Gold-Catalyzed Cyclization of 1-(2'-Azidoaryl) Propynols: Synthesis of Polysubstituted 4-Quinolones

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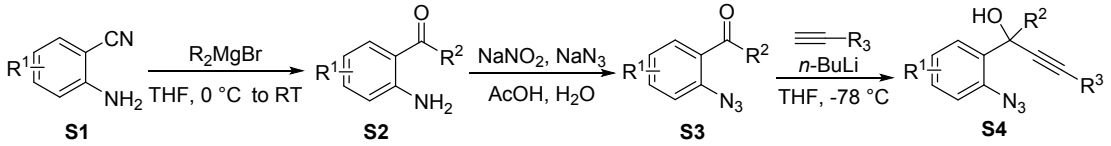
1. General Data

NMR spectra were recorded on Aglient-600 MHz or Brucker-400 MHz spectrometer. Mass spectra were recorded on a Thermo LTQ Orbitrap XL (ESI+). Column chromatography was performed on silica gel or basic alumina (200-300 mesh) eluting with ethyl acetate and petroleum ether. TLC was performed on glass-backed silica plates. All chemicals were used without purification as commercially available unless otherwise noted.

2. General procedure for the Synthesis of Azide Alkynyl Substrates



General procedure for the Synthesis of S2[1]

To a stirred solution of 2-aminobenzonitrile **S1** (1 equiv, 4 mmol) in anhydrous THF (10 mL) was added R_2MgBr (3 equiv, 12 mmol) at 0 ºC over 10 min. The reaction mixture was allowed to warm to room temperature and stir at this temperature overnight. After complete conversion of the nitrile (TLC), the mixture was cooled to 0 °C, and was quenched by addition of 1N HCl (100 mL). The resulting mixture was vigorously stirred until complete hydrolysis of the corresponding imine. Sat. $NaHCO_3$ was then added until pH >7. The organic phase was collected, and the aqueous phase was extracted with EtOAc (50 mL×3). The combined organic phase was washed with brine, dried over Na_2SO_4, filtered and concentrated in vacuo. The residue was purified by column chromatography to afford (EA/PE=1:80) the corresponding 2-aminobenzophenone **S2**.

General procedure for the Synthesis of S3[1]

To a cold (0 °C) solution of **S2** (10.0 mmol, 1 equiv) in 50 mL of acetic acid and 50

[1] a) W. Song, M. Li, J. He, J. Li, K. Dong, Y. Zheng, *Org. Biomol. Chem.* **2019**, *17*, 2663-2669; b) C. Gronnier, G. Boissonnat, F. Gagosz, *Org. Lett.* **2013**, *15*, 4234-4237.

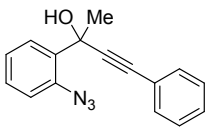
mL of water was added sodium nitrite (30.0 mmol, 3 equiv). After stirring for 1 hour, sodium azide (30.0 mmol, 3 equiv) was added slowly into the stirring mixture, and the mixture was allowed to warm to ambient temperature. After an additional hour of stirring, the resulting mixture was neutralized with a saturated aqueous solution of Na_2CO_3 and extracted with 3 × 20 mL of CH_2Cl_2. The resulting organic phase was dried over Na_2SO_4 and decanted. The filtrate was concentrated in vacuo to afford a yellow oil. The residue was purified by column chromatography (EA/PE = 1:100) to afford the corresponding 2-azidoacetophenone **S3**.

General procedure for the Synthesis of S4[2]

n-Butyllithium/n-hexane solution (1.6 M, 15 mmol, 3 equiv) was added to a solution of phenylacetylene (15 mmol, 3 equiv) in THF (5 mL) at −78 °C. After stirring for 2 h, a solution of **S3** (5 mmol, 1 equiv) in THF (10 mL) was added, and the mixture was stirred for a further 2 h. The mixture was quenched with saturated aqueous ammonium chloride and extracted with dichloromethane. The organic extracts were washed with brine, dried over anhydrous magnesium sulfate, filtered and concentrated in vacuo. The residue was purified by silica gel or basic alumina column chromatography (EA/PE = 1:50) to afford corresponding azide alkynyl substrates **S4**.

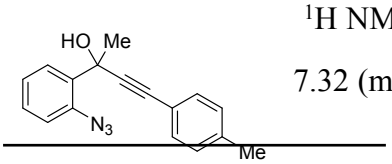
3. ^{1}H NMR Data for the Azide Alkynyl Substrates

2-(2-azidophenyl)-4-phenylbut-3-yn-2-ol (4a)



^{1}H NMR (600 MHz, $CDCl_3$) δ 7.72 (d, *J* = 7.8 Hz, 1H), 7.46 (dd, *J* = 6.3, 2.9 Hz, 2H), 7.38 (t, *J* = 7.6 Hz, 1H), 7.35 – 7.28 (m, 3H), 7.23 (d, *J* = 7.9 Hz, 1H), 7.18 (t, *J* = 7.6 Hz, 1H), 3.89 (s, 1H), 1.99 (s, 3H).

2-(2-azidophenyl)-4-(p-tolyl)but-3-yn-2-ol (4b)

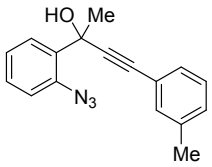


^{1}H NMR (600 MHz, $CDCl_3$) δ 7.72 (d, J = 7.8 Hz, 1H), 7.40 – 7.32 (m, 3H), 7.23 (d, J = 7.9 Hz, 1H), 7.17 (t, J = 7.6 Hz, 1H),

[2] T. Saito, N. Furukawa, T. Otani, *Org. Biomol. Chem.*, **2010**, 8, 1126–1132.

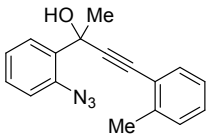
7.11 (d, J = 7.9 Hz, 2H), 3.91 (s, 1H), 2.34 (s, 3H), 1.97 (s, 3H).

2-(2-azidophenyl)-4-(m-tolyl)but-3-yn-2-ol (4c)



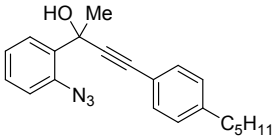
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.69 (d, *J* = 7.8 Hz, 1H), 7.33 (d, *J* = 7.8 Hz, 1H), 7.27 – 7.22 (m, 2H), 7.21 – 7.13 (m, 3H), 7.10 (d, *J* = 7.5 Hz, 1H), 3.94 (s, 1H), 2.29 (s, 3H), 1.95 (s, 3H).

2-(2-azidophenyl)-4-(o-tolyl)but-3-yn-2-ol (4d)



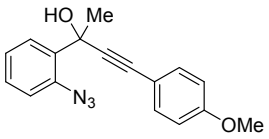
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.74 (d, *J* = 7.8 Hz, 1H), 7.43 (d, *J* = 7.6 Hz, 1H), 7.38 (t, *J* = 8.4 Hz, 1H), 7.25 – 7.16 (m, 4H), 7.13 (t, *J* = 7.3 Hz, 1H), 3.96 (s, 1H), 2.45 (s, 3H), 2.02 (s, 3H).

2-(2-azidophenyl)-4-(4-pentylphenyl)but-3-yn-2-ol (4e)



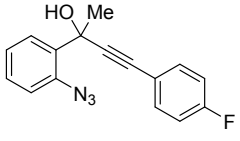
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.71 (d, *J* = 8.8 Hz, 1H), 7.35 (dd, *J* = 9.7, 4.7 Hz, 3H), 7.21 (d, *J* = 7.3 Hz, 1H), 7.16 (t, *J* = 8.0 Hz, 1H), 7.11 (d, *J* = 8.0 Hz, 2H), 3.89 (s, 1H), 2.58 (t, *J* = 7.7 Hz, 2H), 1.96 (s, 3H), 1.58 (m, 2H), 1.33 – 1.26 (m, 4H), 0.87 (t, *J* = 7.0 Hz, 3H).

2-(2-azidophenyl)-4-(4-methoxyphenyl)but-3-yn-2-ol (4f)



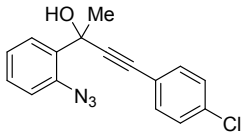
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.72 (d, *J* = 7.9 Hz, 1H), 7.39 (d, *J* = 8.9 Hz, 2H), 7.36 (d, *J* = 9.0 Hz, 1H), 7.23 (d, *J* = 7.9 Hz, 1H), 7.17 (t, *J* = 8.2 Hz, 1H), 6.83 (d, *J* = 8.8 Hz, 2H), 3.88 (s, 1H), 3.81 (s, 3H), 1.97 (s, 3H).

2-(2-azidophenyl)-4-(4-fluorophenyl)but-3-yn-2-ol (4g)



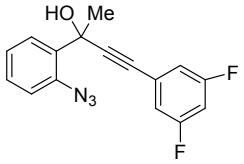
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.69 (d, *J* = 7.7 Hz, 1H), 7.50 – 7.40 (m, 2H), 7.37 (t, *J* = 7.5 Hz, 1H), 7.22 (d, *J* = 7.8 Hz, 1H), 7.17 (t, *J* = 7.6 Hz, 1H), 7.00 (t, *J* = 8.5 Hz, 2H), 4.00 (s, 1H), 1.97 (s, 3H).

2-(2-azidophenyl)-4-(4-chlorophenyl)but-3-yn-2-ol (4h)



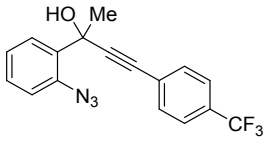
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.60 (d, J = 7.9 Hz, 1H), 7.31 – 7.26 (m, 3H), 7.19 (d, J = 8.4 Hz, 2H), 7.14 (d, J = 7.8 Hz, 1H), 7.09 (t, J = 7.6 Hz, 1H), 3.90 (s, 1H), 1.88 (s, 3H).

2-(2-azidophenyl)-4-(3,5-difluorophenyl)but-3-yn-2-ol (4i)



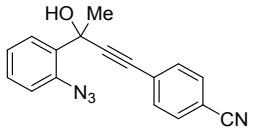
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.63 (d, *J* = 7.7 Hz, 1H), 7.38 (t, *J* = 7.7 Hz, 1H), 7.23 (m, 1H), 7.17 (t, *J* = 7.6 Hz, 1H), 6.94 (d, *J* = 5.6 Hz, 2H), 6.77 (t, *J* = 8.9 Hz, 1H), 3.99 (s, 1H), 1.95 (s, 3H).

2-(2-azidophenyl)-4-(4-(trifluoromethyl)phenyl)but-3-yn-2-ol (4j)



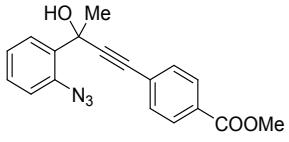
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.68 (d, *J* = 7.8 Hz, 1H), 7.59 – 7.52 (m, 4H), 7.39 (t, *J* = 7.0 Hz, 1H), 7.24 (d, *J* = 7.9 Hz, 1H), 7.19 (t, *J* = 7.6 Hz, 1H), 3.99 (s, 1H), 1.99 (s, 3H).

4-(3-(2-azidophenyl)-3-hydroxybut-1-yn-1-yl)benzonitrile (4k)



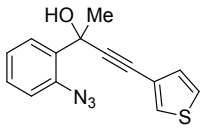
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.65 (d, *J* = 7.8 Hz, 1H), 7.59 (d, *J* = 8.4 Hz, 2H), 7.52 (d, *J* = 8.5 Hz, 2H), 7.39 (t, *J* = 8.4 Hz, 1H), 7.24 (d, *J* = 7.9 Hz, 1H), 7.18 (t, *J* = 7.6 Hz, 1H), 4.06 (s, 1H), 1.97 (s, 3H).

methyl 4-(3-(2-azidophenyl)-3-hydroxybut-1-yn-1-yl)benzoate (4l)



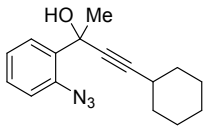
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.98 (d, *J* = 8.3 Hz, 2H), 7.69 (d, *J* = 7.7 Hz, 1H), 7.50 (d, *J* = 8.3 Hz, 2H), 7.38 (t, *J* = 7.7 Hz, 1H), 7.24 (d, *J* = 7.9 Hz, 1H), 7.18 (t, *J* = 7.6 Hz, 1H), 3.99 (s, 1H), 3.91 (s, 3H), 1.99 (s, 3H).

2-(2-azidophenyl)-4-(thiophen-3-yl)but-3-yn-2-ol (4m)



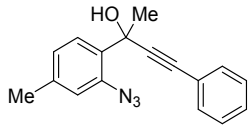
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.70 (d, *J* = 7.8 Hz, 1H), 7.46 (d, *J* = 2.3 Hz, 1H), 7.37 (dd, *J* = 11.3, 4.0 Hz, 1H), 7.25 (d, *J* = 2.7 Hz, 1H), 7.23 (d, *J* = 7.9 Hz, 1H), 7.17 (t, *J* = 7.6 Hz, 1H), 7.12 (d, *J* = 4.9 Hz, 1H), 3.91 (s, 1H), 1.97 (s, 3H).

2-(2-azidophenyl)-4-cyclohexylbut-3-yn-2-ol (4n)



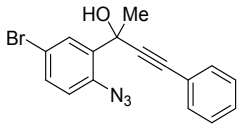
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.69 (d, *J* = 7.8 Hz, 1H), 7.33 (t, *J* = 8.3 Hz, 1H), 7.18 (d, *J* = 7.9 Hz, 1H), 7.14 (t, *J* = 7.9 Hz, 1H), 3.73 (s, 1H), 2.54 – 2.38 (m, 1H), 1.85 (s, 3H), 1.80-1.78 (m, 2H), 1.71 (t, *J* = 4.4 Hz, 2H), 1.50 – 1.46 (m, 3H), 1.33 – 1.30 (m, 3H).

2-(2-azido-4-methylphenyl)-4-phenylbut-3-yn-2-ol (4o)



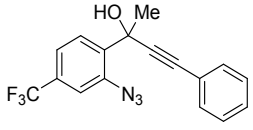
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.83 (d, J = 7.9 Hz, 2H), 7.56 (s, 1H), 7.49 (d, J = 7.7 Hz, 2H), 7.44 (t, J = 7.6 Hz, 2H), 7.38 – 7.34 (t, 1H), 3.17 (s, 1H), 2.41 (s, 3H), 2.03 (s, 3H).

2-(2-azido-5-bromophenyl)-4-phenylbut-3-yn-2-ol (4p)



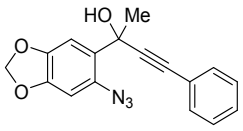
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.86 (s, 1H), 7.48 (d, *J* = 10.6 Hz, 1H), 7.45 (d, *J* = 7.8 Hz, 2H), 7.34 – 7.29 (m, 3H), 7.10 (d, *J* = 8.4 Hz, 1H), 3.67 (s, 1H), 1.95 (s, 3H).

2-(2-azido-4-(trifluoromethyl)phenyl)-4-phenylbut-3-yn-2-ol (4q)



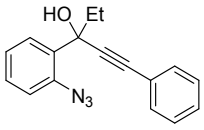
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.86 (d, *J* = 8.0 Hz, 1H), 7.45 – 7.41 (m, 4H), 7.34 – 7.28 (m, 3H), 3.73 (s, 1H), 1.98 (s, 3H).

2-(6-azidobenzo[d][1,3]dioxol-5-yl)-4-phenylbut-3-yn-2-ol (4r)



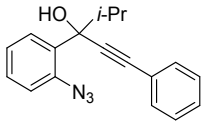
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.44 (d, *J* = 7.4 Hz, 2H), 7.37 – 7.26 (m, 3H), 7.21 (s, 1H), 6.71 (s, 1H), 5.98 (s, 2H), 3.71 (s, 1H), 1.93 (s, 3H).

3-(2-azidophenyl)-1-phenylpent-1-yn-3-ol (4s)



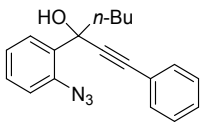
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.80 (d, *J* = 7.8 Hz, 1H), 7.50 (d, *J* = 7.3 Hz, 2H), 7.37 (t, *J* = 7.6 Hz, 1H), 7.34 – 7.29 (m, 3H), 7.22 (d, *J* = 7.9 Hz, 1H), 7.17 (t, *J* = 7.6 Hz, 1H), 3.69 (s, 1H), 2.22 (q, *J* = 6.7 Hz, 2H), 1.06 (t, *J* = 7.3 Hz, 3H).

3-(2-azidophenyl)-4-methyl-1-phenylpent-1-yn-3-ol (4t)



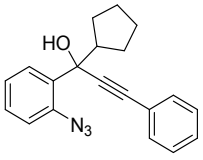
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.86 (d, *J* = 7.8 Hz, 1H), 7.52-7.48 (m, 2H), 7.38 – 7.31 (m, 4H), 7.21 (d, *J* = 7.9 Hz, 1H), 7.16 (t, *J* = 7.6 Hz, 1H), 3.60 (s, 1H), 2.67 – 2.59 (m, 1H), 1.15 (d, *J* = 6.6 Hz, 3H), 0.89 (d, *J* = 6.7 Hz, 3H).

3-(2-azidophenyl)-1-phenylhept-1-yn-3-ol (4u)



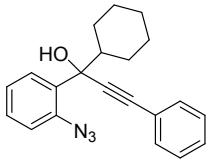
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.81 (d, *J* = 7.8 Hz, 1H), 7.50-7.48 (m, 2H), 7.37 (t, *J* = 7.6 Hz, 1H), 7.35 – 7.29 (m, 3H), 7.22 (d, *J* = 7.9 Hz, 1H), 7.17 (t, *J* = 7.6 Hz, 1H), 3.68 (s, 1H), 2.23 – 2.16 (m, 2H), 1.59 – 1.50 (m, 2H), 1.47 – 1.33 (m, 2H), 0.91 (t, *J* = 7.2 Hz, 3H).

1-(2-azidophenyl)-1-cyclopentyl-3-phenylprop-2-yn-1-ol (4v)



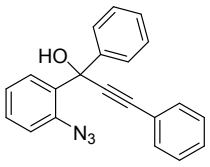
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.84 (d, *J* = 7.8 Hz, 1H), 7.54 – 7.48 (m, 2H), 7.38 – 7.31 (m, 4H), 7.20 (d, *J* = 7.9 Hz, 1H), 7.15 (t, *J* = 7.6 Hz, 1H), 3.78 (s, 1H), 2.97 – 2.88 (m, 1H), 1.89 – 1.79 (m, 2H), 1.74 – 1.66 (m, 2H), 1.54 – 1.40 (m, 4H).

1-(2-azidophenyl)-1-cyclohexyl-3-phenylprop-2-yn-1-ol (4w)



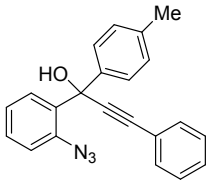
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.83 (d, *J* = 7.8 Hz, 1H), 7.51 (dd, *J* = 6.5, 3.1 Hz, 2H), 7.36 – 7.31 (m, 4H), 7.19 (d, *J* = 7.9 Hz, 1H), 7.14 (t, *J* = 7.6 Hz, 1H), 3.63 (s, *J* = 38.1 Hz, 1H), 2.25 – 2.17 (m, 1H), 2.00 (d, *J* = 12.8 Hz, 1H), 1.81 (d, *J* = 13.1 Hz, 1H), 1.72 – 1.63 (m, 2H), 1.44 – 1.36 (m, 2H), 1.28 – 1.16 (m, 4H).

1-(2-azidophenyl)-1,3-diphenylprop-2-yn-1-ol (4x)



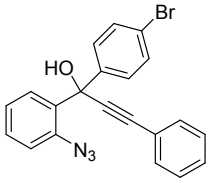
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.67 (d, *J* = 7.7 Hz, 1H), 7.60 (d, *J* = 7.6 Hz, 2H), 7.53 – 7.48 (m, 2H), 7.40 – 7.36 (m, 3H), 7.35 – 7.31 (m, 4H), 7.19 (t, 2H), 4.22 (s, 1H).

1-(2-azidophenyl)-3-phenyl-1-(p-tolyl)prop-2-yn-1-ol (4y)



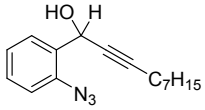
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.58 (d, *J* = 7.3 Hz, 2H), 7.46 (d, *J* = 8.2 Hz, 2H), 7.41 (dd, *J* = 6.5, 3.1 Hz, 2H), 7.25 – 7.17 (m, 5H), 7.05 (d, *J* = 8.0 Hz, 2H), 2.81 (s, 1H), 2.23 (s, 3H).

1-(2-azidophenyl)-1-(4-bromophenyl)-3-phenylprop-2-yn-1-ol (4z)



^{1}H NMR (600 MHz, $CDCl_3$) δ 7.66 (d, *J* = 7.8 Hz, 1H), 7.51 – 7.44 (m, 6H), 7.40 (t, *J* = 7.7 Hz, 1H), 7.36 – 7.30 (m, 3H), 7.22 – 7.14 (m, 2H), 4.23 (s, 1H).

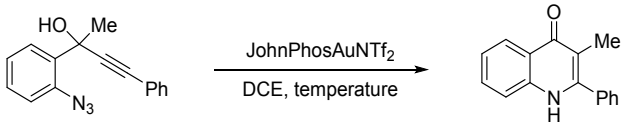
1-(2-azidophenyl)dec-2-yn-1-ol (9)



^{1}H NMR (400 MHz, $CDCl_3$) δ 7.66 (d, J = 6.9 Hz, 1H), 7.36 (t, J = 7.1 Hz, 1H), 7.16 (t, J = 7.2 Hz, 2H), 5.63 (s, 1H), 2.73 (d, J = 5.3 Hz, 1H), 2.26 (t, J = 8.0 Hz, 2H), 1.59 – 1.49 (m, 2H), 1.44 – 1.27 (m, 8H), 0.88 (t, J = 6.7 Hz, 3H).

4. Detailed Optimal Conditions

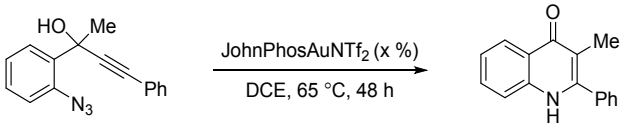
Screening of temperature



4a **8a**

Entry	Temperature (°C)	Yield (%)
1	40	71
2	65	84
3	80	73

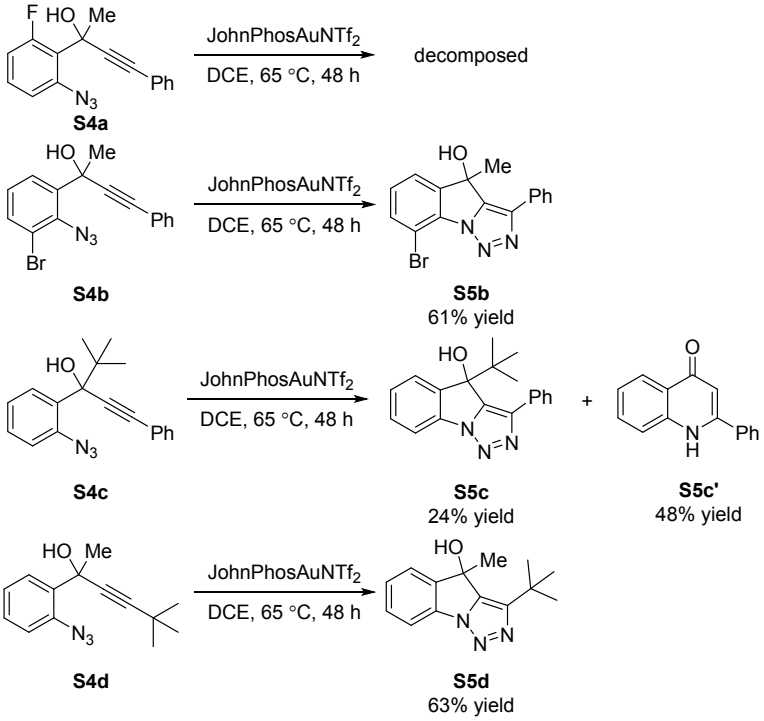
Screening of catalyst loading



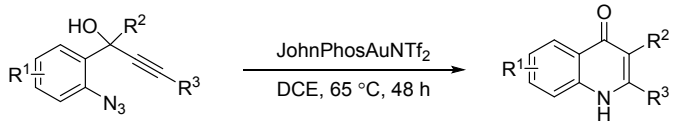
4a **8a**

Entry	x	Yield (%)
1	20	74
2	5	84
3	2	46

Screening of substrates



5. General Procedure for the Synthesis of Substituted Quinolone Products

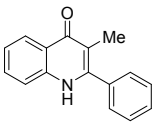


4a-4z, **9** **8a-8z**,**10**

2-(2-azidophenyl)-4-phenylbut-3-yn-2-ol **4a** (26.3 mg, 0.1 mmol) and JohnPhosAuNTf$_2$ (3.9 mg, 0.005 mmol) were added in an oven-dried Schlenk tube. The tube was then sealed, evacuated, and backfilled with nitrogen using standard Schlenk technique. Then, DCE (1 mL) was sequentially added by syringe at ambient temperature. The resulting mixture was heated to 65 °C (oil bath) for 48 hours. Solvents were evaporated under reduced pressure. The residue was directed purified by column chromatography on silica gel (petroleum ether/EtOAc = 2 : 1) to afford product **8a**.

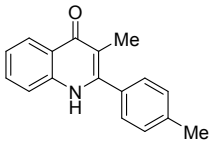
6. Characterization Data for the Substituted Quinolone Products

3-methyl-2-phenylquinolin-4(1H)-one (8a)



8a (19.7 mg) was obtained as a white solid in 84% yield after flash chromatography. Mp: 287-290 °C. ^{1}H NMR (400 MHz, DMSO-d$_6$) δ 11.66 (s, 1H), 8.17 (d, *J* = 8.0 Hz, 1H), 7.68 – 7.54 (m, 7H), 7.33 (t, *J* = 8.0 Hz, 1H), 1.93 (s, 3H). ^{13}C NMR (101 MHz, DMSO-d$_6$) δ 176.78, 147.75, 139.52, 135.15, 131.30, 129.42, 128.98, 128.61, 124.97, 123.10, 122.71, 118.20, 114.40, 12.22. HRMS (ESI) m/z (M+H)$^+$ calculated for $C_{16}H_{14}NO$: 236.1070, observed: 236.1072.

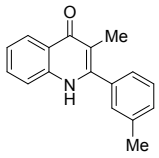
3-methyl-2-(p-tolyl)quinolin-4(1H)-one (8b)



8b (20 mg) was obtained as a white solid in 80% yield after flash chromatography. Mp: 297-299 °C. ^{1}H NMR (400 MHz, DMSO-d$_6$) δ 11.60 (s, 1H), 8.16 (d, *J* = 8.0 Hz, 1H), 7.70 – 7.58 (m, 2H), 7.48 (d, *J* = 8.0 Hz, 2H), 7.41 (d, *J* = 8.0 Hz, 2H), 7.32 (m, 1H), 2.44 (s, 3H), 1.94 (s, 3H).

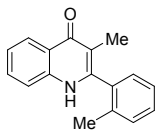
^{13}C NMR (101 MHz, DMSO-d_6) δ 176.69, 147.74, 139.49, 138.97, 132.28, 131.17, 129.04, 128.84, 124.92, 123.04, 122.58, 118.13, 114.30, 20.91, 12.19.HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{17}H_{16}NO$: 250.1227, observed: 250.1229.

3-methyl-2-(m-tolyl)quinolin-4(1H)-one (8c)



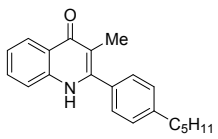
8c (20.2 mg) was obtained as a white solid in 81% yield after flash chromatography. Mp: 296-298 °C.^{1}H NMR (400 MHz, DMSO-d_6) δ 11.63 (s, 1H), 8.17 (d, *J* = 8.0 Hz, 1H), 7.73 – 7.58 (m, 2H), 7.49 (t, *J* = 7.5 Hz, 1H), 7.43 – 7.35 (m, 3H), 7.35 – 7.28 (m, 1H), 2.44 (s, 3H), 1.93 (s, 3H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 176.71, 147.78, 139.48, 137.94, 135.11, 131.19, 129.93, 129.27, 128.44, 126.09, 124.93, 123.07, 122.60, 118.13, 114.29, 20.96, 12.20. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{17}H_{16}NO$: 250.1227, observed: 250.1228.

3-methyl-2-(o-tolyl)quinolin-4(1H)-one (8d)



8d (18.9 mg) was obtained as a white solid in 76% yield after flash chromatography. Mp: 302-304 °C. ^{1}H NMR (600 MHz, DMSO-d_6) δ 11.67 (s, 1H), 8.18 (d, *J* = 8.1 Hz, 1H), 7.68 – 7.58 (m, 2H), 7.52 – 7.43 (m, 2H), 7.42 – 7.36 (m, 2H), 7.34 (t, *J* = 7.4 Hz, 1H), 2.19 (s, 3H), 1.75 (s, 3H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 176.55, 147.32, 139.44, 135.57, 134.78, 131.14, 130.18, 129.27, 128.78, 126.00, 124.91, 123.23, 122.56, 118.02, 114.75, 18.78, 11.57. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{17}H_{16}NO$: 250.1227, observed: 250.1225.

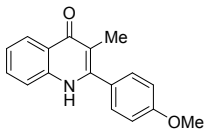
3-methyl-2-(4-pentylphenyl)quinolin-4(1H)-one (8e)



8e (25.9 mg) was obtained as a white solid in 85% yield after flash chromatography. Mp: 318-320 °C. ^{1}H NMR (400 MHz, DMSO-d_6) δ 11.59 (s, 1H), 8.16 (d, *J* = 8.1 Hz, 1H), 7.70 – 7.59 (m, 2H), 7.49 (d, *J* = 7.7 Hz, 2H), 7.42 (d, *J* = 7.8 Hz, 2H), 7.32 (t, *J* = 7.1 Hz, 1H), 2.70 (t, *J* = 7.6 Hz, 2H), 1.93 (s, 3H), 1.73 – 1.58 (m, 2H), 1.42 – 1.31 (m, 4H), 0.91 (t, *J* = 6.6 Hz,

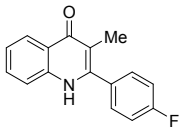
3H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 176.73, 147.74, 143.85, 139.51, 132.52, 131.19, 128.88, 128.44, 124.94, 123.06, 122.59, 118.15, 114.31, 34.94, 30.92, 30.63, 21.98, 13.95, 12.24. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{21}H_{24}NO$: 306.1853, observed: 306.1856.

2-(4-methoxyphenyl)-3-methylquinolin-4(1H)-one (8f)



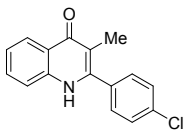
8f (20.9 mg) was obtained as a white solid in 79% yield after flash chromatography. Mp: 306-308 °C. ^{1}H NMR (400 MHz, DMSO-d_6)δ 11.55 (s, 1H), 8.15 (d, *J* = 8.1 Hz, 1H), 7.69 – 7.60 (m, 2H), 7.54 (d, *J* = 8.4 Hz, 2H), 7.32 (t, *J* = 7.9 Hz, 1H), 7.16 (d, *J* = 8.5 Hz, 2H), 3.88 (s, 3H), 1.95 (s, 3H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 176.74, 159.99, 147.56, 139.49, 131.15, 130.44, 127.34, 124.94, 123.03, 122.55, 118.12, 114.32, 113.90, 55.36, 12.29. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{17}H_{16}NO_2$: 266.1176, observed: 266.1174.

