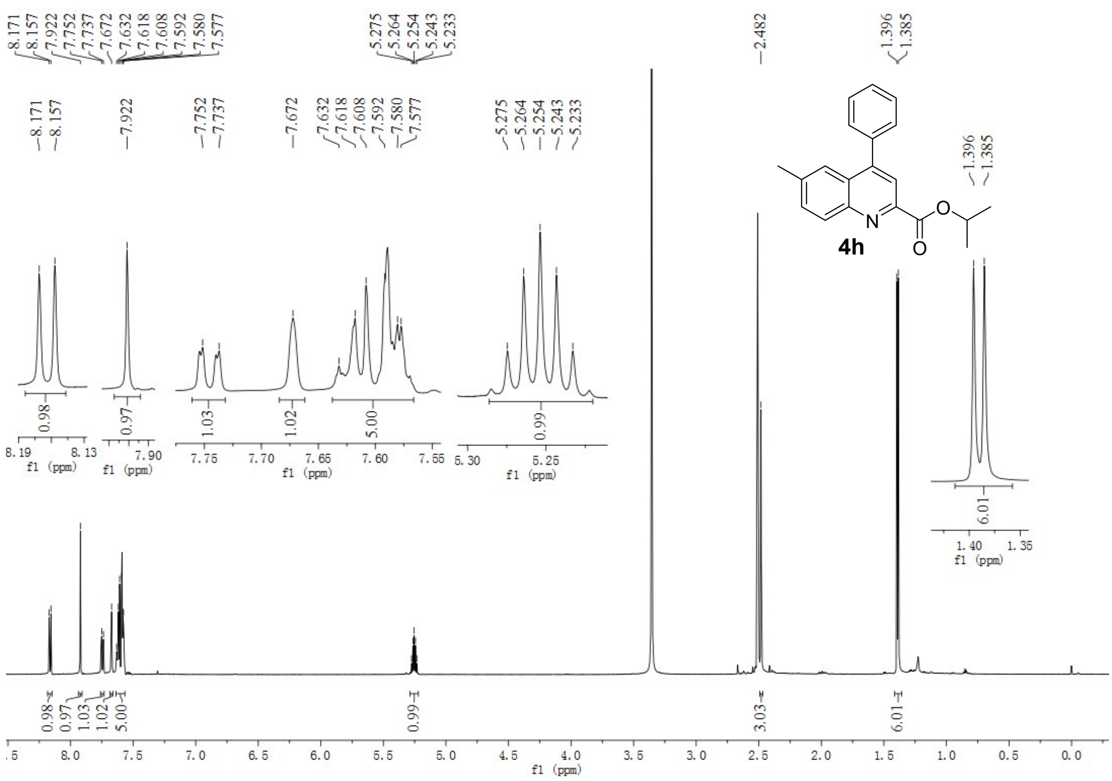

Figure S69. ^{1}H NMR (600 MHz, DMSO-d_6) of compound 4h

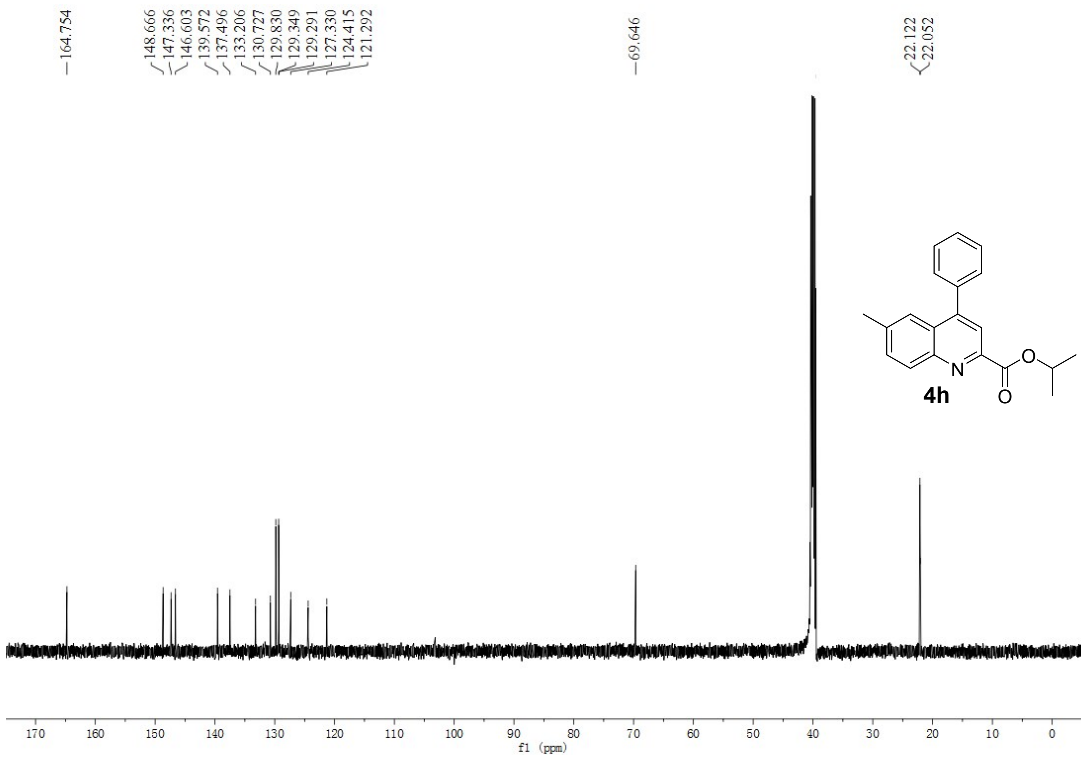

Figure S70. ^{13}C NMR (150 MHz, DMSO-d_6) of compound 4h

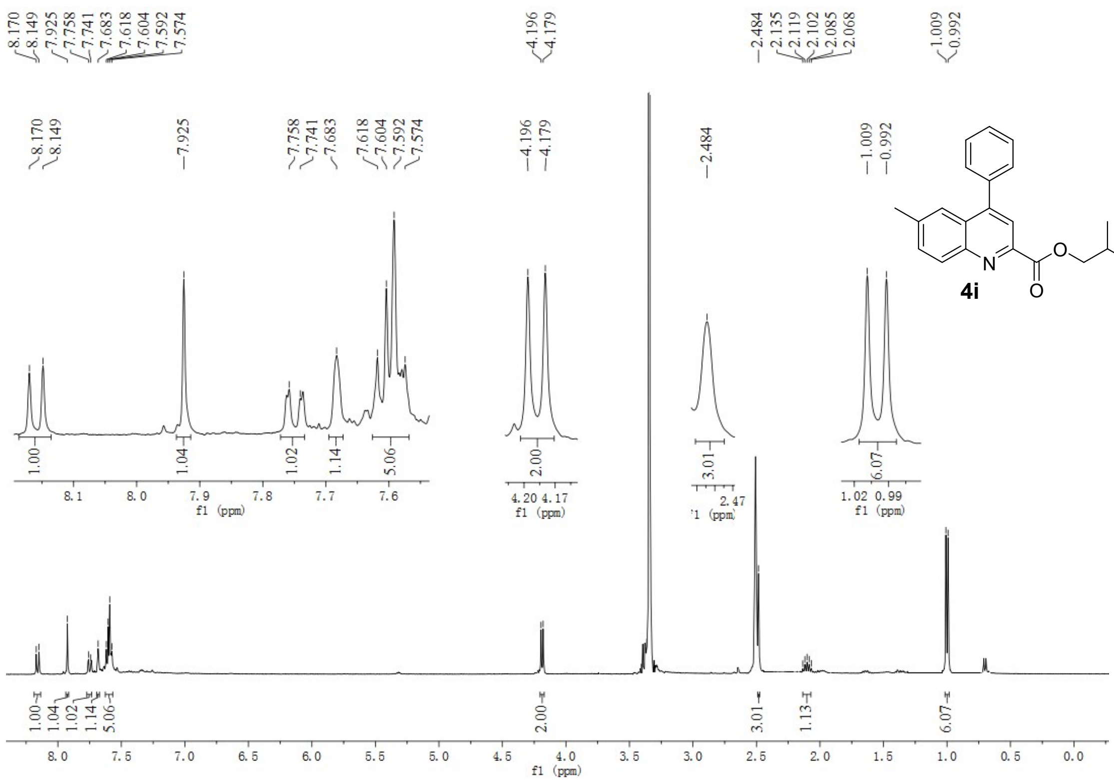

Figure S71. ^{1}H NMR (400 MHz, DMSO-d_6) of compound 4i

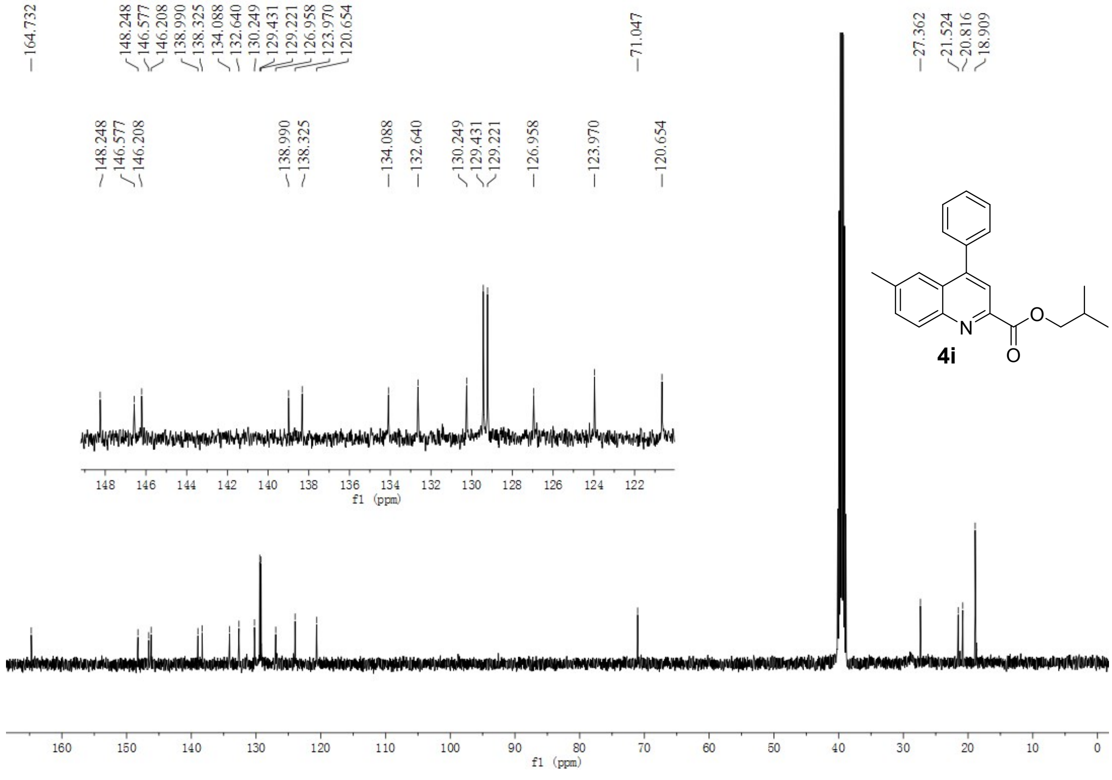

Figure S72. ^{13}C NMR (100 MHz, DMSO-d_6) of compound 4i

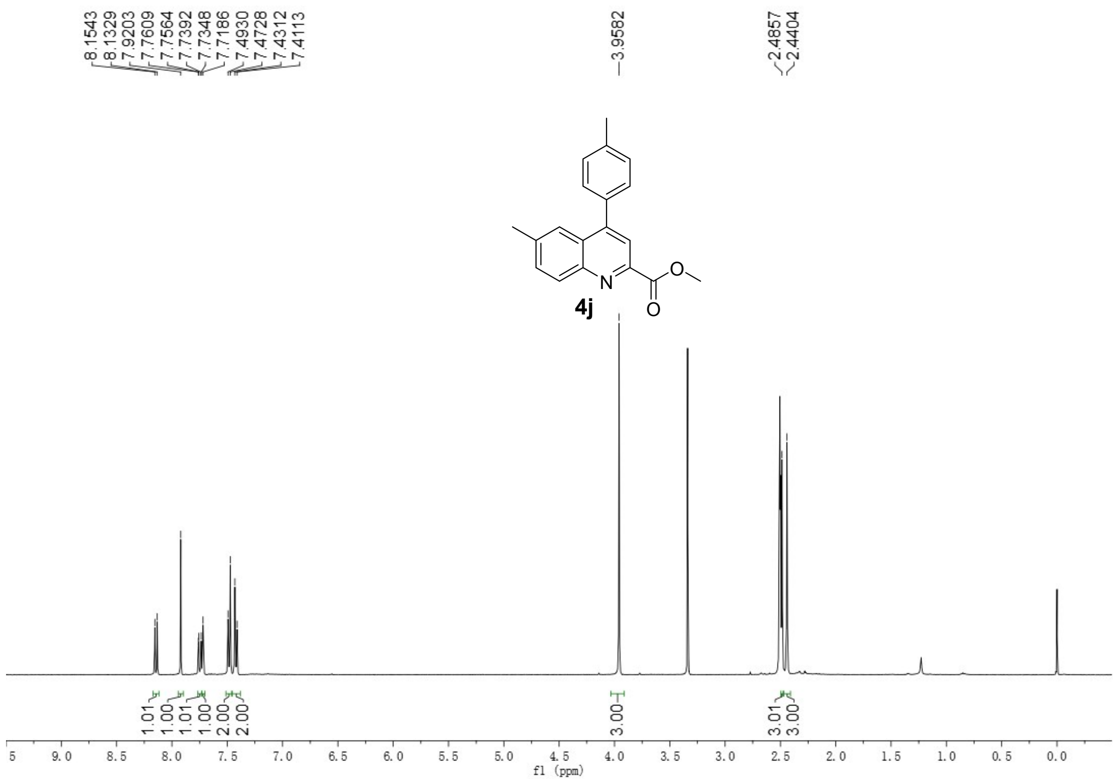

Figure S73. ^{1}H NMR (400 MHz, DMSO-d_6) of compound 4j

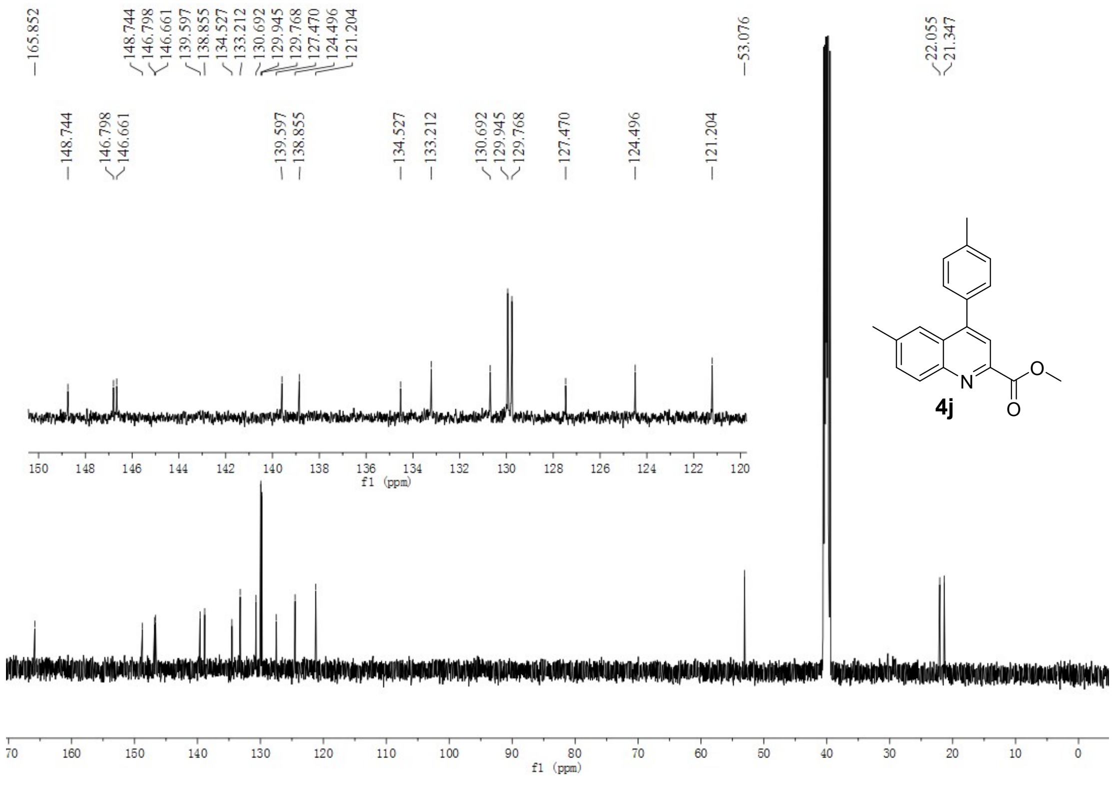

Figure S74. ^{13}C NMR (125 MHz, DMSO-d_6) of compound 4j

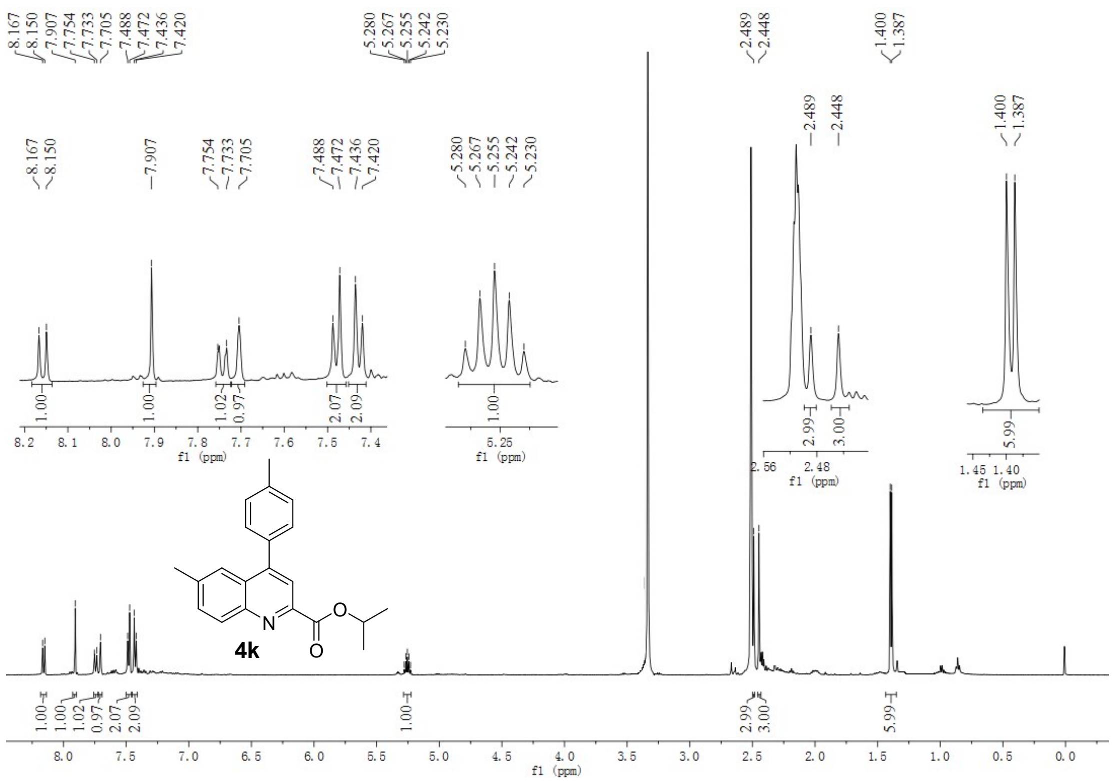