2-(4-fluorophenyl)-3-methylquinolin-4(1H)-one (8g)



8g (18.9 mg) was obtained as a white solid in 75% yield after flash chromatography. Mp: 300-302 °C. ^{1}H NMR (600 MHz, DMSO-d_6) δ 11.65 (s, 1H), 8.16 (d, *J* = 8.1 Hz, 1H), 7.76 – 7.58 (m, 4H), 7.46 (t, *J* = 8.8 Hz, 2H), 7.34 (t, *J* = 7.9 Hz, 1H), 1.92 (s, 3H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 176.69, 162.56 (d, *J* = 246.7 Hz), 146.71, 139.46, 131.50 (d, *J* = 3.1 Hz), 131.34 (d, *J* = 6.3 Hz), 124.96, 123.08, 122.71, 118.15, 115.55 (d, *J* = 21.6 Hz), 114.56, 12.15. ^{19}F NMR (564 MHz, DMSO-d_6) δ -115.99. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{16}H_{13}FNO$: 251.0976, observed: 251.0979.

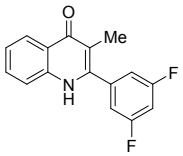
2-(4-chlorophenyl)-3-methylquinolin-4(1H)-one (8h)



8h (20.3 mg) was obtained as a white solid in 76% yield after flash chromatography. Mp: 307-309 °C. ^{1}H NMR (400 MHz, DMSO-d_6) δ 11.67 (s, 1H), 8.17 (d, *J* = 7.9 Hz, 1H), 7.71 – 7.59 (m, 6H), 7.34 (t, *J* = 6.1 Hz, 1H), 1.92 (s, 3H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 176.70, 146.48, 139.48,

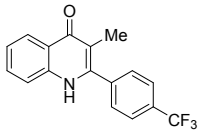
134.22, 133.83, 131.36, 130.93, 128.60, 124.96, 123.08, 122.75, 118.15, 114.55, 12.08. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{16}H_{13}ClNO$: 270.0680, observed: 270.0684.

2-(3,5-difluorophenyl)-3-methylquinolin-4(1H)-one (8i)



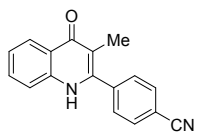
8i (17.7 mg) was obtained as a white solid in 65% yield after flash chromatography. Mp: 311-313 °C. ^{1}H NMR (600 MHz, DMSO-d_6) δ 11.70 (s, 1H), 8.16 (d, *J* = 8.1 Hz, 1H), 7.72 – 7.58 (m, 2H), 7.51 (t, *J* = 9.4 Hz, 1H), 7.44 (d, *J* = 6.0 Hz, 2H), 7.34 (t, *J* = 7.4 Hz, 1H), 1.93 (s, 3H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 176.63, 162.17 (dd, *J* = 247.5, 13.3 Hz), 145.51, 139.40, 138.16 (t, *J* = 10.1 Hz), 131.44, 124.94, 123.08, 122.82, 118.16, 114.61, 112.77 (dd, *J* = 20.7, 5.7 Hz), 104.90 (t, *J* = 25.3 Hz), 11.90. ^{19}F NMR (564 MHz, $CDCl_3$) δ -108.37. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{16}H_{12}F_2NO$: 272.0882, observed: 272.0880.

3-methyl-2-(4-(trifluoromethyl)phenyl)quinolin-4(1H)-one (8j)



8j (20.3 mg) was obtained as a white solid in 67% yield after flash chromatography. Mp: 298-300 °C. ^{1}H NMR (400 MHz, DMSO-d_6) δ 11.77 (s, 1H), 8.18 (d, *J* = 8.0 Hz, 1H), 7.98 (d, *J* = 8.1 Hz, 2H), 7.84 (d, *J* = 8.0 Hz, 2H), 7.70 – 7.61 (m,, 2H), 7.36 (t, *J* = 7.3 Hz, 1H), 1.91 (s, 3H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 176.82, 146.37, 139.56, 139.07, 131.62, 130.15, 129.83 (q, *J* = 32.1 Hz), 125.59 (q, *J* = 3.6 Hz), 125.07, 124.13 (q, *J* = 272.4 Hz), 123.18, 123.02, 118.26, 114.72, 12.06. ^{19}F NMR (564 MHz, $CDCl_3$) δ -56.49. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{17}H_{13}F_3NO$: 304.0944, observed: 304.0945.

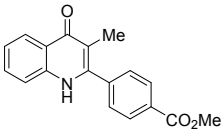
4-(3-methyl-4-oxo-1,4-dihydroquinolin-2-yl)benzonitrile (8k)



8k (20.6 mg) was obtained as a white solid in 79% yield after flash chromatography. Mp: 333-335 °C. ^{1}H NMR (600 MHz, DMSO-d_6) δ 11.78 (s, 1H), 8.17 (d, *J* = 8.0 Hz, 1H), 8.11 (d, *J* = 8.2 Hz, 2H), 7.83 (d, *J* = 8.3 Hz, 2H), 7.67 (t, *J* = 7.6 Hz, 1H), 7.63 (d, *J* = 8.2 Hz, 1H), 7.35 (t, *J* = 7.5 Hz, 1H), 1.90 (s, 3H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 176.67, 145.97, 139.51,

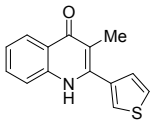
139.48, 132.56, 131.55, 130.21, 125.00, 123.12, 122.94, 118.49, 118.22, 114.66, 112.17, 12.01. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{17}H_{13}N_2O$: 261.1023, observed: 261.1022.

methyl 4-(3-methyl-4-oxo-1,4-dihydroquinolin-2-yl)benzoate (8l)



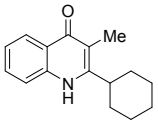
8l (20.5 mg) was obtained as a white solid in 70% yield after flash chromatography. Mp: 325-327 °C. ^{1}H NMR (600 MHz, DMSO-d_6) δ 11.56 (s, 1H), 8.16 (d, *J* = 8.0 Hz, 1H), 7.72 – 7.60 (m, 2H), 7.53 (d, *J* = 8.6 Hz, 2H), 7.32 (t, *J* = 7.3 Hz, 1H), 7.15 (d, *J* = 8.6 Hz, 2H), 3.88 (s, 3H), 1.95 (s, 3H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 176.75, 160.09, 147.83, 139.53, 131.31, 130.54, 127.32, 124.99, 123.02, 122.76, 118.24, 114.43, 113.99, 55.44, 12.39. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{18}H_{16}NO_3$: 294.1125, observed: 294.1121.

3-methyl-2-(thiophen-3-yl)quinolin-4(1H)-one (8m)



8m (20.2 mg) was obtained as a white solid in 84% yield after flash chromatography. Mp: 381-383 °C. ^{1}H NMR (600 MHz, DMSO-d_6) δ ^{1}H NMR (600 MHz, dmso) δ 11.53 (s, 1H), 8.15 (d, *J* = 8.0 Hz, 1H), 7.99 (d, *J* = 2.9 Hz, 1H), 7.84 – 7.79 (m, 1H), 7.68 – 7.62 (m, 2H), 7.45 (d, *J* = 5.0 Hz, 1H), 7.32 (t, *J* = 7.6 Hz, 1H), 2.02 (s, 3H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 176.61, 142.91, 139.42, 135.37, 131.18, 128.39, 127.17, 126.76, 124.89, 122.97, 122.56, 118.07, 114.61, 12.17. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{14}H_{12}NOS$: 242.0634, observed: 242.0635.

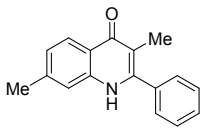
2-cyclohexyl-3-methylquinolin-4(1H)-one (8n)



8n (18.5 mg) was obtained as a white solid in 77% yield after flash chromatography. Mp: 279-281 °C. ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.74 (s, 1H), 8.09 (d, *J* = 7.8 Hz, 1H), 7.76 (d, *J* = 8.1 Hz, 1H), 7.60 (t, *J* = 7.5 Hz, 1H), 7.27 (t, *J* = 6.8 Hz, 1H), 2.99 (s, 1H), 2.08 (s, 3H), 1.97 – 1.60 (m, 7H), 1.51 – 1.31 (m, 3H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 176.30, 152.92, 139.38, 130.82,

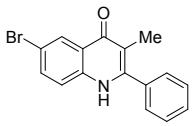
124.86, 122.79, 122.31, 117.90, 112.88, 29.71, 25.95, 25.30, 10.06. ^{13}C NMR (101 MHz, CD_4O) δ 179.42, 156.70, 140.69, 132.64, 126.00, 124.58, 124.20, 118.93, 115.44,, 41.93, 31.37, 27.50, 26.74, 10.55. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{16}H_{20}NO$: 242.1540, observed: 242.1543.

3,7-dimethyl-2-phenylquinolin-4(1H)-one (8o)



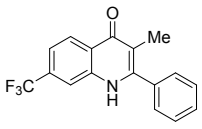
8o (19.6 mg) was obtained as a white solid in 79% yield after flash chromatography. Mp: 294-296 °C. ^{1}H NMR (600 MHz, DMSO-d_6) δ 11.54 (s, 1H), 8.05 (d, *J* = 8.3 Hz, 1H), 7.66 – 7.50 (m, 5H), 7.42 (s, 1H), 7.15 (d, *J* = 8.2 Hz, 1H), 2.44 (s, 3H), 1.91 (s, 3H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 176.58, 147.41, 141.21, 139.68, 135.21, 129.32, 128.95, 128.56, 124.95, 124.43, 121.19, 117.34, 114.11, 21.42, 12.14. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{17}H_{16}NO$: 250.1227, observed: 250.1230.

6-bromo-3-methyl-2-phenylquinolin-4(1H)-one (8p)



8p (25.3 mg) was obtained as a white solid in 81% yield after flash chromatography. Mp: 310-312 °C. ^{1}H NMR (600 MHz, DMSO-d_6) δ 11.81 (s, 1H), 8.25 (d, *J* = 2.3 Hz, 1H), 7.80 (dd, *J* = 8.8, 2.3 Hz, 1H), 7.64 – 7.58 (m, 6H), 1.92 (s, 3H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 175.39, 148.03, 138.26, 134.78, 133.95, 129.50, 128.87, 128.57, 127.01, 124.38, 120.80, 115.17, 114.98, 12.12. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{16}H_{13}BrNO$: 314.0175, observed: 314.0176.

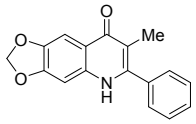
3-methyl-2-phenyl-7-(trifluoromethyl)quinolin-4(1H)-one (8q)



8q (22.4 mg) was obtained as a white solid in 74% yield after flash chromatography. Mp: 317-319 °C. ^{1}H NMR (600 MHz, DMSO-d_6) δ 11.94 (s, 1H), 8.36 (d, *J* = 8.4 Hz, 1H), 8.03 (s, 1H), 7.69 – 7.59 (m, 6H), 1.96 (s, 3H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 176.11, 148.59, 138.91, 134.68, 131.07 (q, *J* = 31.9 Hz), 129.67, 128.91, 128.67, 126.91, 124.85, 123.87 (d, *J*

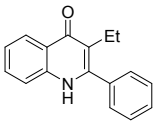
= 272.8 Hz), 118.15 (d, *J* = 3.2 Hz), 115.95, 115.83 (q, *J* = 4.3 Hz), 12.14. ^{19}F NMR (564 MHz, $CDCl_3$) δ -61.07. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{17}H_{13}F_3NO$: 304.0944, observed: 304.0945.

7-methyl-6-phenyl-[1,3]dioxolo[4,5-g]quinolin-8(5H)-one (8r)



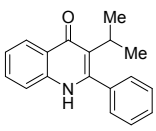
8r (13.2 mg) was obtained as a white solid in 47% yield after flash chromatography. Mp: 321-323 °C. ^{1}H NMR (400 MHz, DMSO-d_6) δ 11.52 (s, 1H), 7.59 (m, 5H), 7.45 (s, 1H), 7.06 (s, 1H), 6.16 (s, 2H), 1.90 (s, 3H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 175.49, 150.82, 146.32, 144.81, 136.44, 135.16, 129.33, 128.98, 128.61, 118.57, 113.52, 101.79, 101.31, 96.47, 12.18. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{17}H_{14}NO_3$: 279.0895, observed: 279.0899.

3-ethyl-2-phenylquinolin-4(1H)-one (8s)



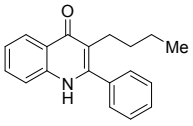
8s (18.7 mg) was obtained as a white solid in 75% yield after flash chromatography. Mp: 226-228 °C. ^{1}H NMR (600 MHz, DMSO-d_6) δ 11.65 (s, 1H), 8.18 (d, *J* = 8.1 Hz, 1H), 7.64 (d, *J* = 3.4 Hz, 2H), 7.62 – 7.53 (m, 5H), 7.33 (t, *J* = 8.1 Hz, 1H), 2.37 (q, *J* = 7.3 Hz, 2H), 0.99 (t, *J* = 7.3 Hz, 3H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 176.34, 148.03, 139.48, 135.15, 131.37, 129.36, 128.64, 128.63, 125.03, 123.70, 122.73, 120.69, 118.19, 19.25, 14.08.HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{17}H_{16}NO$: 250.1227, observed: 250.1223.

3-isopropyl-2-phenylquinolin-4(1H)-one (8t)



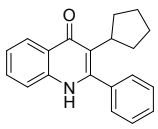
8t (22.3 mg) was obtained as a white solid in 85% yield after flash chromatography. Mp: 292-294 °C. ^{1}H NMR (600 MHz, DMSO-d_6) δ 11.51 (s, 1H), 8.17 (d, *J* = 8.1 Hz, 1H), 7.64 – 7.56 (m, 5H), 7.53 (dd, *J* = 7.5, 1.9 Hz, 2H), 7.31 (t, *J* = 8.1 Hz, 1H), 2.67 (hept, *J* = 6.9 Hz, 1H), 1.30 (d, *J* = 7.0 Hz, 6H). ^{13}C NMR (151 MHz, DMSO-d_6)δ 176.52, 147.71, 139.17, 135.70, 131.16, 129.14, 128.53, 128.49, 124.88, 124.67, 122.86, 122.47, 117.91, 28.78, 20.24. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{18}H_{18}NO$: 264.1383, observed: 264.1386.

3-butyl-2-phenylquinolin-4(1H)-one (8u)



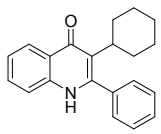
8u (23.3 mg) was obtained as a white solid in 84% yield after flash chromatography. Mp: 313-315 °C. ^{1}H NMR (600 MHz, DMSO-d_6) δ 11.60 (s, 1H), 8.16 (d, *J* = 8.0 Hz, 1H), 7.72 – 7.58 (m, 5H), 7.58 – 7.50 (m, 2H), 7.39 – 7.25 (m,1H), 2.42 – 2.31 (m, 2H), 1.43 – 1.35 (m, 2H), 1.23 – 1.08 (m, 2H), 0.74 (t, *J* = 7.3 Hz, 3H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 176.28, 147.99, 139.40, 135.16, 131.18, 129.20, 128.68, 128.45, 124.95, 123.56, 122.53, 119.28, 118.06, 30.93, 25.32, 22.19, 13.61. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{19}H_{20}NO$: 278.1540, observed: 278.1541.

3-cyclopentyl-2-phenylquinolin-4(1H)-one (8v)



8v (16.8 mg) was obtained as a white solid in 58% yield after flash chromatography. Mp: 324-326 °C. ^{1}H NMR (600 MHz, DMSO-d_6) δ 11.52 (s, 1H), 8.15 (d, *J* = 8.1 Hz, 1H), 7.65 – 7.57 (m, 5H), 7.54 (dd, *J* = 7.5, 1.7 Hz, 2H), 7.31 (t, *J* = 8.0 Hz, 1H), 2.71 – 2.62 (m, 1H), 2.27 – 2.16 (m, 2H), 1.87 – 1.78 (m, 2H), 1.54 – 1.39 (m, 4H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 176.15, 148.24, 139.16, 135.65, 131.15, 129.20, 128.65, 128.54, 124.82, 124.46, 122.49, 120.19, 117.93, 39.41, 29.53, 26.44. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{20}H_{20}NO$: 290.1540, observed: 290.1543.

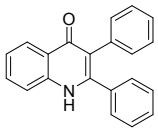
3-cyclohexyl-2-phenylquinolin-4(1H)-one (8w)



8w (23.1 mg) was obtained as a white solid in 76% yield after flash chromatography. Mp: 335-337 °C. ^{1}H NMR (400 MHz, DMSO-d_6) δ 11.48 (s, 1H), 8.14 (d, *J* = 8.1 Hz, 1H), 7.68 – 7.56 (m, 5H), 7.55 – 7.43 (m, 2H), 7.30 (t, *J* = 7.0 Hz, 1H), 2.47 – 2.17 (m, 3H), 1.67 (d, *J* = 12.6 Hz, 2H), 1.57 (d, *J* = 12.3 Hz, 1H), 1.43 (d, *J* = 11.4 Hz, 2H), 1.15 (t, *J* = 12.8 Hz, 1H), 0.97 (q, *J* = 12.6 Hz, 2H). ^{13}C NMR (101 MHz, DMSO-d_6)δ 176.61, 148.16, 139.13, 135.75, 131.23, 129.26, 128.53, 128.51, 124.99, 124.70, 122.61, 122.55, 117.94, 39.46, 29.04,

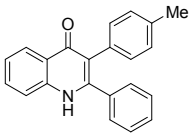
26.72, 25.60. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{21}H_{22}NO$: 304.1696, observed: 304.1699.

2,3-diphenylquinolin-4(1H)-one (8x)



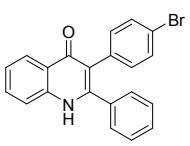
8x (18.2 mg) was obtained as a white solid in 61% yield after flash chromatography. Mp: 342-345 °C. ^{1}H NMR (600 MHz, DMSO-d_6) δ 11.85 (s, 1H), 8.20 (d, *J* = 7.9 Hz, 1H), 7.79 – 7.67 (m, 2H), 7.43 – 7.33 (m, 6H), 7.20 (t, *J* = 7.3 Hz, 2H), 7.14 (t, *J* = 7.3 Hz, 1H), 7.10 (d, *J* = 8.0 Hz, 2H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 175.36, 148.46, 139.65, 135.72, 135.18, 131.67, 129.60, 129.50, 128.90, 128.02, 127.19, 125.92, 125.30, 124.64, 123.13, 120.46, 118.40. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{21}H_{16}NO$: 298.1227, observed: 298.1225.

2-phenyl-3-(p-tolyl)quinolin-4(1H)-one (8y)



8y (15.6 mg) was obtained as a white solid in 50% yield after flash chromatography. Mp: 357-359 °C. ^{1}H NMR (400 MHz, DMSO-d_6) δ 11.81 (s, 1H), 8.18 (d, *J* = 7.9 Hz, 1H), 7.77 – 7.65 (m, 2H), 7.45 – 7.27 (m,6H), 6.99 (q, *J* = 8.2 Hz, 4H), 2.26 (s, 3H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 175.62, 148.49, 139.70, 135.39, 134.95, 132.69, 131.80, 131.61, 129.58, 129.02, 128.19, 128.00, 125.42, 124.64, 123.25, 120.43, 118.47, 20.84. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{22}H_{18}NO$: 312.1383, observed: 312.1380.

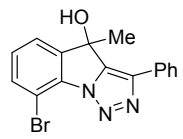
3-(4-bromophenyl)-2-phenylquinolin-4(1H)-one (8z)



8z (31.1 mg) was obtained as a white solid in 83% yield after flash chromatography. Mp: 369-371 °C. ^{1}H NMR (600 MHz, DMSO-d_6) 11.93 (s, 1H), 8.20 (d, *J* = 8.0 Hz, 1H), 7.80 – 7.68 (m, 2H), 7.45 – 7.34 (m, 8H), 7.05 (d, *J* = 8.4 Hz, 2H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 175.10, 148.65, 139.62, 135.10, 134.90, 133.85, 131.89, 130.19, 129.56, 129.19, 128.24,

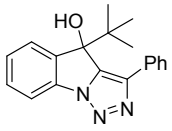
125.32, 124.59, 123.37, 119.25, 119.15, 118.49. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{21}H_{15}BrNO$: 377.0332, observed: 377.0333.

8-bromo-4-methyl-3-phenyl-4H-[1,2,3]triazolo[1,5-a]indol-4-ol (**S5b**)



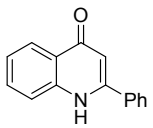
S5b (19.2 mg) was obtained as a white solid in 61% yield after flash chromatography. Mp: 425-427 °C. ^{1}H NMR (400 MHz, DMSO-d_6) δ 8.14 (d, *J* = 7.4 Hz, 2H), 7.80 (dd, *J* = 12.0, 7.8 Hz, 2H), 7.59 (t, *J* = 7.7 Hz, 2H), 7.44 (dd, *J* = 16.1, 7.9 Hz, 2H), 6.78 (s, 1H), 1.79 (s, 3H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 147.05, 143.01, 140.49, 133.87, 133.66, 129.95, 129.35, 129.13, 128.45, 126.48, 124.21, 105.17, 71.36, 23.54. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{16}H_{13}BrN_3O$: 342.0237, observed: 342.0232.

4-(tert-butyl)-3-phenyl-4H-[1,2,3]triazolo[1,5-a]indol-4-ol (S5c)



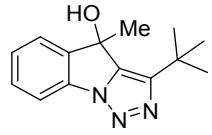
S5c (7.3 mg) was obtained as a white solid in 24% yield after flash chromatography. Mp: 379-382 °C. ^{1}H NMR (600 MHz, DMSO-d_6) δ 8.00 (d, *J* = 7.1 Hz, 2H), 7.88 (d, *J* = 7.7 Hz, 1H), 7.71 (d, *J* = 7.5 Hz, 1H), 7.61 (t, *J* = 7.3 Hz, 1H), 7.55 – 7.38 (m, 4H), 6.93 (s, 1H), 0.83 (s, 9H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 143.16, 142.45, 142.19, 135.76, 131.16, 129.66, 128.39, 128.21, 127.08, 126.82, 111.58, 82.24, 54.94, 25.44. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{19}H_{20}N_3O$: 306.1601, observed: 306.1600.

2-phenylquinolin-4(1H)-one (S5c')



S5c' (13 mg) was obtained as a white solid in 48% yield after flash chromatography. Mp: 256-258 °C. ^{1}H NMR (600 MHz, DMSO-d_6) δ 11.81 (s, 1H), 8.17 (d, *J* = 8.1 Hz, 1H), 7.87 (d, *J* = 3.7 Hz, 2H), 7.83 (d, *J* = 8.3 Hz, 1H), 7.71 (t, *J* = 7.6 Hz, 1H), 7.65 – 7.56 (m, 3H), 7.38 (t, *J* = 7.5 Hz, 1H), 6.39 (s, 1H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 177.07, 150.11, 140.55, 134.22, 131.85, 130.46, 129.02, 127.44, 124.89, 124.76, 123.33, 118.76, 107.38. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{15}H_{12}NO$: 222.0914, observed: 222.0919.

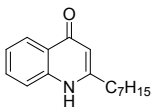
2-(tert-butyl)-3-methylquinolin-4(1H)-one (S5d)



S5d (15.5 mg) was obtained as a white solid in 72% yield after flash chromatography. Mp: 317-319 °C. ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.77 (d, *J* = 7.7 Hz, 1H), 7.70 (d, *J* = 7.4 Hz, 1H), 7.54 (t, *J* = 7.6 Hz, 1H), 7.45 (t, *J* = 7.3 Hz, 1H), 6.26 (s, 1H), 1.78 (s, 3H), 1.46 (s, 9H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 150.62, 144.77, 141.41, 134.39, 129.40, 127.57, 124.81, 111.40, 72.00, 31.14, 30.59, 26.83. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{14}H_{18}N_3O$: 244.1445, observed: 244.1444.

7. Synthesis and characterization of 2-heptylquinolin-4(1H)-one (10)

1-(2-azidophenyl)dec-2-yn-1-ol **9** (27.1 mg, 0.1 mmol) and JohnPhosAuNTf$_2$ (3.9 mg, 0.005 mmol) were added in an oven-dried Schlenk tube. The tube was then sealed, evacuated, and backfilled with nitrogen using standard Schlenk technique. Then, DCE (1 mL) was sequentially added by syringe at ambient temperature. The resulting mixture was heated to 65 °C (oil bath) for 48 hours. Solvents were evaporated under reduced pressure. The residue was directed purified by column chromatography on silica gel (petroleum ether/EtOAc = 2 : 1) to afford product **10**. **10** (13.8 mg) was obtained as a white solid in 64% yield after flash chromatography.[3]



Mp: 251-253 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.92 (s, 1H), 8.37 (d, *J* = 8.2 Hz, 1H), 7.86 (d, *J* = 8.4 Hz, 1H), 7.64 – 7.51 (m, 1H), 7.32 (t, *J* = 7.5 Hz, 1H), 6.27 (s, 1H), 2.84 – 2.60 (m, 2H), 1.84 – 1.60 (m, 2H), 1.31 – 1.13 (m, 8H), 0.80 (t, *J* = 6.9 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 178.97, 155.93, 140.92, 131.87, 125.15, 124.99, 123.68, 118.92, 108.08, 34.46, 31.74, 29.32, 29.30, 29.06, 22.65, 14.12. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{16}H_{22}NO$: 244.1696, observed: 244.1692.

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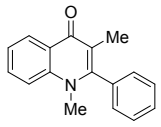
[3] Szamosvári, D.; Reichle, V. F.; Jureschia, M.; Böttcher, T. *Chem*. *Commun*., **2016**, *52*, 13440-13443.

8. Synthesis and characterization of 1,3-dimethyl-2-phenylquinolin-4(1H)-one (11)

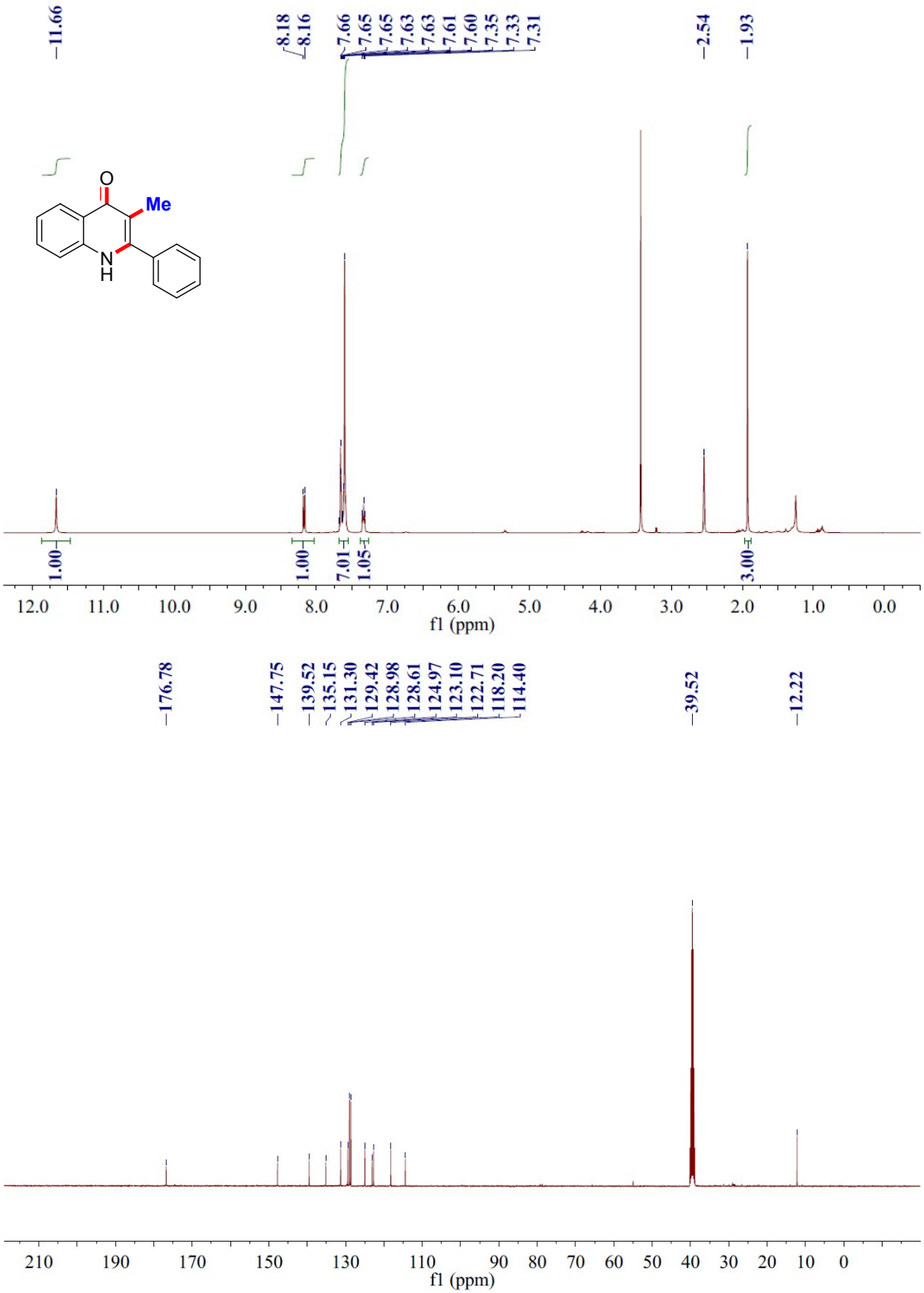
A mixture of 3-methyl-2-phenylquinolin-4(1H)-one **8a** (54 mg, 0.23 mmol) and NaH (9.2 mg, 0.23 mmol, 60 % dispersion in mineral oil) in dry THF (30 mL) was stirred at rt for 30 min. After this period, an excess of MeI (0.28 mL, 4.6 mmol) was added and the reaction mixture was stirred for 6 h. Then it was poured over H_2O (10 mL), ice (10 g), and acidified with diluted HCl (20%) to pH 5. The mixture was extracted with ethyl acetate and dried over anhydrous sodium sulfate. The solvent was evaporated and the residue purified by column chromatography on silica gel (petroleum ether/EtOAc = 4 : 1) . **11** (20.2 mg) was obtained as a white solid in 81% yield.