Figure S75. ^{1}H NMR (500 MHz, DMSO-d_6) of compound 4k

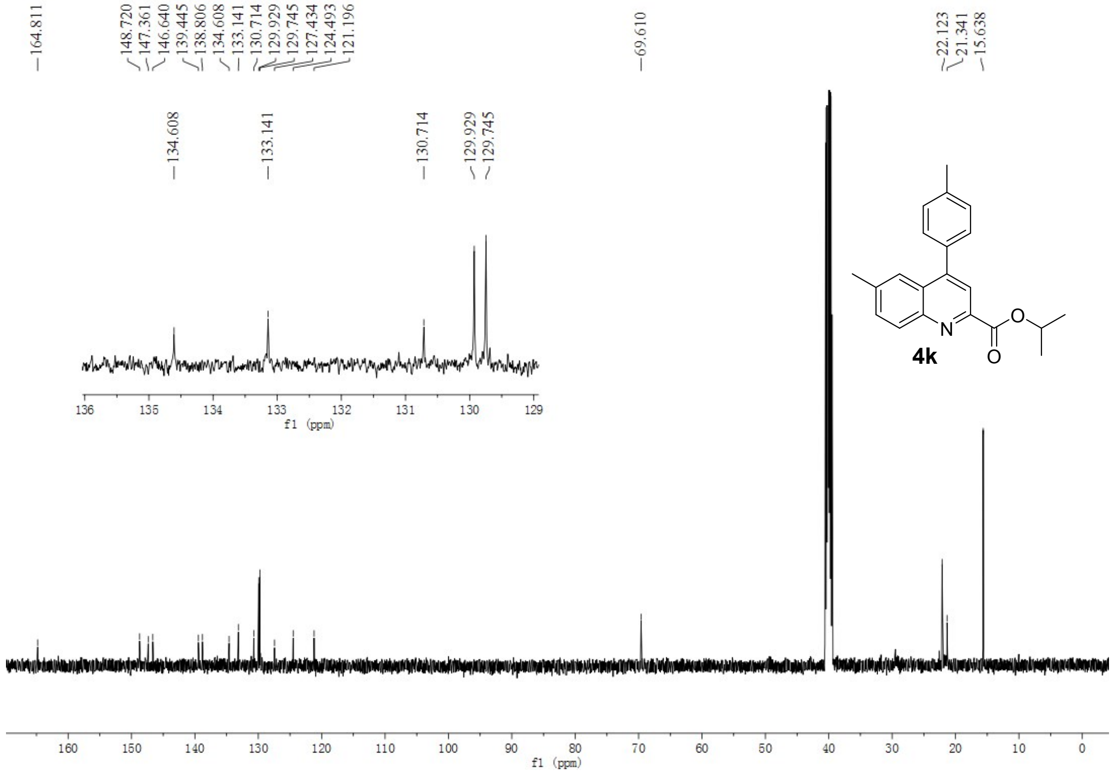

Figure S76. ^{13}C NMR (125 MHz, DMSO-d_6) of compound 4k

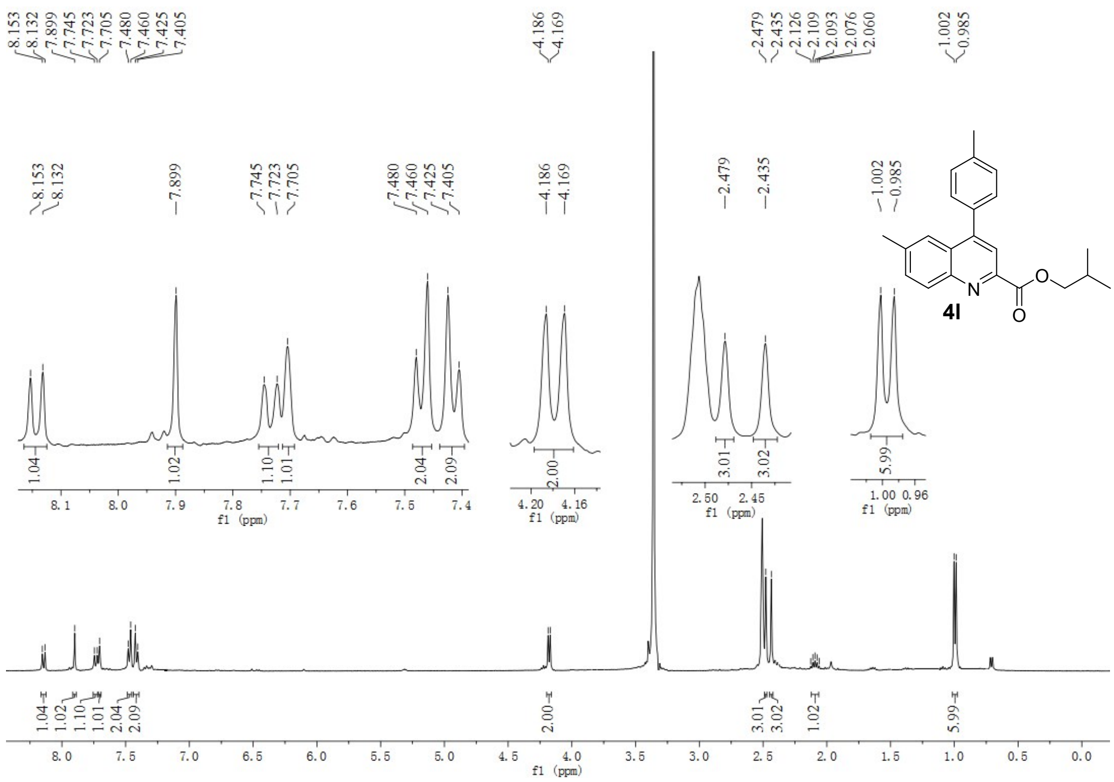

Figure S77. ^{1}H NMR (400 MHz, DMSO-d_6) of compound 4l

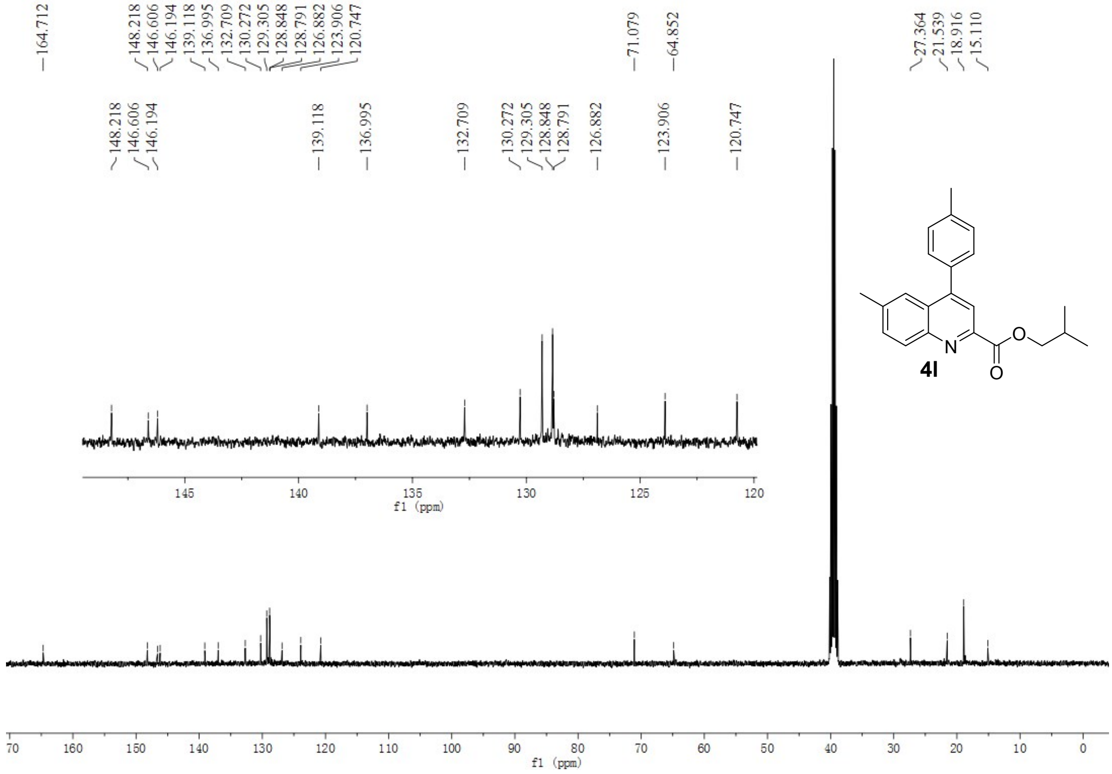

Figure S78. ^{13}C NMR (100 MHz, DMSO-d_6) of compound 4l