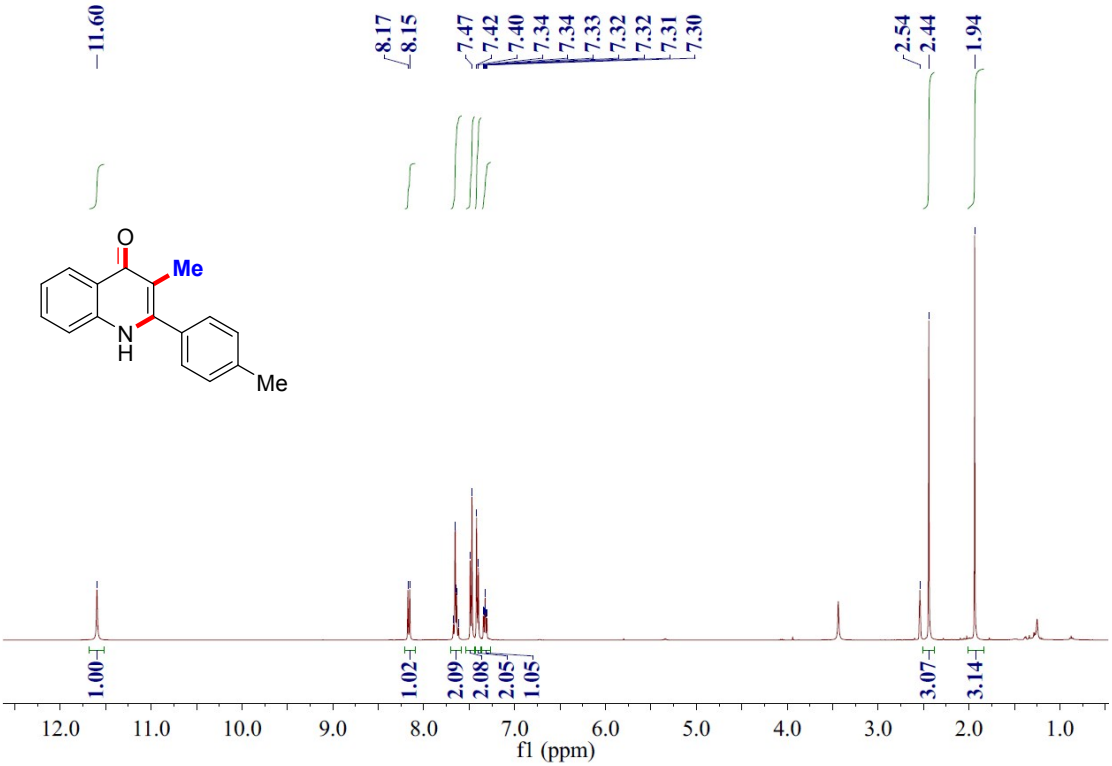
Mp: 140-142 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.56 (d, *J* = 7.3 Hz, 1H), 7.67 (t, *J* = 8.3 Hz, 1H), 7.61 – 7.46 (m, 4H), 7.39 (t, *J* = 7.4 Hz, 1H), 7.29 (d, *J* = 6.4 Hz, 2H), 3.48 (s, 3H), 1.87 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 177.56, 151.24, 140.98, 135.69, 131.89, 129.26, 129.16, 128.49, 126.91, 125.14, 123.14, 118.15, 115.56, , 37.30, 13.41. HRMS (ESI) m/z $(M+H)^+$ calculated for $C_{17}H_{16}NO$: 250.1227, observed: 250.1230.

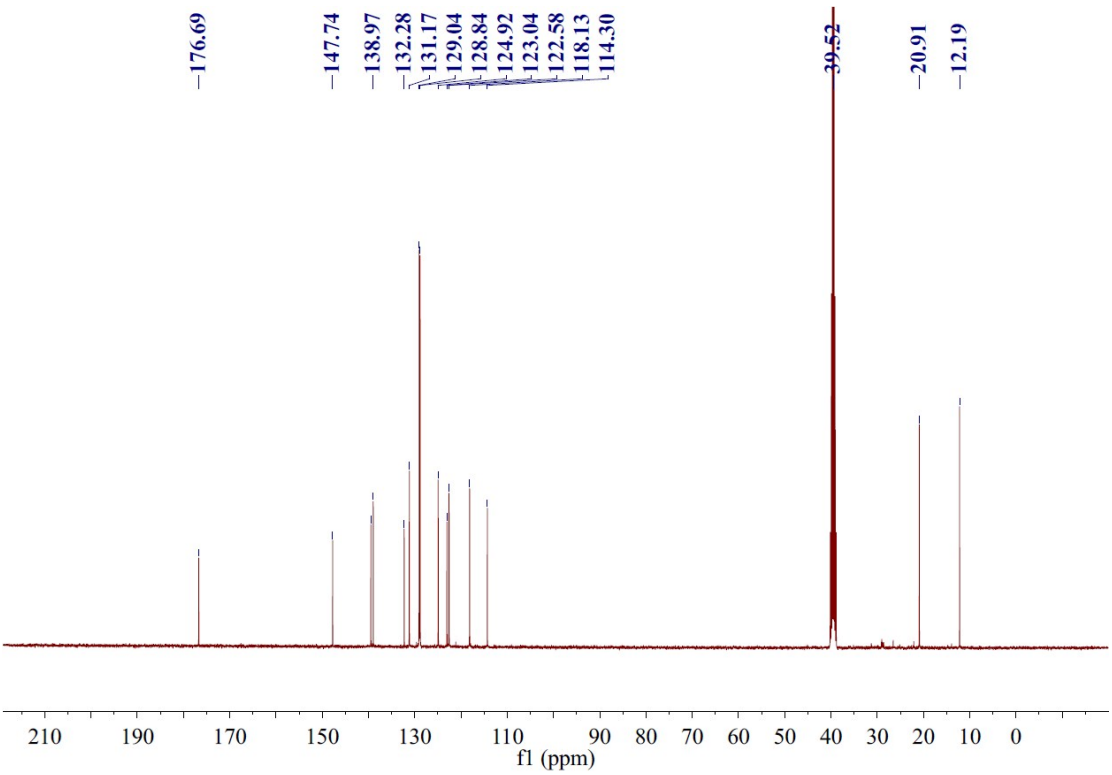
9. ^{1}H NMR, ^{13}C NMR and ^{19}F NMR Spectra for the Substituted 4-Quinolone Products

3-methyl-2-phenylquinolin-4(1H)-one (8a)

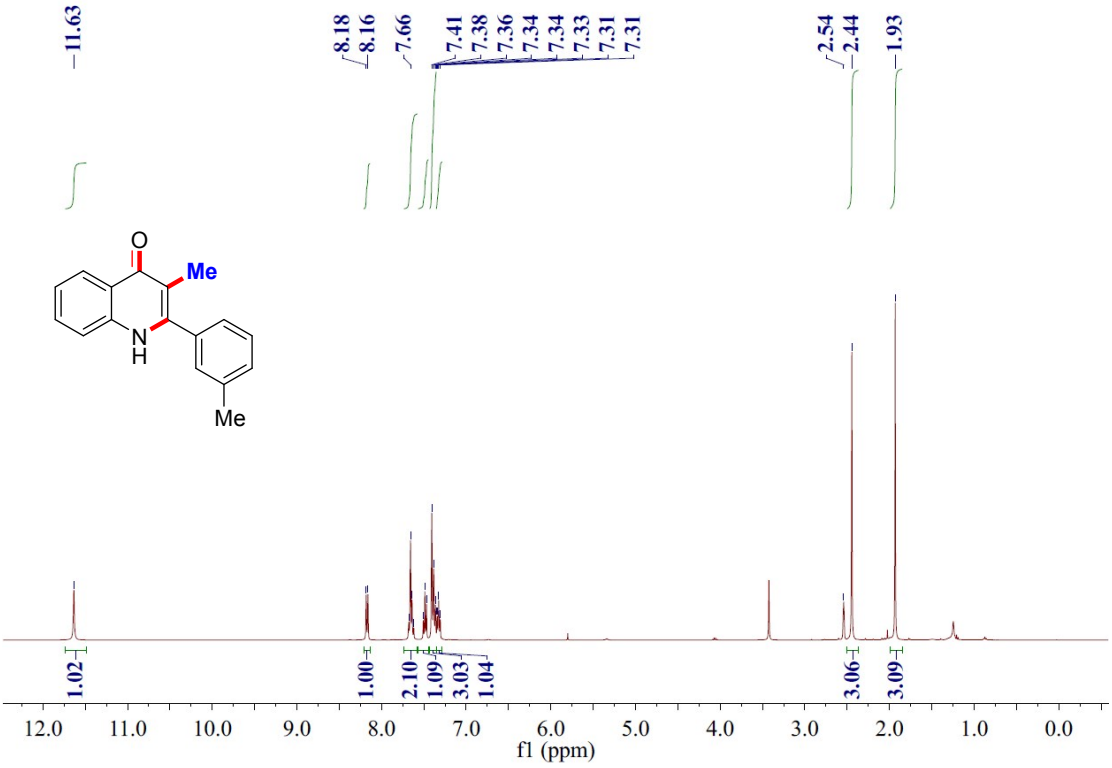


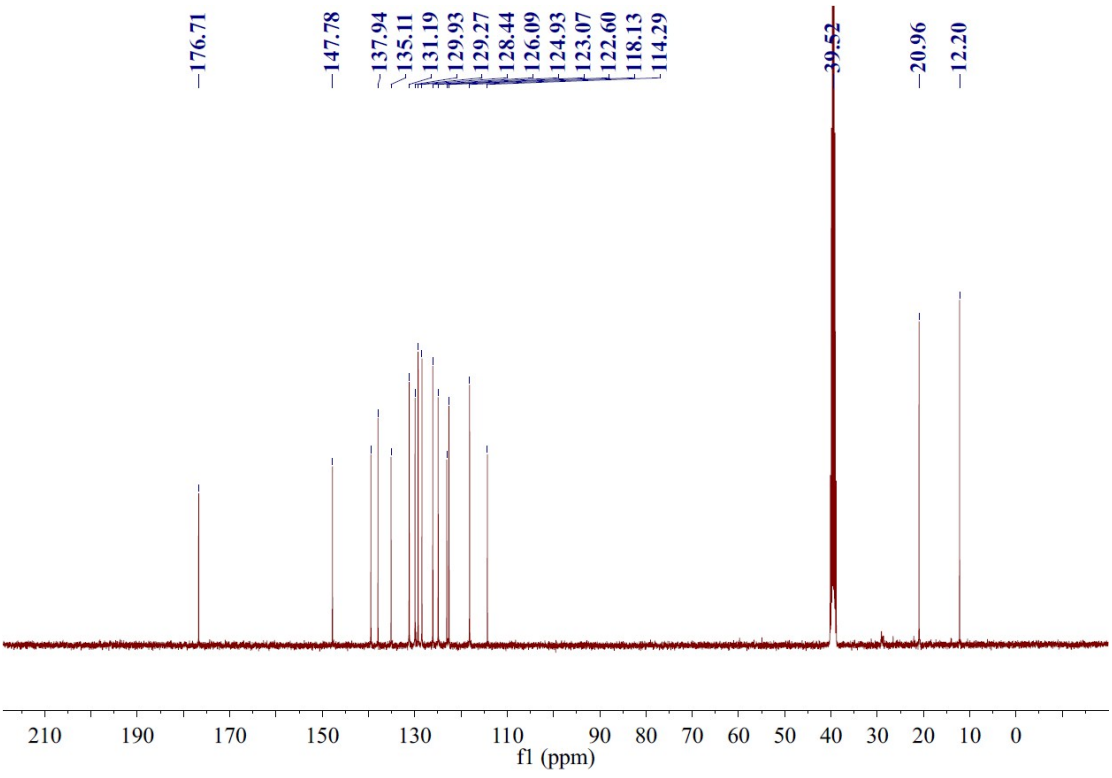
3-methyl-2-(p-tolyl)quinolin-4(1H)-one (8b)



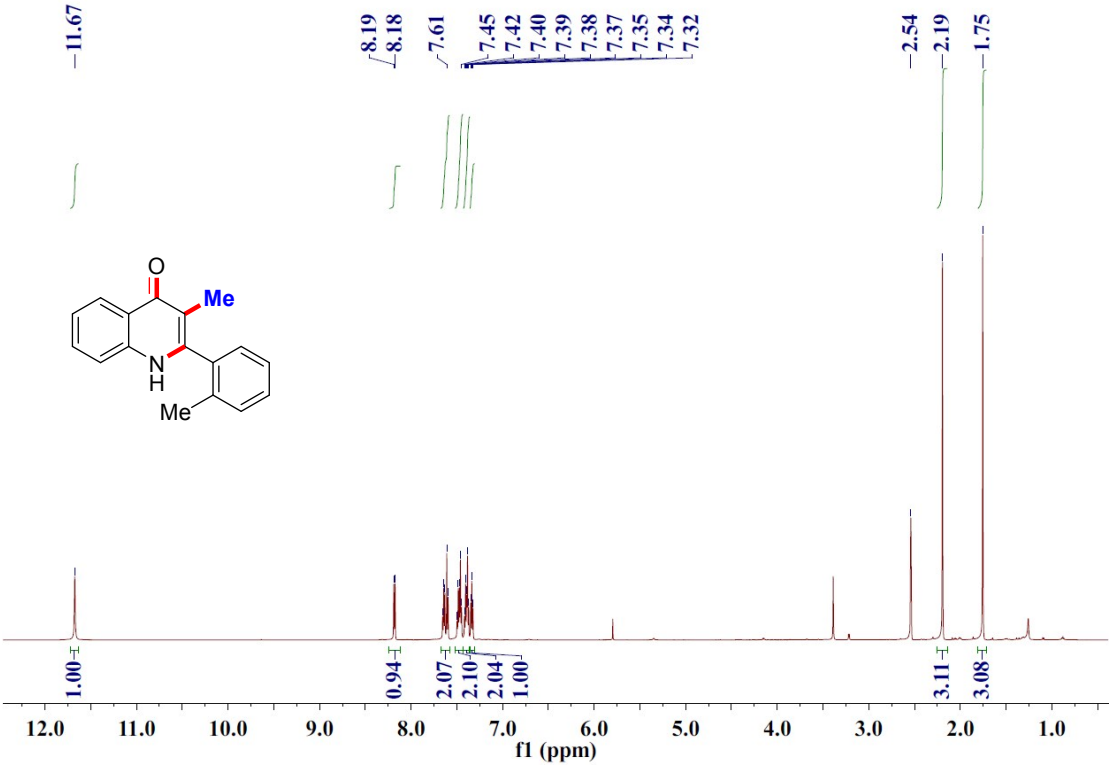


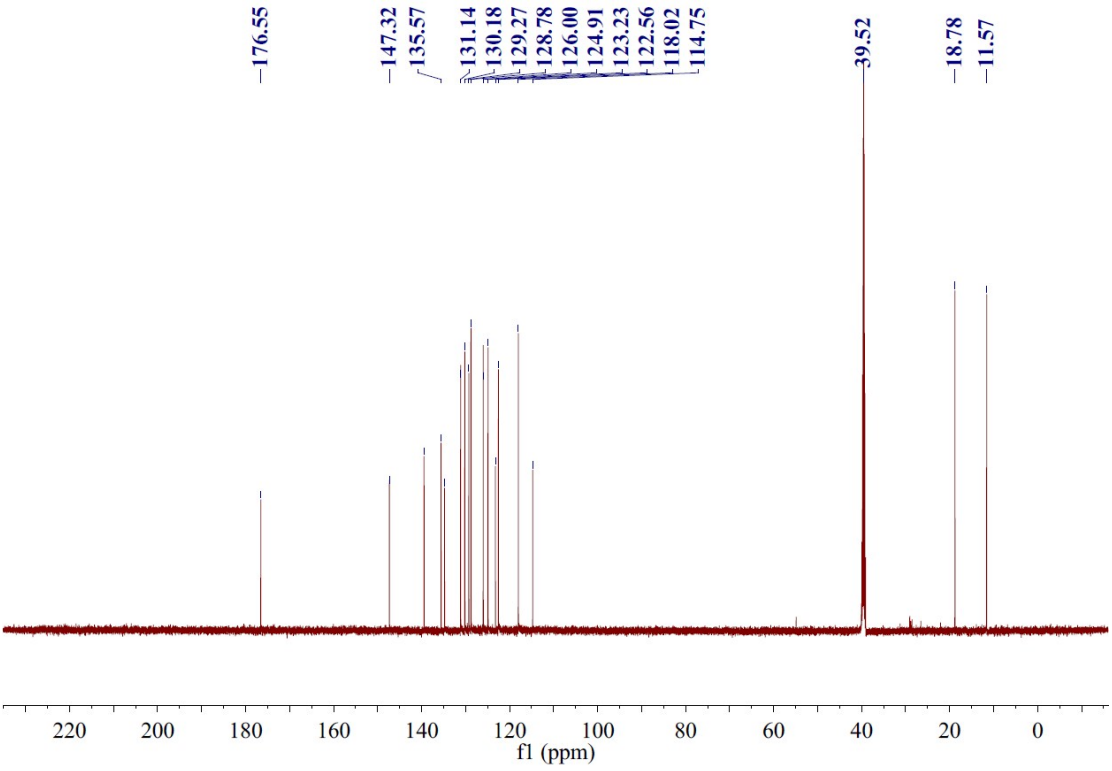
3-methyl-2-(m-tolyl)quinolin-4(1H)-one (8c)



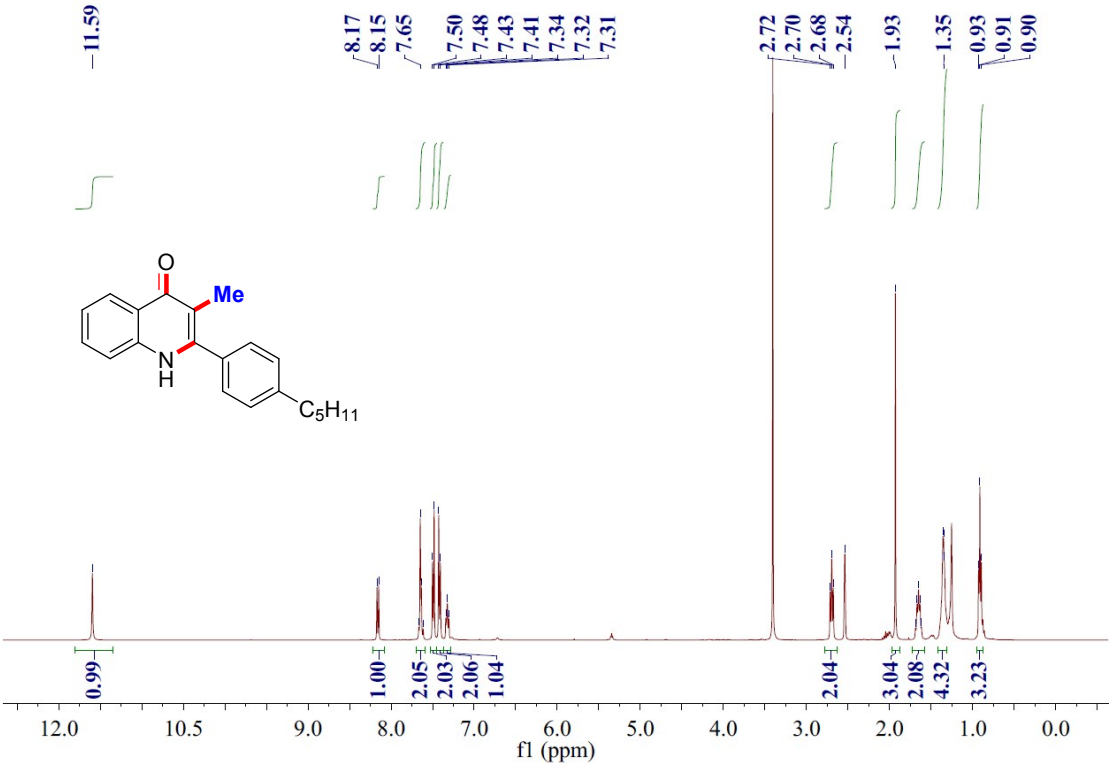


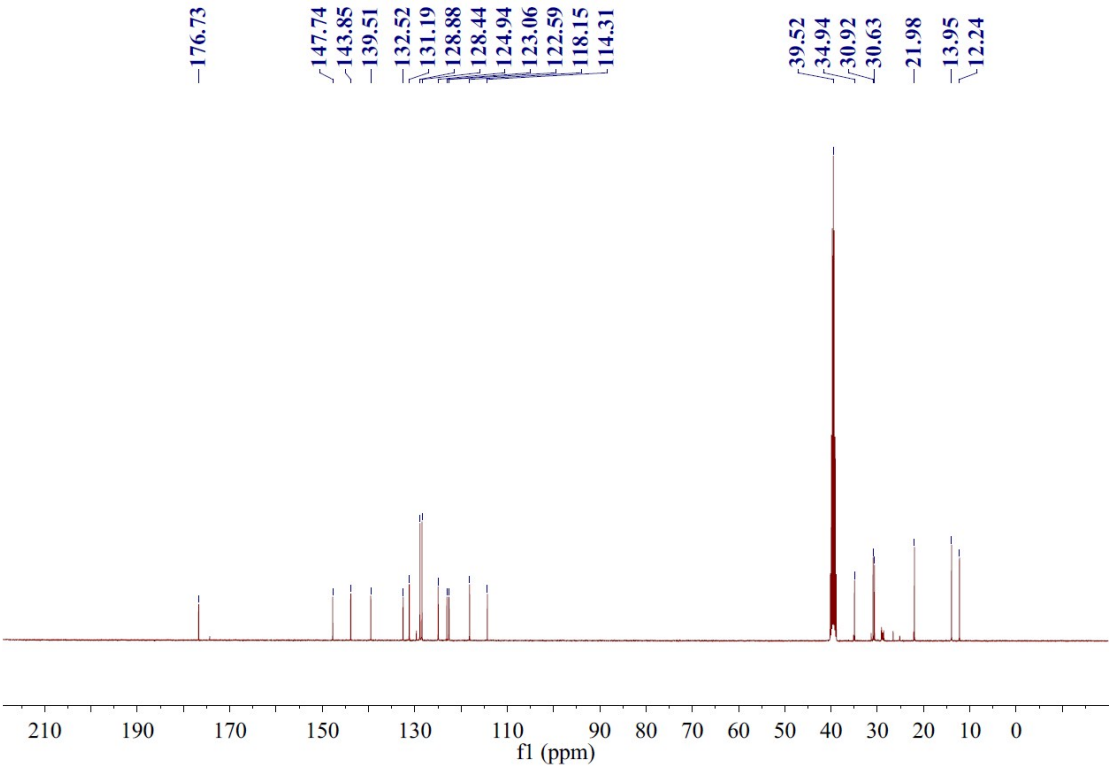
3-methyl-2-(o-tolyl)quinolin-4(1H)-one (8d)



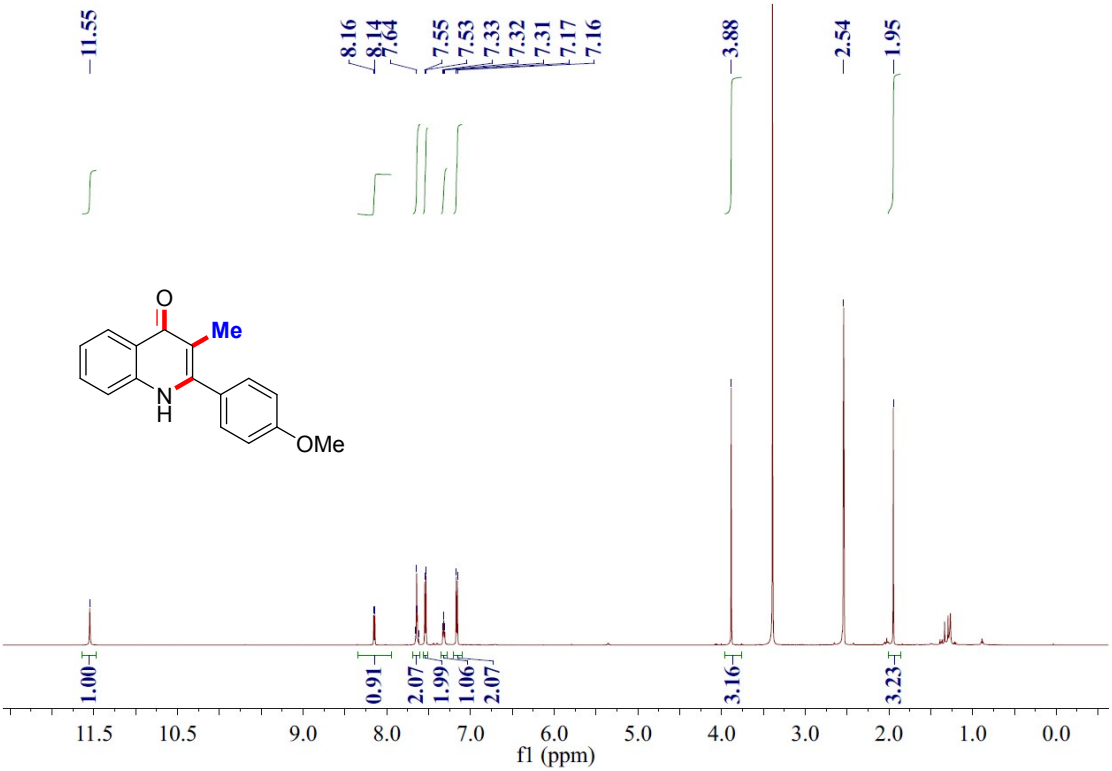


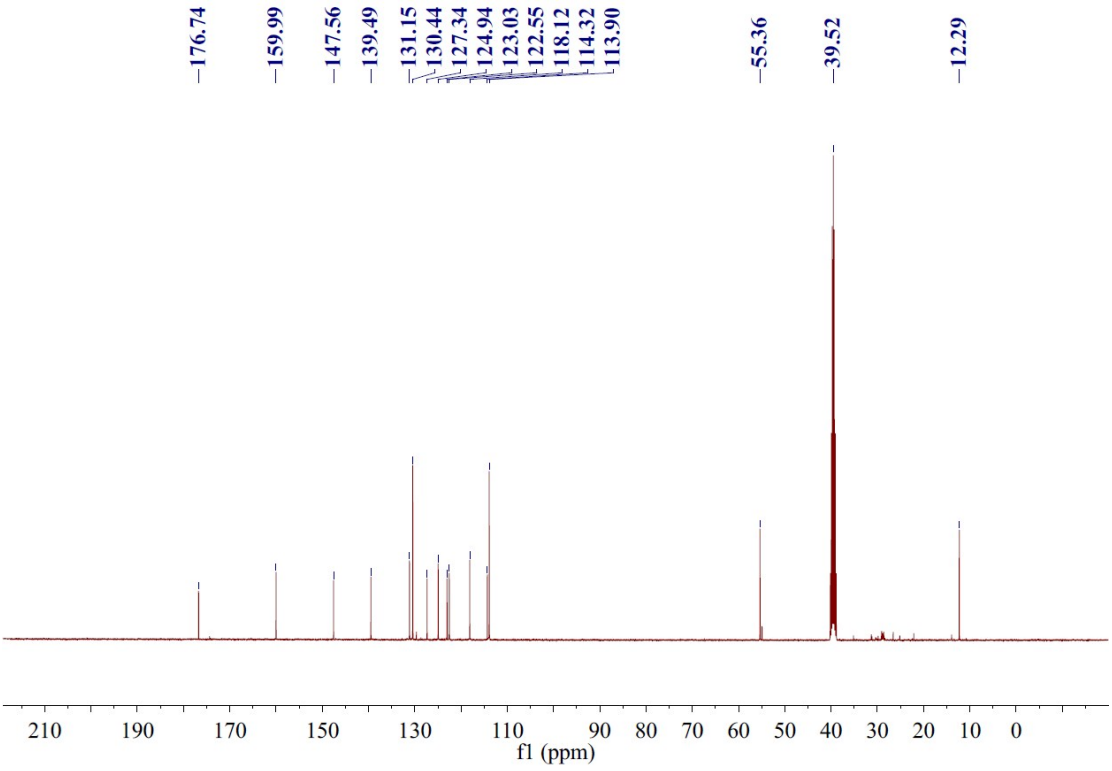
3-methyl-2-(4-pentylphenyl)quinolin-4(1H)-one (8e)



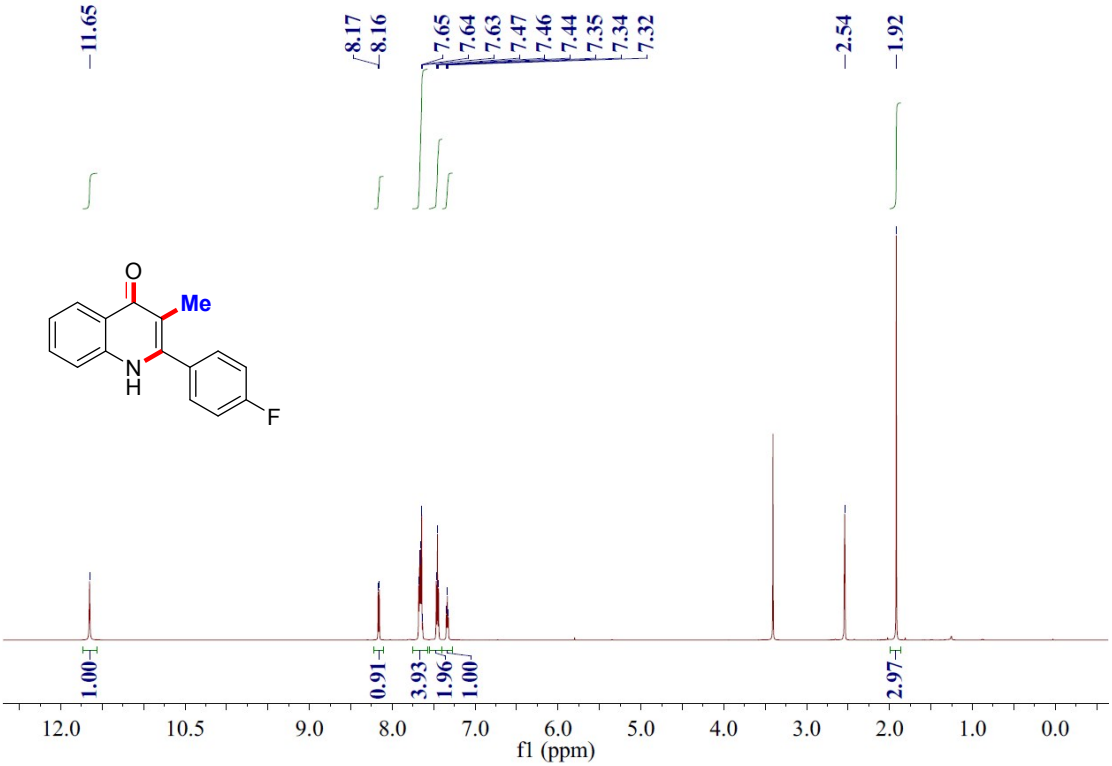


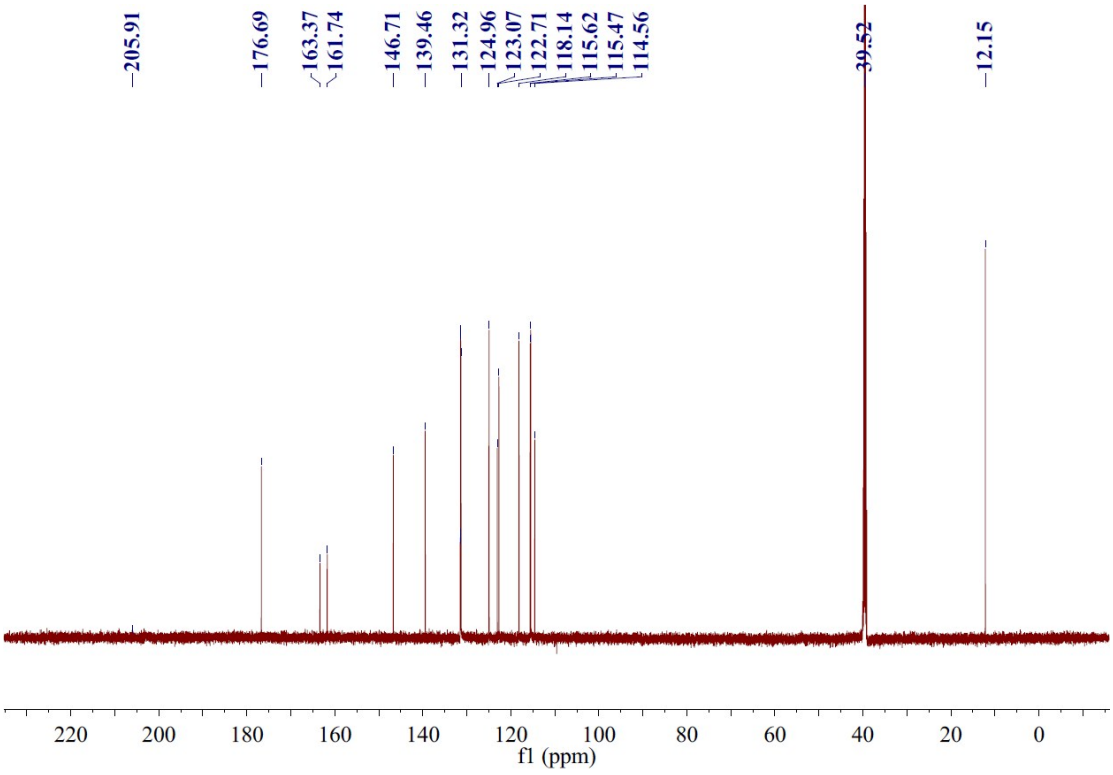
2-(4-methoxyphenyl)-3-methylquinolin-4(1H)-one (8f)