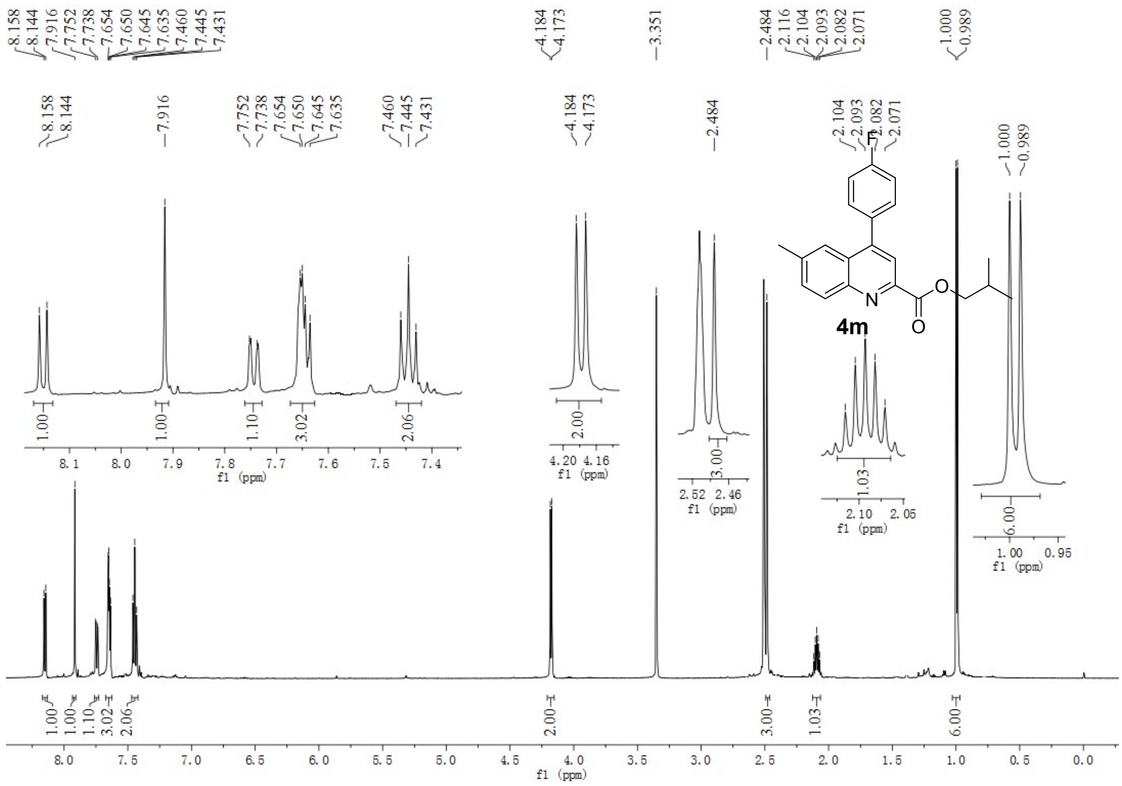

Figure S79. ^{1}H NMR (600 MHz, DMSO-d_6) of compound 4m

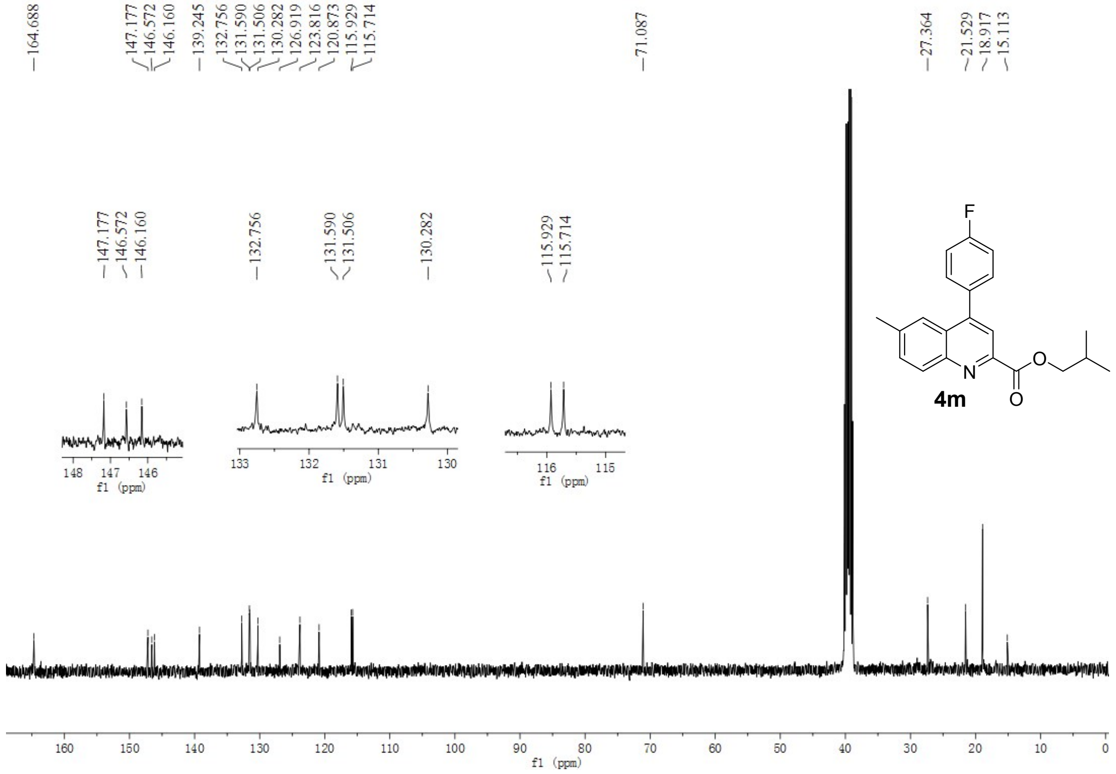

Figure S80. ^{13}C NMR (150 MHz, DMSO-d_6) of compound 4m

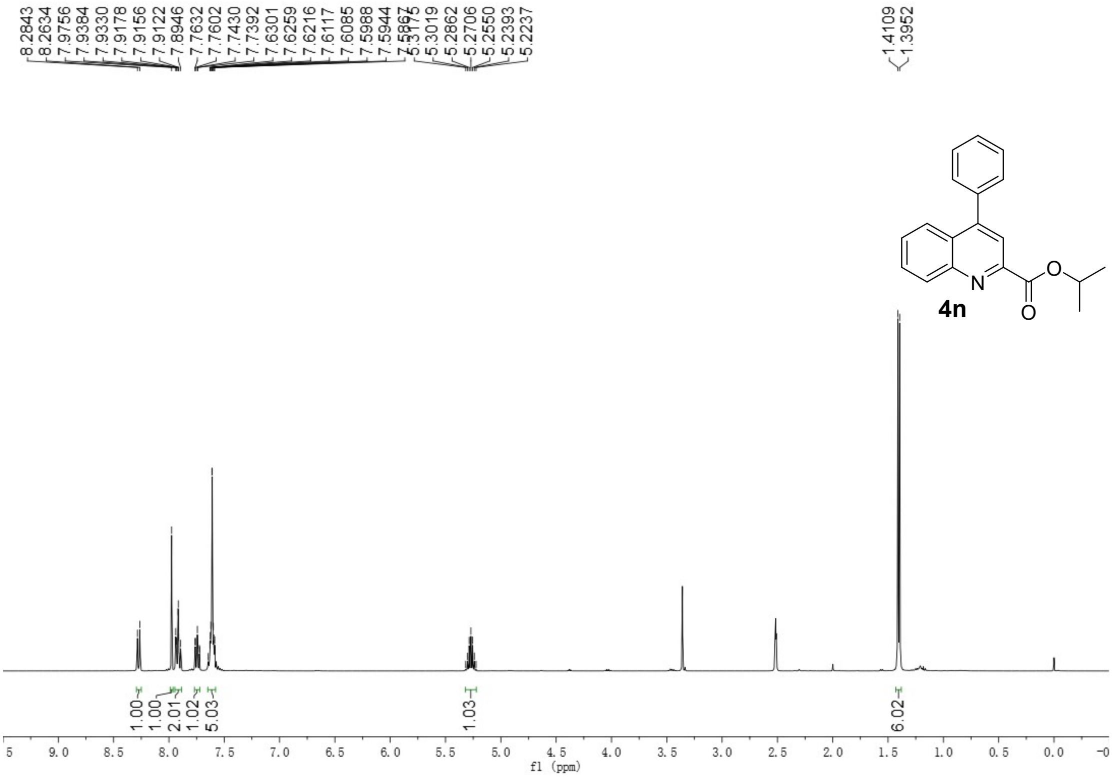

Figure S81. ^{1}H NMR (400 MHz, DMSO-d_6) of compound 4n

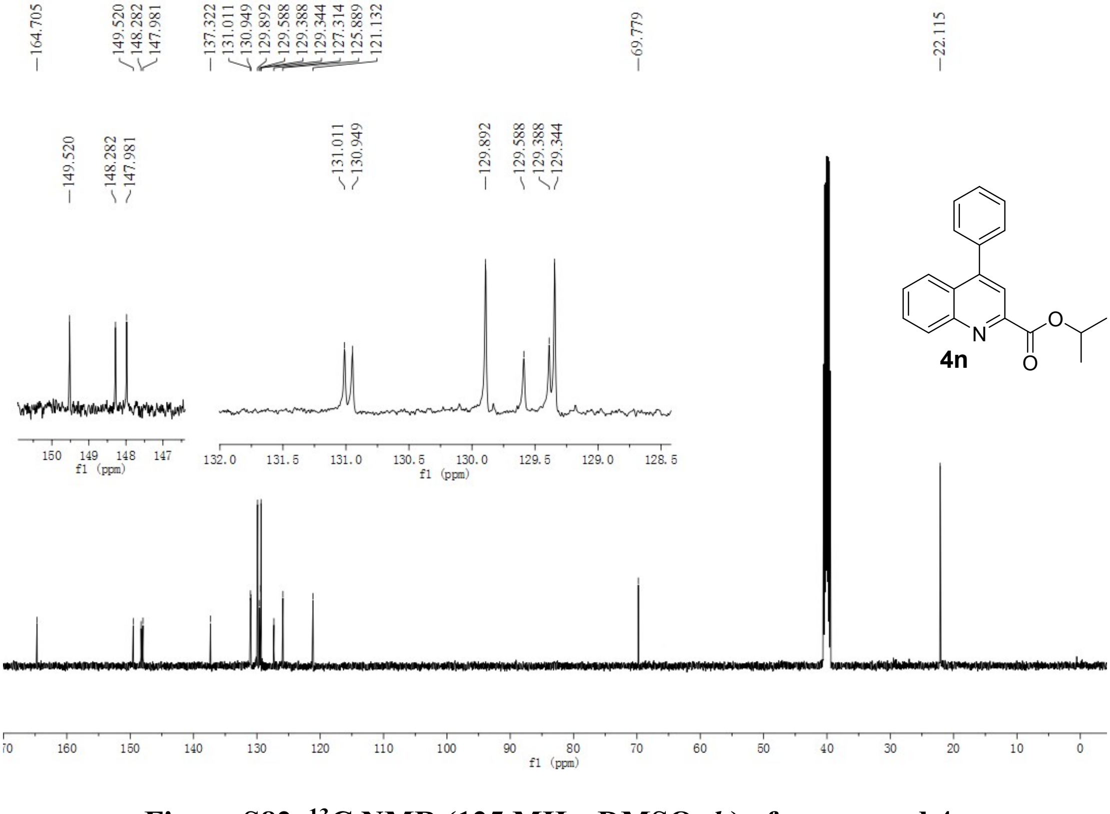

Figure S82. ^{13}C NMR (125 MHz, DMSO-d_6) of compound 4n

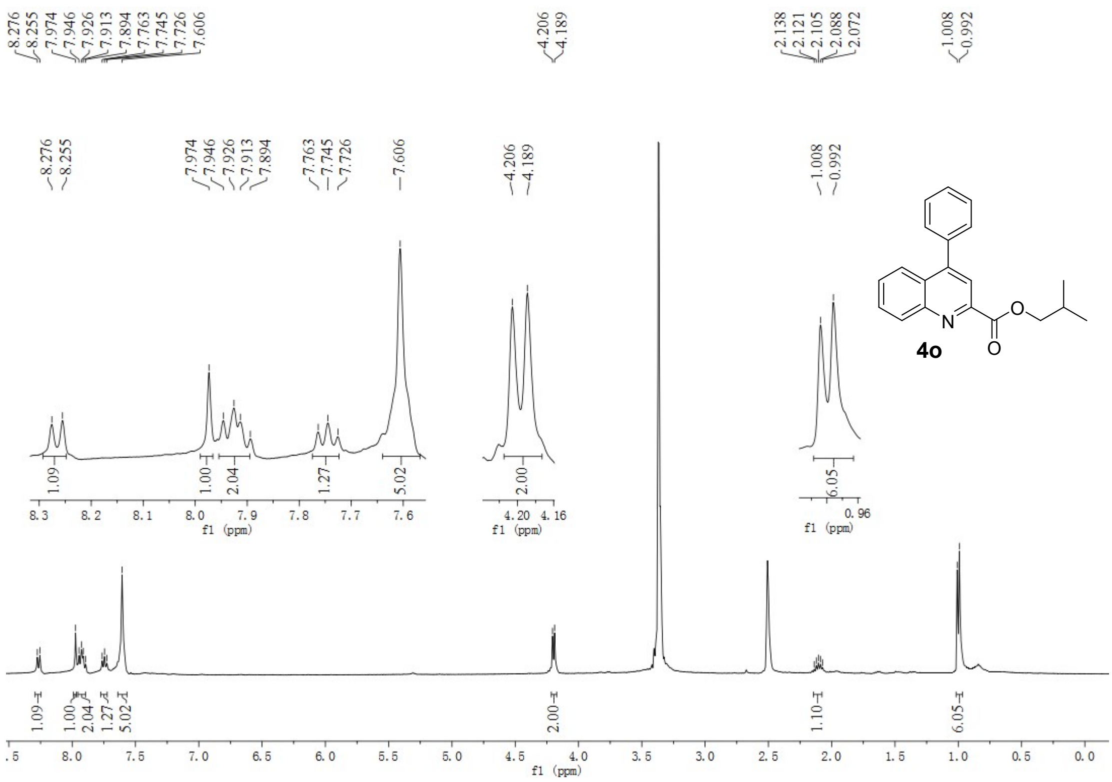

Figure S83. ^{1}H NMR (400 MHz, DMSO-d_6) of compound 4o

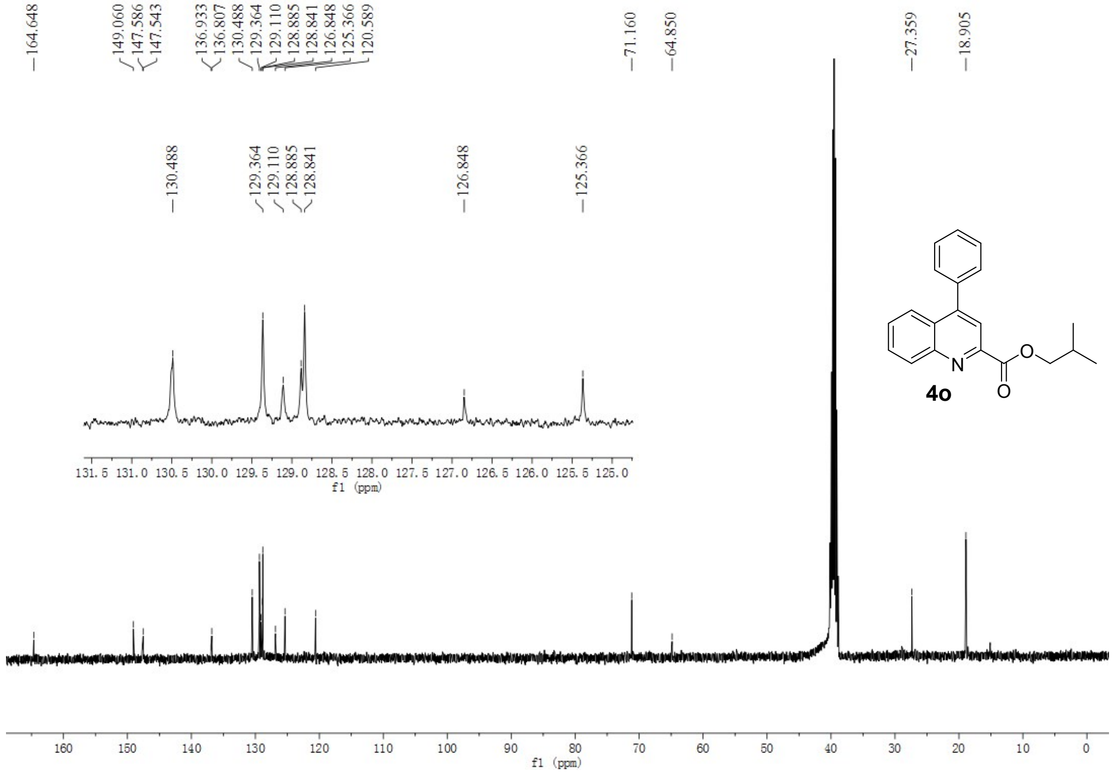

Figure S84. ^{13}C NMR (100 MHz, DMSO-d_6) of compound 4o

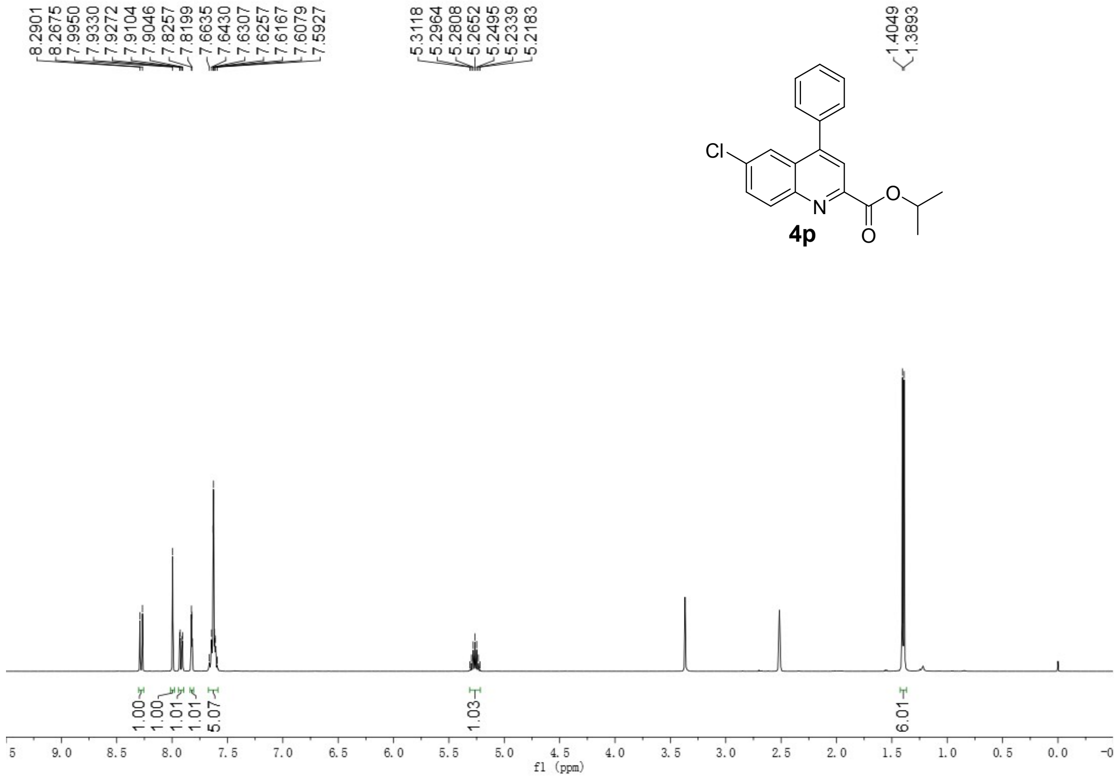