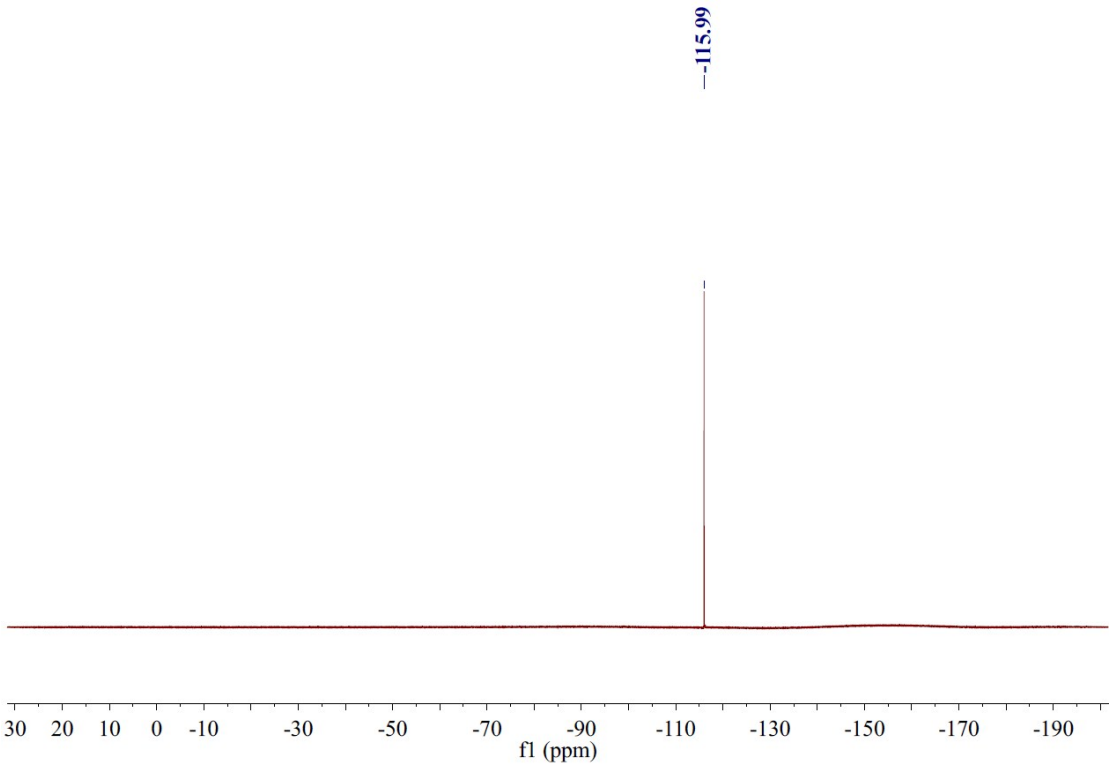




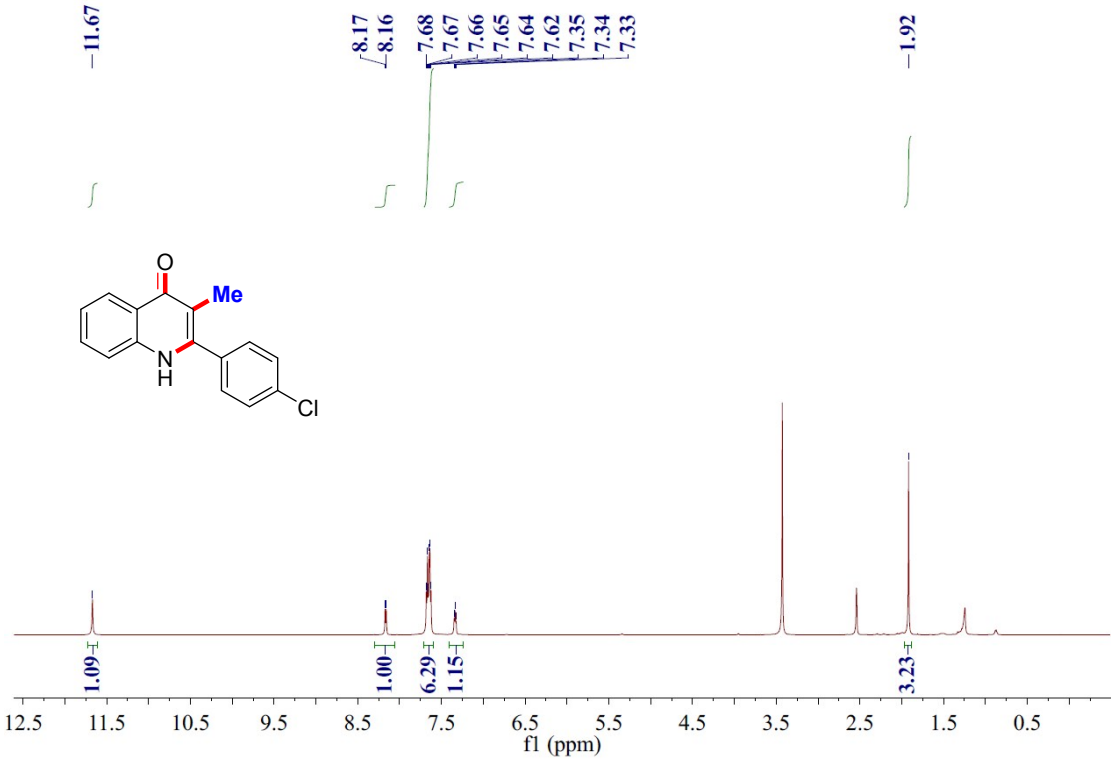
2-(4-fluorophenyl)-3-methylquinolin-4(1H)-one (8g)

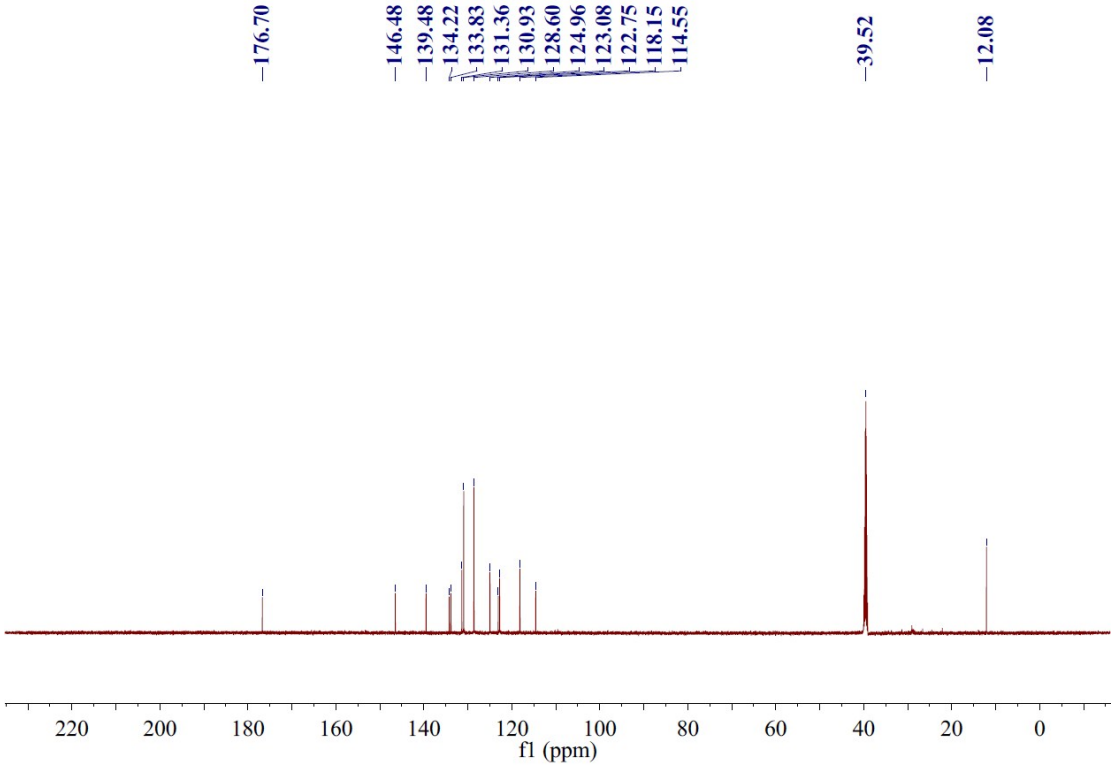




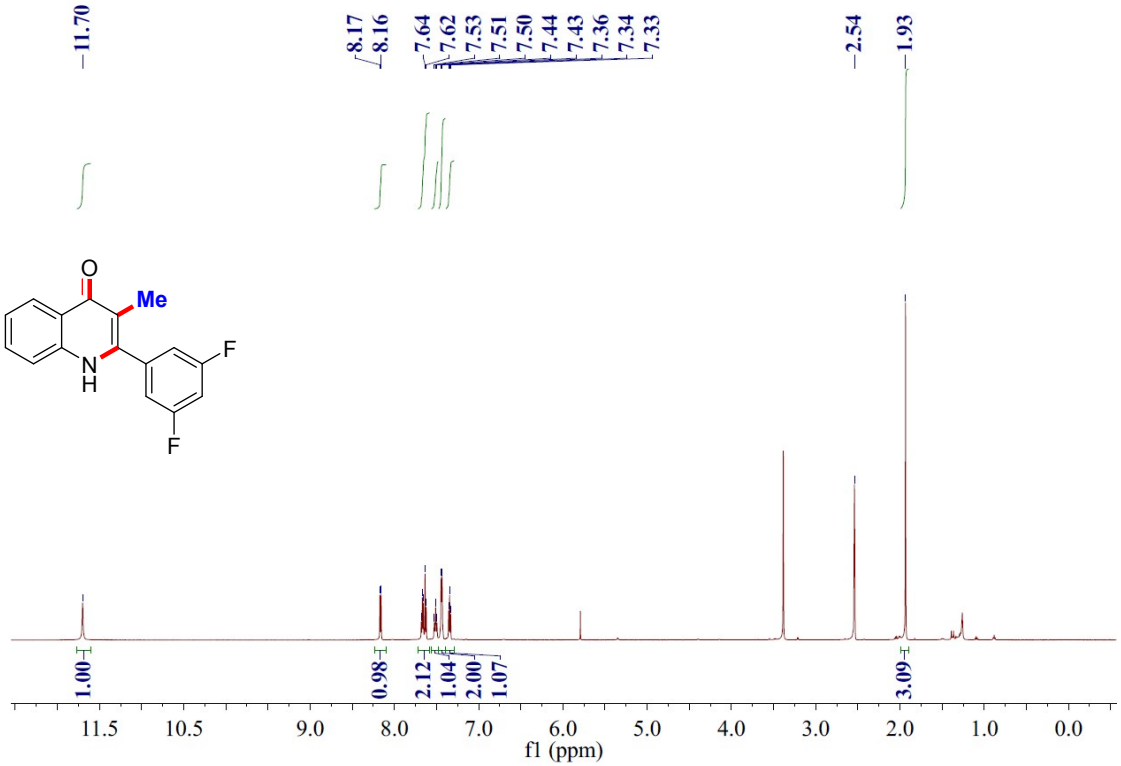

-115.99
30 20 10 0 -10 -30 -50 -70 -90 -110 -130 -150 -170 -190
f1 (ppm)

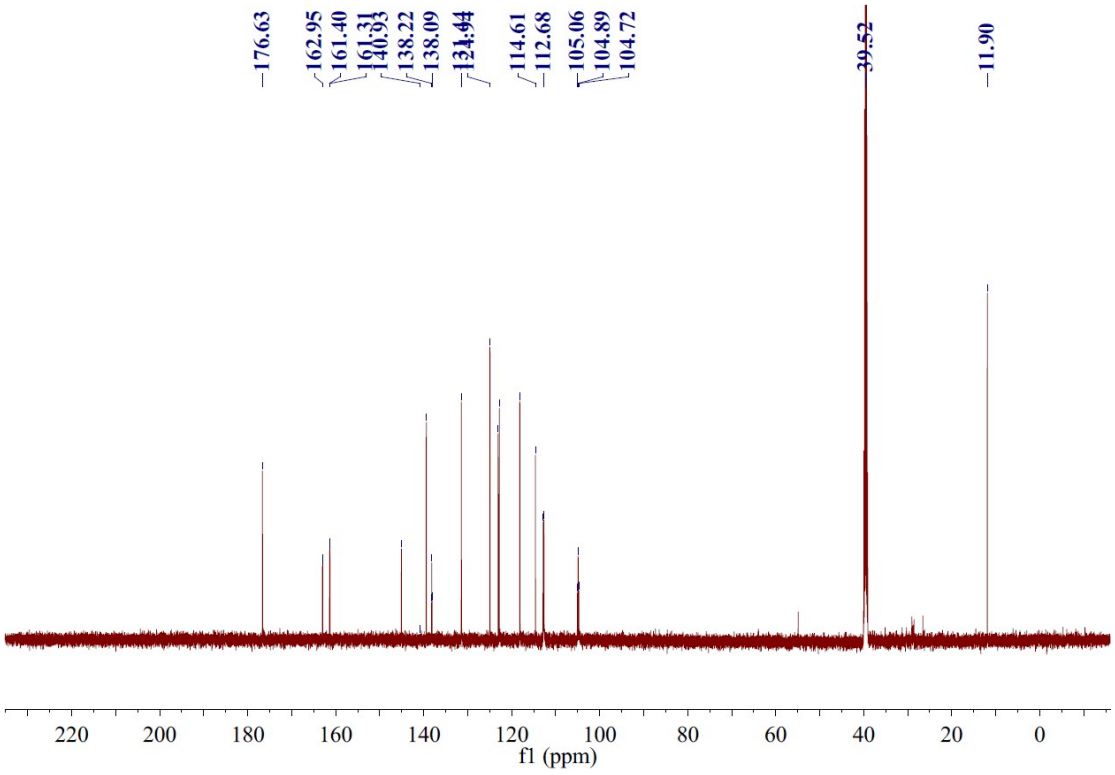
2-(4-chlorophenyl)-3-methylquinolin-4(1H)-one (8h)

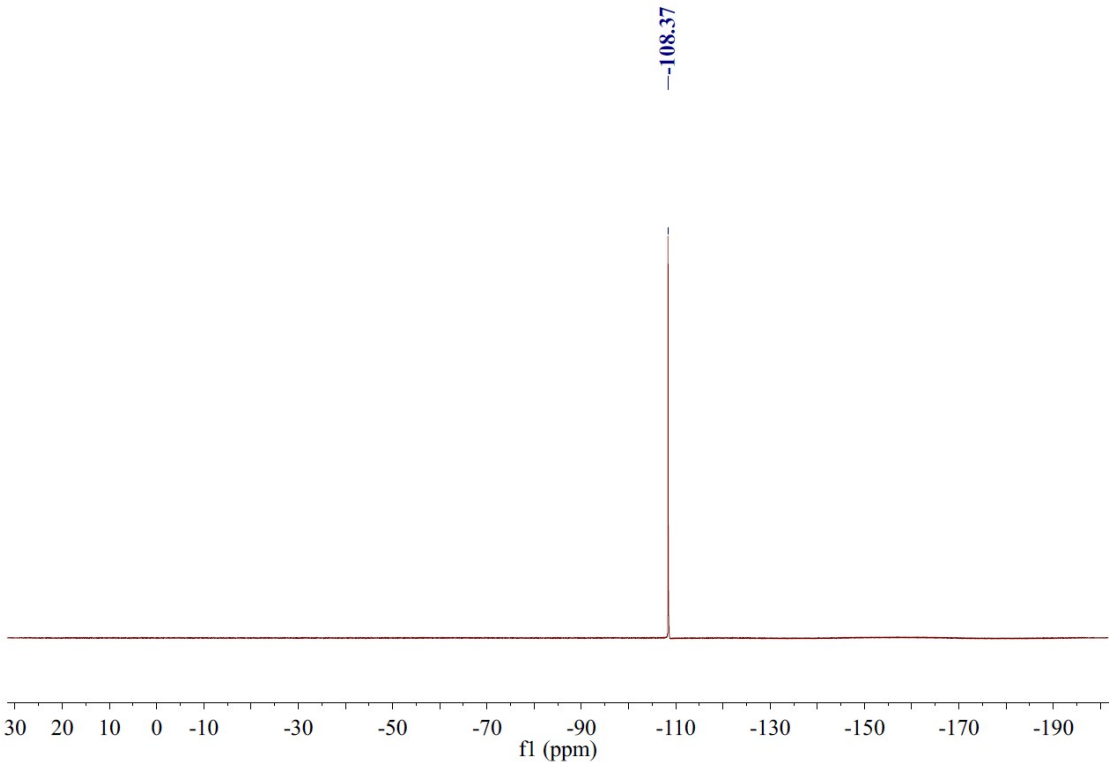




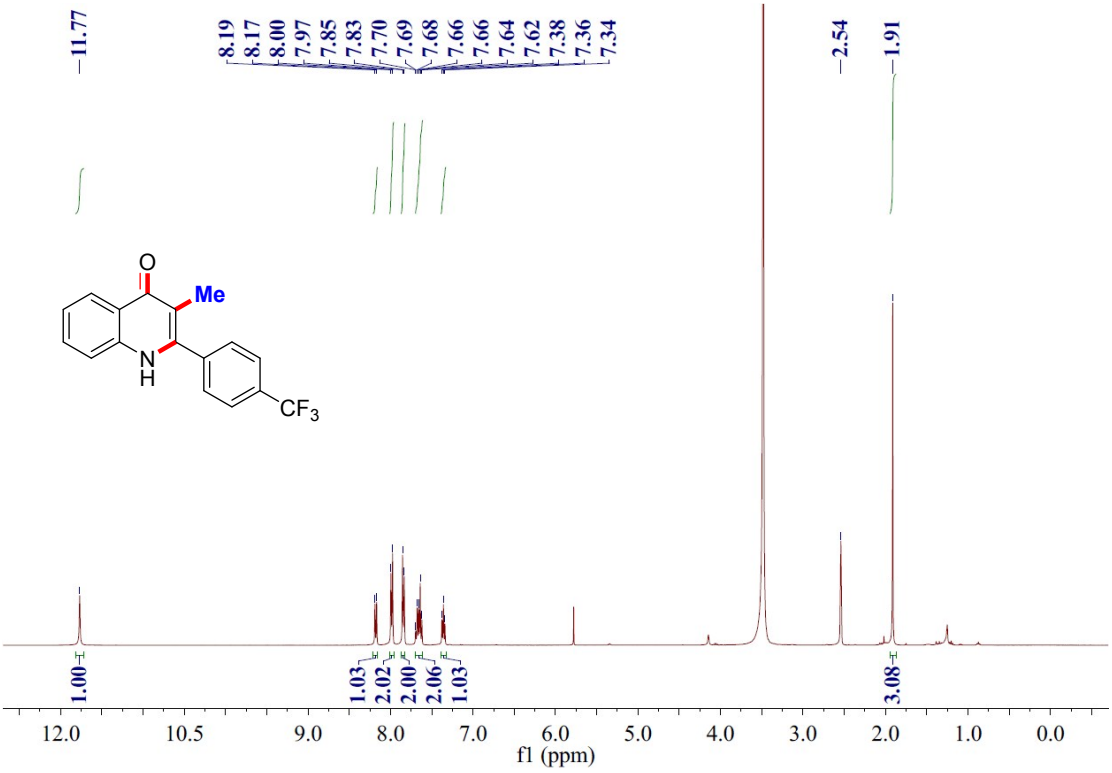
2-(3,5-difluorophenyl)-3-methylquinolin-4(1H)-one (8i)

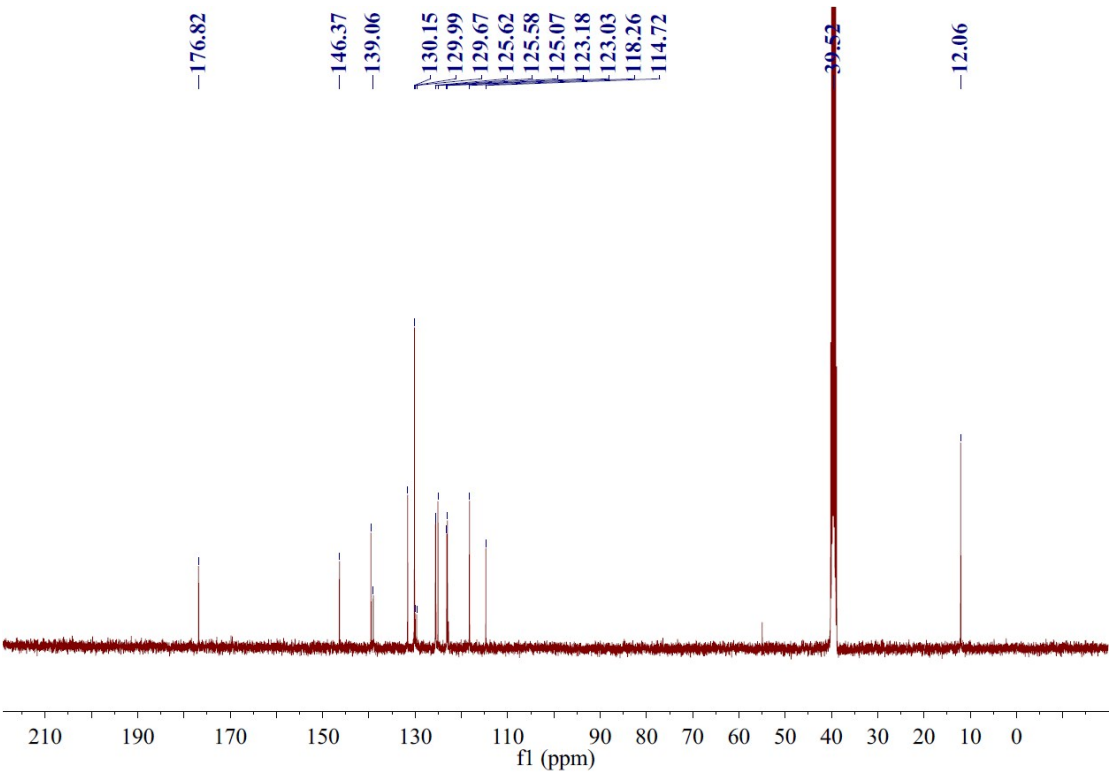


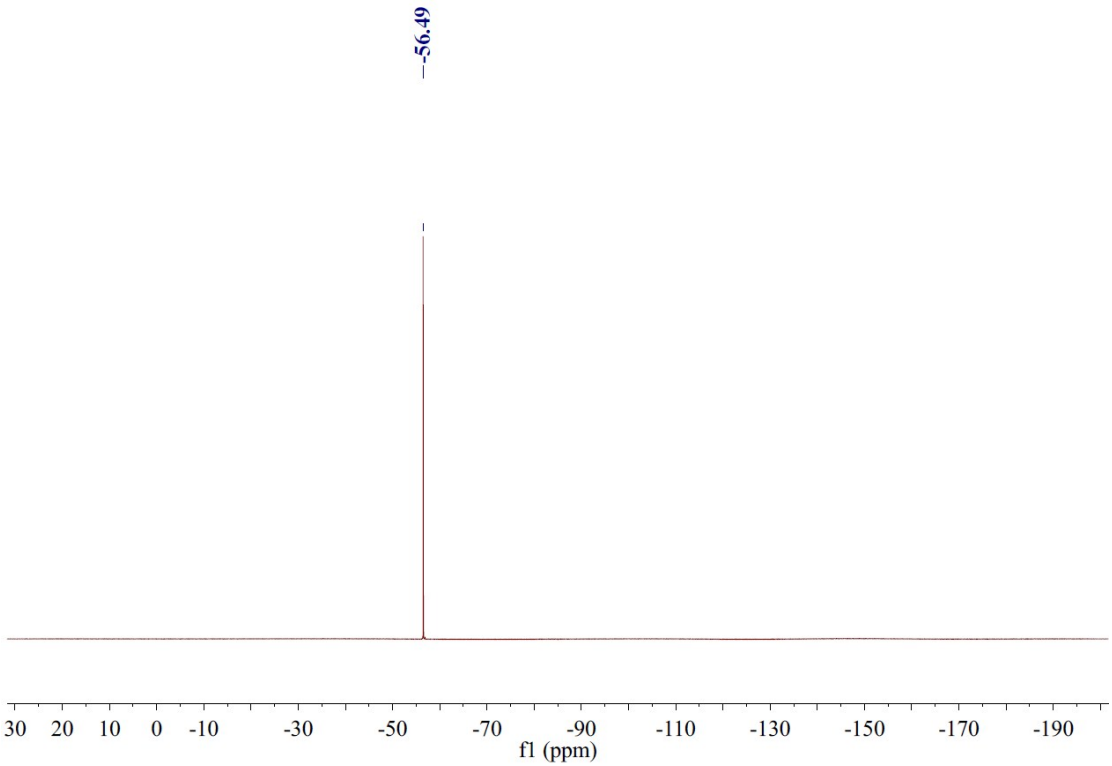



-108.37
30 20 10 0 -10 -30 -50 -70 -90 -110 -130 -150 -170 -190
f1 (ppm)

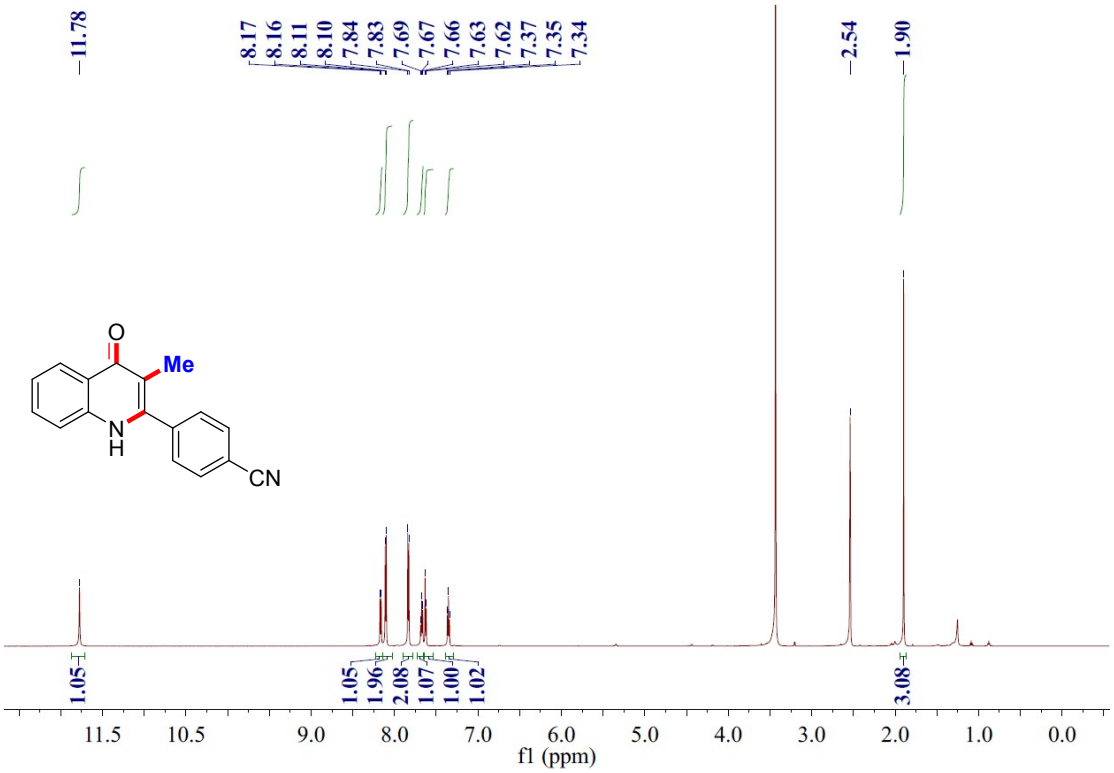
3-methyl-2-(4-(trifluoromethyl)phenyl)quinolin-4(1H)-one (8j)