Figure S85. ^{1}H NMR (400 MHz, DMSO-d_6) of compound 4p

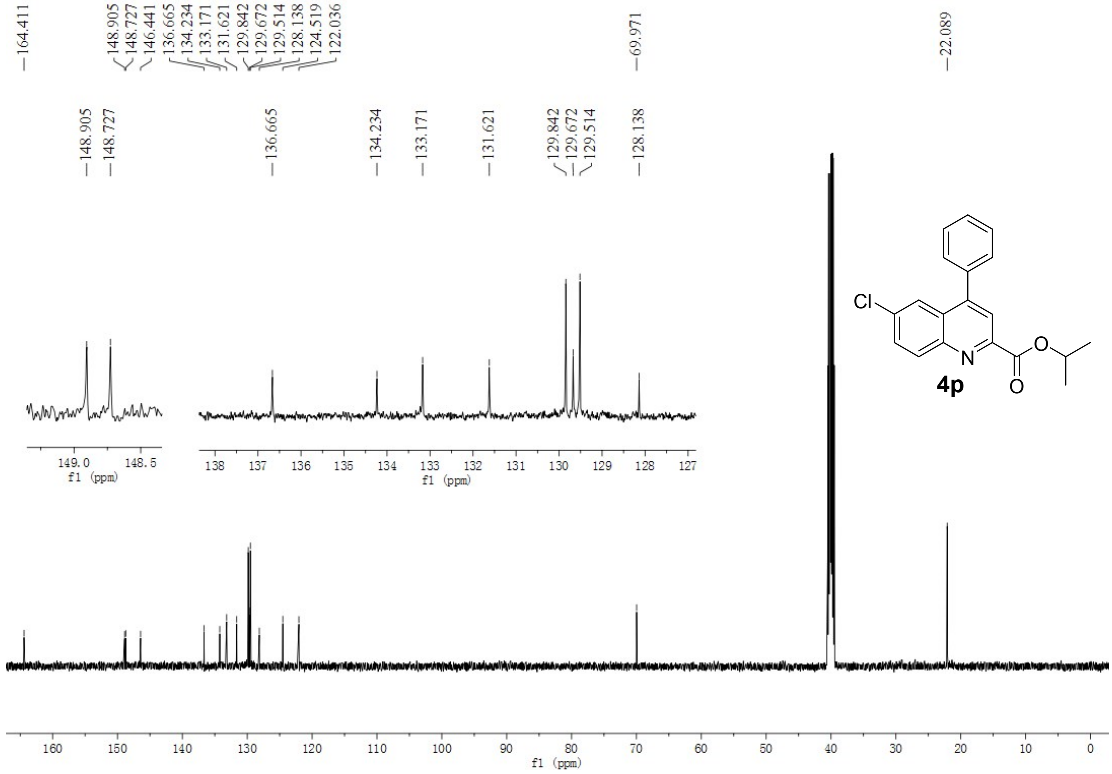

Figure S86. ^{13}C NMR (125 MHz, DMSO-d_6) of compound 4p

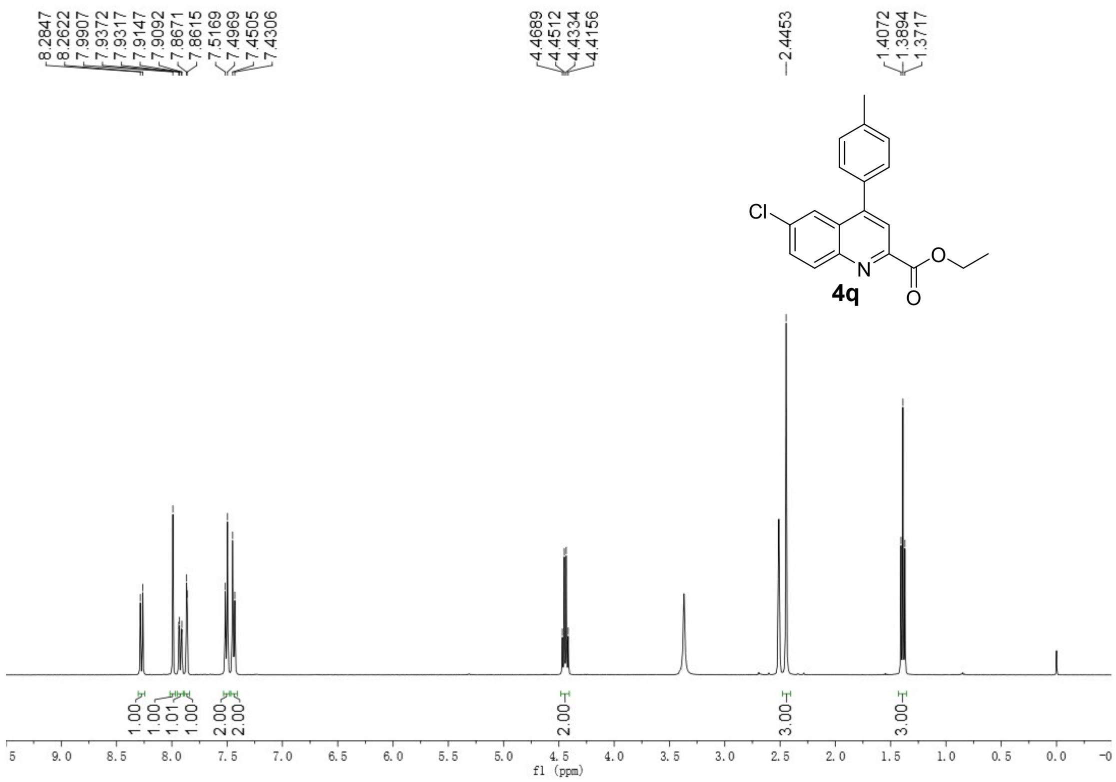

Figure S87. ^{1}H NMR (400 MHz, DMSO-d_6) of compound 4q

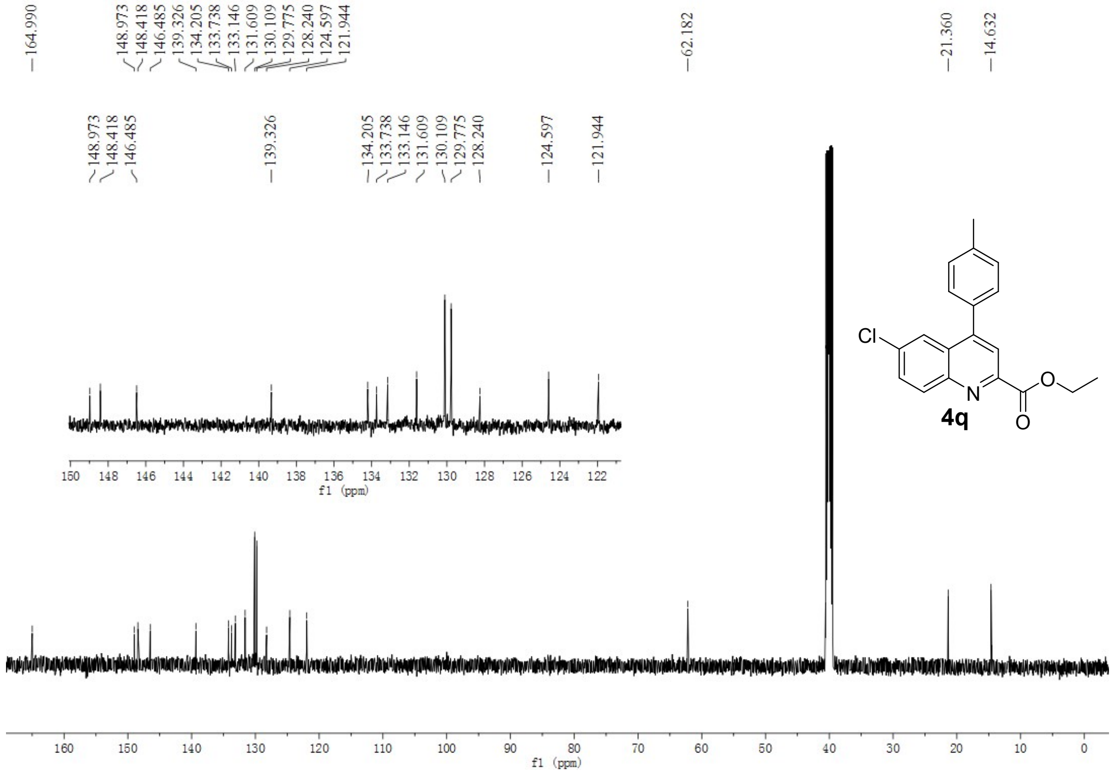