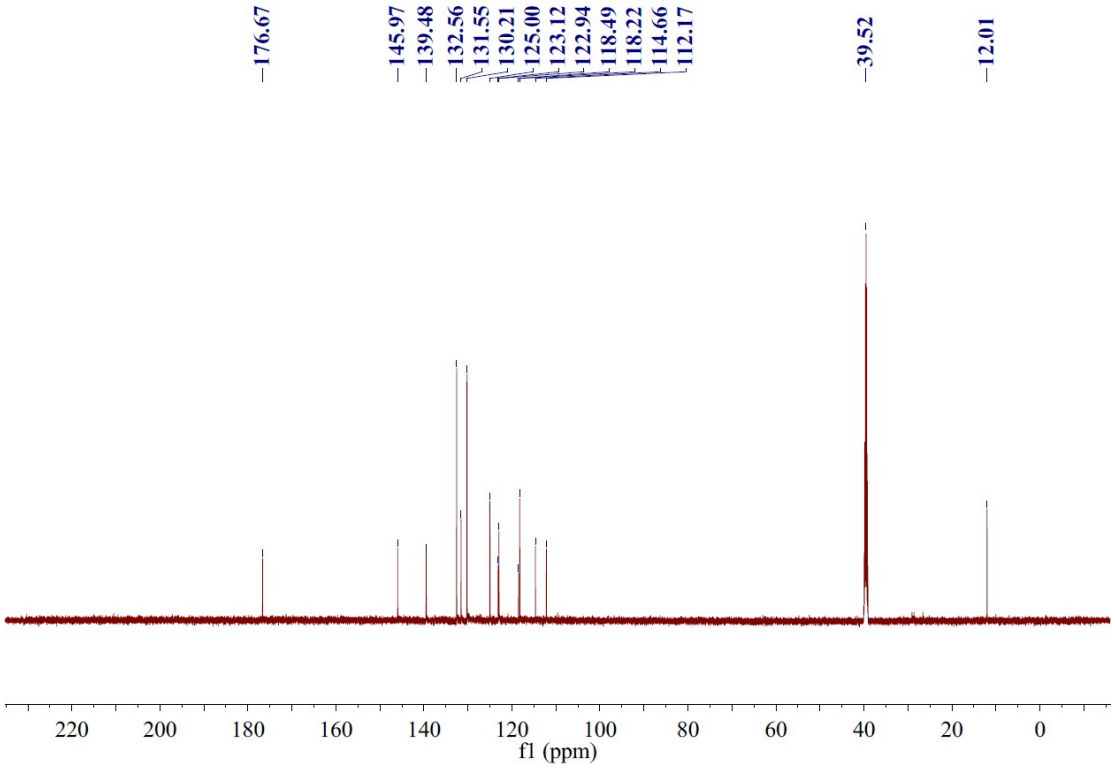




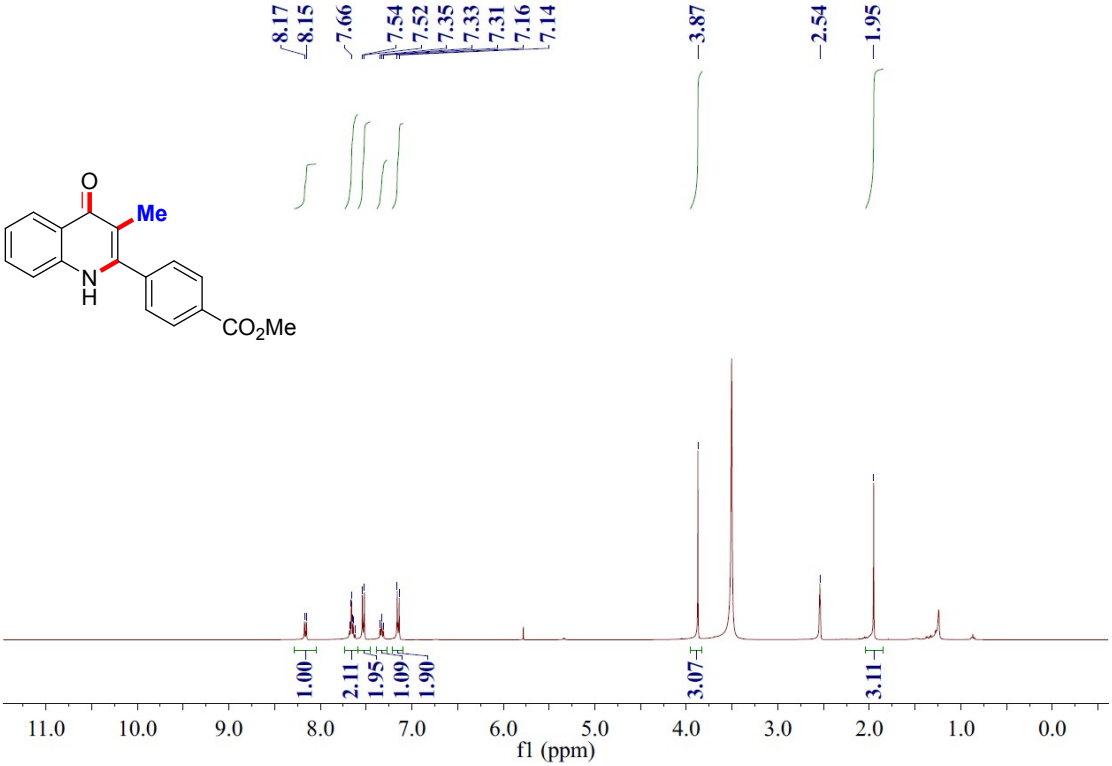

-56.49
30 20 10 0 -10 -30 -50 -70 -90 -110 -130 -150 -170 -190
f1 (ppm)

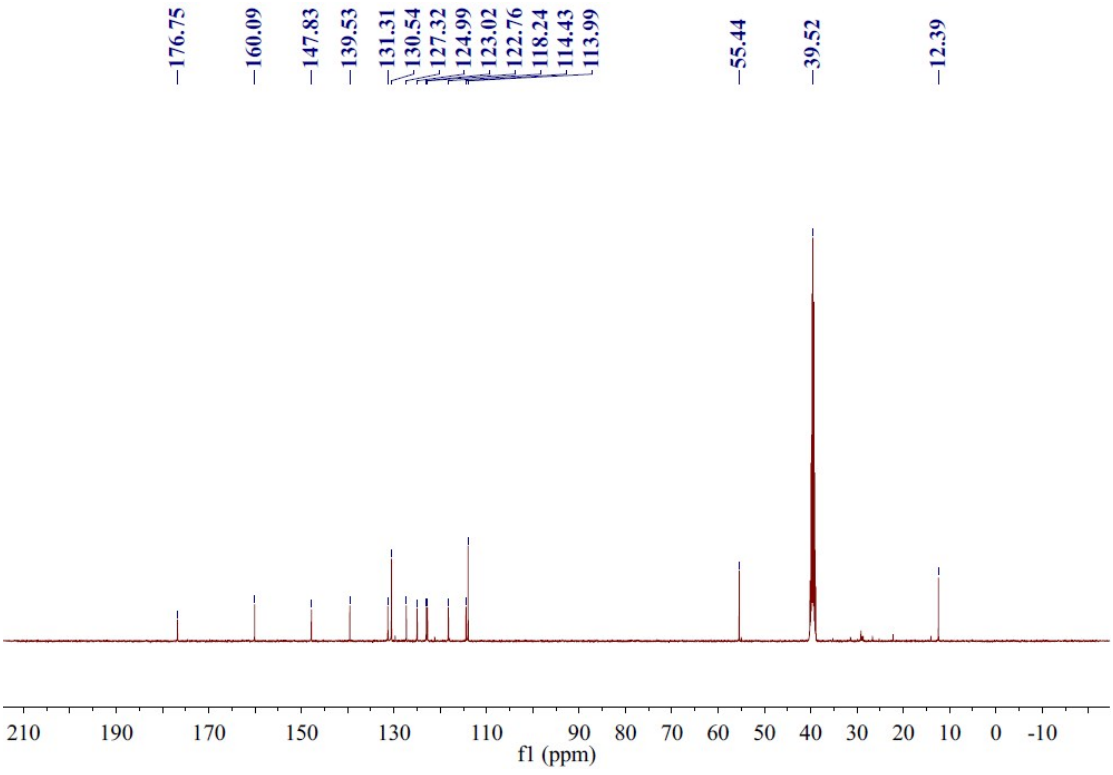
4-(3-methyl-4-oxo-1,4-dihydroquinolin-2-yl)benzonitrile (8k)



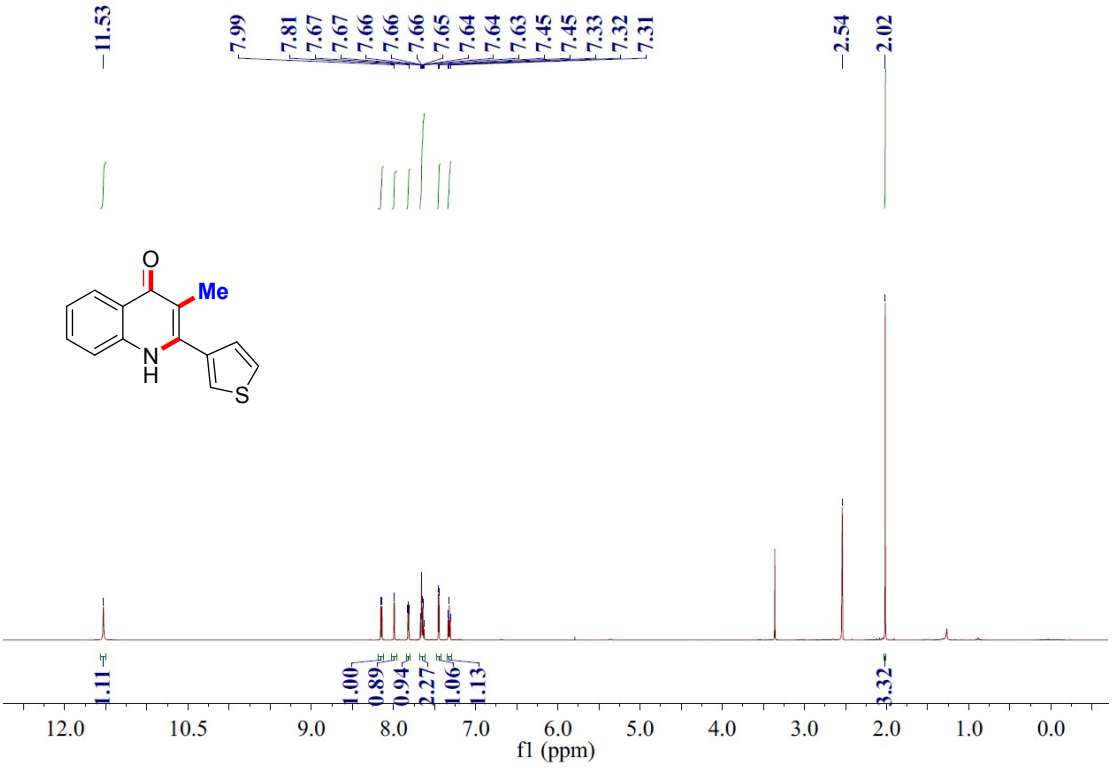


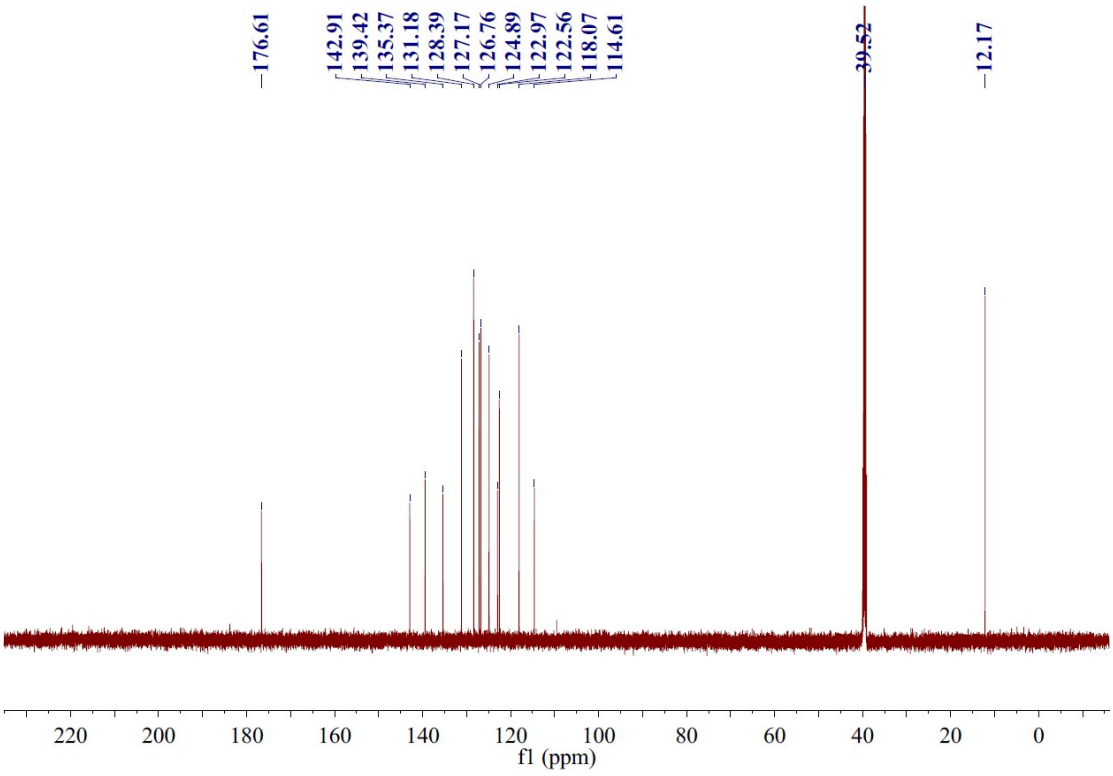
methyl 4-(3-methyl-4-oxo-1,4-dihydroquinolin-2-yl)benzoate (8l)



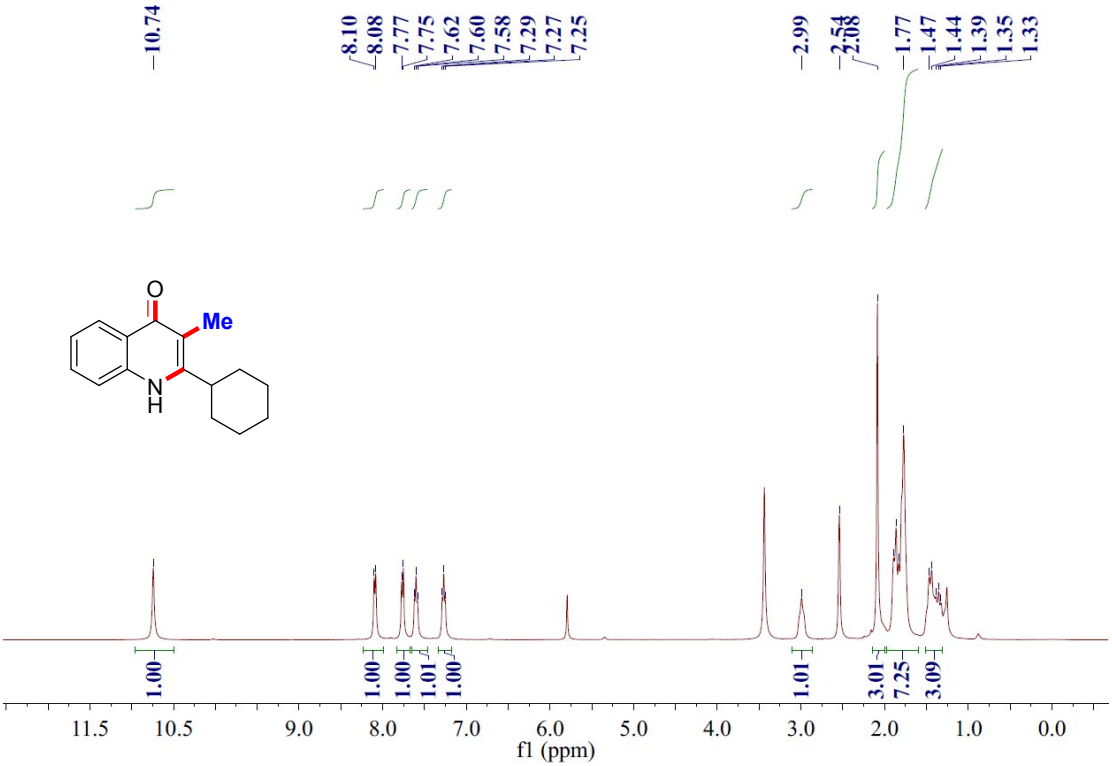


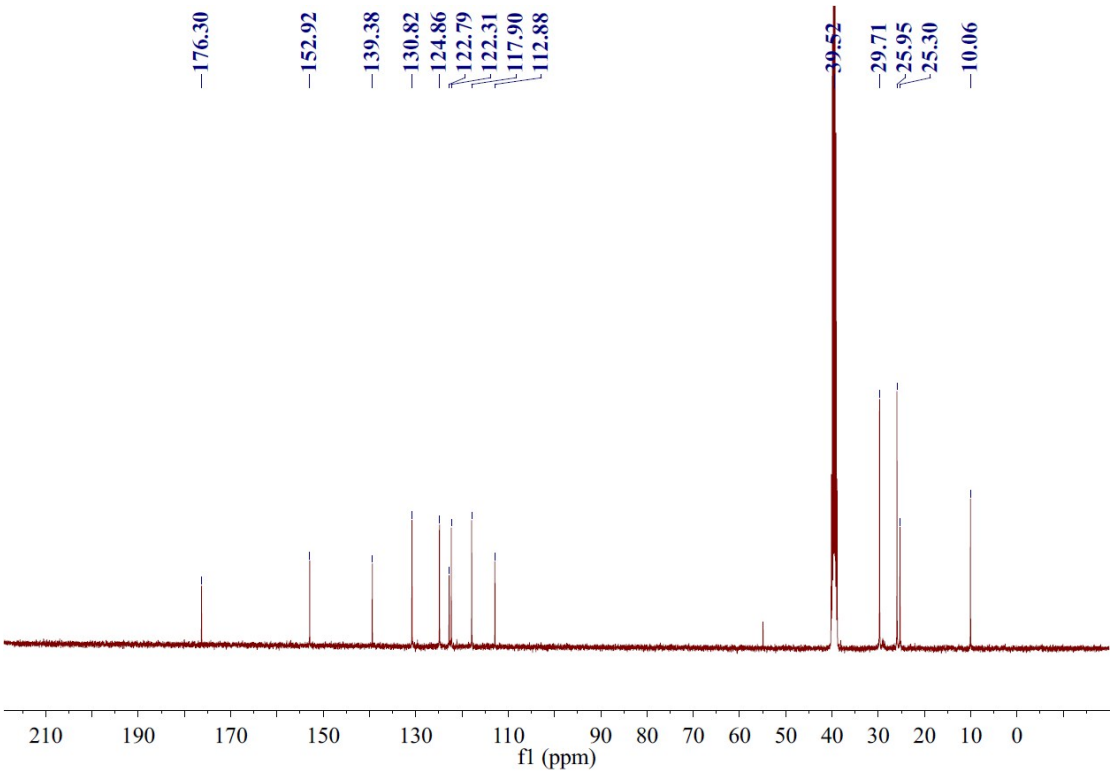
3-methyl-2-(thiophen-3-yl)quinolin-4(1H)-one (8m)

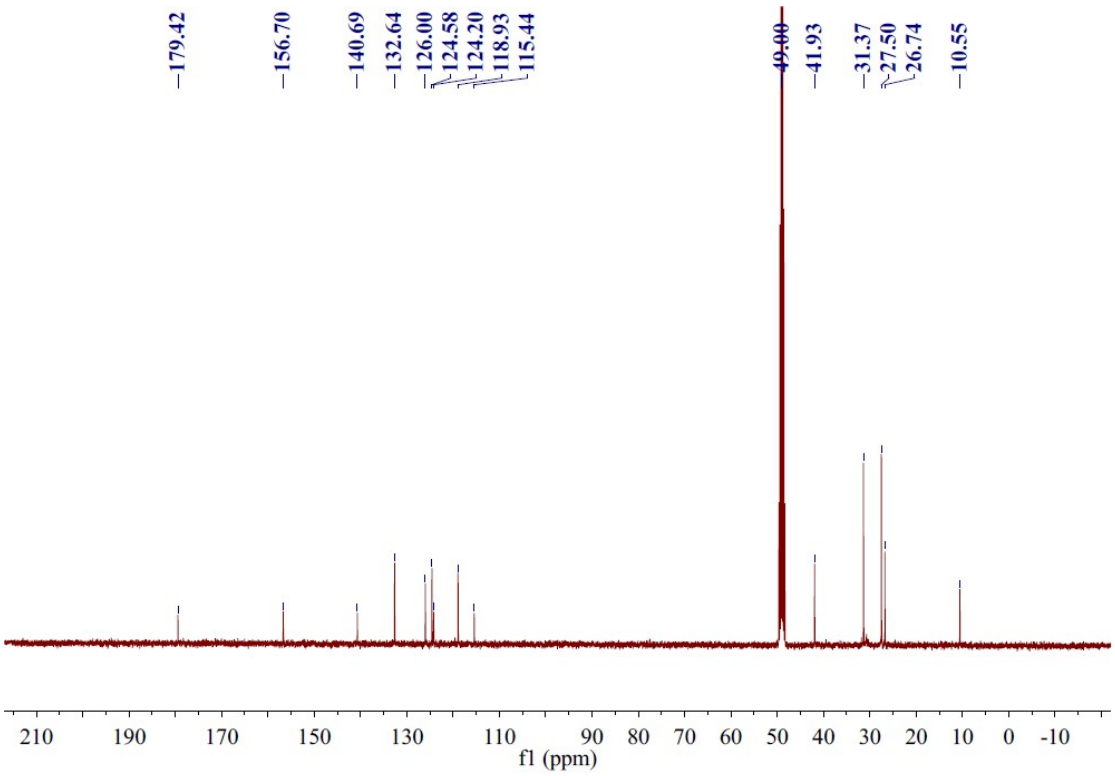




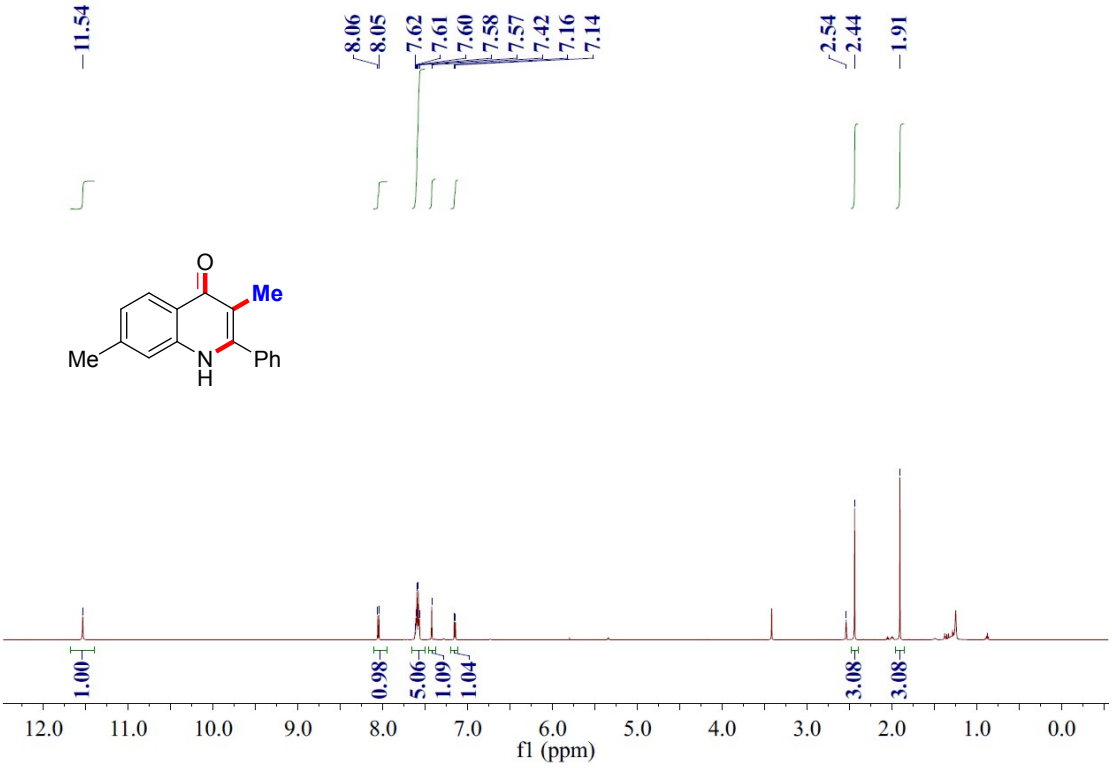
2-cyclohexyl-3-methylquinolin-4(1H)-one (8n)

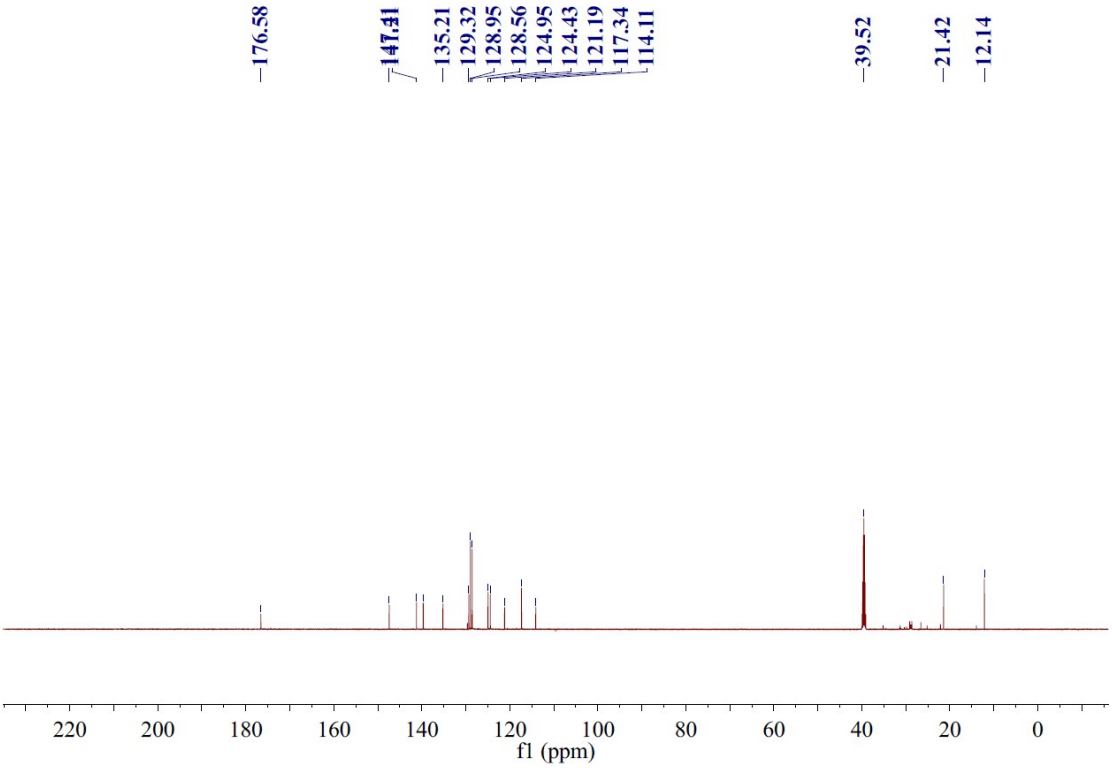




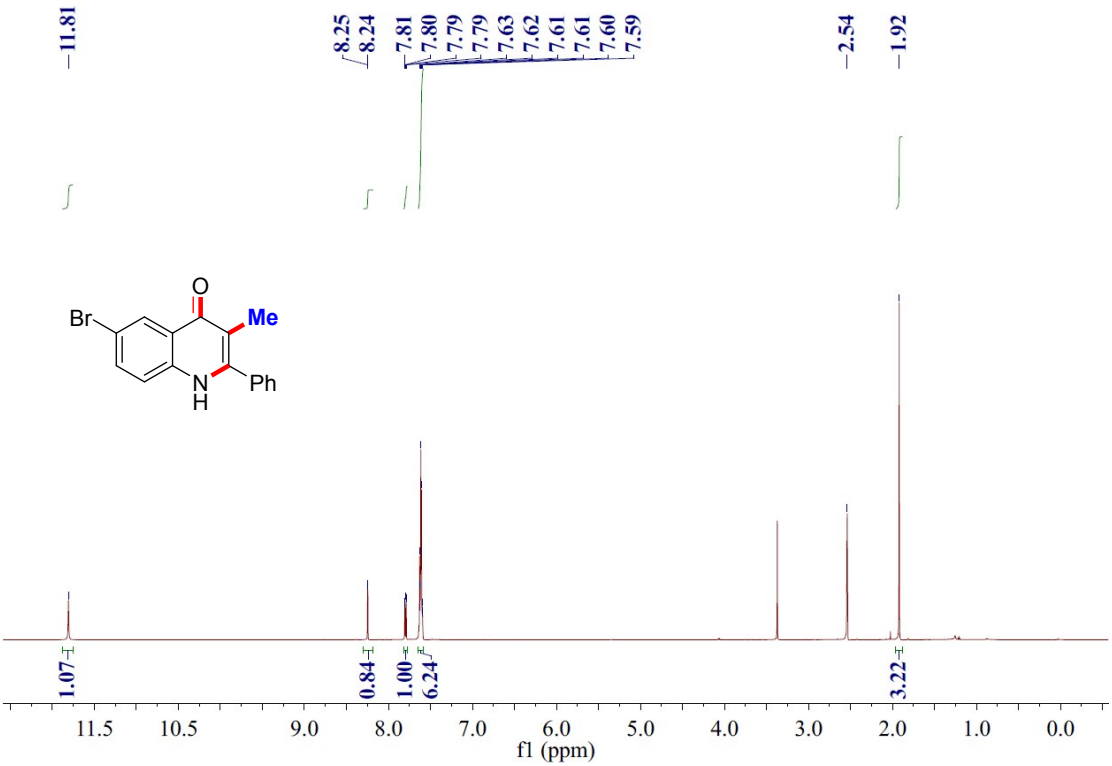

179.42
156.70
140.69
132.64
126.00
124.58
124.20
118.93
115.44
49.00
41.93
31.37
27.50
26.74
10.55
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

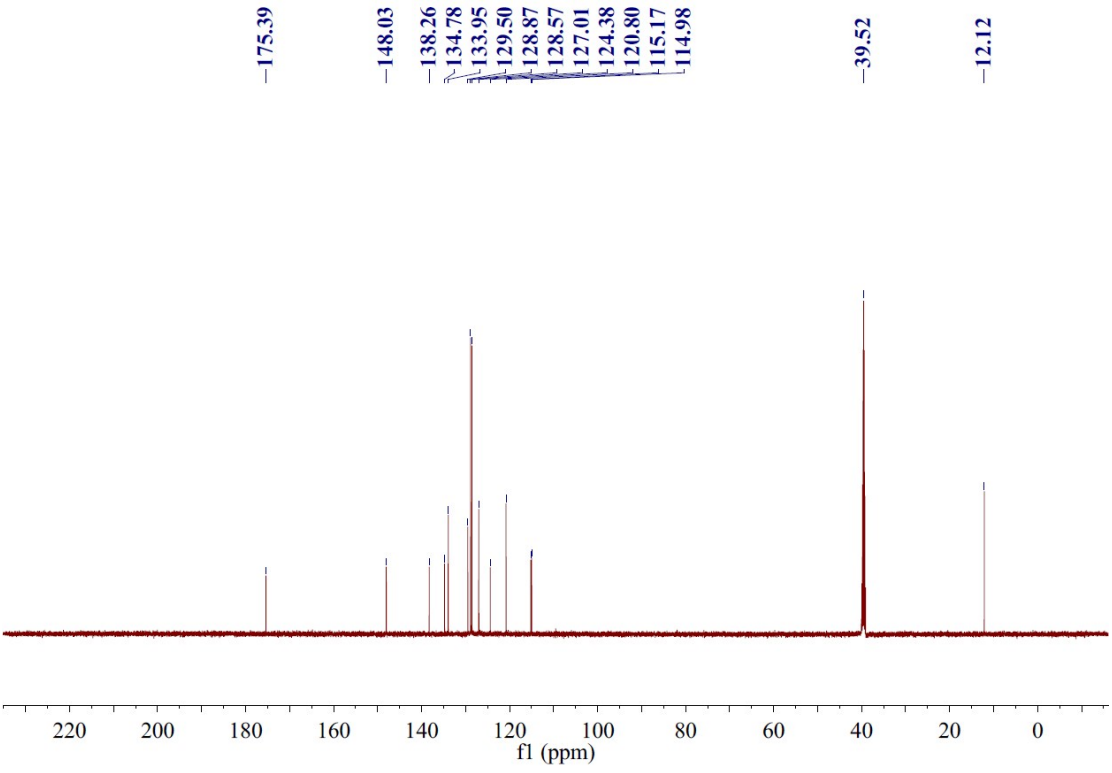
3,7-dimethyl-2-phenylquinolin-4(1H)-one (8o)



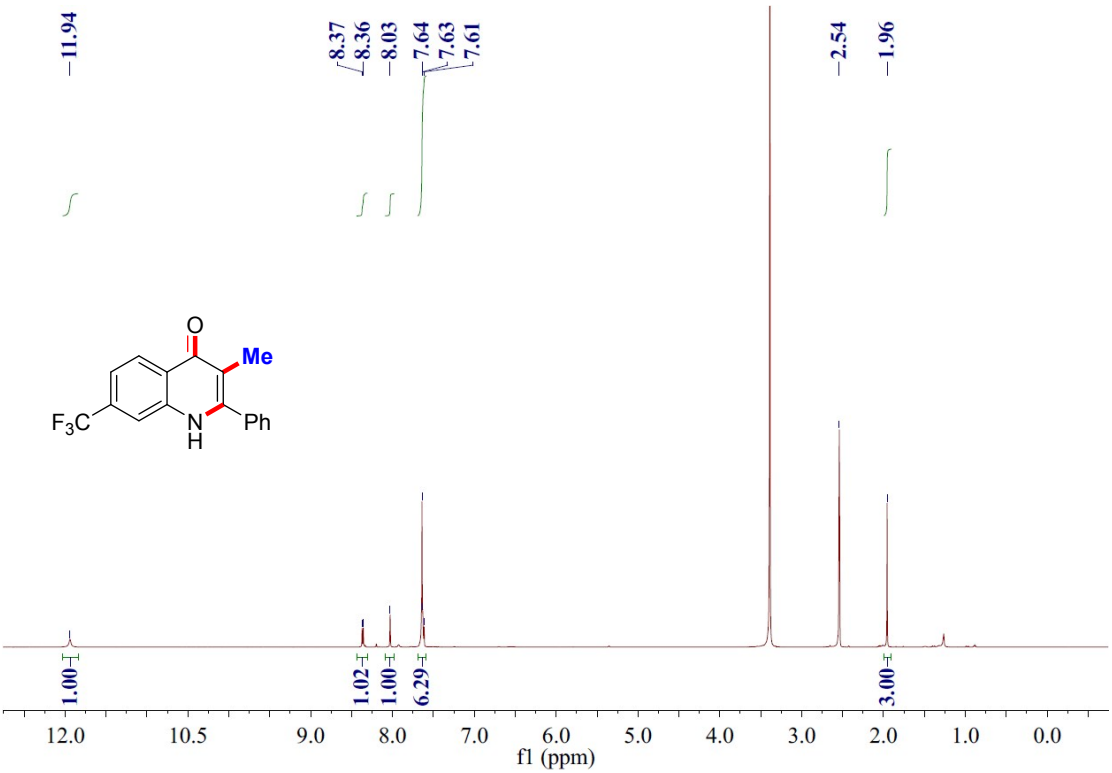


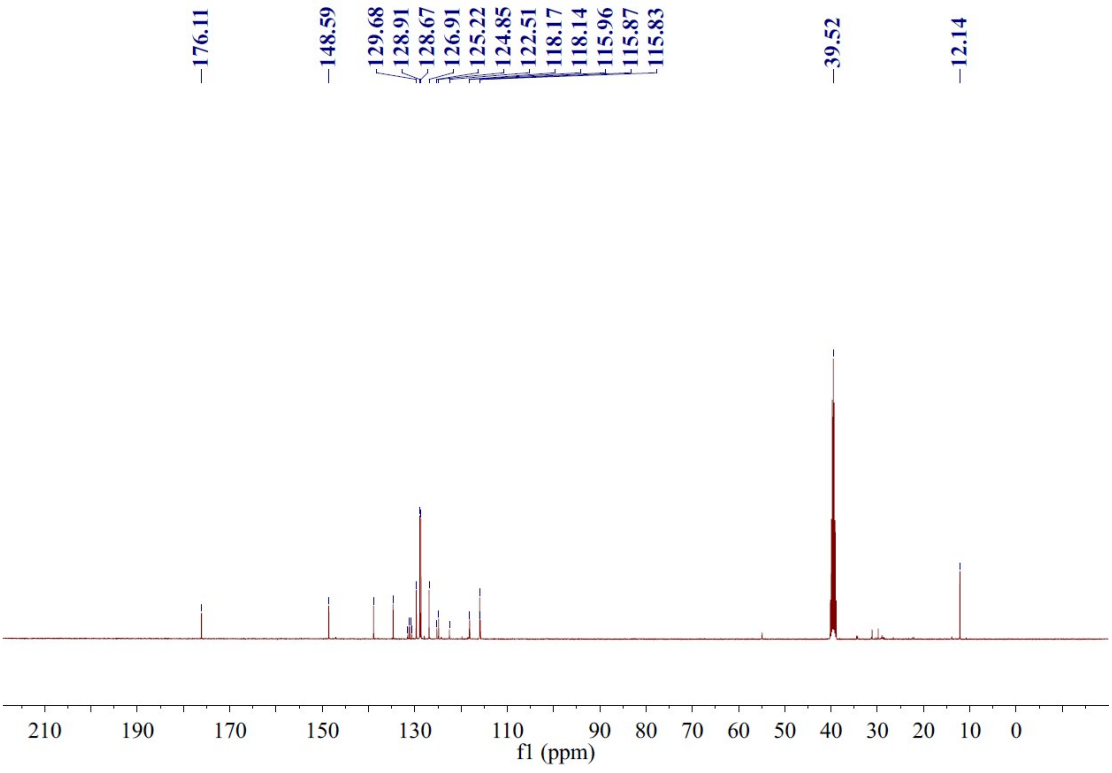
6-bromo-3-methyl-2-phenylquinolin-4(1H)-one (8p)

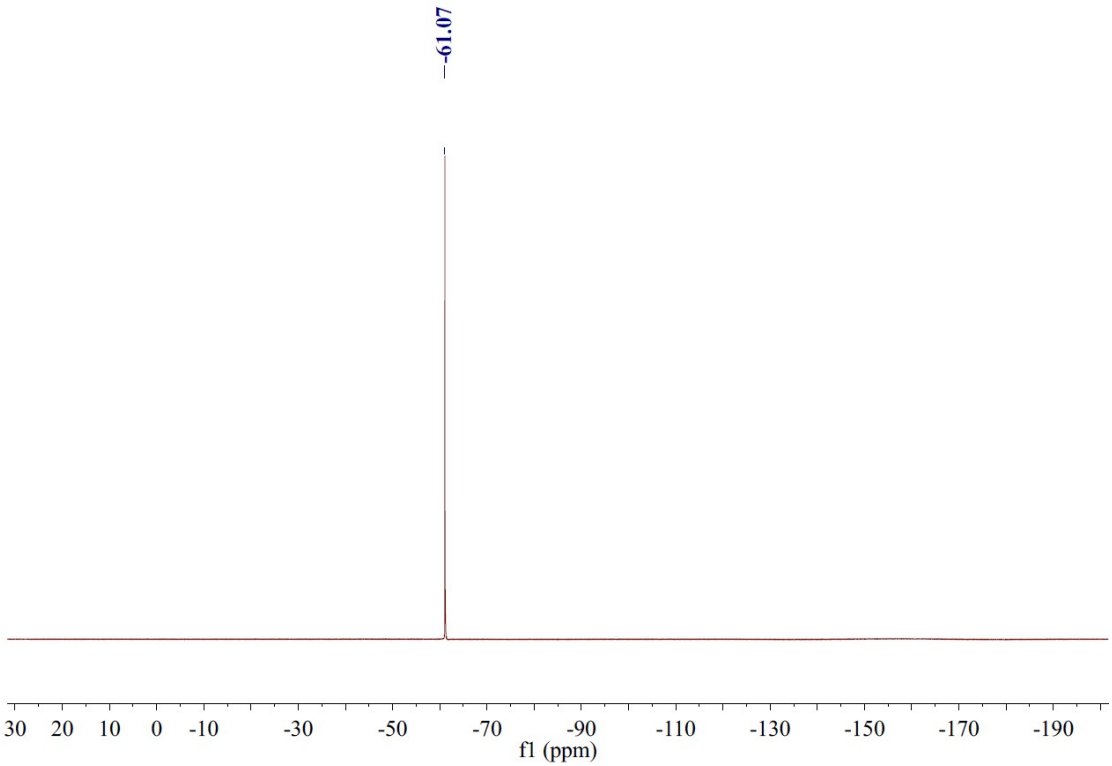




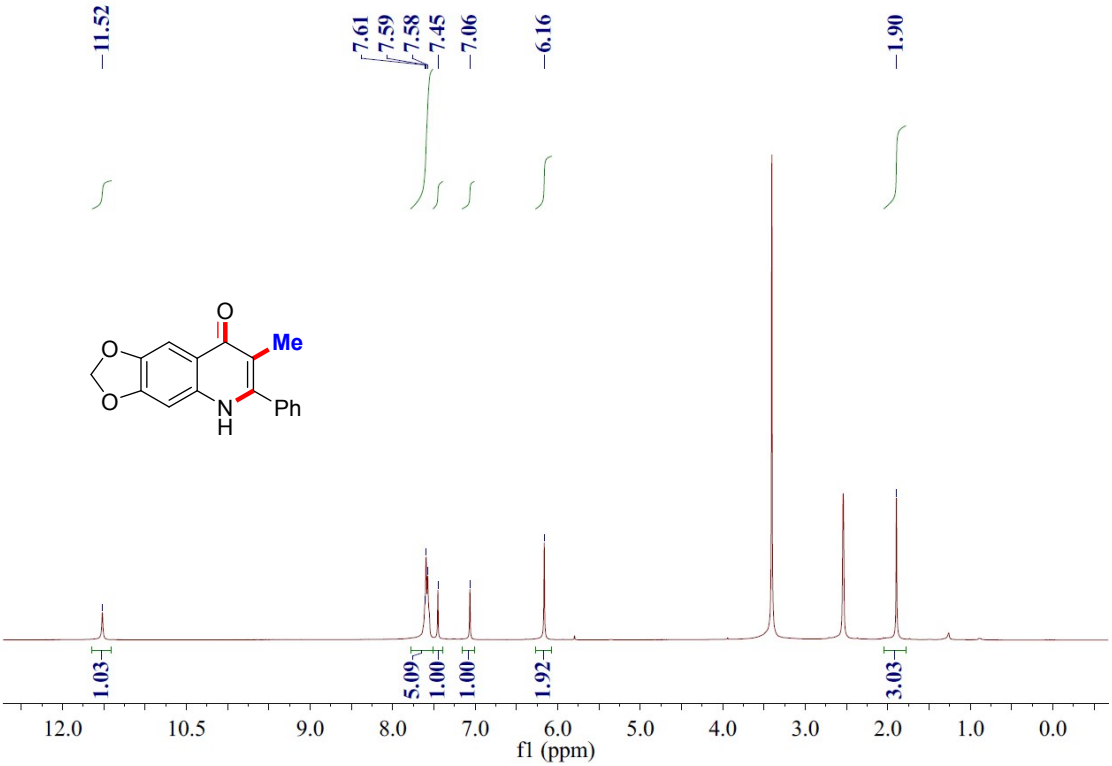
3-methyl-2-phenyl-7-(trifluoromethyl)quinolin-4(1H)-one (8q)

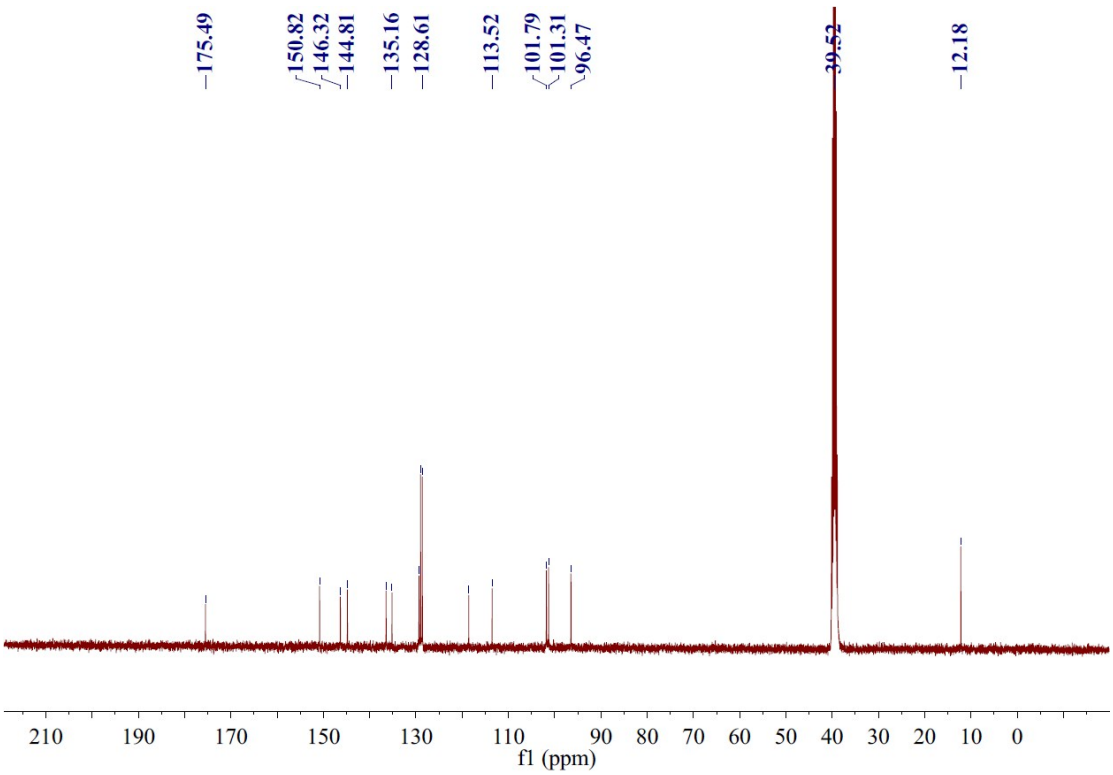




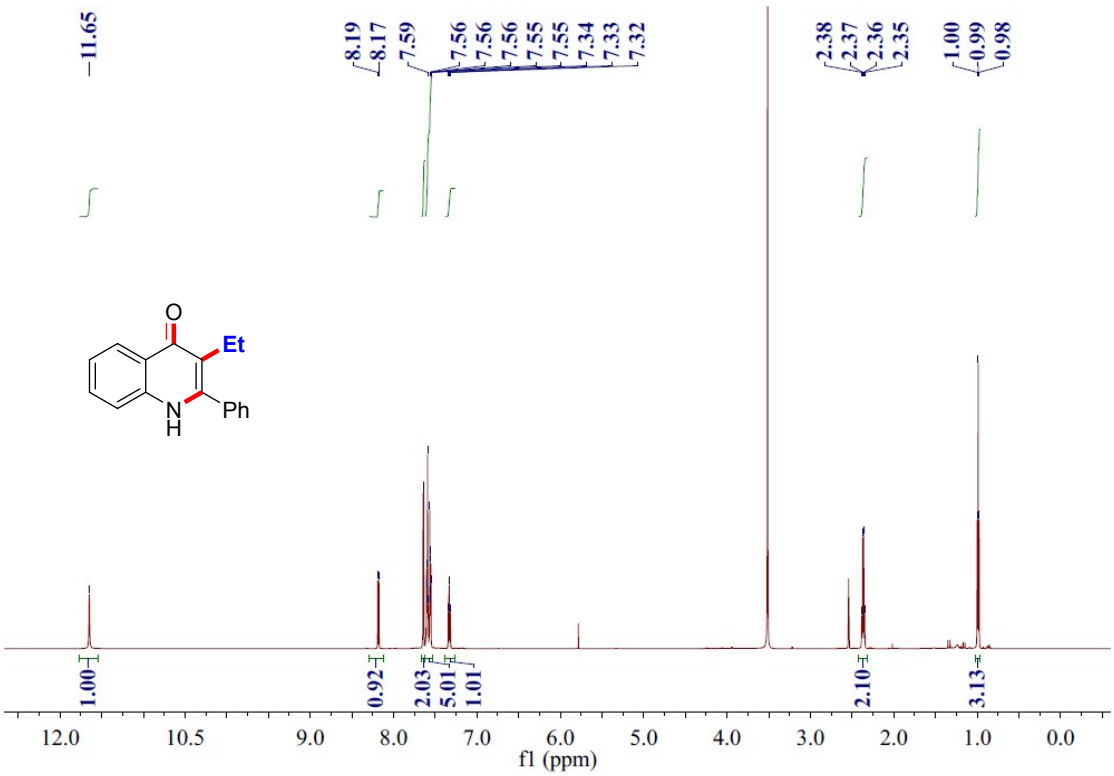

-61.07
30 20 10 0 -10 -30 -50 -70 -90 -110 -130 -150 -170 -190
f1 (ppm)

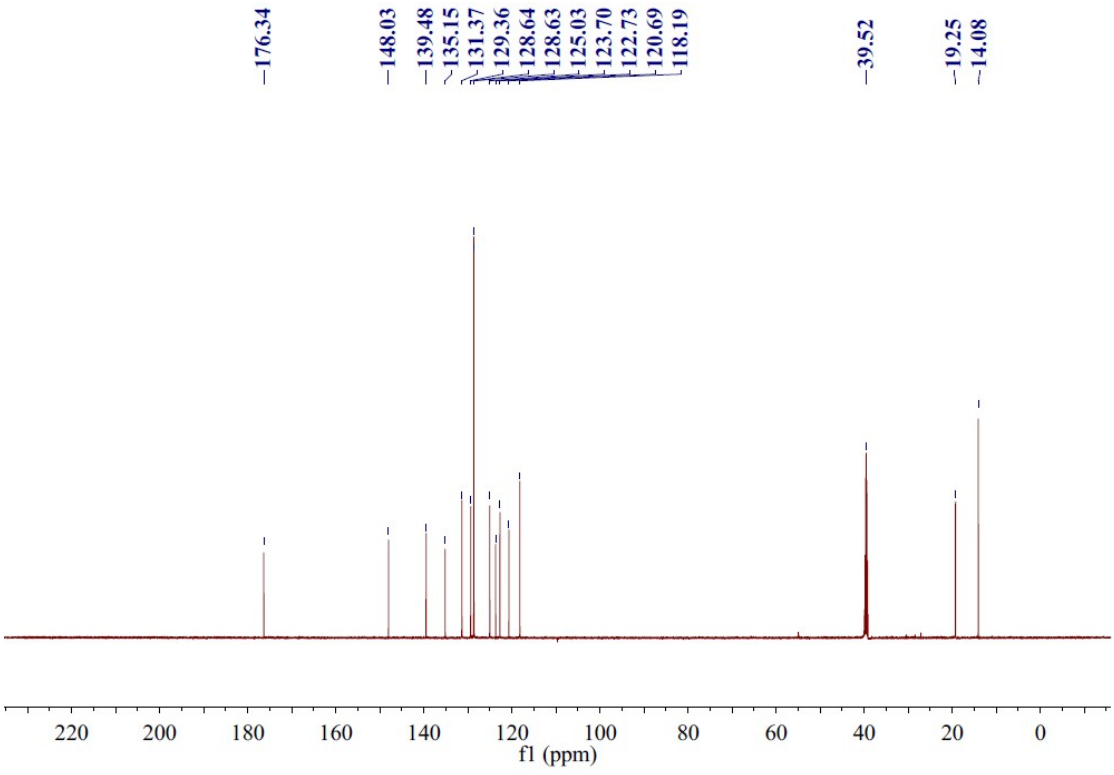
7-methyl-6-phenyl-[1,3]dioxolo[4,5-g]quinolin-8(5H)-one (8r)



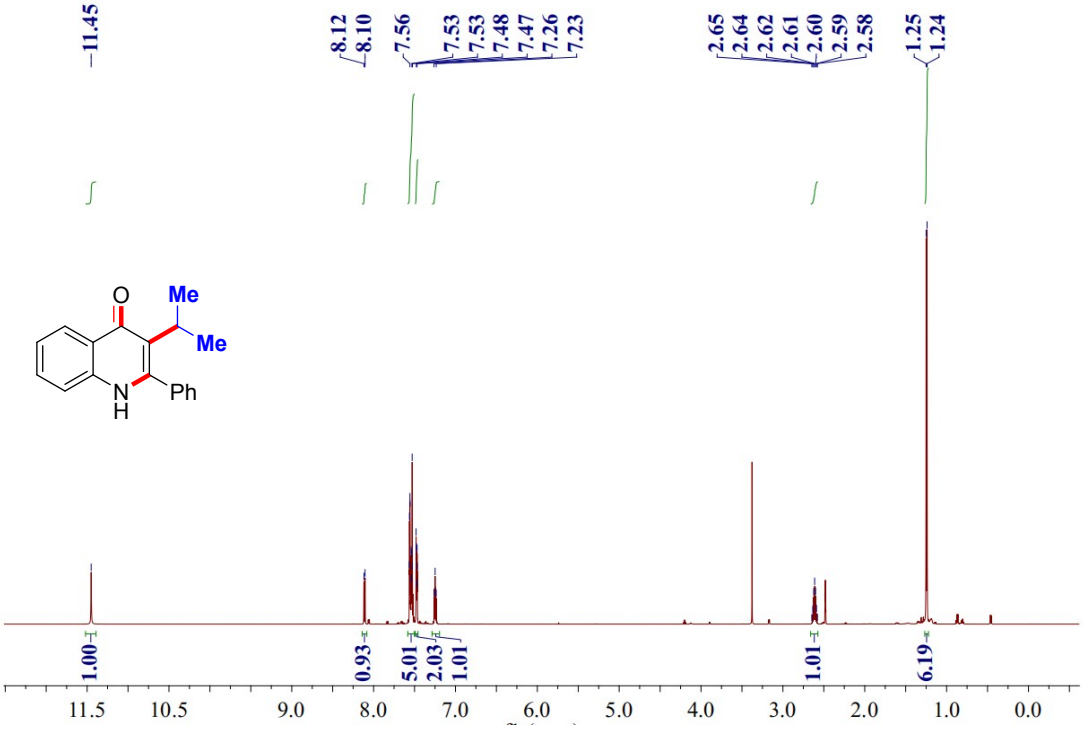


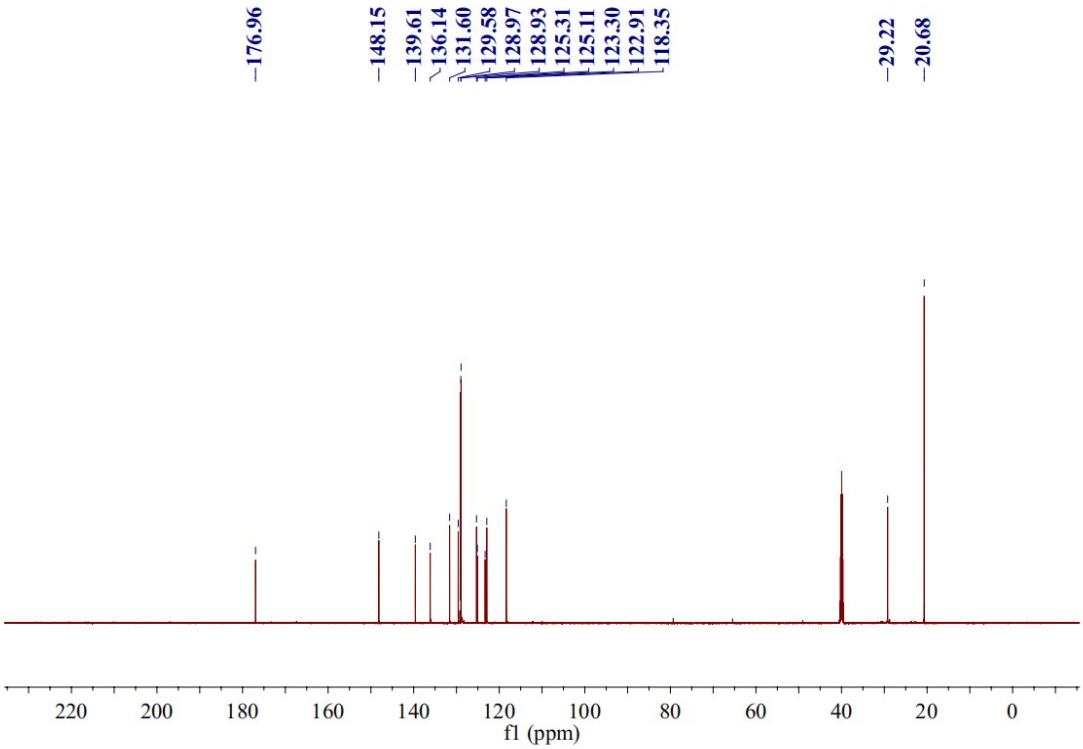
3-ethyl-2-phenylquinolin-4(1H)-one (8s)



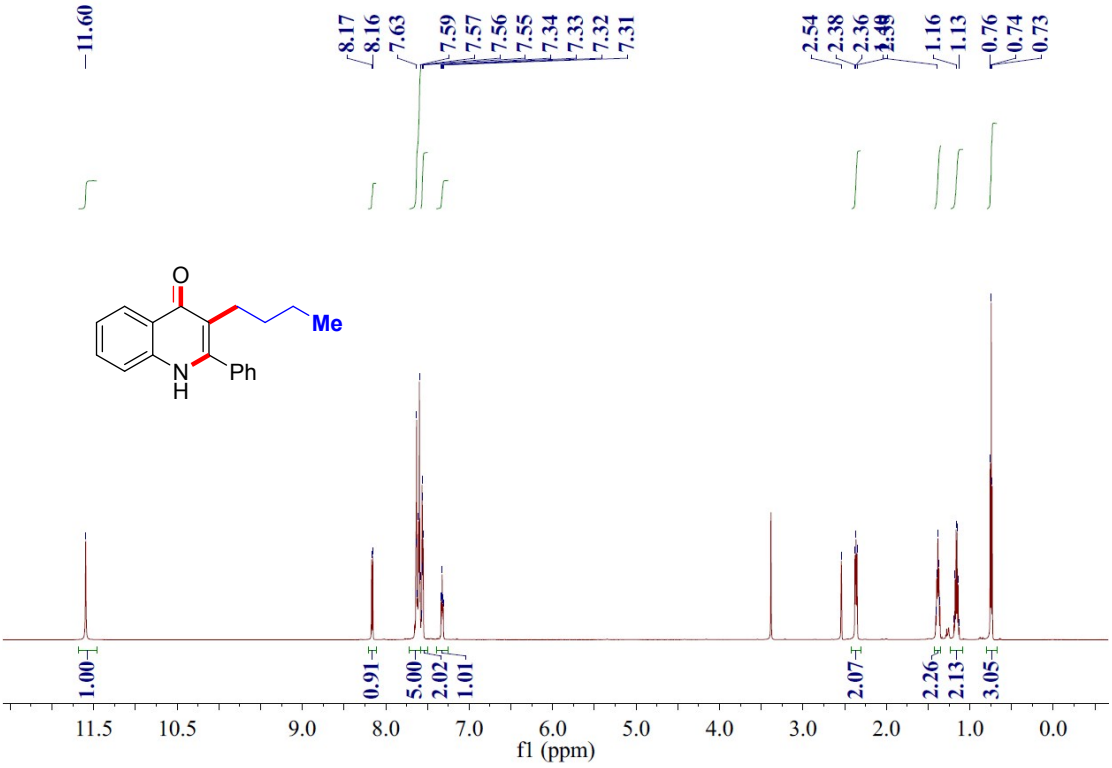


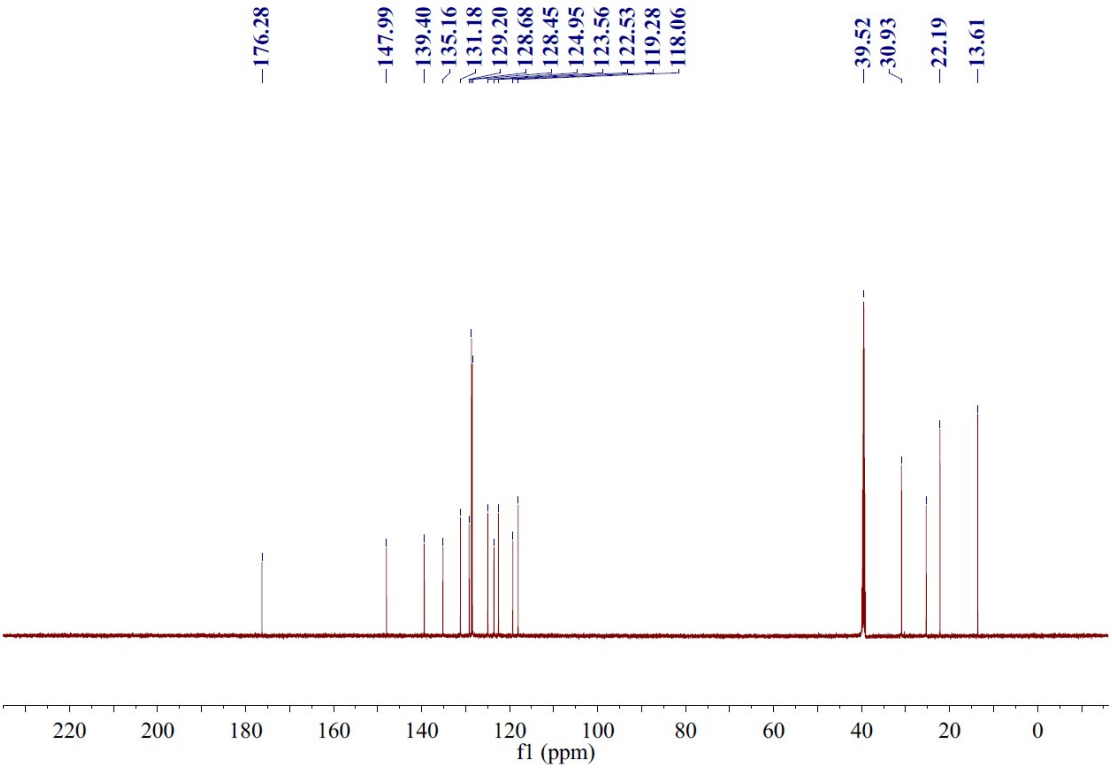
3-isopropyl-2-phenylquinolin-4(1H)-one (8t)