Figure S88. ^{13}C NMR (125 MHz, DMSO-d_6) of compound 4q

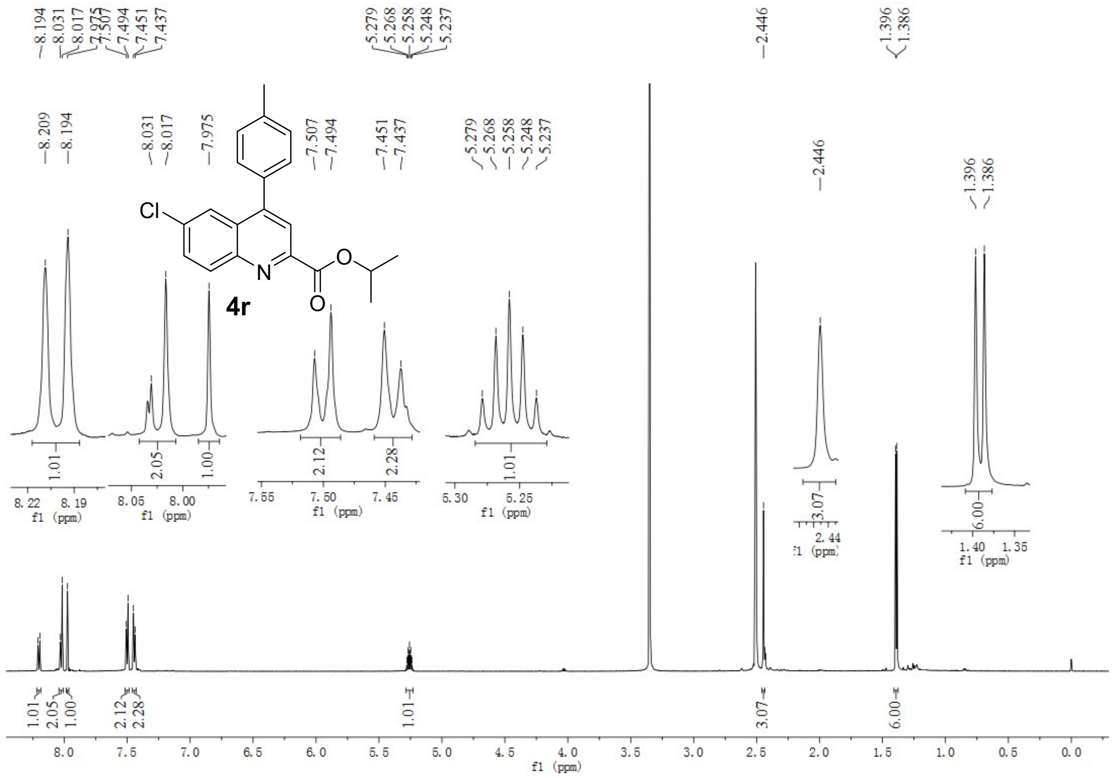

Figure S89. ^{1}H NMR (600 MHz, DMSO-d_6) of compound 4r

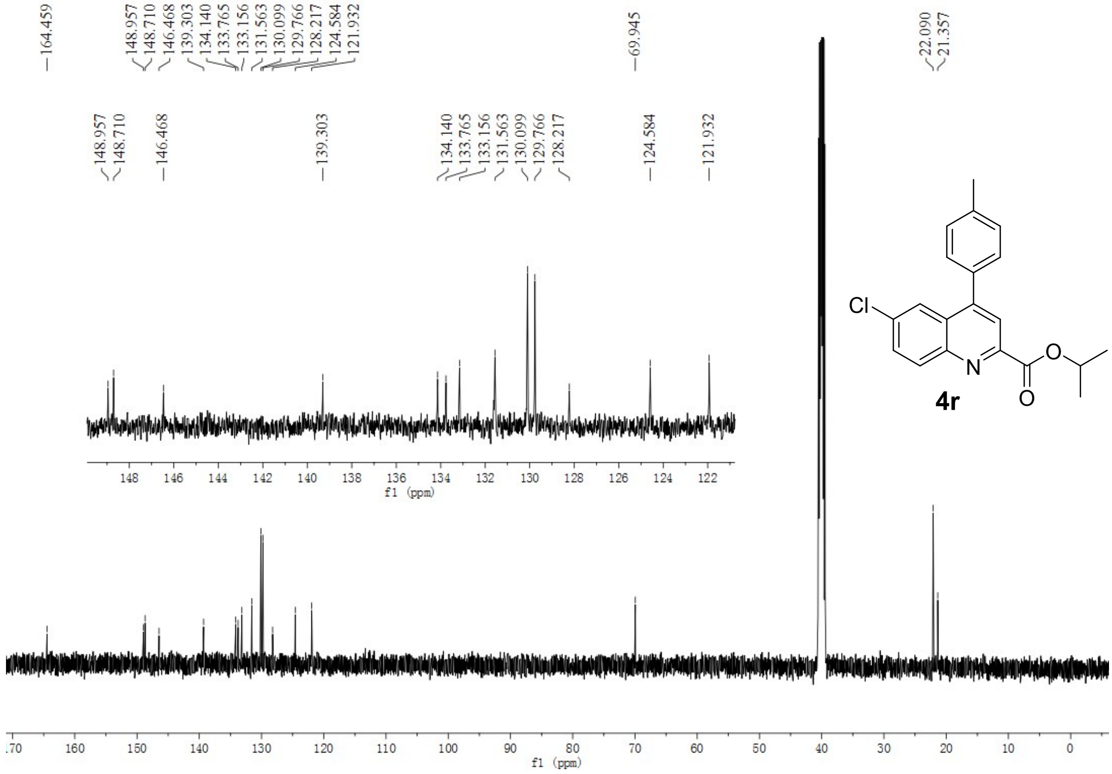

Figure S90. ^{13}C NMR (150 MHz, DMSO-d_6) of compound 4r

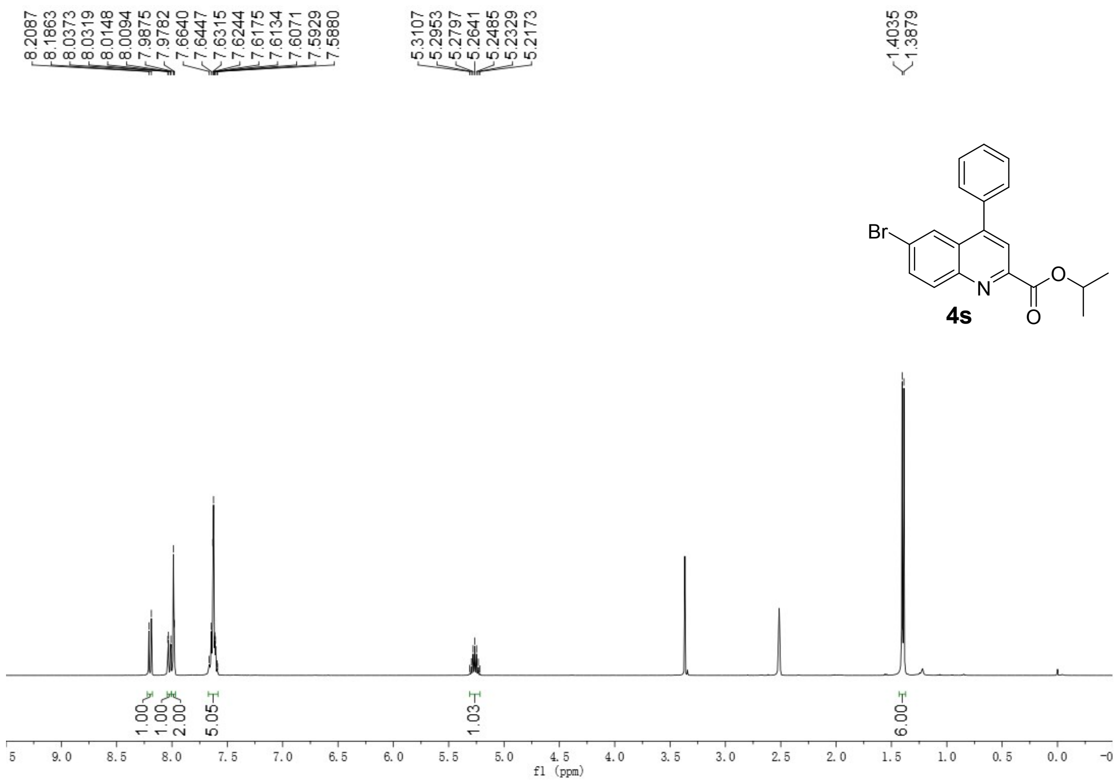

Figure S91. ^{1}H NMR (400 MHz, DMSO-d_6) of compound 4s