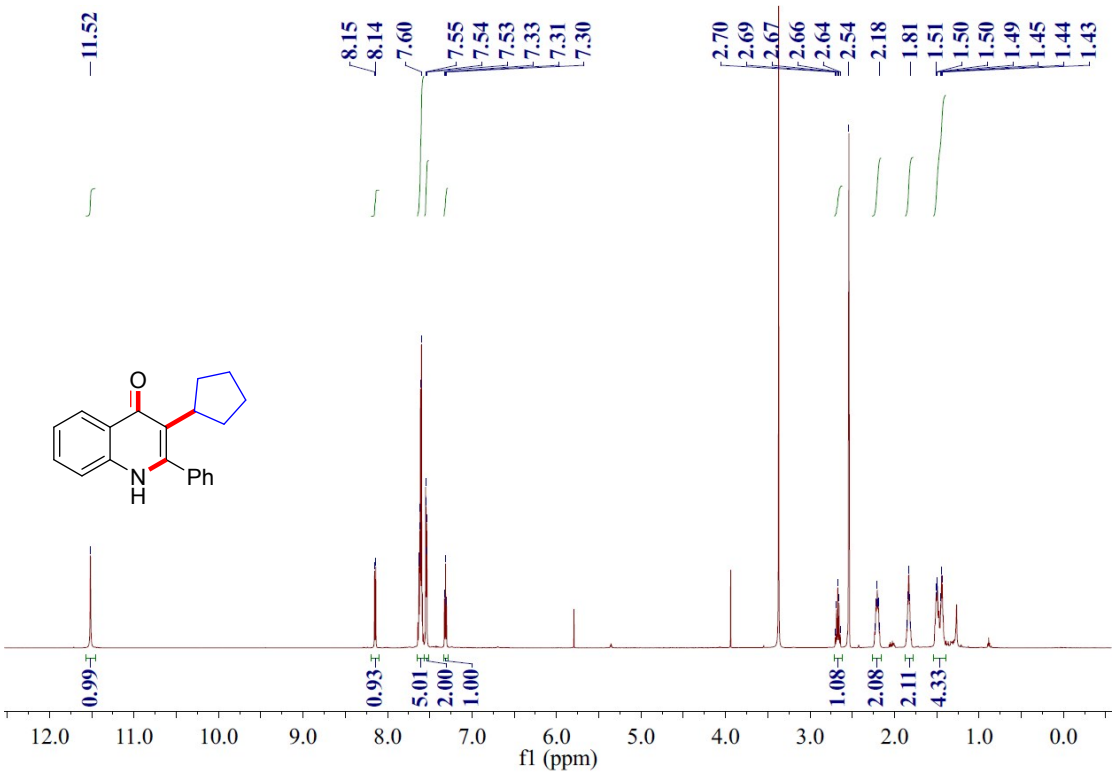


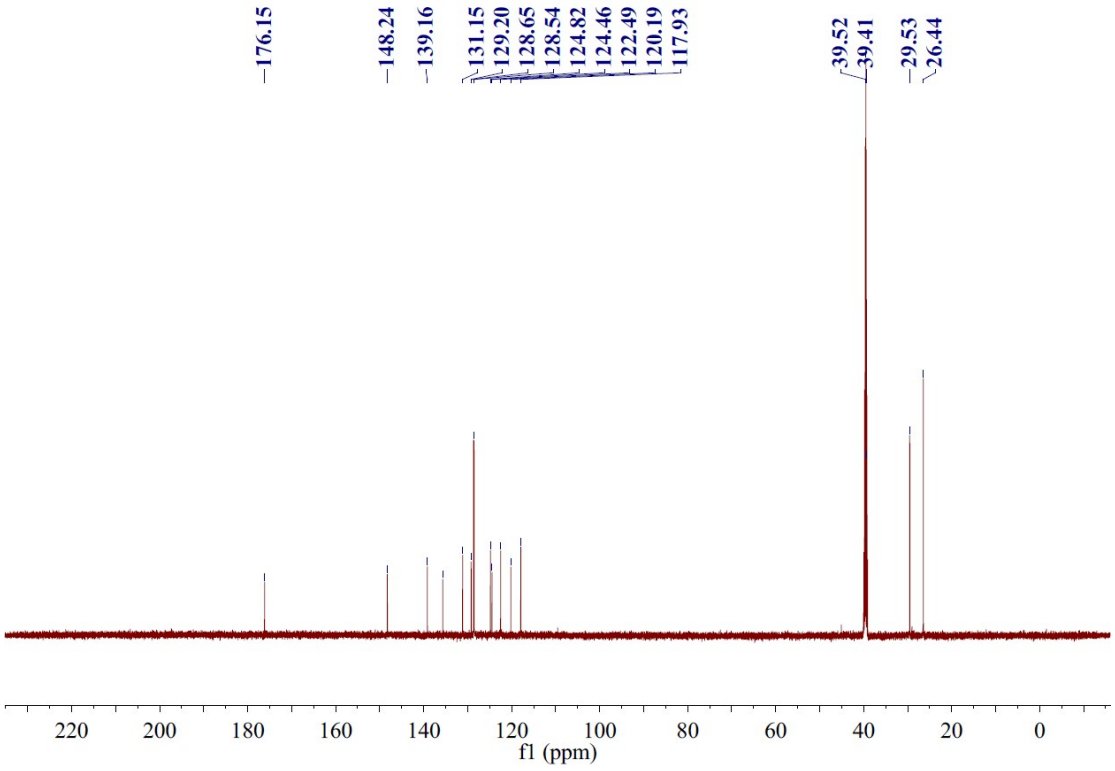
3-butyl-2-phenylquinolin-4(1H)-one (8u)



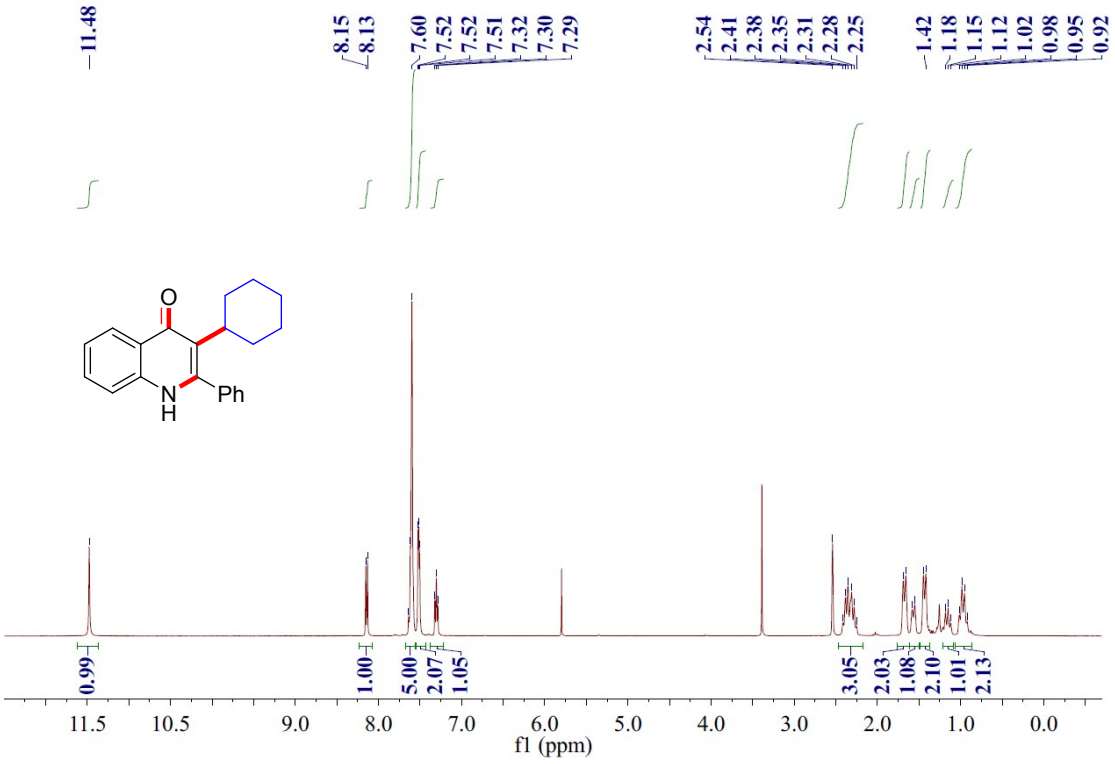


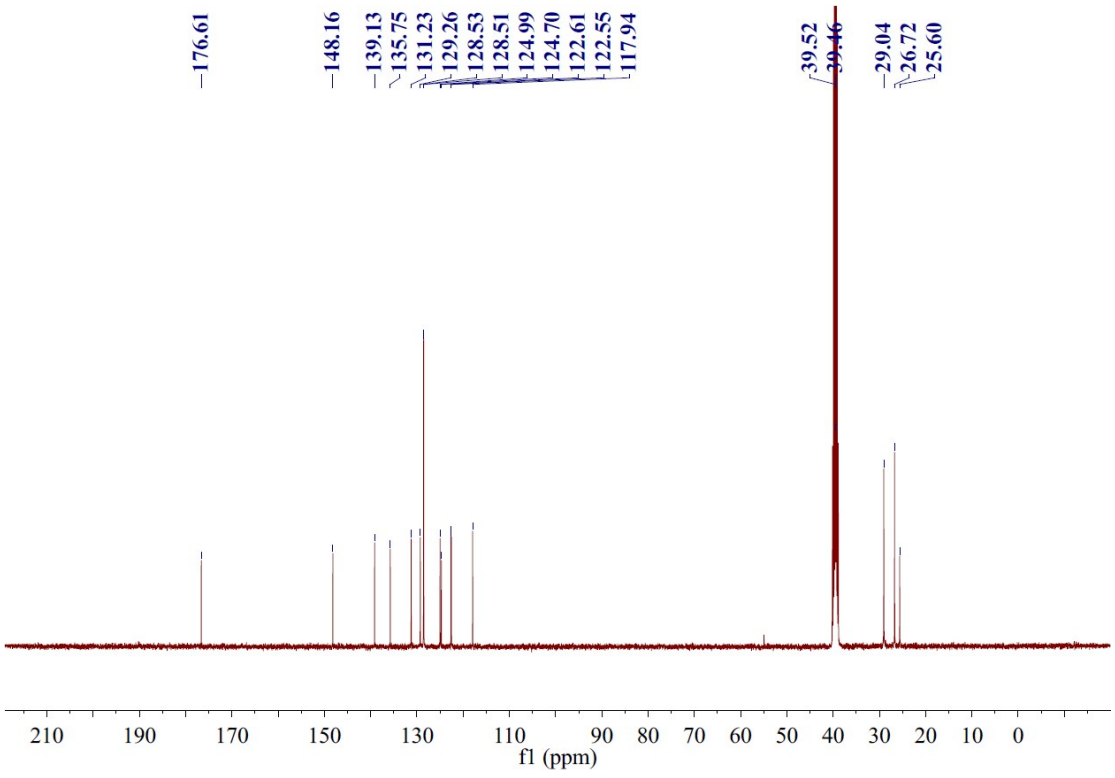
3-cyclopentyl-2-phenylquinolin-4(1H)-one (8v)



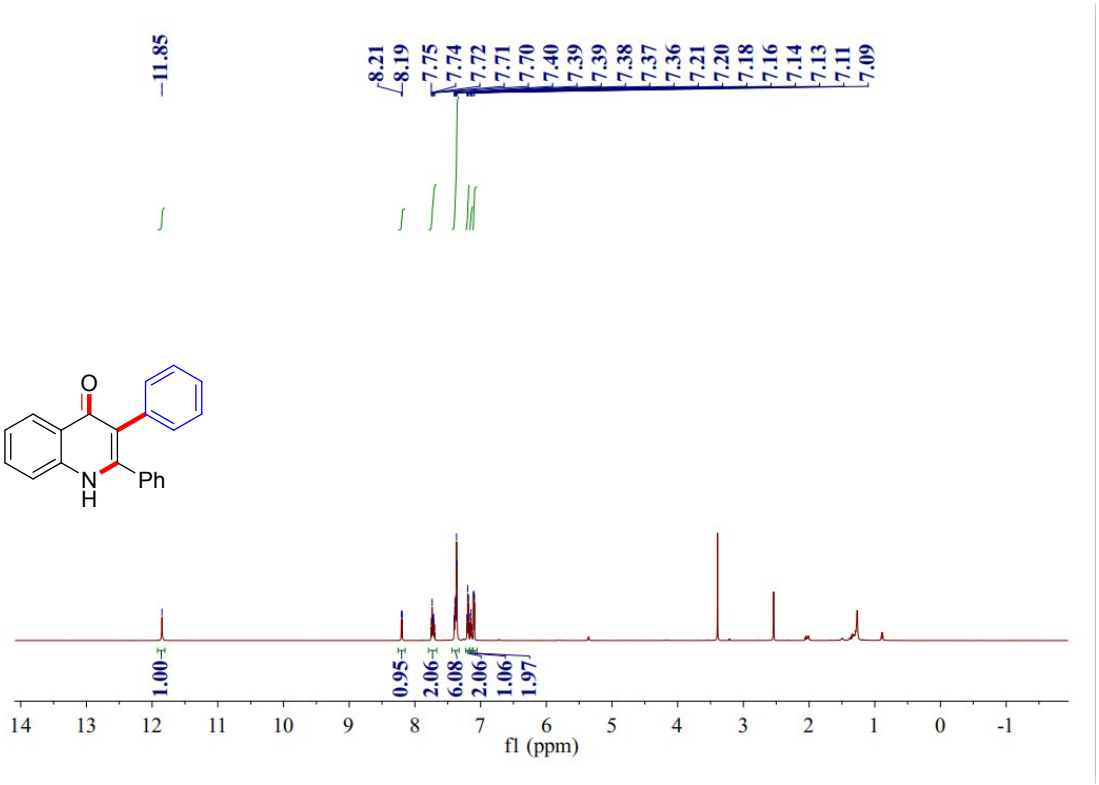


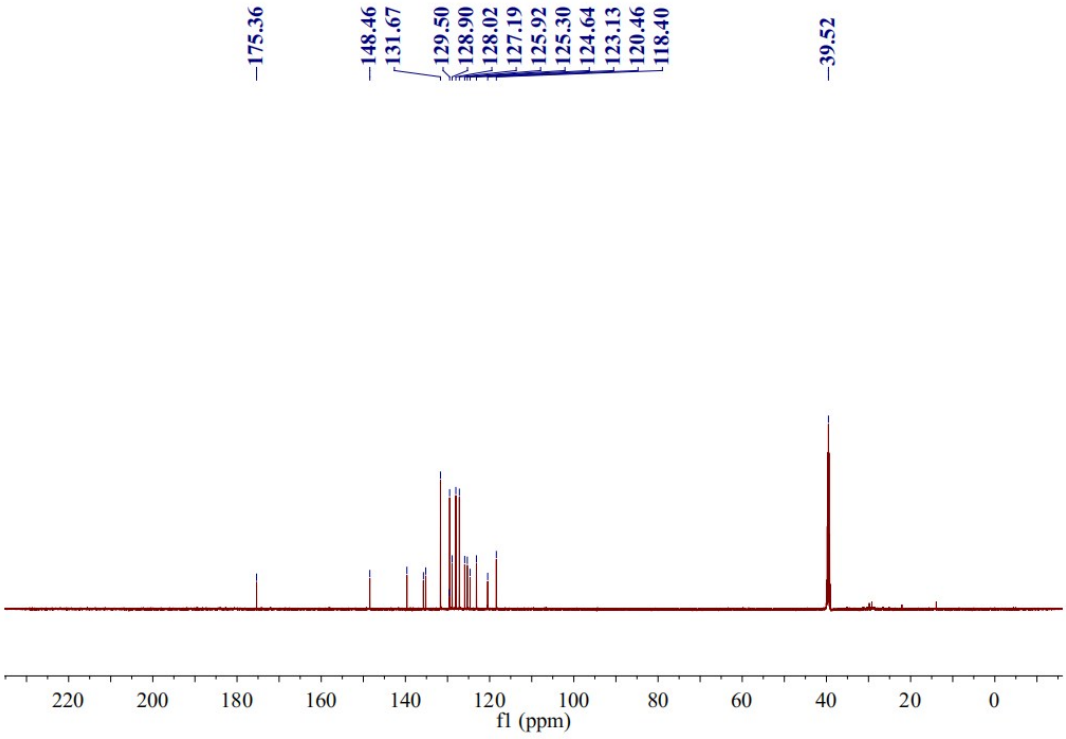
3-cyclohexyl-2-phenylquinolin-4(1H)-one (8w)



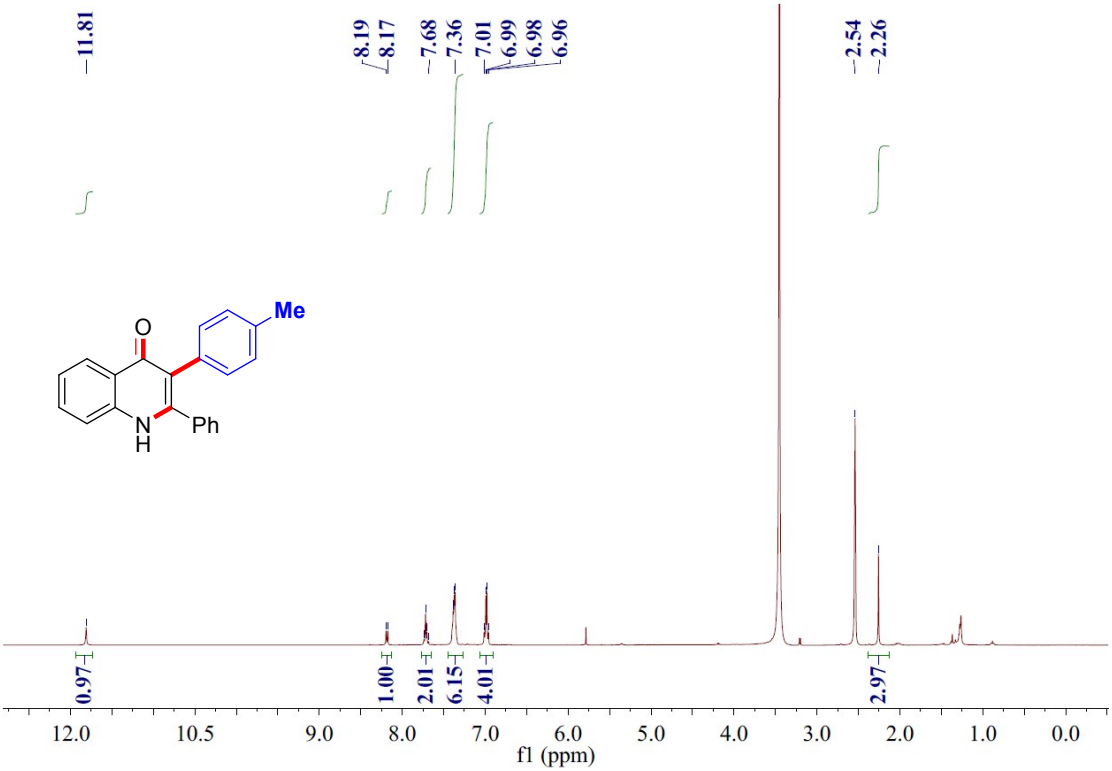


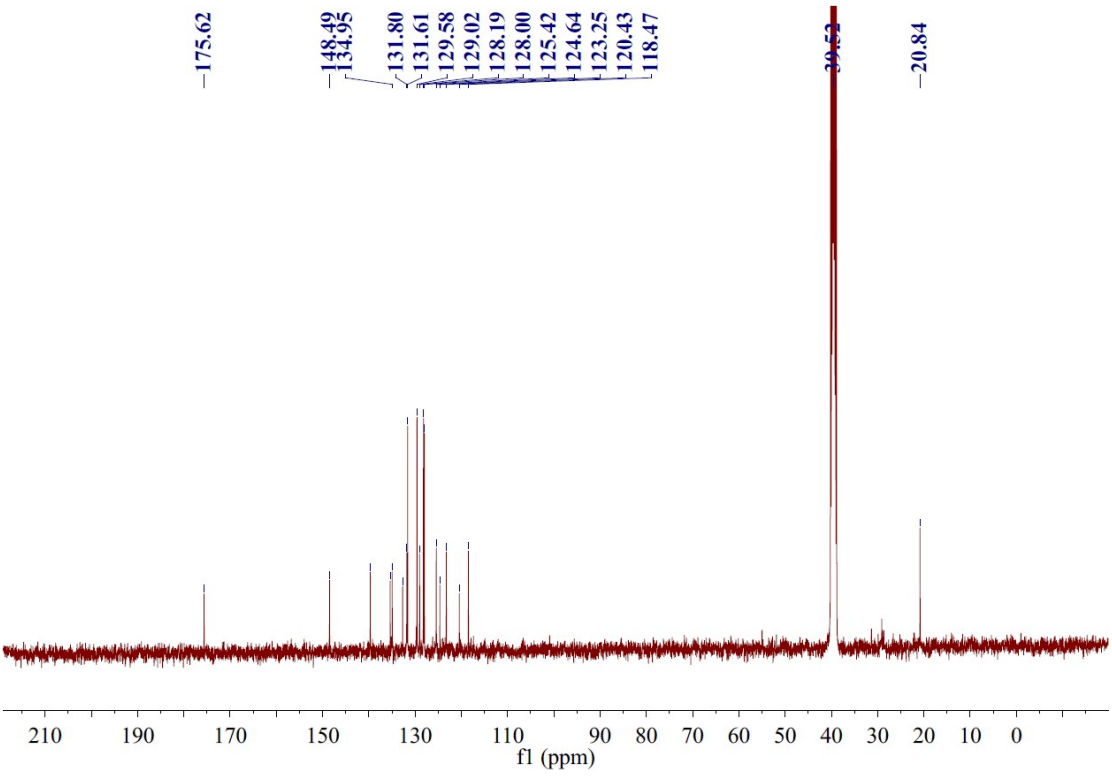
2,3-diphenylquinolin-4(1H)-one (8x)



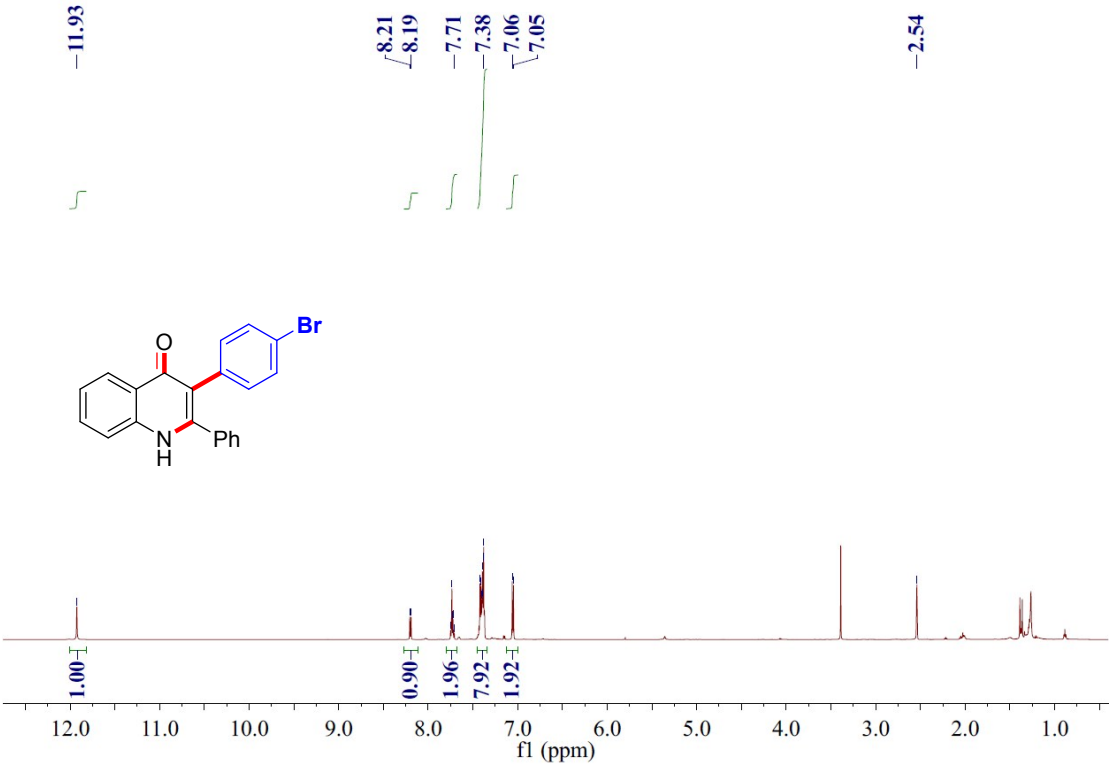


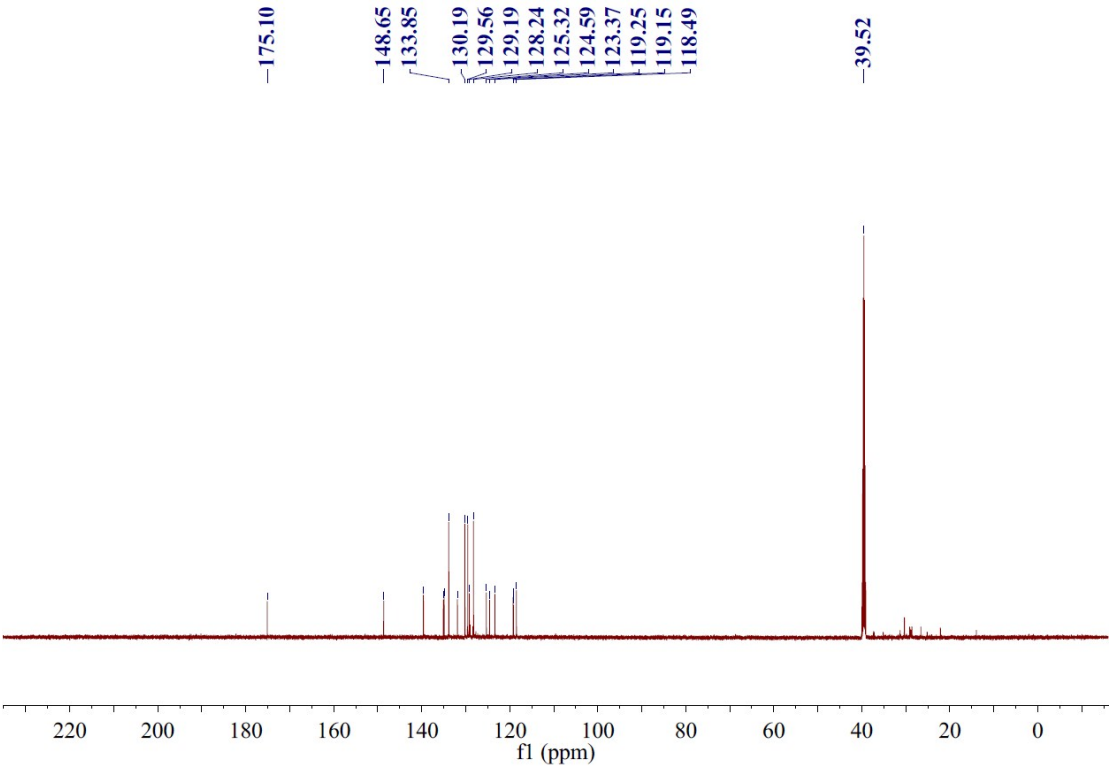
2-phenyl-3-(p-tolyl)quinolin-4(1H)-one (8y)



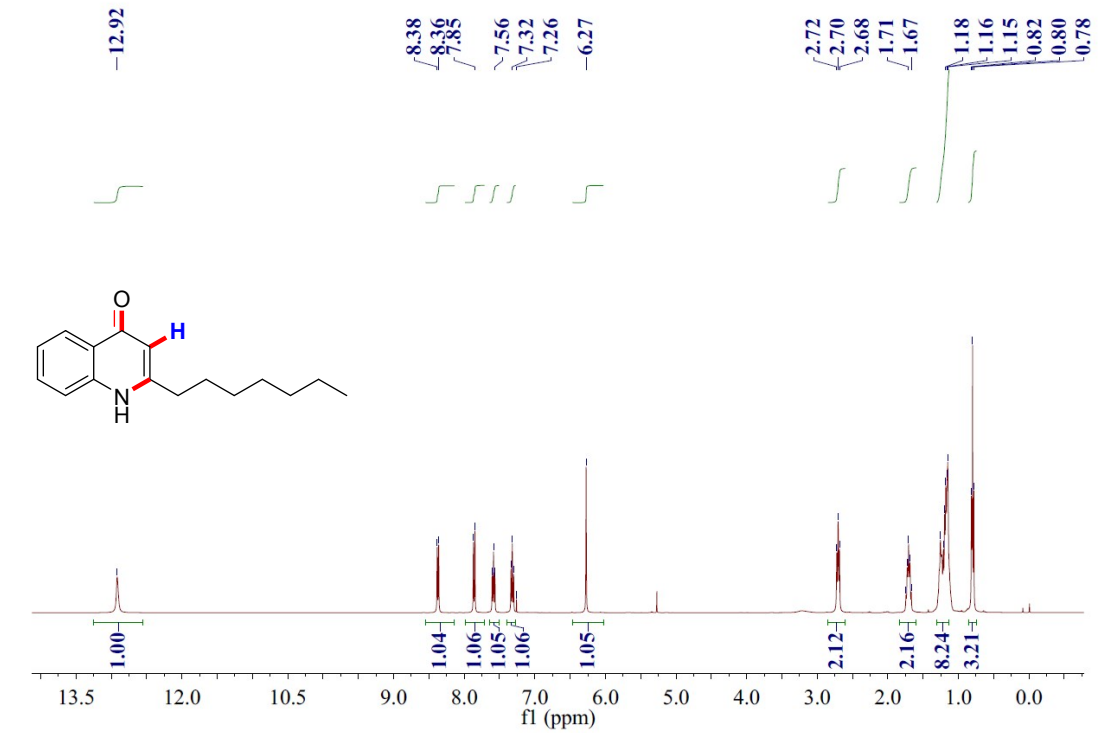


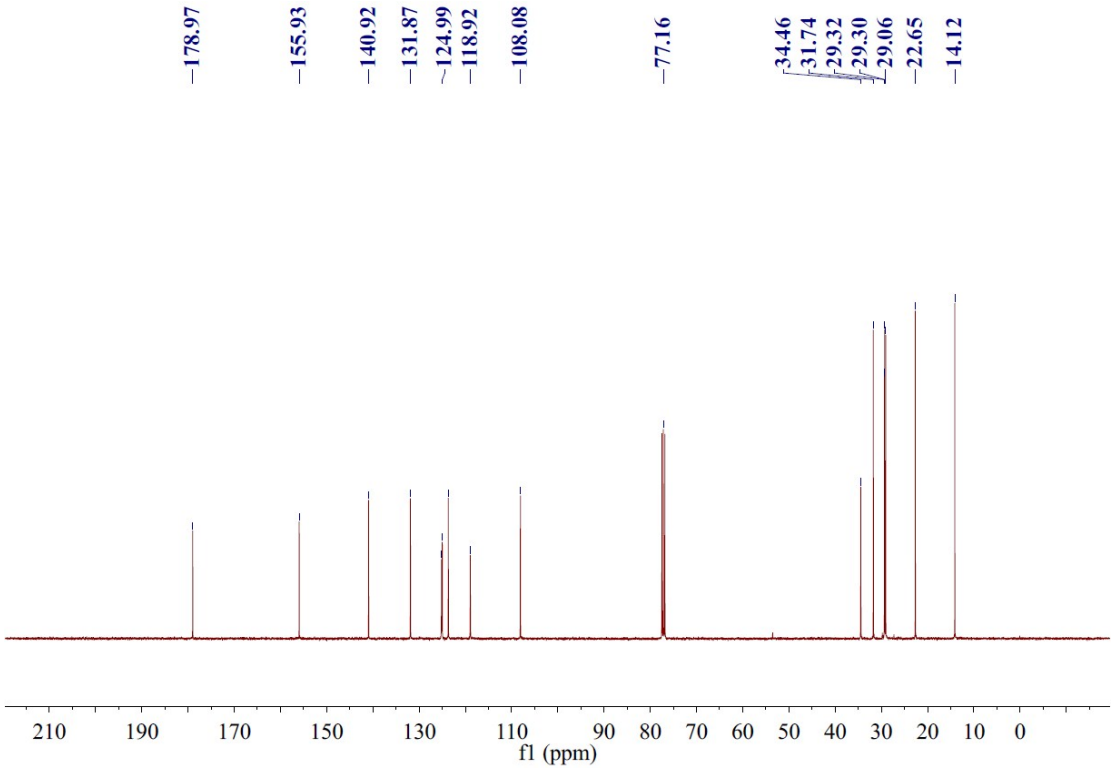
3-(4-bromophenyl)-2-phenylquinolin-4(1H)-one (8z)