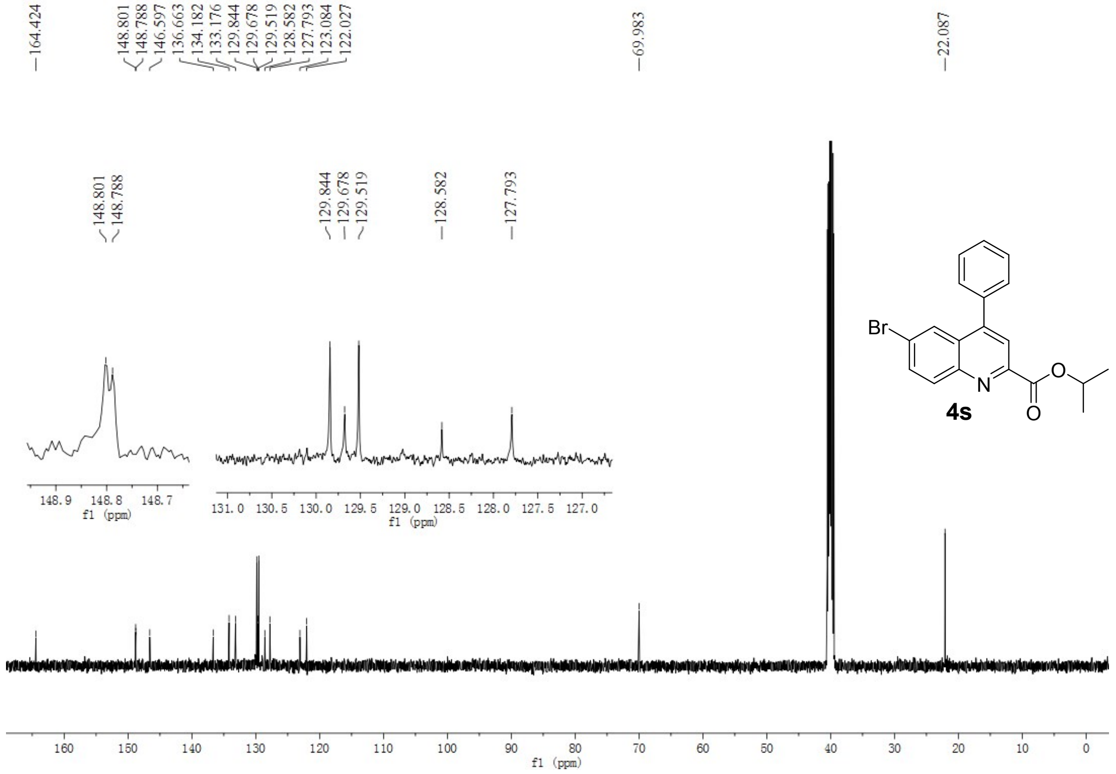

Figure S92. ^{13}C NMR (125 MHz, DMSO-d_6) of compound 4s

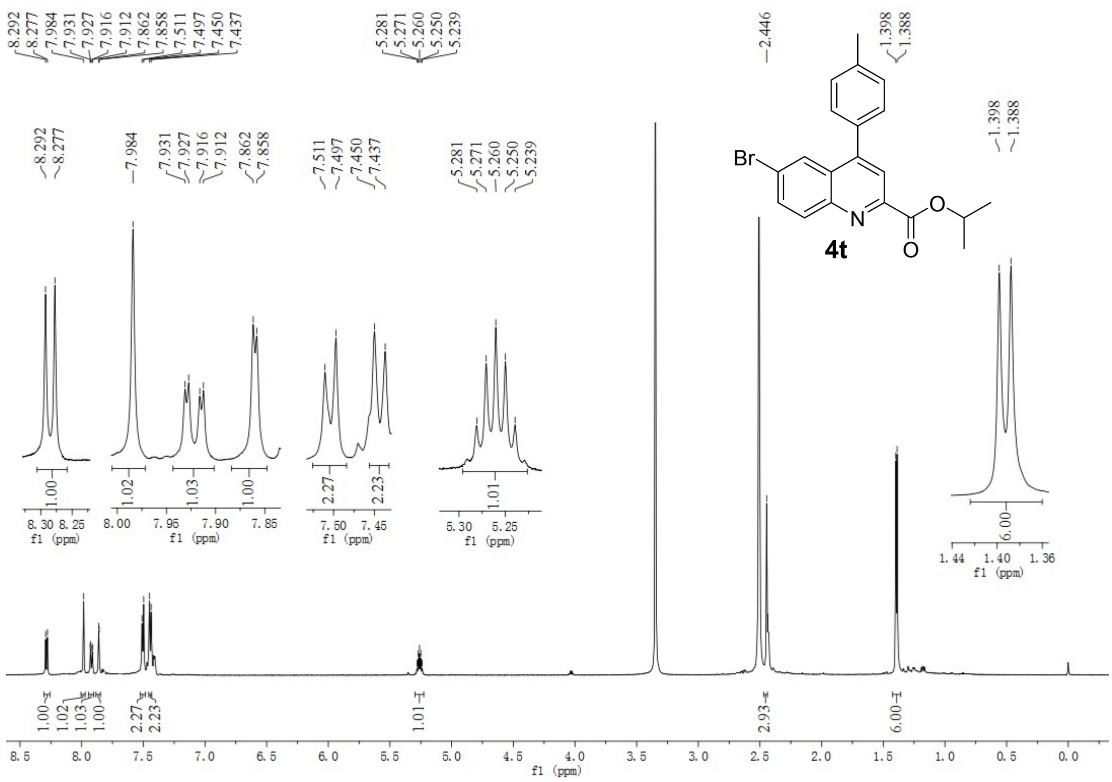

Figure S93. ^{1}H NMR (600 MHz, DMSO-d_6) of compound 4t

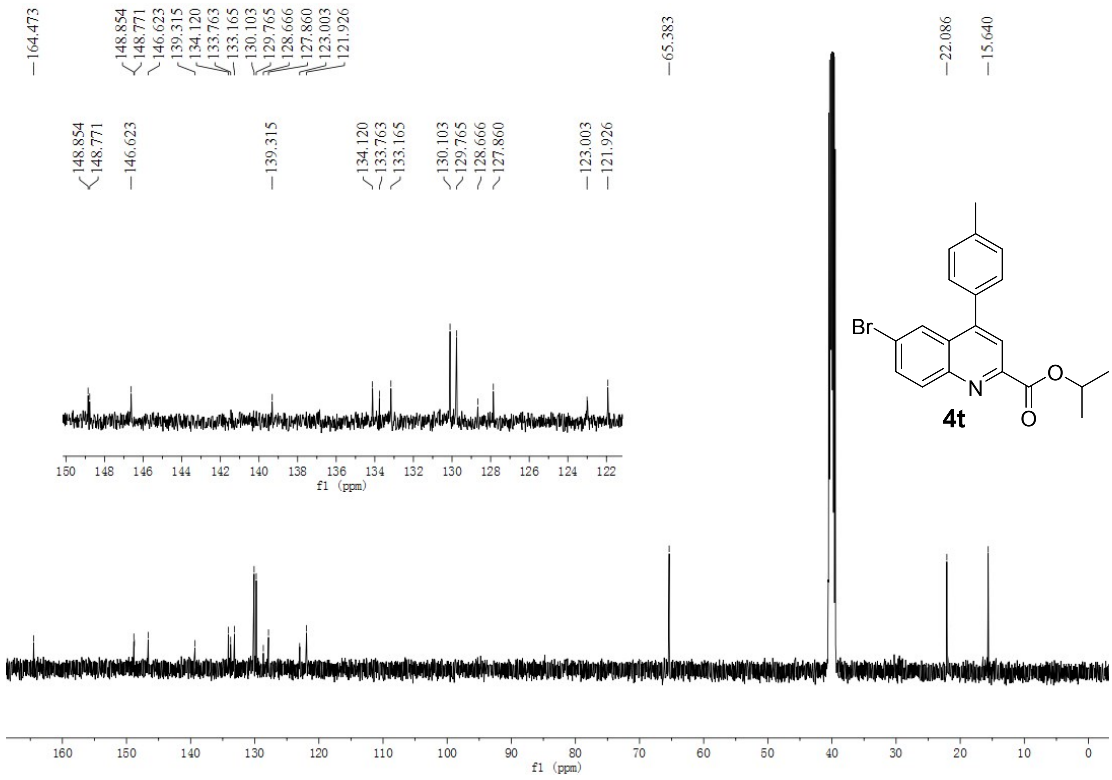

Figure S94. ^{13}C NMR (150 MHz, DMSO-d_6) of compound 4t