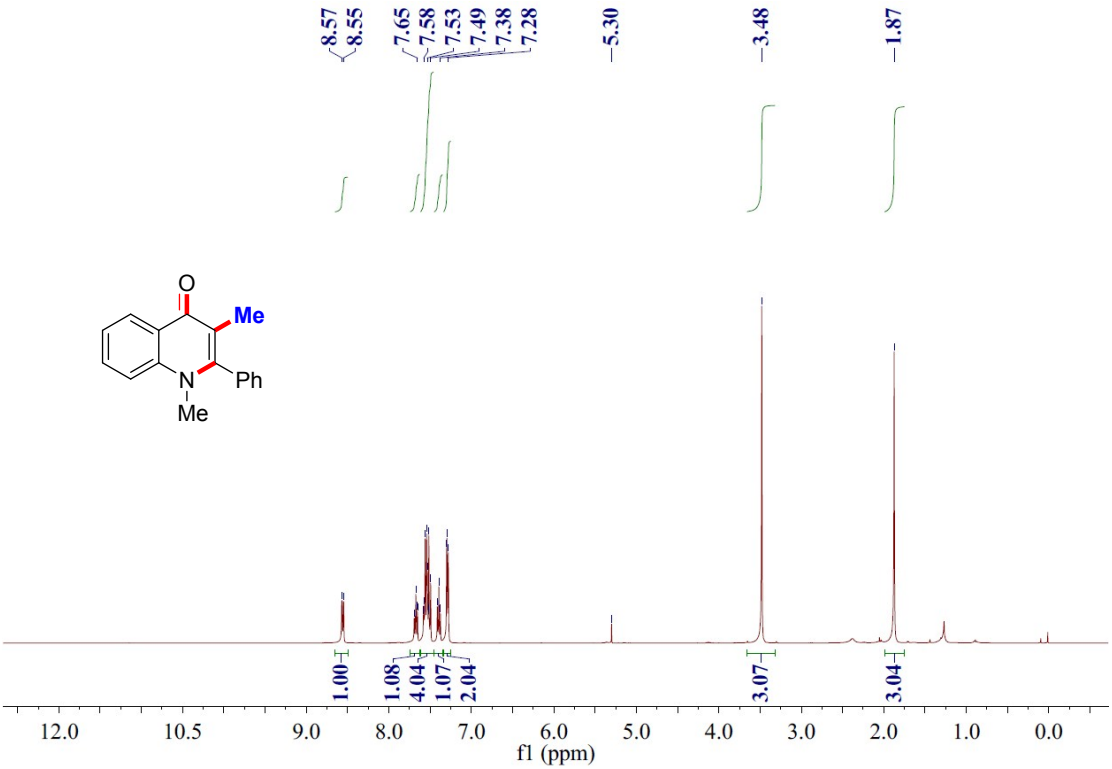


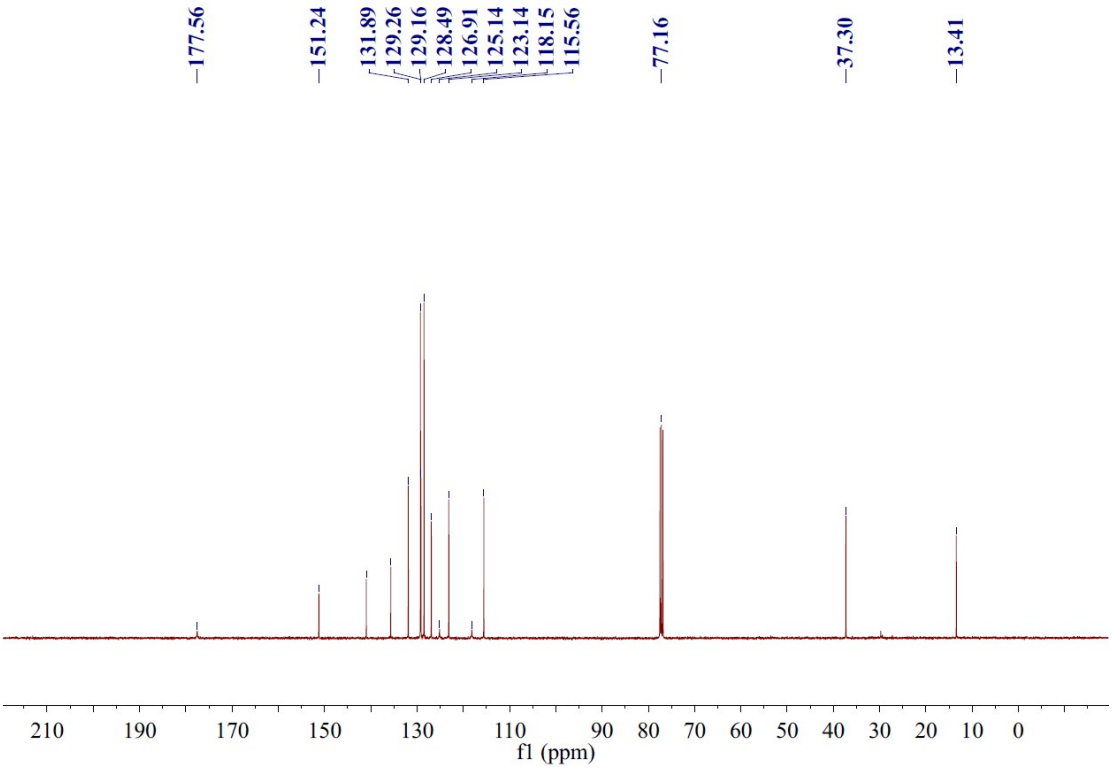
2-heptylquinolin-4(1H)-one (10)



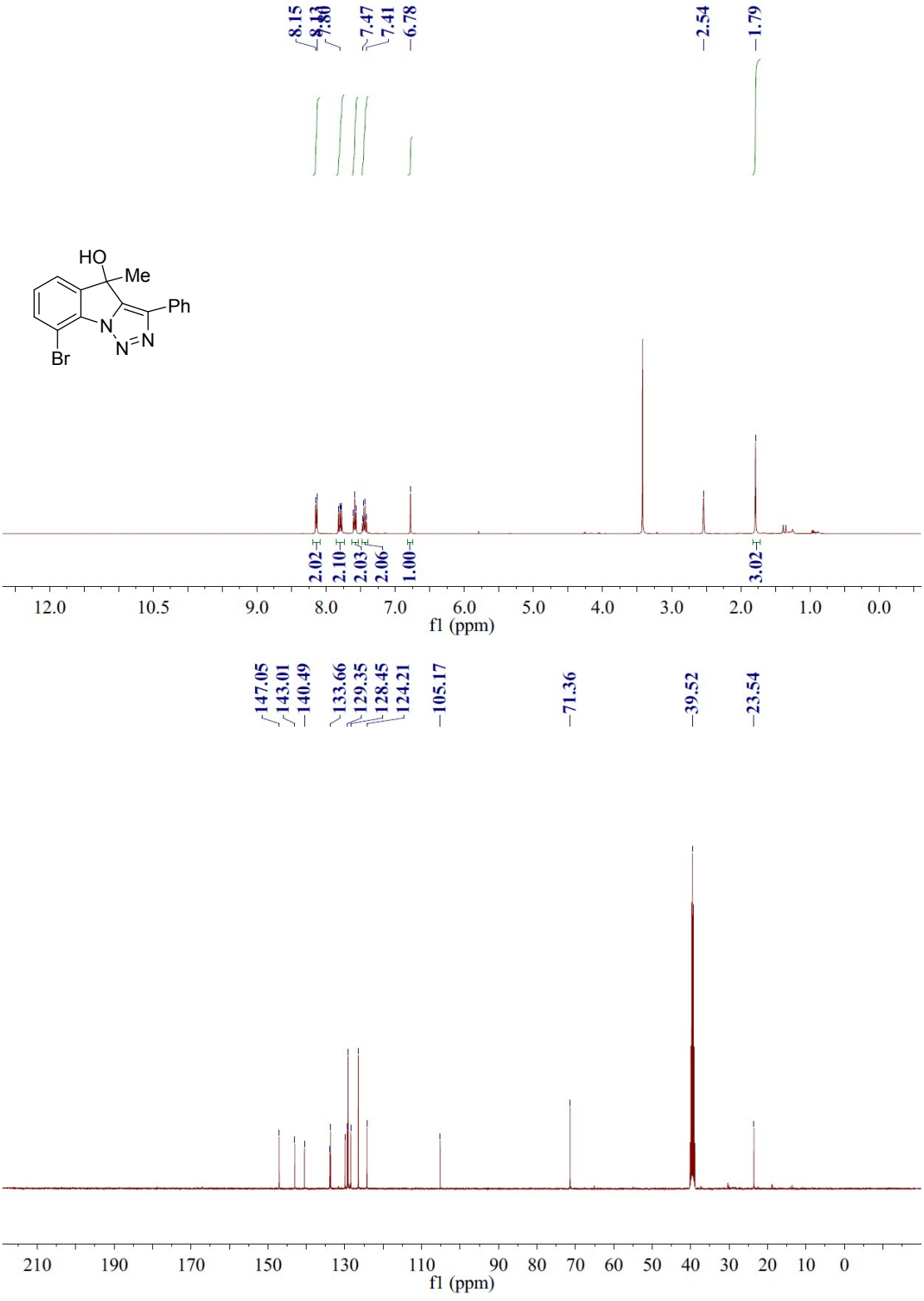


1,3-dimethyl-2-phenylquinolin-4(1H)-one (11)

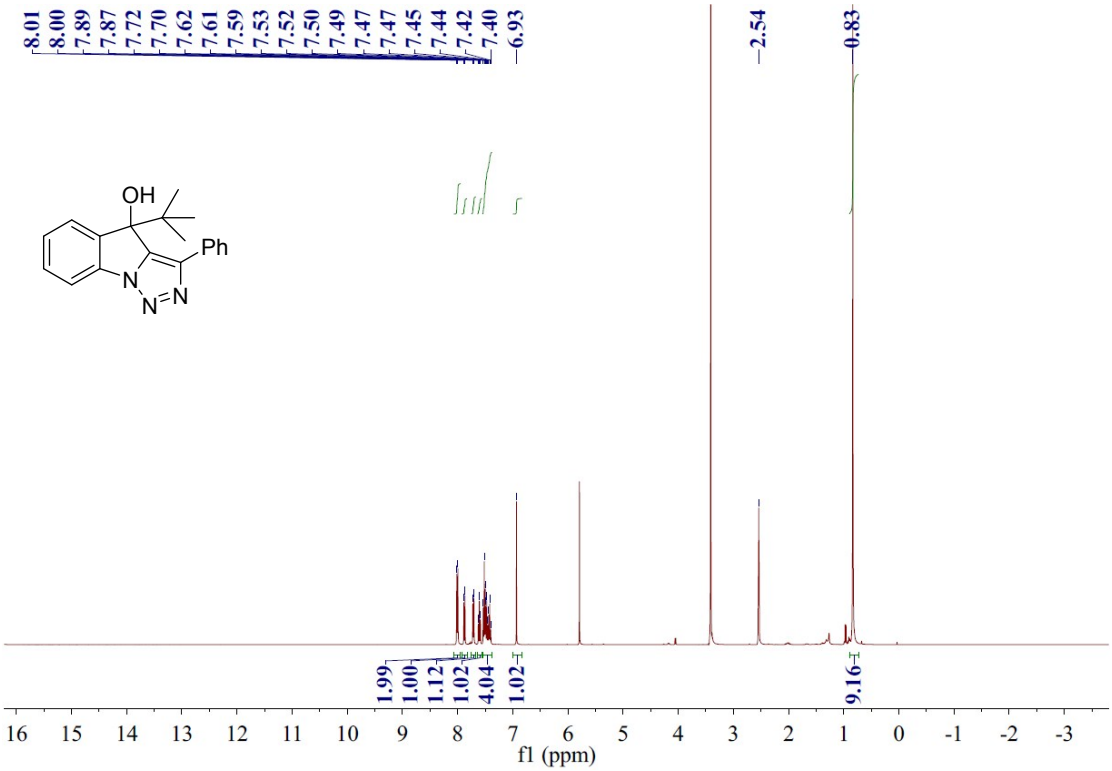


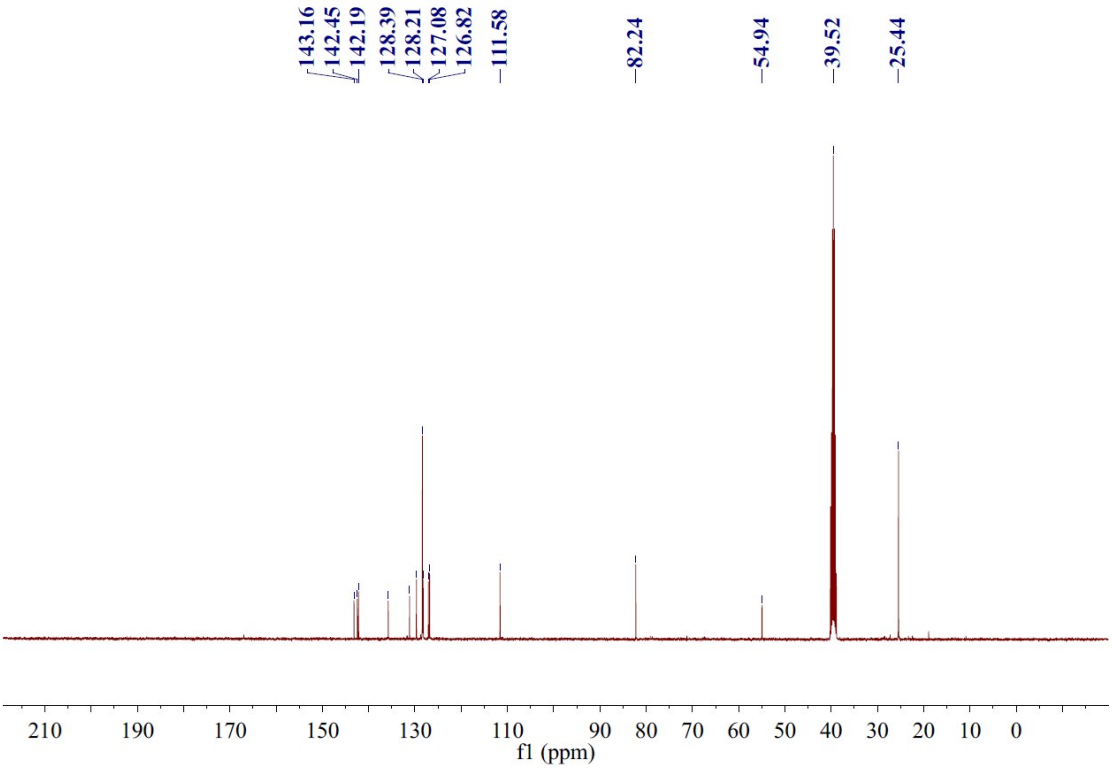


8-bromo-4-methyl-3-phenyl-4H-[1,2,3]triazolo[1,5-a]indol-4-ol (S5b)

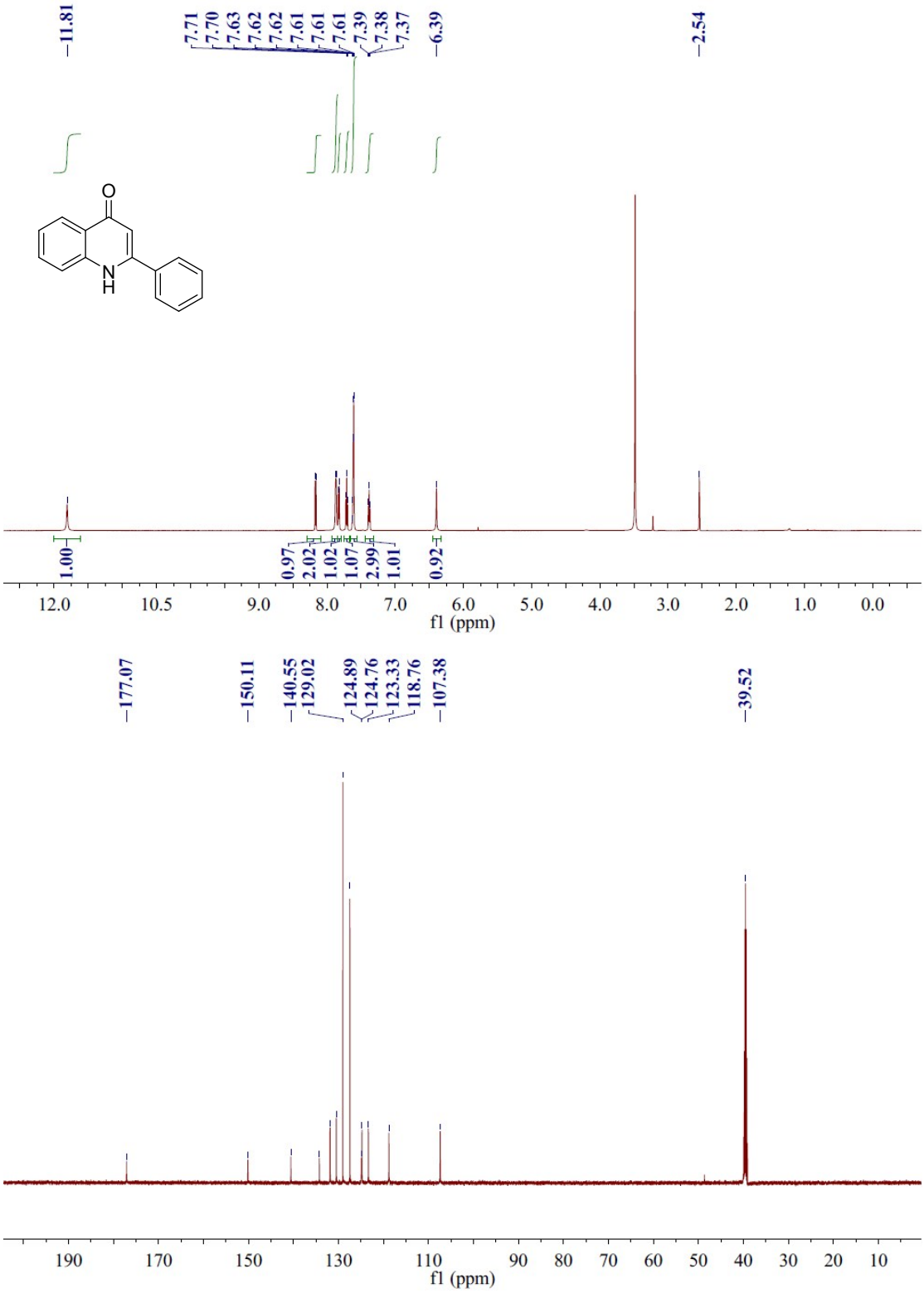


4-(tert-butyl)-3-phenyl-4H-[1,2,3]triazolo[1,5-a]indol-4-ol (S5c)

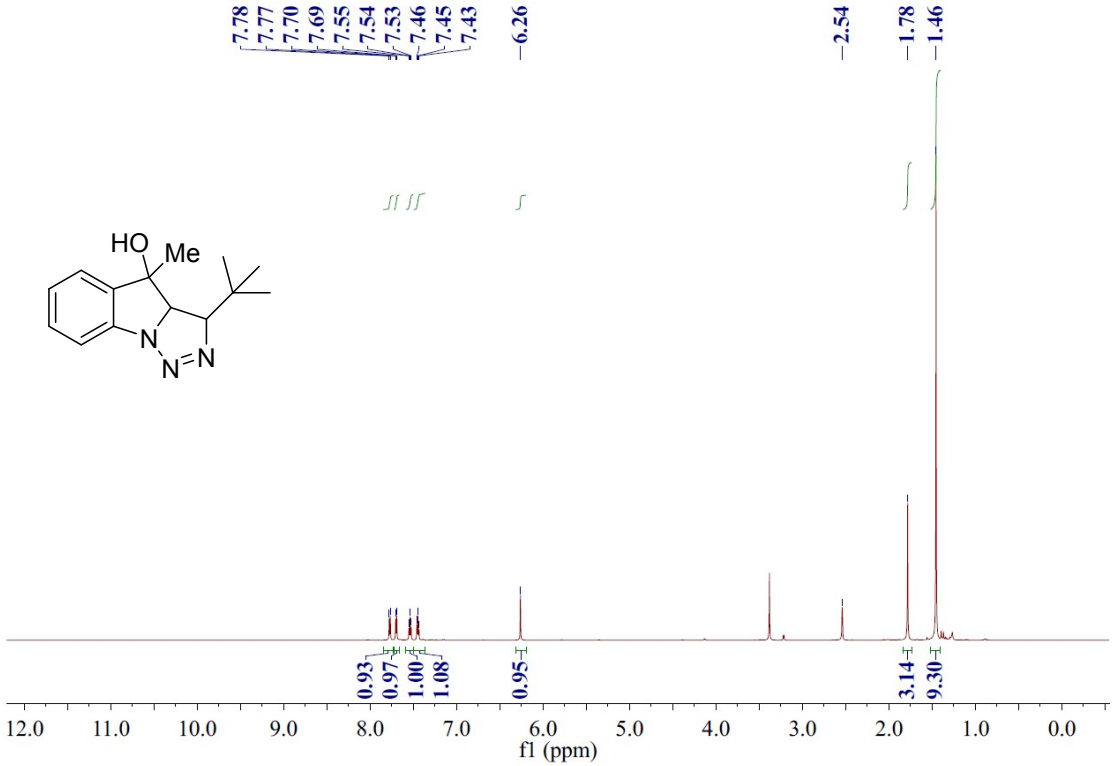


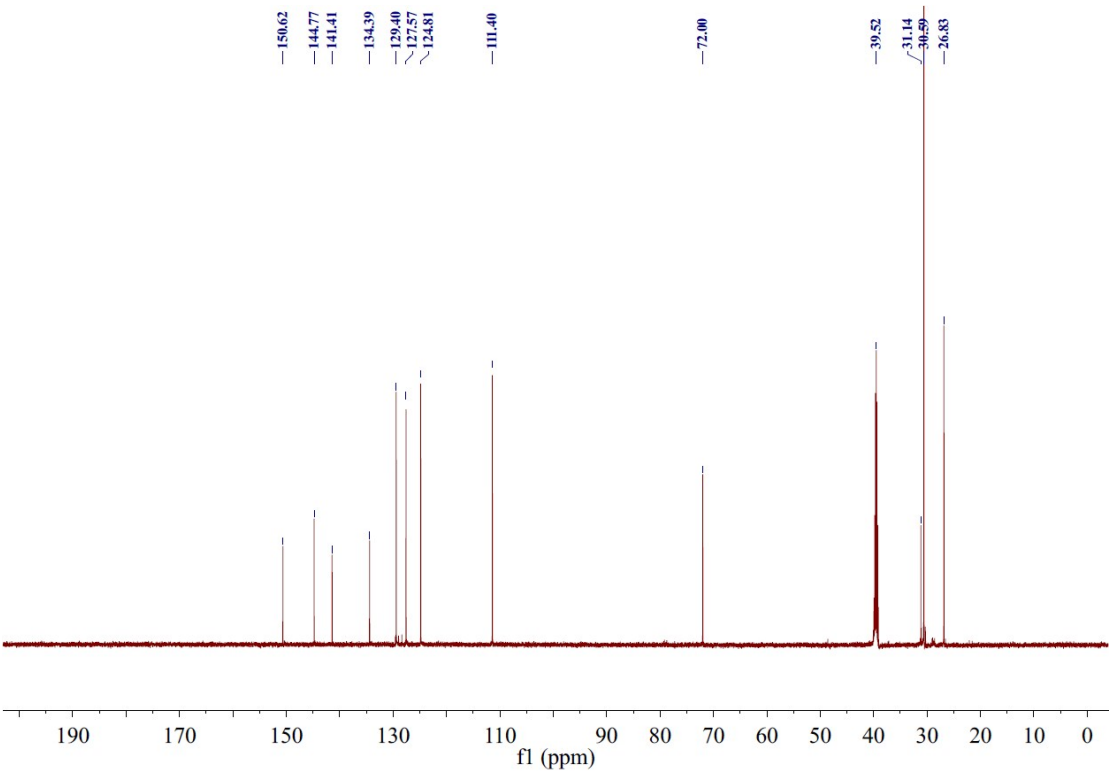


2-phenylquinolin-4(1H)-one (S5c')

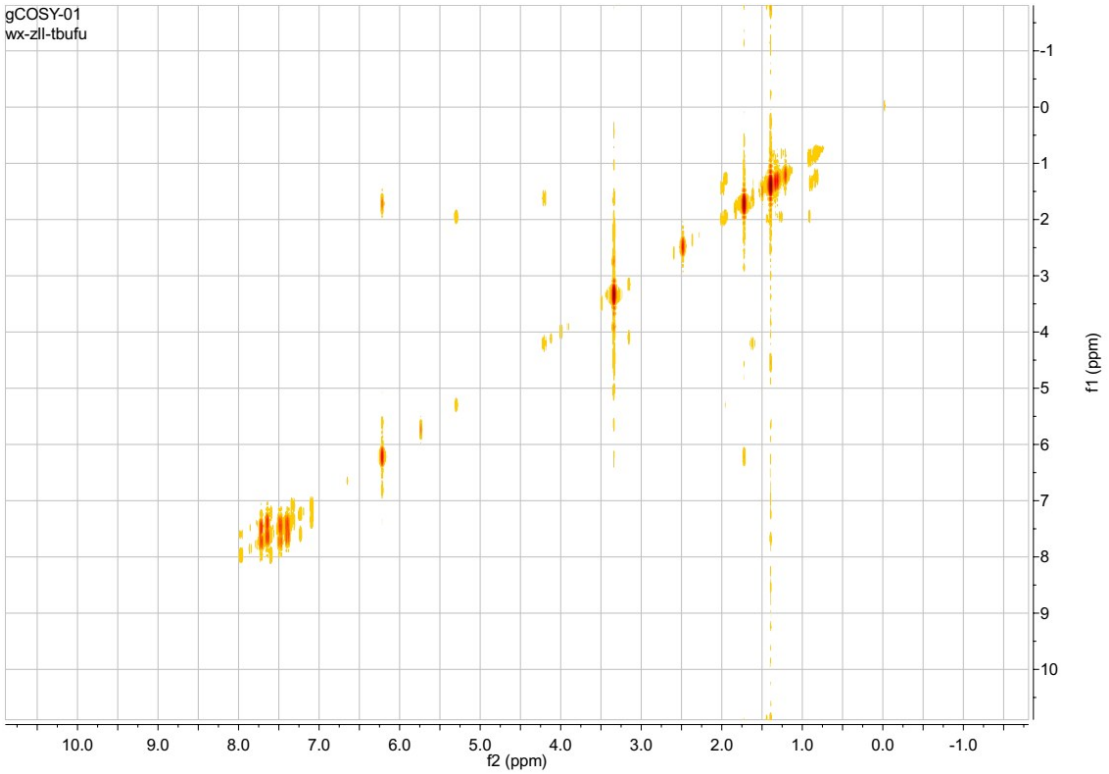


2-(tert-butyl)-3-methylquinolin-4(1H)-one (S5d)





H-H COSY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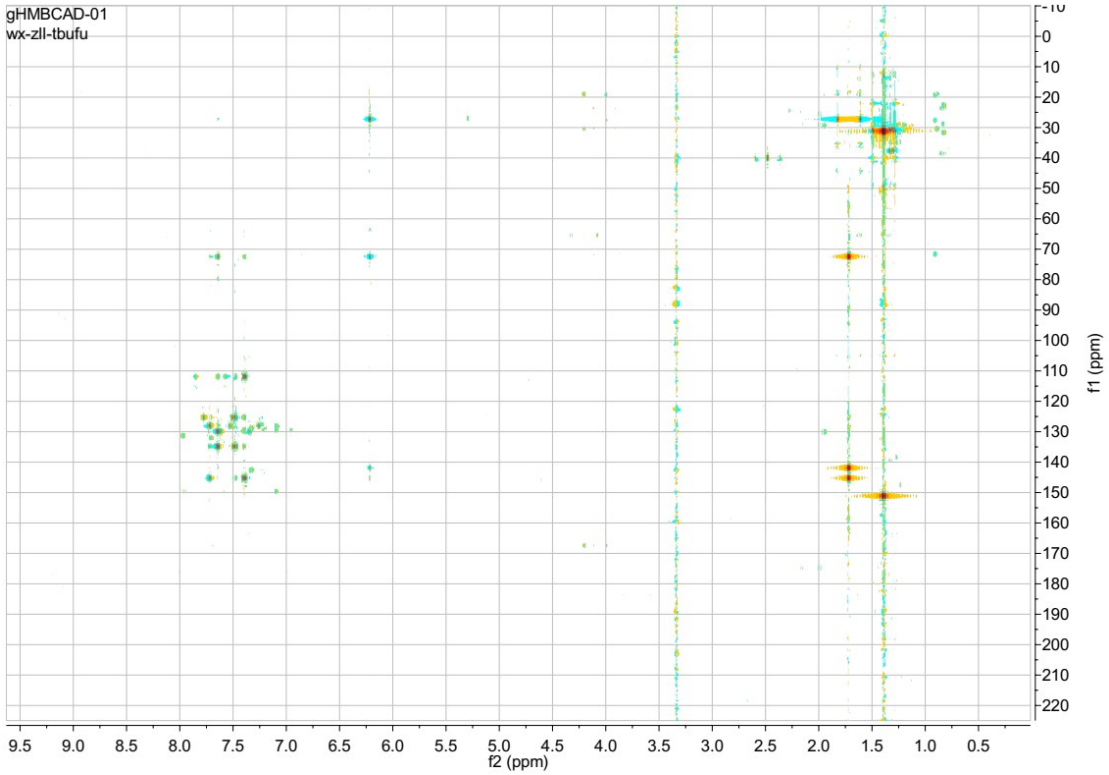
wx-zll-tbufu
f2 (ppm)
f1 (ppm)

HMBC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wx-zll-tbufu
f2 (ppm)
f1 (ppm)

HSQC